St. Cloud EHRM Infrastructure Upgrades VA PROJECT NUMBER: 656-21-235

4801 VETERANS DRIVE ST CLOUD, MN 56303



TECHNICAL SPECIFICATIONS Volume 2: DIVISIONS 21 - 48

ANDERSON ENGINEERING OF MN, LLC Project Number: 16305

Issue for 100% CONSTRUCTION DOCUMENTS Issued for Bidding MARCH 30, 2022

A N D E R S O N

Anderson Engineering of Minnesota, LLC 13605 1st Avenue North Plymouth, MN 55441 Phone: 763-412-4000 Fax: 763-412-4090

Prepared in association with the following: Specialized Engineering Solutions 10360 Ellison Circle Omaha, NE 68134

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

CERTIFICATIONS PAGE

Architect:

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Architect under the laws of the State of Minnesota

Ton

Typed or Printed Name: <u>Tom Olesak</u> License Number: 18157

Professional Engineer: (Civil)

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota

ila J Nil

Typed or Printed Name: <u>Ian J. Weber</u> License Number: <u>55502</u>

Professional Engineer: (Structural)

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota

Typed or Printed Name: <u>Zachary D. Craig</u> License Number: 57219

CERTIFICATIONS PAGE

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

CERTIFICATIONS PAGE

Professional Engineer: (Mechanical)

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota

At D /m

Typed or Printed Name: <u>Robert Lowe</u> License Number: <u>24706</u>

Professional Engineer: (Plumbing)

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota

alt D for

Typed or Printed Name: <u>Robert Lowe</u> License Number: <u>24706</u>

Professional Engineer: (Fire Protection)

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota

At D/we

Typed	or	Printed	Name:	Robert	Lowe			
Licens	se	Number:	24706	_	_			

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

Professional Engineer: (Electrical)

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota

Alex Que

Typed or Printed Name: <u>Alexander Quast</u> License Number: <u>53095</u>

Professional Engineer: (Technology)

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota

Typed or Printed Name: <u>Nathan Timm</u>_____ License Number: 346555

- - - END - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 21 13 13 WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Design, installation and testing shall be in accordance with NFPA 13.
- C. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 07 84 00, FIRESTOPPING.
- C. Section 09 91 00, PAINTING.
- D. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.
- E. Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 DESIGN CRITERIA

- A. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13.
 - Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.
 - 2. Sprinkler Protection: Sprinkler hazard classifications shall be in accordance with NFPA 13. The hazard classification examples of uses and conditions identified in the Annex of NFPA 13 shall be mandatory for areas not listed below. Request clarification from the Government for any hazard classification not identified. To determining spacing and sizing, apply the following coverage classifications:
 - a. Light Hazard Occupancies: Patient care, treatment, and customary access areas.
 - b. Ordinary Hazard Group 1 Occupancies: Laboratories, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, and Repair Shops.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- c. Ordinary Hazard Group 2 Occupancies: Storage rooms, trash rooms, clean and soiled linen rooms, pharmacy and associated storage, laundry, kitchens, kitchen storage areas, retail stores, retail store storage rooms, storage areas, building management storage, boiler plants, energy centers, warehouse spaces, file storage areas for the entire area of the space up to 140 square meters (1500 square feet) and Supply Processing and Distribution (SPD).
- 3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.
- 4. Zoning:
 - a. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.

1.4 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4(A)1 through 1.4(A)5 electronically in pdf format on a compact disc or as directed by the COR. Submittals shall include, but not be limited to, the following:
 - 1. Qualifications:
 - a. Provide a copy of the installing contractors fire sprinkler and state contractor's license.
 - b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- c. Provide documentation showing that the installer has been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
- Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to the Plans and Calculations chapter of NFPA 13. Drawings shall include graphical scales that allow the user to determine lengths when the drawings are reduced in size.
- 3. Manufacturer's Data Sheets: Provide data sheets for all materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheets describe items in addition to those proposed to be used for the system, clearly identify the proposed items on the sheet.
- 4. Calculation Sheets:
 - a. Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of the Plans and Calculations chapter of NFPA 13.
- 5. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. In addition, submittals shall include, but not be limited to, the following:
 - a. A complete set of as-built drawings showing the installed system with the specific interconnections between the system switches and the fire alarm equipment. Provide a complete set in the formats as follows. Submit items 2 and 3 below on a compact disc or as directed by the COR.
 - 1) One full size (or size as directed by the COR) printed copy.
 - 2) One complete set in electronic pdf format.
 - 3) One complete set in AutoCAD format or a format as directed by the COR.
 - b. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13. Certificates shall be provided to document all parts of the installation.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- c. Operations and Maintenance Manuals that include step-by-step procedures required for system startup, operation, shutdown, and routine maintenance and testing. The manuals shall include the manufacturer's name, model number, parts list, and tools that should be kept in stock by the owner for routine maintenance, including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization, including address and telephone number, for each item of equipment.
- d. One paper copy of the Material and Testing Certificates and the Operations and Maintenance Manuals above shall be provided in a binder. In addition, these materials shall be provided in pdf format on a compact disc or as directed by the COR.
- e. Provide one additional copy of the Operations and Maintenance Manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser or as directed by the COR.

1.5 QUALITY ASSURANCE

- A. Installer Reliability: The installer shall possess a valid State of Minnesota fire sprinkler contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
- B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL or approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA. All materials and equipment shall be free from defect. All materials and equipment shall be new unless specifically indicated otherwise on the contract drawings.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA): 13-18Installation of Sprinkler Systems 25-20Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

101-18Life Safety Code

- 170-21Fire Safety Symbols
- C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory (2011)
- D. Factory Mutual Engineering Corporation (FM): Approval Guide

PART 2 - PRODUCTS

2.1 PIPING & FITTINGS

- A. Piping and fittings for sprinkler systems shall be in accordance with NFPA 13.
 - Plain-end pipe fittings with locking lugs or shear bolts are not permitted.
 - Piping sizes 50 mm (2 inches) and smaller shall be black steel Schedule 40 with threaded end connections.
 - Piping sizes 65 mm (2 ½ inches) and larger shall be black steel Schedule 10 with grooved connections. Grooves in Schedule 10 piping shall be rolled grooved only.
 - 4. Use nonferrous piping in MRI Scanning Rooms.
 - 5. Plastic piping shall not be permitted except for drain piping.
 - 6. Flexible sprinkler hose shall be FM Approved and limited to hose with threaded end fittings with a minimum inside diameter or 1-inch and a maximum length of 6-feet.

2.2 VALVES

- A. General:
 - 1. Valves shall be in accordance with NFPA 13.
 - 2. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.
- B. Control Valve: The control valves shall be a listed indicating type. Control valves shall be UL Listed or FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI.
- C. Check Valve: Shall be of the swing type with a flanged cast iron body and flanged inspection plate.
- D. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.3 SPRINKLERS

- A. All sprinklers shall be FM approved quick response. Maximum break away strength shall be certified by the manufacturer to be no more than 39 kPa (85 pounds). Provide FM approved quick response sprinklers in all areas.
- B. Temperature Ratings: In accordance with NFPA 13.
- C. Provide sprinkler guards in accordance with NFPA 13 and when the elevation of the sprinkler head is less than 7 feet 6 inches above finished floor. The sprinkler guard shall be UL listed or FM approved for use with the corresponding sprinkler.

2.4 PIPE HANGERS, SUPPORTS AND RESTRAINT OF SYSTEM PIPING

Pipe hangers, supports, and restraint of system piping shall be in accordance with NFPA 13.

2.5 WALL, FLOOR AND CEILING PLATES

Provide chrome plated steel escutcheon plates.

2.6 VALVE TAGS

Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook, brass chain, or nylon twist tie.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.
- B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. In stairways, locate piping as near to the ceiling as possible to prevent tampering by unauthorized personnel and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). Piping shall not obstruct the minimum means of egress

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

clearances required by NFPA 101. Pipe hangers, supports, and restraint of system piping, shall be installed accordance with NFPA 13.

C. Welding: Conform to the requirements and recommendations of NFPA 13.

- D. Drains: Provide drips and drains, including low point drains, in accordance with NFPA 13. Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.
- E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.
- F. Waterflow Alarm Switches: Install waterflow alarm switches and valves in stairwells or other easily accessible locations.
- G. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.
- H. Provide escutcheon plates for exposed piping passing through walls, floors or ceilings.
- I. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.
- J. Firestopping shall be provided for all penetrations of fire resistance rated construction. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.
- K. Painting of Pipe: In finished areas where walls and ceilings have been painted, paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of gloss red enamel. Exercise care to avoid painting sprinklers. Painting of sprinkler systems above suspended ceilings and

in crawl spaces is not required. Painting shall comply with Section 09 91 00, PAINTING. Any painted sprinkler shall be replaced with a new sprinkler.

- L. Sprinkler System Signage: Provide rigid sprinkler system signage in accordance with NFPA 13 and NFPA 25. Sprinkler system signage shall include, but not limited to, the following:
 - 1. Identification Signs:
 - a. Provide signage for each control valve, drain valve, sprinkler cabinet, and inspector's test.
 - b. Provide valve tags for each operable valve. Coordinate nomenclature and identification of operable valves with COR. Where existing nomenclature does not exist, the Tag Identification shall include no less than the following: (FP-B-F/SZ-#) Fire Protection, Building Number, Floor Number/Smoke Zone (if applicable), and Valve Number. (E.g., FP-500-1E-001) Fire Protection, Building 500, First Floor East, Number 001.)
 - 2. Instruction/Information Signs:
 - a. Provide signage for each control valve to indicate valve function and to indicate what system is being controlled.
 - b. Provide signage indicating the number and location of low point drains.
- S. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.
- M. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve occupied spaces. Request in writing at least one week prior to the planned interruption.

3.2 INSPECTION AND TEST

A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Representative (COR) or his designated representative.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COR to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test

- - - E N D - - -

SECTION 22 05 11 COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section shall apply to all sections of Division 22.
- B. Definitions:
 - 1. Exposed: Piping and equipment exposed to view in finished rooms.
 - 2. Exterior: Piping and equipment exposed to weather be it temperature, humidity, precipitation, wind or solar radiation.

C. Abbreviations/Acronyms:

- 1. ABS: Acrylonitrile Butadiene Styrene
- 2. AC: Alternating Current
- 3. ACR: Air Conditioning and Refrigeration
- 4. A/E: Architect/Engineer
- 5. AFF: Above Finish Floor
- 6. AFG: Above Finish Grade
- 7. AI: Analog Input
- 8. AISI: American Iron and Steel Institute
- 9. AO: Analog Output
- 10. ASHRAE: American Society of Heating Refrigeration, Air Conditioning Engineers
- 11. ASJ: All Service Jacket
- 12. ASME: American Society of Mechanical Engineers
- 13. ASPE: American Society of Plumbing Engineers
- 14. AWG: American Wire Gauge
- 15. BACnet: Building Automation and Control Network
- 16. BAg: Silver-Copper-Zinc Brazing Alloy
- 17. BAS: Building Automation System
- 18. BCuP: Silver-Copper-Phosphorus Brazing Alloy
- 19. bhp: Brake Horsepower
- 20. Btu: British Thermal Unit
- 21. Btu/h: British Thermal Unit per Hour
- 22. BSG: Borosilicate Glass Pipe
- 23. C: Celsius
- 24. CA: Compressed Air
- 25. CD: Compact Disk

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 26. CDA: Copper Development Association 27. CGA: Compressed Gas Association 28. CFM: Cubic Feet per Minute 29. CI: Cast Iron 30. CLR: Color 31. CO: Contracting Officer 32. COR: Contracting Officer's Representative 33. CPVC: Chlorinated Polyvinyl Chloride 34. CR: Chloroprene 35. CRS: Corrosion Resistant Steel 36. CWP: Cold Working Pressure 37. CxA: Commissioning Agent 38. dB: Decibels 39. db(A): Decibels (A weighted) 40. DCW: Domestic Cold Water 41. DDC: Direct Digital Control 42. DFU: Drainage Fixture Units 43. DHW: Domestic Hot Water 44. DHWR: Domestic Hot Water Return 45. DHWS: Domestic How Water Supply 46. DI: Digital Input 47. DI: Deionized Water 48. DISS: Diameter Index Safety System 49. DN: Diameter Nominal 50. DO: Digital Output 51. DOE: Department of Energy 52. DVD: Digital Video Disc 53. DWG: Drawing 54. DWH: Domestic Water Heater 55. DWS: Domestic Water Supply 56. DWV: Drainage, Waste and Vent 57. ECC: Engineering Control Center 58. EL: Elevation 59. EMCS: Energy Monitoring and Control System 60. EPA: Environmental Protection Agency 61. EPACT: Energy Policy Act 62. EPDM: Ethylene Propylene Diene Monomer

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 63. EPT: Ethylene Propylene Terpolymer 64. ETO: Ethylene Oxide 65. F: Fahrenheit 66. FAR: Federal Acquisition Regulations 67. FD: Floor Drain 68. FDC: Fire Department (Hose) Connection 69. FED: Federal 70. FG: Fiberglass 71. FNPT: Female National Pipe Thread 72. FOR: Fuel Oil Return 73. FOS: Fuel Oil Supply 74. FOV: Fuel Oil Vent 75. FPM: Fluoroelastomer Polymer 76. FSK: Foil-Scrim-Kraft Facing 77. FSS: VA Construction & Facilities Management, Facility Standards Service 78. FU: Fixture Units 79. GAL: Gallon 80. GCO: Grade Cleanouts 81. GPD: Gallons per Day 82. GPH: Gallons per Hour 83. GPM: Gallons per Minute 84. HDPE: High Density Polyethylene 85. HEFP: Healthcare Environment and Facilities Program (replacement for OCAMES) 86. HEX: Heat Exchanger 87. Hq: Mercury 88. HOA: Hands-Off-Automatic 89. HP: Horsepower 90. HVE: High Volume Evacuation 91. Hz: Hertz 92. ID: Inside Diameter 93. IE: Invert Elevation 94. INV: Invert 95. IPC: International Plumbing Code 96. IPS: Iron Pipe Size 97. IW: Indirect Waste

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 98. IWH: Instantaneous Water Heater 99. Kg: Kilogram 100. kPa: Kilopascal 101. KW: Kilowatt 102. KWH: Kilowatt Hour 103. lb: Pound 104. lbs/hr: Pounds per Hour 105. LNG: Liquid Natural Gas 106. L/min: Liters per Minute 107. LOX: Liquid Oxygen 108. L/s: Liters per Second 109.m: Meter 110. MA: Medical Air 111. MAWP: Maximum Allowable Working Pressure 112. MAX: Maximum 113. MBH: 1000 Btu per Hour 114. MED: Medical 115. MER: Mechanical Equipment Room 116. MFG: Manufacturer 117.mg: Milligram 118. mg/L: Milligrams per Liter 119. ml: Milliliter 120.mm: Millimeter 121. MIN: Minimum 122. MV: Medical Vacuum 123. N2: Nitrogen 124. N20: Nitrogen Oxide 125. NC: Normally Closed 126. NF: Oil Free Dry (Nitrogen) 127.NG: Natural Gas 128. NIC: Not in Contract 129. NO: Normally Open 130. NOM: Nominal 131. NPTF: National Pipe Thread Female 132. NPS: Nominal Pipe Size 133. NPT: Nominal Pipe Thread 134. NTS: Not to Scale

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 135.02: Oxygen 136.OC: On Center 137. OD: Outside Diameter 138. OSD: Open Sight Drain 139. OS&Y: Outside Stem and Yoke 140. PA: Pascal 141. PBPU: Prefabricated Bedside Patient Units 142. PD: Pressure Drop or Difference 143. PDI: Plumbing and Drainage Institute 144. PH: Power of Hydrogen 145. PID: Proportional-Integral-Differential 146. PLC: Programmable Logic Controllers 147. PP: Polypropylene 148. ppb: Parts per Billion 149. ppm: Parts per Million 150. PSI: Pounds per Square Inch 151. PSIA: Pounds per Square Inch Atmosphere 152. PSIG: Pounds per Square Inch Gauge 153. PTFE: Polytetrafluoroethylene 154. PVC: Polyvinyl Chloride 155. PVDF: Polyvinylidene Fluoride 156. RAD: Radians 157. RO: Reverse Osmosis 158. RPM: Revolutions Per Minute 159. RTD: Resistance Temperature Detectors 160. RTRP: Reinforced Thermosetting Resin Pipe 161. SAN: Sanitary Sewer 162. SCFM: Standard Cubic Feet per Minute 163. SDI: Silt Density Index 164. SMACNA: Sheet Metal and Air Conditioning Contractors National Association 165. SPEC: Specification 166. SPS: Sterile Processing Services 167. SQFT/SF: Square Feet 168.SS: Stainless Steel 169. STD: Standard 170. SUS: Saybolt Universal Second

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 171. SWP: Steam Working Pressure 172. TD: Temperature Difference 173. TDH: Total Dynamic Head 174. TEFC: Totally Enclosed Fan-Cooled 175. TEMP: Temperature 176. TFE: Tetrafluoroethylene 177. THERM: 100,000 Btu 178. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire 179. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire 180. TIL: Technical Information Library http//www.cfm.va.gov/til/indes.asp 181. T/P: Temperature and Pressure 182. TYP: Typical 183. USDA: U.S. Department of Agriculture 184.V: Vent 185.V: Volt 186. VA: Veterans Administration 187. VA CFM: VA Construction & Facilities Management 188. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service 189. VAC: Vacuum 190. VAC: Voltage in Alternating Current 191. VAMC: Veterans Administration Medical Center 192. VHA OCAMES: This has been replaced by HEFP. 193. VSD: Variable Speed Drive 194. VTR: Vent through Roof 195.W: Waste 196. WAGD: Waste Anesthesia Gas Disposal 197. WC: Water Closet 198.WG: Water Gauge 199. WOG: Water, Oil, Gas 200. WPD: Water Pressure Drop 201. WSFU: Water Supply Fixture Units 1.2 RELATED WORK A. Section 01 00 00, GENERAL REQUIREMENTS. B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

```
VAMC St. Cloud, MN
                                                        VA Project 656-21-235
                                                              March 30, 2022
EHRM Infrastructure Upgrades
4801 Veterans Drive
                                                   100% CD Issued for Bidding
St. Cloud, MN 56303
   D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
   E. Section 05 31 00, STEEL DECKING: Building Components for Attachment of
      Hangers.
   F. Section 05 36 00, COMPOSITE METAL DECKING: Building Components for
      Attachment of Hangers.
   G. Section 05 50 00, METAL FABRICATIONS.
   H. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof
     Penetrations.
   I. Section 07 84 00, FIRESTOPPING.
   J. Section 07 92 00, JOINT SEALANTS.
   K. Section 09 91 00, PAINTING.
   L. Section 22 07 11, PLUMBING INSULATION.
1.3 APPLICABLE PUBLICATIONS
   A. The publications listed below shall form a part of this specification
      to the extent referenced. The publications are referenced in the text
     by the basic designation only. Where conflicts occur these
      specifications and the VHA standard will govern.
   B. American Society of Mechanical Engineers (ASME):
      B31.1-2018 .....Power Piping
     ASME Boiler and Pressure Vessel Code -
      BPVC Section IX-2019 .... Welding, Brazing, and Fusing Qualifications
   C. American Society for Testing and Materials (ASTM):
      A36/A36M-2019 .....Standard Specification for Carbon Structural
                             Steel
     A575-96(2018)e1 .....Standard Specification for Steel Bars, Carbon,
                             Merchant Quality, M-Grades
      E84-2020a .....Standard Test Method for Surface Burning
                             Characteristics of Building Materials
     E119-2019a .....Standard Test Methods for Fire Tests of
                             Building Construction and Materials
   D. International Code Council, (ICC):
      IBC-2018 ..... International Building Code
      IPC-2018 .....International Plumbing Code
```

E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 SP-58-2018Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation F. Military Specifications (MIL): P-21035B Galvanizing Repair (Metric) G. National Electrical Manufacturers Association (NEMA): MG 1-2016Motors and Generators H. National Fire Protection Association (NFPA): 51B-2019 Standard for Fire Prevention During Welding, Cutting and Other Hot Work 54-2018National Fuel Gas Code 70-2020National Electrical Code (NEC) 99-2018Healthcare Facilities Code I. NSF International (NSF): 5-2019Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment 14-2019Plastic Piping System Components and Related Materials 61-2019Drinking Water System Components - Health Effects 372-2016 Drinking Water System Components - Lead Content J. Department of Veterans Affairs (VA): PG-18-102014(R18)Plumbing Design Manual PG-18-13-2017(R18)Barrier Free Design Guide 1.4 SUBMITTALS A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.

SAMPLES

C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements. It is the Contractor's responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

unless the Contractor has requested a variance in writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor shall correct at no additional cost or time to the Government even if a submittal was approved.

- D. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical shall be the Contractor's responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- E. Prior to submitting shop drawings for approval, Contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- G. Manufacturer's Literature and Data including: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
 - 1. Equipment and materials identification.
 - 2. Firestopping materials.
 - 3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
 - 4. Wall, floor, and ceiling plates.
- H. Coordination/Shop Drawings:
 - Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. The coordination/shop drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to 1 foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed coordination/shop drawings of all piping and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.
- 3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
- 4. In addition, for plumbing systems, provide details of the following:
 - a. Mechanical equipment rooms.
 - b. Hangers, inserts, supports, and bracing.
 - c. Pipe sleeves.
 - d. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- I. Plumbing Maintenance Data and Operating Instructions:
 - Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
 - Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - a. Include complete list indicating all components of the systems.

1.5 QUALITY ASSURANCE

A. Mechanical, electrical, and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional plumbing.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Products Criteria:
 - Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years.
 - All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 - 3. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Contracting Officers Representative (COR).
 - 4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
 - 5. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
 - 6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
 - 7. Asbestos products or equipment or materials containing asbestos is prohibited.
- C. Welding: Before any welding is performed, Contractor shall submit a certificate certifying that welders comply with the following requirements:
 - Qualify welding processes and operators for piping according to ASME BPVC, Section IX, "Welding and Brazing Qualifications". Provide proof of current certification to CO.
 - Comply with provisions of ASME B31 series "Code for Pressure Piping".

22 05 11 - 11 COMMON WORK RESULTS FOR PLUMBING

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- 4. All welds shall be stamped according to the provisions of the AWS or ASME as required herein and by the association code.
- D. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- E. Execution (Installation, Construction) Quality:
 - All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the COR for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the COR at least 10 working days prior to commencing installation of any item.
 - 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution. Failure of the Contractor to resolve or call attention to any discrepancies or deficiencies to the COR will result in the Contractor correcting at no additional cost or time to the Government.
 - 3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.
 - 4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five

projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.

- 5. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work shall be removed and done again at no additional cost or time to the Government.
- F. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.
- G. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- H. Plumbing Systems: IPC, International Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the IPC. For IPC codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall". Reference to the "code official" or "owner" shall be interpreted to mean the COR.
- I. Cleanliness of Piping and Equipment Systems:
 - Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
 - 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
 - 3. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
 - 4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protection of Equipment:
 - Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage or theft.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost or additional time to the Government.
- 3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
- Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- 5. Protect plastic piping and tanks from ultraviolet light (sunlight) while in pre-construction. Plastic piping and tanks shall not be installed exposed to sunlight without metal jacketing to block ultraviolet rays.

1.7 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. The installing Contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:
 - Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.
 - 2. As-built drawings are to be provided, with a copy of them on AutoCAD version provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.
- C. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.
- D. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics_), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 JOB CONDITIONS - WORK IN EXISTING BUILDING

- A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.
- B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.
- C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the demands are not critical to the operation of the VAMC. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least 10 working days advance notice to the COR. The request shall include a detailed plan on the proposed shutdown and the intended work to be done along with manpower levels. All equipment and materials must be onsite and verified with plan 5 work days prior to the shutdown or it will need to be rescheduled.
- D. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- E. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.
- F. Temporary Facilities: Refer to Paragraph, TEMPORARY PIPING AND EQUIPMENT in this section.

PART 2 - PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

- A. Non-pressure PVC pipe shall contain a minimum of 25 percent recycled content. Steel pipe shall contain a minimum of 25 percent recycled content.
- B. Plastic pipe, fittings and solvent cement shall meet NSF 14 and shall bear the NSF seal "NSF-PW". Polypropylene pipe and fittings shall comply with NSF 14 and NSF 61. Solder or flux containing lead shall not be used with copper pipe.
- C. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption and shall be certified in accordance with NSF 61 or NSF 372.
- D. In-line devices such as building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.

2.2 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements.

2.3 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.4 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown in the drawings, or shown in the maintenance manuals. Coordinate equipment and

22 05 11 - 16 COMMON WORK RESULTS FOR PLUMBING

valve identification with local VAMC shops. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.

- B. Valve Tags and Lists:
 - Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
 - 2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gauge, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

2.5 FIRESTOPPING

A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 22 07 11, PLUMBING INSULATION, for pipe insulation.

2.6 GALVANIZED REPAIR COMPOUND

A. Mil. Spec. DOD-P-21035B, paint.

2.7 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC) The Support system of suspended equipment over 227 kg (500 pounds) shall be submitted for approval of the COR in all cases. See the above specifications for lateral force design requirements.
- B. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP-58. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction:
 - 1. Concrete insert: Type 18, MSS SP-58.
 - Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

- Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
- D. For Attachment to Steel Construction: MSS SP-58.
 - 1. Welded attachment: Type 22.
 - 2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.
- E. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING. Section 05 36 00, COMPOSITE METAL DECKING.
- F. For Attachment to Wood Construction: Wood screws or lag bolts.
- G. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- H. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gauge), designed to accept special spring held, hardened steel nuts.
 - 1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
 - 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 8 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- I. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
 - 1. General Types (MSS SP-58):
 - a. Standard clevis hanger: Type 1; provide locknut.
 - b. Riser clamps: Type 8.
 - c. Wall brackets: Types 31, 32 or 33.

- d. Roller supports: Type 41, 43, 44 and 46.
- e. Saddle support: Type 36, 37 or 38.
- f. Turnbuckle: Types 13 or 15.
- g. U-bolt clamp: Type 24.
- h. Copper Tube:
 - Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.
 - For vertical runs use epoxy painted, copper-coated or plastic coated riser clamps.
 - For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
 - Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
- i. Supports for plastic piping: As recommended by the pipe manufacturer with black rubber tape extending 1 inch beyond steel support or clamp. Spring Supports (Expansion and contraction of vertical piping):
 - Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2) Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
- j. Spring hangers are required on all plumbing system pumps one horsepower and greater.
- 2. Plumbing Piping (Other Than General Types):
 - a. Horizontal piping: Type 1, 5, 7, 9, and 10.
 - b. Chrome plated piping: Chrome plated supports.
 - c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
 - d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gauge) minimum.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- J. Pre-insulated Calcium Silicate Shields:
 - Provide 360-degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
 - Pre-insulated calcium silicate shields to be installed at the point of support during erection.
 - 3. Shield thickness shall match the pipe insulation.
 - The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
 - a. Shields for supporting cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.
 - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-58. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
 - 5. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.

2.8 **PIPE PENETRATIONS**

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
 - 1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
 - For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
 - For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- D. Penetrations are prohibited through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of COR.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
- G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
- I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
- K. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

2.9 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

> 22 05 11 - 21 COMMON WORK RESULTS FOR PLUMBING

- B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3 inch) pipe, 0.89 mm (0.035 inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

2.10 ASBESTOS

A. Materials containing asbestos are prohibited.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.
- B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
- C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown in the drawings shall not be changed nor reduced.
- D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.
- E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- F. Cutting Holes:
 - 1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and
drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.

- Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- 3. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other services are not shown but must be provided.
- H. Protection and Cleaning:
 - Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced at no additional cost or time to the Government.
 - 2. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical damage. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- I. Gauges, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gauges shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- J. Work in Existing Building:
 - Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
 - 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

piping at times that will cause the least interfere with normal operation of the facility.

- K. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers' putty.
- L. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above data equipment, and electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve shall be provided in low point of casement pipe.
- M. Inaccessible Equipment:
 - Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or additional time to the Government.
 - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the COR.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work shall be provided.
- D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC) and these specifications.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- E. Overhead Supports:
 - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
 - Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
 - 3. Tubing and capillary systems shall be supported in channel troughs.

3.3 PLUMBING SYSTEMS DEMOLITION

- A. Rigging access, other than indicated in the drawings, shall be provided after approval for structural integrity by the COR. Such access shall be provided at no additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards including NFPA 51B. Inspections will be made by personnel of the VAMC, and the Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

D. All valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate. Coordinate with the COR and Infection Control.

3.4 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
 - 1. The final result shall be a smooth, even-colored, even-textured factory finish on all items. Lead based paints shall not be used.

3.5 **IDENTIFICATION SIGNS**

A. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.6 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.

- - - E N D - - -

SECTION 22 05 23 GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.
- B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.
- B. American Society of Mechanical Engineers (ASME): A112.14.1-2017Backwater Valves
- C. American Society of Sanitary Engineering (ASSE):

1001-2017 Performance Requirements for Atmospheric Type Vacuum Breakers

- 1003-2020Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
- 1011-2017Performance Requirements for Hose Connection Vacuum Breakers
- 1013-2021Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
- 1015-2021Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 1017-2009Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems 1020-2020Performance Requirements for Pressure Vacuum Breaker Assembly 1035-2008Performance Requirements for Laboratory Faucet Backflow Preventers 1069-2005Performance Requirements for Automatic Temperature Control Mixing Valves 1070-2015Performance Requirements for Water Temperature Limiting Devices 1071-2012 Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment D. American Society for Testing and Materials (ASTM): A126-2004(R2019)Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings A276/A276M-2017Standard Specification for Stainless Steel Bars and Shapes A536-1984(R2019e)Standard Specification for Ductile Iron Castings B62-2017 Standard Specification for Composition Bronze or Ounce Metal Castings B584-2014Standard Specification for Copper Alloy Sand Castings for General Applications E. International Code Council (ICC): IPC-2018 International Plumbing Code F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-25-2018Standard Marking Systems for Valves, Fittings, Flanges and Unions SP-67-2017Butterfly Valves SP-70-2011Gray Iron Gate Valves, Flanged and Threaded Ends SP-71-2018Gray Iron Swing Check Valves, Flanged and Threaded Ends SP-80-2019Bronze Gate, Globe, Angle, and Check Valves

22 05 23 **-** 2

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 SP-85-2011Gray Iron Globe & Angle Valves, Flanged and Threaded Ends SP-110-2010Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends G. National Environmental Balancing Bureau (NEBB): 8th Edition 2015 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems H. NSF International (NSF): 61-2019Drinking Water System Components - Health Effects 372-2016Drinking Water System Components - Lead Content I. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR): 10th EditionManual of Cross-Connection Control 1.4 SUBMITTALS A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES. B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING", with applicable paragraph identification. C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity. 1. Ball Valves. 2. Gate Valves. 1.5 DELIVERY, STORAGE, AND HANDLING A. Valves shall be prepared for shipping as follows: 1. Protect internal parts against rust and corrosion. 2. Protect threads, flange faces, grooves, and weld ends. 3. Set gate valves closed to prevent rattling. 4. Set ball valves open to minimize exposure of functional surfaces. B. Valves shall be prepared for storage as follows: 1. Maintain valve end protection. 2. Store valves indoors and maintain at higher than ambient dew point temperature.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.6 AS BUILT DOCUMENTATION

A. Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Asbestos packing and gaskets are prohibited.
- B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing greater than 15 percent zinc shall not be permitted.
- C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.
- D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
- E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.
- F. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

2.2 SHUT-OFF VALVES

- A. Cold, Hot and Re-circulating Hot Water:
 - 1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.

2.3 MANUAL BALANCING VALVES

A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitted with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

values shall have memory stops that allow the value to close for service and then reopened to set point without disturbing the balance position. All values shall have calibrated nameplates to assure specific value settings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
- B. Valves shall be installed in horizontal piping with stem at or above center of pipe.
- C. Valves shall be installed in a position to allow full stem movement.
- D. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.3 ADJUSTING

A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.4 STARTUP AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

- - - E N D - - -

SECTION 22 07 11 PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for the following:
 - 1. Plumbing piping.
- B. Definitions:
 - 1. ASJ: All Service Jacket, Kraft paper, white finish facing or jacket.
 - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
 - 3. All insulation systems installed within supply, return, exhaust, relief and ventilation air plenums shall be limited to uninhabited crawl spaces, areas above a ceiling or below the floor, attic spaces, interiors of air conditioned or heating ducts, and mechanical equipment rooms shall be noncombustible or shall be listed and labeled as having a flame spread indexes of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723. Note: ICC IMC, Section 602.2.1.
 - Cold: Equipment or piping handling media at design temperature of 15 degrees C (60 degrees F) or below.
 - 5. Concealed: Piping above ceilings and in chases, and pipe spaces.
 - 6. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
 - 7. FSK: Foil-scrim-Kraft facing.
 - Hot: Plumbing equipment or piping handling media above 40 degrees C (104 degrees F).
 - Density: kg/m³ kilograms per cubic meter (Pcf pounds per cubic foot).
 - 10. Thermal conductance: Heat flow rate through materials.
 - a. Flat surface: Watts per square meter (BTU per hour per square foot).
 - b. Pipe or Cylinder: Watts per linear meter (BTU per hour per linear foot) for a given outside diameter.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 11. Thermal Conductivity (k): Watts per meter, per degree K (BTU inch thickness, per hour, per square foot, per degree F temperature difference).
- 12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders/vapor barriers shall have a maximum published permeance of .02 perms.
- 13. HWR: Hot water recirculating.
- 14. CW: Cold water.
- 15. SW: Soft water.
- 16. HW: Hot water.

17. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Insulation material and insulation production method.
- D. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
- F. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold-water piping.
- G. Section 23 21 13, HYDRONIC PIPING.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM): B209-2014Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate C411-2019Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C449-2007 (R2019)Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement C450-2008 (R2018)Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging Adjunct to C450Compilation of Tables that Provide Recommended Dimensions for Prefab and Field Thermal Insulating Covers, etc. C533-2019 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation C534/C534M-2019Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form C547-2019 Standard Specification for Mineral Fiber Pipe Insulation C552-2017Standard Specification for Cellular Glass Thermal Insulation C553-2019Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications C591-2019Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation C680-2019Standard Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs C612-2019Standard Specification for Mineral Fiber Block and Board Thermal Insulation C1126-2019Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation C1136-2017 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C1710-2016Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form D1668/D1668M-1997a (2014)e1 Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing E84-2020aStandard Test Method for Surface Burning Characteristics of Building Materials E2231-2019Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation to Assess Surface Burning Characteristics C. Federal Specifications (Fed. Spec.): L-P-535E-1979Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride -Vinyl Acetate), Rigid. D. International Code Council, (ICC): IMC-2018International Mechanical Code E. Military Specifications (Mil. Spec.): MIL-A-3316C (2)-1990 ... Adhesives, Fire-Resistant, Thermal Insulation MIL-A-24179A (2)-1987 .. Adhesive, Flexible Unicellular-Plastic Thermal Insulation MIL-PRF-19565C (1)-1988 Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier MIL-C-20079H-1987Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass F. National Fire Protection Association (NFPA): 90A-2018Standard for the Installation of Air-Conditioning and Ventilating Systems G. Underwriters Laboratories, Inc (UL): 723-2008 (R2018)Standard for Test for Surface Burning Characteristics of Building Materials 1887-2004 (R2013)Standard for Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics H. 3E Plus® version 4.1 Insulation Thickness Computer Program: Available

from NAIMA with free download; https://insulationinstitute.org/toolsresources/

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 07 11, PLUMBING INSULATION", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
- D. Shop Drawings:
 - All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM Designation, Federal and Military specifications.
 - a. Insulation materials: Specify each type used and state surface burning characteristics.
 - b. Insulation facings and jackets: Each type used and state surface burning characteristics.
 - c. Insulation accessory materials: Each type used.
 - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation shall follow the guidelines in accordance with ASTM C1710.
 - e. Make reference to applicable specification paragraph numbers for coordination.
 - f. All insulation fittings (exception flexible unicellular insulation) shall be fabricated in accordance with ASTM C450 and the referenced Adjunct to ASTM C450.

1.5 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. Criteria:
 - Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through
 4.3.3.6, 4.3.11.2.6, parts of which are quoted as follows:

4.3.3.1 Pipe and duct insulation and coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels and duct silencers used in duct systems shall have, in the form in

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with ASTM E84 and appropriate mounting practice, e.g. ASTM E2231.

4.3.3.3 Coverings and linings for air ducts, pipes, plenums and panels including all pipe and duct insulation materials shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service. In no case shall the test temperature be below 121 degrees C (250 degrees F).

4.3.11.2.6.3 Nonferrous fire sprinkler piping shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

- 2. Test methods: ASTM E84, UL 723, and ASTM E2231.
- 3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.
- 4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- C. Every package or standard container of insulation or accessories delivered to the job site for use shall have a manufacturer's stamp or label giving the name of the manufacturer, description of the material, and the production date or code.

1.6 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2020 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

1.7 STORAGE AND HANDLING OF MATERIAL

A. Store materials in clean and dry environment, pipe insulation jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

- A. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 16 kg/m³ (nominal 1 pcf), k = 0.045 (0.31) Class B-5, Density 32 kg/m³ (nominal 2 pcf), k = 0.04 (0.27) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F).
- B. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (446 degrees F) with an all service vapor retarder jacket (ASJ) and with polyvinyl chloride (PVC) premolded fitting covering.

2.2 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C552, density 120 kg/m³ (7.5 pcf) nominal, k = 0.033 (0.29) at 24 degrees C (75 degrees F).
- B. Pipe insulation for use at process temperatures below ambient air to 482 degrees C (900 degrees F) with or without all service vapor retarder jacket (ASJ).
- C. Pipe insulation for use at process temperatures for pipe and tube below ambient air temperatures or where condensation control is necessary are to be installed with a vapor retarder/barrier system of with or without

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

all service vapor retarder sealed jacket (ASJ) system. Without ASJ shall require all longitudinal and circumferential joints to be vapor sealed with vapor barrier mastic.

2.3 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

A. ASTM C534/C534M, k = 0.039 (0.27) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (199 degrees F). Under high humidity exposures for condensation control an external vapor retarder/barrier jacket is required. Consult ASTM C1710.

2.4 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be ASJ or PVDC Vapor Retarder jacketing.
- B. ASJ shall be white finish (kraft paper) bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture is 50 units, suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: FSK or PVDC type for concealed ductwork and equipment.
- D. Except for flexible elastomeric cellular thermal insulation (not for high humidity exposures), field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity locations conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- E. Except for cellular glass thermal insulation, when all longitudinal and circumferential joints are vapor sealed with a vapor barrier mastic or caulking, vapor barrier jackets may not be provided. For aesthetic and physical abuse applications, exterior jacketing is recommended. Otherwise field applied vapor barrier jackets shall be provided, in addition to the applicable specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity locations conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.
- F. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2070 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be PVC conforming to Fed Spec L-P-535E, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape. Staples, tacks, or any other attachment that penetrates the PVC covering is not allowed on any form of a vapor barrier system in below ambient process temperature applications.

2.5 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass insulation of the same thickness as adjacent insulation.

Nominal Pipe Size and Accessories Material (Insert Blocks)				
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)			
Up through 125 (5)	150 (6) long			
150 (6)	150 (6) long			
200 (8), 250 (10), 300 (12)	225 (9) long			

Nominal Pipe Size and Accessories Material (Insert Blocks)				
Nominal Pipe Size mm (inches) Insert Blocks mm (inches)				
350 (14), 400 (16)	300 (12) long			
450 through 600 (18 through 24)	350 (14) long			

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree halfshells) on bottom half of pipe at supports. Material shall be cellular glass. Insulation at supports shall have same thickness as adjacent insulation.

2.6 ADHESIVE, MASTIC, CEMENT

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- C. Mil. Spec. MIL-A-24179A, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- D. Mil. Spec. MIL-PRF-19565C, Type I: Protective finish for outdoor use.
- E. Mil. Spec. MIL-PRFC-19565C, Type I or Type II: Vapor barrier compound for indoor use.
- F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
- G. Other: Insulation manufacturers' published recommendations.

2.7 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching galvanized steel. Staples are not allowed for below ambient vapor barrier applications.
- C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy or stainless steel.
- D. Bands: 13 mm (1/2 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.
- E. Tacks, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall NOT be used to attach/close the any type of vapor retarder jacketing. Thumb tacks sometimes used on PVC

jacketing and preformed fitting covers closures are not allowed for below ambient vapor barrier applications.

2.8 REINFORCEMENT AND FINISHES

- A. Glass fabric, open weave: ASTM D1668/D1668M, Type III (resin treated) and Type I (asphalt or white resin treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079H, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.
- E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.
- F. PVC fitting cover: Fed. Spec L-P-535E, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 10 to 121 degrees C (50 to 250 degrees F). Below 10 degrees C (50 degrees F) and above 121 degrees C (250 degrees F) provide mitered pipe insulation of the same type as insulating straight pipe. Provide double layer insert. Provide vapor barrier pressure sensitive tape matching the color of the PVC jacket.

2.9 FIRESTOPPING MATERIAL

A. Other than pipe insulation, refer to Section 07 84 00, FIRESTOPPING.

2.10 FLAME AND SMOKE

A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM and UL standards and specifications. See paragraph "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Contracting Officer's Representative (COR) for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions or as noted, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate

each pipe individually. Do not use scrap pieces of insulation where a full-length section will fit.

- C Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down and sealed at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A).
- D. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 15 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- E. Install vapor stops with operating temperature 15 degrees C (60 degrees F) and below at all insulation terminations on either side of valves, pumps, fittings, and equipment and particularly in straight lengths every 4.6 to 6.1 meters (approx. 15 to 20 feet) of pipe insulation. The annular space between the pipe and pipe insulation of approx. 25 mm (1 inch) in length at every vapor stop shall be sealed with appropriate vapor barrier sealant.
- F. Insulation on hot piping shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer coating (caution about coating's maximum temperature limit) or jacket material.
- G. Plumbing work not to be insulated unless otherwise noted:
 - 1. Piping and valves of fire protection system.
 - 2. Chromium plated brass piping.
 - 3. Water piping in contact with earth.
 - 4. Distilled water piping.
- H. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum wet or dry film thickness.
- I. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. Use of polyurethane or polyisocyanurate spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

- J. Firestop Pipe insulation:
 - Provide firestopping insulation at fire and smoke barriers through penetrations. Firestopping insulation shall be UL listed as defined in Section 07 84 00, FIRESTOPPING.
 - Pipe penetrations requiring fire stop insulation including, but not limited to the following:
 - a. Pipe risers through floors
 - b. Pipe chase walls and floors
 - c. Smoke partitions
 - d. Fire partitions
 - e. Hourly rated walls
- K. Provide vapor barrier systems as follows:
- All interior piping conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.) below ambient air temperature in high humidity locations.
- L. Provide PVC jackets over insulation as follows:
 - 1. Piping exposed in building, within 1829 mm (6 feet) of the floor, on piping that is not precluded in previous sections.
 - 2. A 50 mm (2 inch) jacket overlap is required at longitudinal and circumferential joints with the overlap at the bottom.

3.2 INSULATION INSTALLATION

- A. Molded Mineral Fiber Pipe and Tubing Covering:
 - 1. Fit insulation to pipe, aligning all longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation except for cold piping. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide cellar glass inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
 - 2. Contractor's options for fitting, flange and valve insulation:
 - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 15 degrees C (60 degrees F) or more.
 - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts surface temperature of above 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Provide mitered preformed

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

insulation of the same type as the installed straight pipe insulation for pipe temperatures below 4 degrees C (40 degrees F). Secure first layer of mineral fiber insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.

- c. Factory preformed, ASTM C547 or fabricated mitered sections, joined with adhesive or (hot only) wired in place. (Bio-based materials shall be utilized when possible.) For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 15 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
- d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
- 3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.
- B. Cellular Glass Insulation:
 - 1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
- C. Flexible Elastomeric Cellular Thermal Insulation:
 - Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer. External vapor barrier jacketing may be required for expected or anticipated high humidity exposures. See ASTM C1710.
 - 2. Pipe and tubing insulation:
 - a. Use proper size material. Do not stretch or strain insulation.
 - b. To avoid undue compression of insulation, use supports as recommended by the elastomeric insulation manufacturer. Insulation shields are specified under Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
 - c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed.

- Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
- 4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.

3.3 PIPE INSULATION SCHEDULE

A. Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)							
		Nominal Pipe Size Millimeters (Inches)					
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 - 32 (1 - 1¼)	38 - 75 (1 ¹ / ₂ - 3)	100 (4) and Greater		
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)		
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)		
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Cellular Glass Thermal	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)		
<pre>(4-15 degrees C (40-60 degrees F) (//Ice water piping//)</pre>	Flexible Elastomeric Cellular Thermal (Above ground piping only)	25 (1.0)	25(1.0)	25 (1.0)	25 (1.0)		
4-15 degrees C (40-60 degrees F) (//Ice water piping//	Cellular Glass Thermal	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)		

- - - E N D - - -

SECTION 22 11 00 FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Domestic water systems, including piping and all necessary accessories as designated in this section.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. Section 07 84 00, FIRESTOPPING.
- E. Section 07 92 00, JOINT SEALANTS.
- F. Section 09 91 00, PAINTING.
- G. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- H. Section 22 07 11, PLUMBING INSULATION.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):

A13.1-2007 (R2015)Scheme for Identification of Piping Systems B16.3-2016Malleable Iron Threaded Fittings: Classes 150 and 300

Fittings: Classes 150, 300, 600, 900, 1500, and 2500

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 ASME Boiler and Pressure Vessel Code -BPVC Section IX-2019 ... Welding, Brazing, and Fusing Qualifications C. American Society of Sanitary Engineers (ASSE): 1010-2004Performance Requirements for Water Hammer Arresters D. American Society for Testing and Materials (ASTM): A47/A47M-1999 (R2018) .. Standard Specification for Ferritic Malleable Iron Castings A53/A53M-2018Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless A183-2014Standard Specification for Carbon Steel Track Bolts and Nuts A269/A269M-2019e1Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service A312/A312M-2019Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes A403/A403M-2020Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings A536-1984 (R2019)Standard Specification for Ductile Iron Castings A733-2016Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples B32-2008 (R2014)Standard Specification for Solder Metal B43-2020Standard Specification for Seamless Red Brass Pipe, Standard Sizes B61-2008 (R2015)Standard Specification for Steam or Valve Bronze Castings B62-2017Standard Specification for Composition Bronze or Ounce Metal Castings B75/B75M-2019Standard Specification for Seamless Copper Tube B88-2016 Standard Specification for Seamless Copper Water Tube

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 B584-2014Standard Specification for Copper Alloy Sand Castings for General Applications B687-1999 (R2018)Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples C919-2019Standard Practice for Use of Sealants in Acoustical Applications D1785-2015Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 D2000-2018Standard Classification System for Rubber Products in Automotive Applications D2564-2018Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems D2657-2015Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings D2855-1996 (R2015)Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings D4101-2017Standard Specification for Polypropylene Injection and Extrusion Materials E1120-2016Standard Specification for Liquid Chlorine E1229-2016Standard Specification for Calcium Hypochlorite F2389-2019Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems F2620-2019Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings F2769-2018Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems E. American Water Works Association (AWWA): C110-2012Ductile-Iron and Gray-Iron Fittings C151-2017Ductile Iron Pipe, Centrifugally Cast C153-2019Ductile-Iron Compact Fittings C203-2015Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C213-2015Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines C651-2014Disinfecting Water Mains F. American Welding Society (AWS): A5.8M/A5.8-2011-AMD1 ... Specification for Filler Metals for Brazing and Braze Welding G. International Code Council (ICC): IPC-2018 International Plumbing Code H. Manufacturers Specification Society (MSS): SP-58-2018Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation SP-72-2010aBall Valves with Flanged or Butt-Welding Ends for General Service SP-110-2010Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends I. NSF International (NSF): 14-2017Plastics Piping System Components and Related Materials 61-2019aDrinking Water System Components - Health Effects 372-2011Drinking Water System Components - Lead Content J. Plumbing and Drainage Institute (PDI): PDI-WH 201-2017Water Hammer Arrestors K. Department of Veterans Affairs: H-18-10Plumbing Design Manual 1.4 SUBMITTALS A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND

- SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1. All items listed in Part 2 - Products.

1.5 QUALITY ASSURANCE

- A. A certificate shall be submitted prior to welding of steel piping showing the Welder's certification. The certificate shall be current and no more than one year old. Welder's qualifications shall be in accordance with ASME BPVC Section IX.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.
- C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

1.6 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certificate if applicable that all results of tests were within limits specified. If a certificate is not available, all documentation shall be on the Certifier's letterhead.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material or equipment containing a weighted average of greater than0.25 percent lead are prohibited in any potable water system intended

22 11 00 - 5 FACILITY WATER DISTRIBUTION for human consumption and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.

B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 ABOVE GROUND (INTERIOR) WATER PIPING

- A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless steel, ASTM A312, schedule 40 shall be used.
- B. Fittings for Copper Tube:
 - Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
 - Mechanical press-connect fittings for copper pipe and tube <u>are</u> prohibited. See Plumbing Design Manual for additional information.
 - 3. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting. Braze joints.
 - 4. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.
- C. Fittings for Stainless Steel:
 - Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ASME B16.9.
- D. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.
- E. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.
- F. Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.

2.3 EXPOSED WATER PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets,

equipment, and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

- 1. Pipe: ASTM B43, standard weight.
- 2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
- 3. Nipples: ASTM B687, Chromium-plated.
- Unions: MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
- B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.4 DIELECTRIC FITTINGS

A. Provide dielectric couplings or unions between pipe of dissimilar metals.

2.5 STERILIZATION CHEMICALS

- A. Hypochlorite: ASTM E1229.
 - B. Liquid Chlorine: ASTM E1120.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with the International Plumbing Code and the following:
 - Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
 - Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
 - All pipe runs shall be laid out to avoid interference with other work/trades.
 - Install union and shut-off valve on pressure piping at connections to equipment.
 - 5. Pipe Hangers, Supports and Accessories:
 - a. All piping shall be supported per the IPC, MSS SP-58, and SMACNA as required.

- b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- c. Floor, Wall and Ceiling Plates, Supports, Hangers:
 - 1) Solid or split un-plated cast iron.
 - 2) All plates shall be provided with set screws.
 - 3) Pipe Hangers: Height adjustable clevis type.
 - 4) Adjustable Floor Rests and Base Flanges: Steel.
 - 5) Concrete Inserts: "Universal" or continuous slotted type.
 - 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - 7) Pipe Hangers and Riser Clamps: Malleable iron or carbon steel. Pipe Hangers and riser clamps shall have a copper finish when supporting bare copper pipe or tubing.
 - 8) Rollers: Cast iron.
 - Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
 - 10) Hangers and supports utilized with insulated pipe and tubing shall have 180-degree (minimum) metal protection shield centered on and welded to the hanger and support. The shield thickness and length shall be engineered and sized for distribution of loads to preclude crushing of insulation without breaking the vapor barrier. The shield shall be sized for the insulation and have flared edges to protect vapor-retardant jacket facing. To prevent the shield from sliding out of the clevis hanger during pipe movement, centerribbed shields shall be used.
 - 11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
 - 12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints. Restraint calculations shall be based on the criteria from the manufacturer regarding their restraint design.

- Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- 7. Penetrations:
 - a. Firestopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the firestopping materials.
 - b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
 - c. Acoustical sealant: Where pipes pass through sound rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.
- B. Domestic Water piping shall conform to the following:
 - Grade all lines to facilitate drainage. Provide drain values at bottom of risers and all low points in system. Design domestic hot and cold water circulating lines with no traps.
 - Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

- A. General: Test system either in its entirety or in sections. Submit testing plan to COR 10 working days prior to test date.
- B. Potable Water System: Test after installation of piping, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 1035 kPa (150 psig) gage for two hours. No

decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.

- C. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.
- D. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

3.3 STERILIZATION

- A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.
- B. Use liquid chlorine or hypochlorite for sterilization.

- - - E N D - - -

SECTION 22 13 00 FACILITY SANITARY AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.
- B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- E. Section 07 92 00, JOINT SEALANTS: Sealant products.
- F. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- G. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.
- H. Section 22 07 11, PLUMBING INSULATION.
VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern. B. American Society of Mechanical Engineers (ASME): A13.1-2015Identification of Piping Systems A112.36.2M-1991Cleanouts A112.6.3-2019Floor and Trench Drains B1.20.1-2013Pipe Threads, General Purpose (Inch) B16.1-2015Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250 B16.4-2016Grey Iron Threaded Fittings Classes 125 and 250 B16.15-2018Cast Copper Alloy Threaded Fittings, Classes 125 and 250 B16.18-2018Cast Copper Alloy Solder Joint Pressure Fittings B16.21-2016Nonmetallic Flat Gaskets for Pipe Flanges B16.22-2018Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings B16.23-2016Cast Copper Alloy Solder Joint Drainage Fittings: DWV B16.24-2016Cast Copper Alloy Pipe Flanges and Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500 B16.29-2017Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings: DWV B16.39-2019Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300 B18.2.1-2012Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series) C. American Society of Sanitary Engineers (ASSE): 1001-2017Performance Requirements for Atmospheric Type Vacuum Breakers 1018-2001 Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied

> 22 13 00 - 2 FACILITY SANITARY AND VENT PIPING

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 1044-2015 Performance Requirements for Trap Seal Primer Devices - Drainage Types and Electronic Design Types 1079-2012Performance Requirements for Dielectric Pipe Unions D. American Society for Testing and Materials (ASTM): A53/A53M-2018Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless A74-2020Standard Specification for Cast Iron Soil Pipe and Fittings A888-2020aStandard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications B32-2008(R2014)Standard Specification for Solder Metal B43-2020Standard Specification for Seamless Red Brass Pipe, Standard Sizes B88-2016Standard Specification for Seamless Copper Water Tube B306-2013 Standard Specification for Copper Drainage Tube (DWV) B687-1999(R2016)Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples B813-2016Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube B828-2016 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings C564-2020Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings D2321-2020Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications D2564-2012(R2018)Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 D2665-2014Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings D2855-2015Standard Practice for Two-Step (Primer and Solvent Cement) Method of Joining Poly(Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) CPVCP Pipe and Piping Components with Tapered Sockets D5926-2015Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems F402-2018Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings F477-2014Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe F1545-2015e1Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges E. Cast Iron Soil Pipe Institute (CISPI): 2006Cast Iron Soil Pipe and Fittings Handbook 301-2018Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 310-2018Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications F. Copper Development Association, Inc. (CDA): A4015-14/19Copper Tube Handbook G. International Code Council (ICC): IPC-2018 International Plumbing Code H. Manufacturers Standardization Society (MSS): SP-123-2018Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube I. National Fire Protection Association (NFPA): 70-2020National Electrical Code (NEC)

J. Underwriters' Laboratories, Inc. (UL): 508-99 (R2018)Standard For Industrial Control Equipment

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Piping.
 - 2. Penetration Sleeves.
 - 3. Pipe Fittings.
 - 4. Traps.
 - 5. Exposed Piping and Fittings.

1.5 QUALITY ASSURANCE

A. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

A. Comply with requirements in Paragraph "AS-BUILT DOCUMENTATION" of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

PART 2 - PRODUCTS

2.1 SANITARY WASTE, DRAIN, AND VENT PIPING

- A. Cast iron waste, drain, and vent pipe and fittings.
 - Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:

a. Interior waste and vent piping above grade.

- Cast iron Pipe shall be bell and spigot or hubless (plain end or nohub or hubless).
- 3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.
- Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.

- 5. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.
- B. Copper Tube, (DWV):
 - Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
 - 2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
 - 3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.
 - 4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

2.2 SPECIALTY PIPE FITTINGS

- A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
 - 1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
 - 2. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.
- B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 861 kPa (125 psig) at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.
- C. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of 2070 kPa (300 psig) at 107 degrees C (225 degrees F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.3 CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.
- B. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

2.4 PENETRATION SLEEVES

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that shall extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that shall extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.
- B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings where possible.
- F. The piping shall be installed to permit valve servicing or operation.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- G. The piping shall be installed free of sags and bends.
- H. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back-to-back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow greater than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"
- J. Aboveground copper tubing shall be installed according to Copper Development Association's (CDA) "Copper Tube Handbook".
- K. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 JOINT CONSTRUCTION

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
 - Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.

- 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead-free alloy solder conforming to ASTM B32 shall be used.

3.3 SPECIALTY PIPE FITTINGS

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES

- A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.
- B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 91 00, PAINTING. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
 - 1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500
 mm (60 inches) with 10 mm (3/8 inch) rod.
 - 2. 75 mm or DN75 (NPS 3 inch): 1500 mm (60 inches) with 15 mm (1/2 inch) rod.
 - 3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 inch to NPS 5 inch): 1500 mm (60 inches) with 18 mm (5/8 inch) rod.
 - 4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 20 mm (3/4 inch) rod.
 - 5. 250 mm or DN250 to 300 mm or DN300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 23 mm (7/8 inch) rod.
- E. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 m (15 feet).

- F. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:
 - 1. Solid or split unplated cast iron.
 - 2. All plates shall be provided with set screws.
 - 3. Height adjustable clevis type pipe hangers.
 - 4. Adjustable floor rests and base flanges shall be steel.
 - 5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - 6. Riser clamps shall be malleable iron or steel.
 - 7. Rollers shall be cast iron.
 - See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.
- G. Miscellaneous materials shall be provided as specified, required, directed or as noted in the contract documents for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
- H. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- I. Penetrations:
 - Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
 - Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

3.5 TESTS

A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Waste System tests shall be conducted before fixtures are connected. A water test or air test shall be conducted, as directed.
 - 1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
 - For an air test, an air pressure of 34 kPa (5 psig) gauge shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gauge shall be used for the air test.
 - 3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
 - 4. Final Tests: Either one of the following tests may be used.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of .25 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
 - b. Peppermint Test: Introduce 60 ml (2 ounces) of peppermint into each line or stack.

- - - E N D - - -

SECTION 22 14 00 FACILITY STORM DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for storm drainage systems, including piping and all necessary accessories as designated in this section.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- E. Section 07 92 00, JOINT SEALANTS.
- F. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- G. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.
- H. Section 22 07 11, PLUMBING INSULATION.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

в.	American Society of Mechanical Engineers (ASME):
	A112.6.4-2003 (R2019) .Roof, Deck, and Balcony Drains
	A13.1-2007 (R2018)Scheme for Identification of Piping Systems
	B1.20.1-2013Pipe Threads, General Purpose, Inch
	B16.3-2016Malleable Iron Threaded Fittings: Classes 150
	and 300
	B16.9-2018Factory-Made Wrought Buttwelding Fittings
	B16.11-2016Forged Fittings, Socket-Welding and Threaded
	B16.12-2009 (R2019)Cast Iron Threaded Drainage Fittings
	B16.15-2018Cast Copper Alloy Threaded Fittings: Classes
	125 and 250
	B16.18-2018Cast Copper Alloy Solder-Joint Pressure
	Fittings

22 14 00 - 1 FACILITY STORM DRAINAGE VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 B16.22-2018Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings B16.23-2016Cast Copper Alloy Solder Joint Drainage Fittings - DWV B16.29-2017Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV C. American Society of Sanitary Engineering (ASSE) 1079-2012Performance Requirements for Dielectric Pipe Unions D. American Society for Testing and Materials (ASTM): A47/A47M-1999 (R2018) .. Standard Specification for Ferritic Malleable Iron Castings A53/A53M-2018Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless A74-2020aStandard Specification for Cast Iron Soil Pipe and Fittings A183-2014Standard Specification for Carbon Steel Track Bolts and Nuts A312/A312M-2019Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes A536-1984(R2019)Standard Specification for Ductile Iron Castings A733-2016Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples A888-2021Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications B32-2008 (R2014)Standard Specification for Solder Metal B61-2008 (R2015)Standard Specification for Steam or Valve Bronze Castings B62-2015 Standard Specification for Composition Bronze or Ounce Metal Castings B75/B75M-2020Standard Specification for Seamless Copper Tube B88-2020Standard Specification for Seamless Copper Water Tube

> 22 14 00 - 2 FACILITY STORM DRAINAGE

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 B306-2020 Standard Specification for Copper Drainage Tube (DWV) B584-2014Standard Specification for Copper Alloy Sand Castings for General Applications B687-1999 (R2016)Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples B828-2002 (R2016)Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings B813-2016Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube C564-2020aStandard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings C1173-2010 (R2018)Standard Specification for Flexible Transition Couplings for Underground Piping Systems D1785-2021Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120 D2000-2018Standard Classification System for Rubber Products in Automotive Applications D2321-2014e1 R2020Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications D2564-2020Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems D2665-2020Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings D2855-1996 (R2020)Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings D4101-2017e1Standard Specification for Polypropylene Injection and Extrusion Materials D5926-2020Standard for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems

> 22 14 00 - 3 FACILITY STORM DRAINAGE

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 F477-2021Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe F656-2021Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings F1545-2015aStandard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges E. American Welding Society (AWS): A5.8M/A5.8 AMD1-2011 ... Specification for Filler Metals for Brazing and Braze Welding F. Copper Development Association (CDA): A4015-2011Copper Tube Handbook G. Cast Iron Soil Pipe Institute (CISPI): 301-2018Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 310-2018 Standard Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications H. International Code Council (ICC): IPC-2018International Plumbing Code I. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-72-2010aBall Valves with Flanged or Butt-Welding Ends for General Service SP-110-2010Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 14 00, FACILITY STORM DRAINAGE", with applicable paragraph identification.

- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Pipe and Fittings.
 - 2. Specialty Pipe Fittings.
 - 3. Cleanouts.
 - 7. Sleeve Flashing Devices.

1.5 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2020 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- C. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 STORM WATER DRAIN PIPING

- A. Cast Iron Storm Pipe and Fittings:
 - Cast iron storm pipe and fittings shall be used for the following applications:
 - a. Interior storm piping above grade.
 - b. All mechanical equipment rooms or other areas containing mechanical air handling equipment.
 - The cast iron storm pipe shall be bell and spigot, or hubless (plain end or no-hub) as required by selected jointing method.

- 3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.
- 4. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.
- B. Roof drain piping and body of drain in locations where the outdoor conditions are subject to freezing shall be insulated.

2.3 SPECIALTY PIPE FITTINGS

- A. Transition pipe couplings shall join piping with small differences in outside diameters or be of different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be unshielded, elastomeric, sleeve type reducing or transition pattern conforming with ASTM C1173 and include shear ring and corrosion resistant metal tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
 - 1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
 - 2. dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.
- B. Dielectric fittings shall conform to ASSE 1079 with a pressure rating of 1035 kPa (150 psig) at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.
- C. Dielectric flanges shall conform to ASSE 1079 with a pressure rating of 1035 kPa (150 psig). The flange shall be a factory fabricated, bolted, companion flange assembly. The end connection shall be threaded or solder-joint copper alloy and threaded ferrous.
- D. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

E. Dielectric nipples shall be electroplated steel and shall conform with ASTM F1545 with a pressure ratings of 2070 kPa (300 psig) at 107 degrees C (225 degrees F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.4 CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. A minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged storm sewer line.
- B. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel bronze square frame and stainless steel cover with minimum opening of 150 mm by 150 mm (6 inch by 6 inch) shall be provided at each wall cleanout.
- C. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.6 WATERPROOFING

A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproofed caulked joint shall be provided at the top hub.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the IPC and these specifications.
- B. Branch piping shall be installed from the piping system and connect to all drains and outlets.

- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
- D. All pipe runs shall be laid out to avoid interference with other work/trades.
- E. The piping shall be installed above accessible ceilings to allow for ceiling panel removal.
- F. Unless otherwise stated on the documents, minimum horizontal slope shall be one inch for every 2.44 m (8 feet) (1 percent slope) of pipe length.
- G. The piping shall be installed free of sags and bends.
- H. Changes in direction for storm drainage piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep ¼ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and 1/8 bend fittings shall be used if two drains are installed back-to-back or side by side with common drain pipe. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"

3.2 JOINT CONSTRUCTION

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

3.3 SPECIALTY PIPE FITTINGS

A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.

B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES

- A. All piping shall be supported according to the IPC, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications.
- B. Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with zinc Chromate primer paint.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
 - 1. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
 - 2. NPS 3 (DN 80): 1500 mm (60 inches) with 15 mm (1/2 inch) rod.
 - 3. NPS 4 to NPS 5 (DN 100 to DN 125): 1500 mm (60 inches) with 18 mm (5/8 inch) rod.
 - 4. NPS 6 to NPS 8 (DN 150 to DN 200): 1500 mm (60 inches) with 20 mm (3/4 inch) rod.
 - 5. NPS 10 to NPS 12 (DN 250 to DN 300): 1500 mm (60 inches) with 23 mm (7/8 inch) rod.
- E. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 m (15 feet).
- F. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, wall and ceiling plates shall have the following characteristics:
 - 1. Solid or split unplated cast iron.
 - 2. All plates shall be provided with set screws.
 - 3. Height adjustable clevis type pipe hangers.
 - 4. Adjustable Floor Rests and Base Flanges shall be steel.
 - 5. Hanger Rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - 6. Riser Clamps shall be malleable iron or steel.
 - 7. Roller shall be cast iron.
 - 8. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (minimum) metal protection shield centered on and welded to the hanger and support. The shield shall be 100 mm (4)

inches) in length and be 1.6 mm (16 gage) steel. The shield shall be sized for the insulation.

- G. Miscellaneous materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
- H. Cast escutcheon with set screw shall be installed at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- I. Penetrations:
 - Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
 - Water proofing: At floor penetrations, Clearances around the pipe shall be completely sealed and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.

3.5 INSULATION

A. Insulate horizontal sections and 600 mm (2 feet) past changes of direction to vertical sections for interior section of roof drains. Install insulation in accordance with the requirements of Section 22 07 11, PLUMBING INSULATION.

3.6 TESTS

- A. Storm sewer system shall be tested either in its entirety or in sections.
- B. Storm Water Drain tests shall be conducted before fixtures are connected. A water test or air test shall be conducted, as directed.
 - If entire system is tested with water, tightly close all openings in pipes except the highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of

22 14 00 - 10 FACILITY STORM DRAINAGE

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.

- For an air test, an air pressure of 34 kPa (5 psig) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the test.
- Final Tests: While either one of the following tests may be used, Contractor shall check with VA as to which test will be performed.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 0.25 kPa (1 inch of water) with a smoke machine. <u>Chemical smoke is prohibited</u>.
 - b. Peppermint Test: Introduce .06 liters (2 ounces) of peppermint into each line or stack.
- C. COR shall witness all tests. Contractor shall coordinate schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to flushing, disinfection/sterilization, startup, and testing.

- - - E N D - - -

SECTION 23 05 11 COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23.
- B. Definitions:
 - 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
 - 2. Exterior: Piping, ductwork, and equipment exposed to weather be it temperature, humidity, precipitation, wind, or solar radiation.

C. Abbreviations/Acronyms:

- 1. ac: Alternating Current
- 2. AC: Air Conditioning
- 3. ACU: Air Conditioning Unit
- 4. ACR: Air Conditioning and Refrigeration
- 5. AI: Analog Input
- 6. AISI: American Iron and Steel Institute
- 7. AO: Analog Output
- 8. ASJ: All Service Jacket
- 9. AWG: American Wire Gauge
- 10. BACnet: Building Automation and Control Networking Protocol
- 11. BAg: Silver-Copper-Zinc Brazing Alloy
- 12. BAS: Building Automation System
- 13. BCuP: Silver-Copper-Phosphorus Brazing Alloy
- 14. bhp: Brake Horsepower
- 15. Btu: British Thermal Unit
- 16. Btu/h: British Thermal Unit Per Hour
- 17. CDA: Copper Development Association
- 18. C: Celsius
- 19. CD: Compact Disk
- 20. CFM: Cubic Foot Per Minute
- 21. CH: Chilled Water Supply
- 22. CHR: Chilled Water Return
- 23. CLR: Color
- 24. CO: Carbon Monoxide
- 25. COR: Contracting Officer's Representative
- 26. CPD: Condensate Pump Discharge

23 05 11 - 1 COMMON WORK RESULTS FOR HVAC VAMC St. Cloud, MN EHRM Infrastructure Upgrades 4801 Veterans Drive St. Cloud, MN 56303 27. CPM: Cycles Per Minute 28. CPVC: Chlorinated Poly VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 28. CPVC: Chlorinated Polyvinyl Chloride
- 29. CRS: Corrosion Resistant Steel
- 30. CTPD: Condensate Transfer Pump Discharge
- 31. CTPS: Condensate Transfer Pump Suction
- 32. CW: Cold Water
- 33. CWP: Cold Working Pressure
- 34. CxA: Commissioning Agent
- 35. dB: Decibels
- 36. dB(A): Decibels (A weighted)
- 37. DDC: Direct Digital Control
- 38. DI: Digital Input
- 39. DO: Digital Output
- 40. DVD: Digital Video Disc
- 41. DN: Diameter Nominal
- 42. DWV: Drainage, Waste and Vent
- 43. EPDM: Ethylene Propylene Diene Monomer
- 44. EPT: Ethylene Propylene Terpolymer
- 45. ETO: Ethylene Oxide
- 46. F: Fahrenheit
- 47. FAR: Federal Acquisition Regulations
- 48. FD: Floor Drain
- 49. FED: Federal
- 50. FG: Fiberglass
- 51. FGR: Flue Gas Recirculation
- 52. FOS: Fuel Oil Supply
- 53. FOR: Fuel Oil Return
- 54. FSK: Foil-Scrim-Kraft facing
- 55. FWPD: Feedwater Pump Discharge
- 56. FWPS: Feedwater Pump Suction
- 57. GC: Chilled Glycol Water Supply
- 58. GCR: Chilled Glycol Water Return
- 59. GH: Hot Glycol Water Heating Supply
- 60. GHR: Hot Glycol Water Heating Return
- 61. gpm: Gallons Per Minute
- 62. HDPE: High Density Polyethylene
- 63. Hg: Mercury

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 64. HOA: Hands-Off-Automatic 65. hp: Horsepower 66. HPS: High Pressure Steam (414 kPa (60 psig) and above) 67. HPR: High Pressure Steam Condensate Return 68. HW: Hot Water 69. HWH: Hot Water Heating Supply 70. HWHR: Hot Water Heating Return 71. Hz: Hertz 72. ID: Inside Diameter 73. IPS: Iron Pipe Size 74. kg: Kilogram 75. klb: 1000 lb 76. kPa: Kilopascal 77. lb: Pound 78. lb/hr: Pounds Per Hour 79. L/s: Liters Per Second 80. L/min: Liters Per Minute 81. LPS: Low Pressure Steam (103 kPa (15 psig) and below) 82. LPR: Low Pressure Steam Condensate Gravity Return 83. MAWP: Maximum Allowable Working Pressure 84. MAX: Maximum 85. MBtu/h: 1000 Btu/h 86. MBtu: 1000 Btu 87. MED: Medical 88. m: Meter 89. MFG: Manufacturer 90. mg: Milligram 91. mg/L: Milligrams Per Liter 92. MIN: Minimum 93. MJ: Megajoules 94. ml: Milliliter 95. mm: Millimeter 96. MPS: Medium Pressure Steam (110 kPa (16 psig) through 414 kPa (60 psig)) 97. MPR: Medium Pressure Steam Condensate Return 98. MW: Megawatt 99. NC: Normally Closed

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 100.NF: Oil Free Dry (Nitrogen) 101. Nm: Newton Meter 102. NO: Normally Open 103. NOx: Nitrous Oxide 104. NPT: National Pipe Thread 105. NPS: Nominal Pipe Size 106. OD: Outside Diameter 107. OSD: Open Sight Drain 108. OS&Y: Outside Stem and Yoke 109. PC: Pumped Condensate 110. PID: Proportional-Integral-Differential 111. PLC: Programmable Logic Controllers 112. PP: Polypropylene 113. PPE: Personal Protection Equipment 114. ppb: Parts Per Billion 115. ppm: Parts Per Million 116. PRV: Pressure Reducing Valve $\$ 117. PSIA: Pounds Per Square Inch Absolute 118. psig: Pounds Per Square Inch Gauge 119. PTFE: Polytetrafluoroethylene 120. PVC: Polyvinyl Chloride 121. PVDC: Polyvinylidene Chloride Vapor Retarder Jacketing, White 122. PVDF: Polyvinylidene Fluoride 123. rad: Radians 124. RH: Relative Humidity 125. RO: Reverse Osmosis 126. rms: Root Mean Square 127. RPM: Revolutions Per Minute 128. RS: Refrigerant Suction 129. RTD: Resistance Temperature Detectors 130. RTRF: Reinforced Thermosetting Resin Fittings 131. RTRP: Reinforced Thermosetting Resin Pipe 132. SCFM: Standard Cubic Feet Per Minute 133. SPEC: Specification 134. SPS: Sterile Processing Services 135. STD: Standard 136. SDR: Standard Dimension Ratio

> 23 05 11 - 4 COMMON WORK RESULTS FOR HVAC

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 137. SUS: Saybolt Universal Second 138.SW: Soft water 139. SWP: Steam Working Pressure 140. TAB: Testing, Adjusting, and Balancing 141. TDH: Total Dynamic Head 142. TEFC: Totally Enclosed Fan-Cooled 143. TFE: Tetrafluoroethylene 144. THERM: 100,000 Btu 145. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire 146. THWN: Thermoplastic Heat & Water-Resistant Nylon Coated Wire 147. T/P: Temperature and Pressure 148. USDA: U.S. Department of Agriculture 149.V: Volt 150. VAC: Vacuum 151. VA: Veterans Administration 152. VAC: Voltage in Alternating Current 153. VA CFM: VA Construction & Facilities Management 154. VA CFM CSS: VA Construction & Facilities Management, Consulting Support Service 155. VAMC: Veterans Administration Medical Center 156. VHA OCAMES: Veterans Health Administration - Office of Capital Asset Management Engineering and Support 157. VR: Vacuum condensate return 158. WCB: Wrought Carbon Steel, Grade B 159. WG: Water Gauge or Water Column 160.WOG: Water, Oil, Gas 1.2 RELATED WORK A. Section 01 00 00, GENERAL REQUIREMENTS. B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. D. Section 05 50 00, METAL FABRICATIONS. E. Section 07 84 00, FIRESTOPPING. F. Section 07 92 00, JOINT SEALANTS. G. Section 09 91 00, PAINTING. H. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. I. Section 23 07 11, HVAC AND BOILER PLANT INSULATION. J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

> 23 05 11 - 5 COMMON WORK RESULTS FOR HVAC

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

K. Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.

L. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.
- B. Air Movement and Control Association (AMCA): 410-1996Recommended Safety Practices for Users and

Installers of Industrial and Commercial Fans

C. American Society of Mechanical Engineers (ASME):

B31.1-2018Power Piping

B31.9-2017Building Services Piping

ASME Boiler and Pressure Vessel Code:

BPVC Section IX-//2019// Welding, Brazing, and Fusing Qualifications

D. American Society for Testing and Materials (ASTM):

A36/A36M-2019Standard Specification for Carbon Structural Steel

A575-1996(R2018)Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

E. Association for Rubber Products Manufacturers (ARPM):

IP-20-2015Specifications for Drives Using Classical V-Belts and Sheaves

IP-21-2016Specifications for Drives Using Double-V (Hexagonal) Belts

IP-24-2016Specifications for Drives Using Synchronous Belts

IP-27-2015Specifications for Drives Using Curvilinear Toothed Synchronous Belts

F. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc.: SP-58-2018Pipe Hangers and Supports-Materials, Design,

Manufacture, Selection, Application, and Installation

SP-127-2014aBracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, and Application

G.Military Specifications (MIL):

MIL-P-21035B-2013Paint High Zinc Dust Content, Galvanizing Repair (Metric)

H. National Fire Protection Association (NFPA): 70-2020National Electrical Code (NEC) 101-2018Life Safety Code

I. Department of Veterans Affairs (VA):

PG-18-10-2016Physical Security and Resiliency Design Manual

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 11, COMMON WORK RESULTS FOR HVAC", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc are accessable from the floor or permanent work platform. It is the Contractor's responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor shall correct at no additional cost or time to the Government even if a submittal was approved.
- D. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical shall be the Contractor's responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- E. Prior to submitting shop drawings for approval, Contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed contract documents, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together. Coordinate and properly integrate materials and equipment to provide a completely compatible and efficient installation.
- G. Coordination/Shop Drawings:
 - Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
 - 2. The coordination/shop drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed coordination/shop drawings of all piping and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.
 - Do not install equipment or piping until coordination/shop drawings have been approved.
 - 4. In addition, for HVAC systems, provide details of the following:a. Mechanical equipment rooms.
 - b. Hangers, inserts, supports, and bracing.
 - c. Pipe sleeves.
 - d. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- H. Manufacturer's Literature and Data: Include full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity. Submit under the pertinent section rather than under this section.

- 1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the COR.
- 2. Submit electric motor data and variable speed drive data with the driven equipment.
- 3. Equipment and materials identification.
- 4. Fire-stopping materials.
- 5. Hangers, inserts, supports and bracing. Provide complete stress analysis for variable spring and constant support hangers.
- 6. Wall, floor, and ceiling plates.
- I. Rigging Plan: Provide documentation of the capacity and weight of the rigging and equipment intended to be used. The plan shall include the path of travel of the load, the staging area and intended access, and qualifications of the operator and signal person.
- J. HVAC Maintenance Data and Operating Instructions:
 - Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
 - Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - a. Include complete list indicating all components of the systems.
 - b. Include complete diagrams of the internal wiring for each item of equipment.
 - c. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
 - 3. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 QUALITY ASSURANCE

A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC.

- B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- C. Equipment Vibration Tolerance:
 - Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
 - 2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.
- D. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
 - Refer to all other sections for quality assurance requirements for systems and equipment specified therein.
 - 3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 - 4. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.
 - 5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

the same manufacturer and model number, or if different models are required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).

- 6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
- 7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- Use of asbestos products or equipment or materials containing asbestos is prohibited.
- E. HVAC Equipment Service Providers: Service providers shall be authorized and trained by the manufacturers of the equipment supplied. These providers shall be capable of responding onsite and provide acceptable service to restore equipment operations within 4hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shutdown of equipment; or within 24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service personnel and companies providing service under these conditions for (as applicable to the project): ductless split system air conditioning units and associated air cooled condensing units, control systems, critical instrumentation, and programming.
- F. HVAC Mechanical Systems Welding: Before any welding is performed, Contractor shall submit a certificate certifying that welders comply with the following requirements:
 - 1. Qualify welding processes and operators for piping according to ASME BPVC Section IX. Provide proof of current certification.
 - 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 - 3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
 - 4. All welds shall be stamped according to the provisions of the AWS or ASME as required herein and by the associated code.
- G. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR with submittals. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material and removal by the Contractor and no additional cost or time to the Government.

- H. Execution (Installation, Construction) Quality:
 - 1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract documents to the COR for resolution. Provide written hard copies and computer files on CD or DVD of manufacturer's installation instructions to the COR with submittals prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received and approved by the VA. Failure to furnish these recommendations is a cause for rejection of the material.
 - 2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to, all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to the COR for resolution. Failure of the Contractor to resolve, or point out any issues will result in the Contractor correcting at no additional cost or time to the Government.
 - 3. Complete coordination/shop drawings shall be required in accordance with Article, SUBMITTALS. Construction work shall not start on any system until the coordination/shop drawings have been approved by VA.
 - 4. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work shall be removed and done again at no additional cost or time to the Government.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- I. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.
- J. Guaranty: Warranty of Construction, FAR Clause 52.246-21.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protection of Equipment:
 - Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage or theft.
 - Repair damaged equipment in first class, new operating condition and appearance; or, replace same as determined and directed by the COR. Such repair or replacement shall be at no additional cost or time to the Government.
 - 3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
 - 4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- B. Cleanliness of Piping and Equipment Systems:
 - Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
 - 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
 - 3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.7 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

- C. The installing Contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:
 - Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.
 - 2. As-built drawings are to be provided, with a copy of them on AutoCAD version 2020 provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.
- D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.
- E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal

pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

1.8 JOB CONDITIONS - WORK IN EXISTING BUILDING

- A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the VAMC.
- B. Maintenance of Service: Schedule all work to permit continuous service as required by the VAMC.
- C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the demands are not critical to the operation of the VAMC. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least 10 working days advance notice to the COR. The request shall include a detailed plan on the proposed shutdown and the intended work to be done along with manpower levels. All equipment and materials must be onsite and verified with plan 5 days prior to the shutdown or it will need to be rescheduled.
- D. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.
- E. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

23 05 11 - 15 COMMON WORK RESULTS FOR HVAC
PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
 - All components of an assembled unit need not be products of same manufacturer.
 - Constituent parts that are alike shall be products of a single manufacturer.
 - 3. Components shall be compatible with each other and with the total assembly for intended service.
 - Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Equipment and components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions must be approved by the VA, but may be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 LIFTING ATTACHMENTS

A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.4 ELECTRIC MOTORS

A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

2.5 EQUIPMENT AND MATERIALS IDENTIFICATION

- A.Use symbols, nomenclature and equipment numbers specified, shown on the contract documents and shown in the maintenance manuals. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 5 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 mm (3/16 inch) high riveted or bolted to the equipment.
- D. Control Items: Label all instrumentation, temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 - HVAC and Mechanical Rooms: Provide for all valves other than for equipment in Section 23 82 00, CONVECTION HEATING AND COOLING UNITS and Section 23 36 00, AIR TERMNAL UNITS.
 - 2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 6 mm (1/4 inch) for service designation on 19-gauge 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

- 3. Valve lists: Typed or printed plastic coated card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
- Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color-coded thumb tack in ceiling.

2.6 FIRESTOPPING

A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION, for firestop pipe and duct insulation.

2.7 GALVANIZED REPAIR COMPOUND

A. Mil-P-21035B, paint form.

2.8 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- B. Supports for Roof Mounted Items:
 - 1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 by 100 mm (2 by 4 inches) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 275 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
 - Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.
- C. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-58. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.
- D. Attachment to Concrete Building Construction:
 - 1. Concrete insert: MSS SP-58, Type 18.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
- 3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
- E. Attachment to Steel Building Construction:
 - 1. Welded attachment: MSS SP-58, Type 22.
 - 2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.
- F. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING.
- G. Attachment to existing structure: Support from existing floor/roof frame.
- H. Attachment to Wood Construction: Wood screws or lag bolts.
- I. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- J. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (12 gauge), designed to accept special spring held, hardened steel nuts. Trapeze hangers are prohibited for use for steam supply and condensate piping.
 - Allowable hanger load: Manufacturers rating less 91 kg (200 pounds).
 - 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.
- K. Supports for Piping Systems:
 - Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39

23 05 11 - 19 COMMON WORK RESULTS FOR HVAC

saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.

- 2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
- a. Standard clevis hanger: Type 1; provide locknut.
- b. Riser clamps: Type 8.
- c. Wall brackets: Types 31, 32 or 33.
- d. Roller supports: Type 41, 43, 44 and 46.
- e. Saddle support: Type 36, 37 or 38.
- f. Turnbuckle: Types 13 or 15. Preinsulate.
- g. U-bolt clamp: Type 24.
- h. Copper Tube:
 - Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non-adhesive isolation tape to prevent electrolysis.
 - 2) For vertical runs use epoxy painted or plastic-coated riser clamps.
 - For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
 - Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
- 3. High and Medium Pressure Steam (MSS SP-58):
- a. Provide eye rod or Type 17 eye nut near the upper attachment.
- b. Piping 50 mm (2 inches) and larger: Type 43 roller hanger. For roller hangers requiring seismic bracing provide a Type 1 clevis hanger with Type 41 roller attached by flat side bars.
- c. Piping with Vertical Expansion and Contraction:
 - Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- L. Pre-insulated Calcium Silicate Shields:
 - Provide 360-degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
 - Pre-insulated calcium silicate shields to be installed at the point of support during erection.
 - 3. Shield thickness shall match the pipe insulation.
 - 4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
 - a. Shields for supporting chilled or cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal. Provide for an adequate vapor barrier in chilled lines.
 - b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-58. To support the load, the shields may have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
 - Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

2.9 PIPE PENETRATIONS

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
 - 1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
 - For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
 - For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations through beams or ribs are prohibited, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.
- G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.10 DUCT PENETRATIONS

- A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 450 mm (18 inches) high with continuously welded seams, builtin cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.
- B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07 84 00, FIRESTOPPING.

2.11 SPECIAL TOOLS AND LUBRICANTS

A. Furnish, and turn over to the COR, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

> 23 05 11 - 22 COMMON WORK RESULTS FOR HVAC

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.
- D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- E. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.12 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035 inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.13 ASBESTOS

A. Materials containing asbestos are prohibited.

PART 3 - EXECUTION

3.1 GENERAL

A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. The coordination/shop drawings shall be submitted for review. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Equipment coordination/shop drawings shall be prepared to coordinate proper location and personnel access of all facilities. The

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

drawings shall be submitted for review. Follow manufacturer's published recommendations for installation methods not otherwise specified.

- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the contract documents.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
 - Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill is prohibited, except as permitted by COR where working area space is limited.
 - 2. Locate holes to avoid interference with structural members such as slabs, columns, ribs, beams or reinforcing. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
 - 3. Do not penetrate membrane waterproofing.
- F. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- G. Electrical Interconnection of Instrumentation or Controls: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Devices shall be located so they are easily accessible for testing, maintenance, calibration, etc. The COR has the final

determination on what is accessible and what is not. Comply with NFPA 70.

- H. Protection and Cleaning:
 - Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
 - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- I. Concrete and Grout: Use concrete and non-shrink grout 20 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- J. Install gauges, thermometers, values and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gauges to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- K. Install steam piping expansion joints as per manufacturer's recommendations.
- L. Work in Existing Building:
 - Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
 - 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
- M. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and data/telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork,

23 05 11 - 25 COMMON WORK RESULTS FOR HVAC

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

leak protection apparatus or other installations foreign to the electrical installation shall not be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 feet) above the equipment or to ceiling structure, whichever is lower (NFPA 70).

- N. Inaccessible Equipment:
 - Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance or inspections, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or time to the Government.
 - 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to motors, fans, pumps, belt guards, transformers, high voltage lines, conduit and raceways, piping, hot surfaces, and ductwork. The COR has final determination on whether an installation meets this requirement or not.

3.3 TEMPORARY PIPING AND EQUIPMENT

- A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Article, ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

3.4 RIGGING

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of

phasing and maintenance of service requirements as well as structural integrity of the building.

- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Follow approved rigging plan.
- G. Restore building to original condition upon completion of rigging work.

3.5 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels designed by a structural engineer, secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COR.
- B. Use of chain pipe supports; wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above are prohibited. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work.
- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-58. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.

- E. HVAC Vertical Pipe Supports:
 - Up to 150 mm (6-inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
 - Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.
- F. Overhead Supports:
 - Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
 - 2. Tubing and capillary systems shall be supported in channel troughs.
 - 3. /

3.6 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the contract documents, shall be provided by the Contractor after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Debris accumulated in the area to the detriment of plant operation is prohibited. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VAMC, and Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with contract documents where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the contract documents of the other disciplines in the project for additional facilities to be demolished or handled.

D. All indicated valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these contract documents. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

3.7 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
 - Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
 - 2. The following material and equipment shall not be painted:
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.
 - d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.

23 05 11 - 29 COMMON WORK RESULTS FOR HVAC

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- h. Valve stems and rotating shafts.
- i. Pressure gauges and thermometers.
- j. Glass.
- k. Nameplates.
- 3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
- 4. Pumps, motors, steel and cast-iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.
- 5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats. This may include painting exposed metals where hangers were removed or where equipment was moved or removed.
- Paint shall withstand the following temperatures without peeling or discoloration:
- a. Condensate and Feedwater: 38 degrees C (100 degrees F) on insulation jacket surface and 121 degrees C (250 degrees F) on metal pipe surface.
- b. Steam: 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (374 degrees F) on metal pipe surface.
- 7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.
- 8. Lead based paints are prohibited.

3.8 IDENTIFICATION SIGNS

- A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16 inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

D. Attach ceiling grid label on ceiling grid location directly underneath above-ceiling air terminal, control system component, valve, filter unit, fan etc.

3.9 MOTOR AND DRIVES

- A. Use synchronous belt drives only on equipment controlled by soft starters or variable frequency drive motor controllers without a bypass contactor. Use V-belt drives on all other applications.
- B. Alignment of V-Belt Drives: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- C. Alignment of Synchronous Belt Drives: Set driving and driven shafts parallel and align so that the corresponding pulley flanges are in the same plane.
- D. Alignment of Direct-Connect Drives: Securely mount motor in accurate alignment so that shafts are per coupling manufacturer's tolerances when both motor and driven machine are operating at normal temperatures.

3.10 LUBRICATION

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. Field-check all devices for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings or devices. A minimum of 0.95 liter (1 quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application shall be provided; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to COR in unopened containers that are properly identified as to application.
- C. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- D. All lubrication points shall be extended to one side of the equipment.

3.11 STARTUP, TEMPORARY OPERATION AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.

C. Startup of equipment shall be performed as described in equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.12 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS Article, TESTS, and in individual Division 23 specification sections and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost or time to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.
- D. No adjustments may be made during the acceptance inspection. All adjustments shall have been made by this point.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:
 - 1. Planning systematic TAB procedures.
 - 2. Design Review Report.
 - 3. Systems Inspection report.
 - 5. Systems Readiness Report.
 - Balancing existing, renovated air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
 - 7. Vibration and sound measurements.
 - 8. Recording and reporting results.

B. Definitions:

- Basic TAB used in this Section: Chapter 39, "Testing, Adjusting and Balancing" of 2019 ASHRAE Handbook, "HVAC Applications".
- 2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
- 3. AABC: Associated Air Balance Council.
- 4. NEBB: National Environmental Balancing Bureau.
- 5. TABB: Testing Adjusting and Balancing Bureau
- 6. SMACNA: Sheet Metal Contractors National Association
- 7. Hydronic Systems: Includes chilled water, condenser water, heating hot water and glycol-water systems.
- Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
- 9. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

- D. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- E. Section 23 07 11, HVAC, AND BOILER PLANT INSULATION.
- H. Section 23 31 00, HVAC DUCTS AND CASINGS.

1.3 QUALITY ASSURANCE

- A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC, and Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANTS and STEAM GENERATION.
- B. Qualifications:
 - TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
 - 2. The TAB agency shall be either a certified member of AABC, NEEB, TABB or NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another qualified TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC, TABB or NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
 - 3. TAB Specialist: The TAB specialist shall be either a member of AABC or TABB or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.

- 4. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Resident Engineer. The responsibilities would specifically include: a. Shall directly supervise all TAB work.
 - b. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC, TABB or NEBB.
 - c. Would follow all TAB work through its satisfactory completion.
 - d. Shall provide final markings of settings of all HVAC adjustment devices.
 - e. Permanently mark location of duct test ports.
 - f. Shall document critical paths from the fan or pump. These critical paths are ones in which are 100% open from the fan or pump to the terminal device. This will show the least amount of restriction is being imposed on the system by the TAB firm.
- 5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC, TABB or NEBB
- C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards, TABB/SMACNA International Standards, or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.
- D. TAB Criteria:
 - 1. One or more of the applicable AABC, NEBB, TABB or SMACNA publications, supplemented by ASHRAE Handbook "2019 HVAC

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

Applications" Chapter 39, and requirements stated herein shall be the basis for planning, procedures, and reports.

- 2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow 2011 ASHRAE Handbook "2019 HVAC Applications", Chapter 39, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.
 - a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus 10 percent.
 - e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus 10 percent except if the air to a space is 100 CFM or less the tolerance would be minus 5 to plus 5 percent.
 - f. Heating hot water pumps and hot water coils: Minus 5 percent to plus 5 percent.
- Systems shall be adjusted for energy efficient operation as described in PART 3.
- 4. Typical TAB procedures and critical path results shall be demonstrated to the Resident Engineer for one air distribution system (including all fans, three terminal units, three rooms randomly selected by the COR one of which shall be a critical path) and one hydronic system (pumps and three coils) as follows: a. When field TAB work begins.
 - b. During each partial final inspection and the final inspection for the project if requested by VA.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.
- C. For use by the Resident Engineer staff, submit one complete set of applicable AABC, NEBB or TABB publications that will be the basis of TAB work.
- D. Submit Following for Review and Approval:

- Design Review Report within 90 days for conventional design projects after the system layout on air and water side is completed by the Contractor.
- 2. Systems inspection report on equipment and installation for conformance with design.
- 4. Systems Readiness Report.
- Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
- Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
- Include in each report the critical path for each balanced branch (air and hydronic. Every branch shall have at least one terminal device damper 100% open.
- E. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area with noted critical paths.

1.5 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE): Handbook 2019HVAC Applications ASHRAE Handbook, Chapter 39, Testing, Adjusting, and Balancing and Chapter 49, Sound and Vibration Control
- C. Associated Air Balance Council (AABC): 7th Edition 2016AABC National Standards for Total System Balance
- D. National Environmental Balancing Bureau (NEBB):

9th Edition 2019Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

- 3rd Edition 2015Procedural Standards for the Measurement of Sound and Vibration
- 2rd Edition 2019 ... Standard for Whole Building Technical Commissioning of New Construction

23 05 93 - 5

TESTING, ADJUSTING, AND BALANCING FOR HVAC

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

3rd Edition 2005HVAC SYSTEMS Testing, Adjusting and Balancing TABB- TAB Procedural Guide Current Edition

PART 2 - PRODUCTS

2.1 PLUGS

Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

See Section 23 07 11, HVAC and BOILER PLANT INSULATION Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to TAB Criteria in Article, Quality Assurance.
- B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 DESIGN REVIEW REPORT

The TAB Specialist shall review the Contract Plans and specifications and advise the Resident Engineer of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.3 SYSTEMS INSPECTION REPORT

- A. Inspect equipment and installation for conformance with design. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.
- C. Reports: Follow check list format developed by AABC, NEBB or SMACNA (TABB), supplemented by narrative comments. Check for conformance with submittals.

3.4 SYSTEM READINESS REPORT

A. The TAB Contractor shall measure existing air and water flow rates associated with existing systems utilized to serve renovated areas as indicated on drawings. Submit report of findings to resident engineer.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Inspect each System to ensure that it is complete including installation and operation of controls. Submit report to RE in standard format and forms prepared and or approved by the Commissioning Agent.
- C. Verify that all items such as ductwork piping, dampers, valves, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the Resident Engineer.

3.5 TAB REPORTS

- B. The TAB contractor shall provide raw data immediately in writing to the Resident Engineer if there is a problem in achieving intended results before submitting a formal report.
- C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated after engineering and construction have been evaluated and re-submitted for approval at no additional cost to the Government.
- D. Do not proceed with the remaining systems until intermediate report is approved by the Resident Engineer.

3.6 TAB PROCEDURES

- A. TAB shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC, TABB or NEBB. Balancing shall be done proportionally to all applicable systems.
- B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.
- C. Coordinate TAB procedures with existing systems and any phased construction completion requirements for the project. Provide TAB reports for pre construction air and water flow rate. Return existing areas outside the work area to pre constructed conditions.
- D. Allow 15 days time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- E. Air Balance and Equipment Test: Include applicable existing air handling units, existing fans, room diffusers/outlets/inlets, and new computer room AC units.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 1. Artificially load air filters by partial blanking to produce static air pressure drop of manufacturer's recommended pressure drop.
- Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- 4. Variable air volume (VAV) systems:
 - a. Coordinate TAB, including system volumetric controls, with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
 - b. Section 23 36 00, AIR TERMINAL UNITS, specifies that maximum and minimum flow rates for air terminal units (ATU) be factory set. Check and readjust ATU flow rates if necessary to meet design criteria. Balance air distribution from ATU on full cooling maximum scheduled cubic meters per minute (cubic feet per minute).
 - c. Adjust operating pressure control setpoint to maintain the design flow to each space with the lowest setpoint.
- 5. Record final measurements for applicable existing air handling equipment performance data sheets.
- F. Water Balance and Equipment Test:4. Record final measurements for relocated hydronic equipment on performance data sheets. Make air and water temperature measurements at the same time.

3.7 MARKING OF SETTINGS

Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Resident Engineer.

3.8 IDENTIFICATION OF TEST PORTS

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

3.9 PHASING

A. Phased Projects: Testing and Balancing Work to follow project with areas shall be completed per the project phasing. Upon completion of

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

the project all areas shall have been tested and balanced per the contract documents.

B. Existing Areas: Systems that serve areas outside of the project scope shall not be adversely affected. Measure existing parameters where shown to document system capacity.

- - E N D - - -

SECTION 23 07 11 HVAC AND BOILER PLANT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for
 - 1. HVAC piping, ductwork and equipment.
- B. Definitions
 - 1. ASJ: All service jacket, white finish facing or jacket.
 - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
 - 3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
 - 4. Concealed: Ductwork and piping above ceilings and in chases, and pipe spaces.
 - 5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical//, Boiler Plant// and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
 - 6. FSK: Foil-scrim-kraft facing.
 - 7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F); HVAC equipment or piping handling media above 41 degrees C (105 degrees F)
 - Density: kg/m³ kilograms per cubic meter (Pcf pounds per cubic foot).
 - 9. Runouts: Branch pipe connections up to 25-mm (one-inch) nominal size to fan coil units or reheat coils for terminal units.
 - 10. Thermal conductance: Heat flow rate through materials.
 - a. Flat surface: Watt per square meter (BTU per hour per square foot).
 - b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).
 - 11. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
- 13. HPS: High pressure steam (415 kPa [60 psig] and above).
- 14. HPR: High pressure steam condensate return.
- 15. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig].
- 16. MPR: Medium pressure steam condensate return.
- 17. LPS: Low pressure steam (103 kPa [15 psig] and below).
- 18. LPR: Low pressure steam condensate gravity return.
- 19. PC: Pumped condensate.
- 20. HWH: Hot water heating supply.
- 21. HWHR: Hot water heating return.
- 22. GH: Hot glycol-water heating supply.
- 23. GHR: Hot glycol-water heating return.
- 24. FWPD: Feedwater pump discharge.
- 25. FWPS: Feedwater pump suction.
- 26. CTPD: Condensate transfer pump discharge.
- 27. CTPS: Condensate transfer pump suction.
- 28. VR: Vacuum condensate return.
- 29. CPD: Condensate pump discharge.
- 30. R: Pump recirculation.
- 31. FOS: Fuel oil supply.
- 32. FOR: Fuel oil return.
- 33. CW: Cold water.
- 34. SW: Soft water.
- 35. HW: Hot water.
- 36. CH: Chilled water supply.
- 37. CHR: Chilled water return.
- 38. GC: Chilled glycol-water supply.
- 39. GCR: Chilled glycol-water return.
- 40. RS: Refrigerant suction.
- 41. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.2 RELATED WORK

- A Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Section 07 84 00, FIRESTOPPING.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- D. Section 23 21 13, HYDRONIC PIPING.
- E. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING

1.3 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Criteria:
 - 1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in <u>4.3.3.1.1</u> or <u>4.3.3.1.2.</u>, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with <u>NFPA 255</u>, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See <u>4.2.4.2</u>.)

4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

(1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors

(2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface

Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, Standard for Safety Optical-Fiber Cable Raceway.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

(1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides

(2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in <u>NFPA 251</u>, Standard Methods of Tests of Fire Endurance of Building Construction and Materials

- 2. Test methods: ASTM E84, UL 723, or NFPA 255.
- 3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

- 4. All materials shall be compatible and suitable for service temperature and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings:
 - All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
 - a. Insulation materials: Specify each type used and state surface burning characteristics.
 - b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
 - c. Insulation accessory materials: Each type used.
 - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
 - e. Make reference to applicable specification paragraph numbers for coordination.

1.5 STORAGE AND HANDLING OF MATERIAL

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.): L-P-535E (2)- 1999 Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride -Vinyl Acetate), Rigid. C. Military Specifications (Mil. Spec.): MIL-A-3316C -1990 Adhesives, Fire-Resistant, Thermal Insulation MIL-A-24179A (1)-2016 Adhesive, Flexible Unicellular-Plastic Thermal Insulation MIL-C-19565C (1)- 2016 Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier MIL-C-20079H-1987Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass D. American Society for Testing and Materials (ASTM): A167-99 2014Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip B209-2014Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate C411-2019Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation C449-2019Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement C533-2019 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation C534-2019...Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form C547-2019Standard Specification for Mineral Fiber pipe Insulation C552-2017Standard Specification for Cellular Glass Thermal Insulation

23 07 11 - 6 HVAC AND BOILER PLANT INSULATION VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C553-2019Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications C585-2016 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System) R (1998) C612-2019Standard Specification for Mineral Fiber Block and Board Thermal Insulation C1126-2019Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation C1136- 2017Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation D1668-97a 2017Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing E84-2020Standard Test Method for Surface Burning Characteristics of Building Materials E119-2019Standard Test Method for Fire Tests of Building Construction and Materials E136-2019 Standard Test Methods for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C (1380 F) E. National Fire Protection Association (NFPA): 90A-2018Standard for the Installation of Air Conditioning and Ventilating Systems 96-2018Standards for Ventilation Control and Fire Protection of Commercial Cooking Operations 101-2018Life Safety Code 251-2014Standard methods of Tests of Fire Endurance of Building Construction Materials 255-2006Standard Method of tests of Surface Burning Characteristics of Building Materials F. Underwriters Laboratories, Inc (UL): 723-2018UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 09/08

> 23 07 11 - 7 HVAC AND BOILER PLANT INSULATION

G. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS): SP58-2018Pipe Hangers and Supports Materials, Design,

and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m³ (3 pcf), k = 0.037 (0.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.
- B. ASTM C553 (Blanket, Flexible) Type I, Class B-5, Density 32 kg/m³ (2 pcf), k = 0.04 (0.27) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.3 RIGID CELLULAR PHENOLIC FOAM

- A. Preformed (molded) pipe insulation, ASTM C1126, type III, grade 1, k = 0.021(0.15) at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.
- B. Equipment and Duct Insulation, ASTM C 1126, type II, grade 1, k = 0.021 (0.15) at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with rigid cellular phenolic insulation and covering, and all service vapor retarder jacket.

2.4 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C177, C518, density 120 kg/m³ (7.5 pcf) nominal, k = 0.033 (0.29) at 240 degrees C (75 degrees F).
- B. Pipe insulation for use at temperatures up to 200 degrees C (400 degrees F) with all service vapor retarder jacket.

2.5 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

ASTM C177, C518, k = 0.039 (0.27) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from

VAMC St. Cloud, MN VA Project 656-21-235 EHRM Infrastructure Upgrades March 30, 2022 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

2.6 CALCIUM SILICATE

- A. Preformed pipe Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- B. Premolded Pipe Fitting Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- C. Equipment Insulation: ASTM C533, Type I and Type II
- D. Characteristics:

Insulation Characteristics		
ITEMS	TYPE I	TYPE II
Temperature, maximum degrees C	649 (1200)	927 (1700)
(degrees F)		
Density (dry), Kg/m ³ (lb/ ft3)	232 (14.5)	288 (18)
Thermal conductivity:		
Min W/ m K (Btu in/h ft² degrees F)@	0.059	0.078
mean temperature of 93 degrees C	(0.41)	(0.540)
(200 degrees F)		
Surface burning characteristics:		
Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

2.7 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt

strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping and ductwork as well as on interior piping and ductwork exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity areasconveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.
- E. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- F. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- H. Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.
VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.8 PIPE COVERING PROTECTION SADDLES

A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)				
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)			
Up through 125 (5)	150 (6) long			
150 (6)	150 (6) long			
200 (8), 250 (10), 300 (12)	225 (9) long			
350 (14), 400 (16)	300 (12) long			
450 through 600 (18 through 24)	350 (14) long			

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).
- C. Boiler Plant Pipe supports: MSS SP58, Type 39. Apply at all pipe support points, except where MSS SP58, Type 3 pipe clamps provided as part of the support system.
- 2.9 ADHESIVE, MASTIC, CEMENT
 - A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
 - B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
 - C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
 - D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
 - E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.
 - F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
 - G. Other: Insulation manufacturers' published recommendations.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.10 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching monel or galvanized steel.
- C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- D. Bands: 13 mm (0.5 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.11 REINFORCEMENT AND FINISHES

- A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.
- E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.
- F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.12 FIRESTOPPING MATERIAL

Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

2.13 FLAME AND SMOKE

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full-length section will fit.
- C. Insulation materials shall be installed in a first-class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Construct insulation on parts of equipment such as chilled water pumps , convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- G. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- H. HVAC work not to be insulated:
 - 1. Internally insulated ductwork and air handling units.
 - 2. Relief air ducts (Economizer cycle exhaust air).
 - 3. Exhaust air ducts and plenums, and ventilation exhaust air shafts.
 - 4. In hot piping: Unions, flexible connectors, control valves, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
 - 5. Specialties:
 - b. Control valves-water and steam(NI)
 - c. Level sensors-piping, valves and blowdown(NI)
 - e. Strainers under 65 mm (2-1/2 inch) pipe size(RJ)
 - h. Ball joints except piping between joints (NI)
- I. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- J. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- K. Firestop Pipe and Duct insulation:
 - Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
 - Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
 - a. Pipe risers through floors
 - b. Pipe or duct chase walls and floors
 - c. Smoke partitions
 - d. Fire partitions
- L. Provide vapor barrier jackets over insulation as follows:
 - 1. All piping and ductwork exposed to outdoor weather.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- All interior piping and ducts conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.) below ambient air temperature in high humidity areas.
- M. Provide metal jackets over insulation as follows:
 - 1. All piping and ducts exposed to outdoor weather.
 - 2. Piping exposed in building, within 1800 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
 - 3. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Mineral Fiber Board:

- Faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
- 2. Plain board:
 - a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
 - b. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, trowel led to a smooth finish.
 - c. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.

- 3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, and duct work exposed to outdoor weather:
 - a. 50 mm (2 inch) thick insulation faced with ASJ (white all service jacket): Supply air duct.
 - b. 50 mm (2 inch) thick insulation faced with ASJ: mixed air plenums.
- Cold equipment: 40 mm (1-1/2inch) thick insulation faced with ASJ.
 a.Chilled water pumps.
- B. Flexible Mineral Fiber Blanket:
 - 1. Adhere insulation to metal with 75 mm (3 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.
 - 2. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.
 - 3. Concealed supply air ductwork.
 - a. Above ceilings at a roof level, in attics, and duct work exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with FSK.
 - b. Above ceilings for other than roof level: 40 mm (1 ½ inch) thick insulation faced with FSK.
 - 4. Concealed return air duct:
 - a. In attics (where not subject to damage) and where exposed to outdoor weather: 50mmm (2 inch)thick insulation faced with FSK,
 - b. Above ceilings at a roof level, unconditioned areas, and in chases with external wall or containing steam piping; 40 mm (1-1/2 inch) thick, insulation faced with FSK.

23 07 11 - 16 HVAC AND BOILER PLANT INSULATION

- c. Concealed return air ductwork in other locations need not be insulated.
- 5. Concealed outside air duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.
- C. Molded Mineral Fiber Pipe and Tubing Covering:
 - 1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
 - 2. Contractor's options for fitting, flange and valve insulation:
 - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
 - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
 - c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
 - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
 - 3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.
- D. Rigid Cellular Phenolic Foam:
 - Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).

- Note the NFPA 90A burning characteristics requirements of 25/50 in paragraph 1.3.B
- 3. Provide secure attachment facilities such as welding pins.
- 4. Apply insulation with joints tightly drawn together
- 5. Apply adhesives, coverings, neatly finished at fittings, and valves.
- Final installation shall be smooth, tight, neatly finished at all edges.
- 7. Minimum thickness in millimeters (inches) specified in the schedule at the end of this section.
- Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a maximum water vapor permeance of 0.00 perms.
- 9. Condensation control insulation: Minimum 25 mm (1.0 inch) thick for all pipe sizes.
 - a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.
- E. Cellular Glass Insulation:
 - 1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
 - 3. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ for chilled water pumps, water filters, chemical feeder pots or tanks, expansion tanks, air separators and air purgers.
 - 4. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a water vapor permeability of 0.00 perms.
- F. Flexible Elastomeric Cellular Thermal Insulation:
 - Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
 - 2. Pipe and tubing insulation:
 - a. Use proper size material. Do not stretch or strain insulation.
 - b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

23 07 11 - 18 HVAC AND BOILER PLANT INSULATION

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.
- 3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
- 4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.
- Use Class S (Sheet), 20 mm (3/4 inch) thick for the following:
 a. Chilled water pumps
- 7. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a water vapor permeance of 0.00 perms.
- G. Calcium Silicate:
 - 1. Minimum thickness in millimeter (inches) specified in the schedule at the end of this section for piping other than in boiler plant.

3.8 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Wall Thickness Millimeters (Inches)					
		Nominal	Pipe Size	Millimeters	(Inches)
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 - 32 (1 - 14)	38 - 75 $(1\frac{1}{2} - 3)$	100 (4) and Above
	Insulation Wall Thickness Millimeters (Inches)				
122-177 degrees C (251-350 degrees F) (HPS, MPS)	Mineral Fiber (Above ground piping only)	75 (3)	100 (4)	113 (4.5)	113 (4.5)
93-260 degrees C (200-500 degrees F) (HPS, HPR)	Calcium Silicate	100 (4)	125 (5)	150 (6)	150 (6)
100-121 degrees C (212-250 degrees F)	Mineral Fiber (Above ground piping only)	62 (2.5)	62 (2.5)	75 (3.0)	75 (3.0)

(HPR, MPR, LPS, vent piping from PRV Safety Valves, Condensate receivers and flash tanks)					
100-121 degrees C (212-250 degrees F)	Rigid Cellular Phenolic Foam	50 (2.0)	50 (2.0)	75 (3.0)	75 (3.0)
(HPR, MPR, LPS, vent piping from PRV Safety Valves, Condensate receivers and flash tanks)					
38-94 degrees C (100-200 degrees F)	Mineral Fiber (Above ground	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
(LPR, PC, HWH, HWHR, GH and GHR)	piping only)				
38-99 degrees C	Rigid Cellular	38	38 (1.5)	50 (2.0)	50 (2.0)
(100-211 degrees F)	Phenolic Foam	(1.5)			
(LPR, PC, HWH, HWHR, GH and GHR)					
38-94 degrees C (100-200 degrees F)	Flexible Elastomeric	38 (1.5)	38 (1.5)		
(LPR, PC, HWH, HWHR, GH and GHR)	Thermal (Above ground piping only)				
4-16 degrees C	Rigid Cellular	38 (1 E)	38 (1.5)	38 (1.5)	38 (1.5)
(40-60 degrees F)	Phenolic Foam	(1.5)			
(CH, CHR, GC, GCR and RS for DX refrigeration)					
4-16 degrees C	Cellular	50	50 (2.0)	75 (3.0)	75 (3.0)
(40-60 degrees F)	Cell	(2.0)			
(CH and CHR within chiller room and pipe chase and underground)					
4-16 degrees C	Cellular	38	38 (1.5)	38 (1.5)	38 (1.5)
(40-60 degrees F)	Cell	(1.3)			
(CH, CHR, GC, GCR and RS for DX refrigeration)					

(40-60 degrees F)	Flexible	38	38 (1.5)	38 (1.5)	38 (1.5)
(CH, CHR, GC, GCR and RS for DX refrigeration)	Elastomeric	(1.5)			
	Cellular				
	Thermal (Above				
	ground piping				
	only)				

- - - E N D - - -

SECTION 23 21 13 HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Water piping to connect HVAC equipment, including the following:
 - 1. Chilled water, heating hot water and drain piping.
 - 2. Extension of domestic water make-up piping for HVAC systems.
 - 3. Glycol-water piping.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- E. Section 23 07 11, HVAC AND BOILER PLANT INSULATION: Piping insulation.
- F. Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.
- G. Section 23 82 00, CONVECTION HEATING AND COOLING UNITS: Induction units, fan coil units, Unit Heaters and radiant ceiling panels.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.
- B. American Society of Mechanical Engineers (ASME): B1.20.1-2013Pipe Threads, General Purpose (Inch) B16.3-2016Malleable Iron Threaded Fittings: Classes 150 and 300 B16.4-2016Gray Iron Threaded Fittings: (Classes 125 and 250) B16.5-2017Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard B16.9-2018Factory Made Wrought Buttwelding Fittings B16.11-2016Forged Fittings, Socket-Welding and Threaded

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 B16.18-2018Cast Copper Alloy Solder Joint Pressure Fittings B16.22-2018Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings B16.24-2016Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500 B16.39-2019Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300 B16.42-2016Ductile Iron Pipe Flanges and Flanged Fittings B31.9-2017Building Services Piping B40.100-2013Pressure Gauges and Gauge Attachments ASME Boiler and Pressure Vessel Code: BPVC Section VIII-2019 .Rules for Construction of Pressure Vessels C. American Society for Testing and Materials (ASTM): A47/A47M-2018Standard Specification for Ferritic Malleable Iron Castings A53/A53M-2018Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless A106/A106M-2019Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service A126-2004(R2019)Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings A183-2020Standard Specification for Carbon Steel Track Bolts and Nuts A216/A216M-2018Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service A307-2016Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength A536-1984(R2019)Standard Specification for Ductile Iron Castings B62-2017 Standard Specification for Composition Bronze or Ounce Metal Castings

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 B88-2016 Standard Specification for Seamless Copper Water Tube F439-2019Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 F441/F441M-2015Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80 D. American Welding Society (AWS): B2.1/B2.1M-2014Standard for Welding Procedure and Performance Specification E. Expansion Joint Manufacturer's Association, Inc. (EJMA): EJMA 2017Expansion Joint Manufacturer's Association Standards, Tenth Edition F. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.: SP-67-2017Butterfly Valves SP-70-2014Gray Iron Gate Valves, Flanged and Threaded Ends SP-71-2018Gray Iron Swing Check Valves, Flanged and Threaded Ends SP-80-2019Bronze Gate, Globe, Angle, and Check Valves SP-85-2014Gray Iron Globe and Angle Valves, Flanged and Threaded Ends SP-110-2014Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends SP-125-2018Gray Iron and Ductile Iron In-line, Spring-Loaded, Center-Guided Check Valves G. Tubular Exchanger Manufacturers Association (TEMA): TEMA Standards20199th Edition

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 21 13, HYDRONIC PIPING", with applicable paragraph identification.

- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Pipe and tubing, with specification, class or type, and schedule.
 - Pipe fittings, including miscellaneous adapters and special fittings.
 - 3. Flanges, gaskets and bolting.
 - 4. Couplings and fittings.
 - 5. Valves of all types.
 - 6. Strainers.
 - 7. Flexible connectors for water service.
 - 8. Pipe alignment guides.
 - 9. Expansion joints.
 - 10. Expansion compensators.
 - 11. All specified hydronic system components.
 - 12. Water flow measuring devices.
 - 13. Gauges.
 - 14. Thermometers and test wells.
- D. Submit the welder's qualifications in the form of a current (less than one-year old) and formal certificate.
- E. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- F. As-Built Piping Diagrams: Provide drawing as follows for chilled water, and heating hot water system and other piping systems and equipment.
 - One wall-mounted stick file with complete set of prints. Mount stick file in the chiller plant or control room along with control diagram stick file.
 - 2. One complete set of reproducible drawings.
 - 3. One complete set of drawings in electronic AutoCAD and pdf format.
- G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.
- B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than oneyear old.
- C. All couplings, fittings, valves, and specialties shall be the products of a single manufacturer.
 - 1. All castings used for coupling housings, fittings, valve bodies,
 - etc., shall be date stamped for quality assurance and traceability.

1.6 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD. All aspects of system operation and maintenance procedures, including applicable piping isometrics, shall be included in the operation and maintenance manual. Notes on all special systems or devices shall be included.

- B. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:
 - Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.
 - As-built drawings are to be provided, with a copy of them on AutoCAD version 2020 provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- C. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.
- D. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND TUBING

- A. Chilled Water, Heating Hot Water, and Glycol-Water, and Vent Piping:1. Steel: ASTM A53/A53M Grade B, seamless or ERW, Schedule 40.
 - 2. Copper water tube option: ASTM B88, Type K or L, hard drawn.
- B. Extension of Domestic Water Make-up Piping: ASTM B88, Type K or L, hard drawn copper tubing.
- C. Cooling Coil Condensate Drain Piping:
 - 1.
 - From fan coil or other terminal units: Copper water tube, ASTM B88, Type M for runouts and Type L for mains.
- D.
- E. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.3 FITTINGS FOR STEEL PIPE

- A. 50 mm (2 inches) and Smaller: Screwed or welded joints.
 - 1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
 - 2. Forged steel, socket welding or threaded: ASME B16.11.
 - 3. Screwed: 150-pound malleable iron, ASME B16.3. 125-pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
 - 4. Unions: ASME B16.39.
 - Water hose connection adapter: Brass, pipe thread to 20 mm (3/4 inch) garden hose thread, with hose cap nut.
- B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints.
 - Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
 - 2. Welding flanges and bolting: ASME B16.5:
 - a. Water service: Weld neck or slip-on, plain face, with 3.2 mm (1/8 inch) thick full-face neoprene gasket suitable for 104 degrees C (220 degrees F).
 - 1) Contractor's option: Convoluted, cold formed 150-pound steel flanges, with Teflon gaskets, may be used for water service.
 - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gauge connections.

2.4 FITTINGS FOR COPPER TUBING

- A. Joints:
 - Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
 - 2.
- B. Bronze Flanges and Flanged Fittings: ASME B16.24.
- C. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.5 DIELECTRIC FITTINGS

A. Provide where copper tubing and ferrous metal pipe are joined.

23 21 13-7 HYDRONIC PIPING

- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2-1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Dielectric gasket material shall be compatible with hydronic medium.
- D. Temperature Rating, 99 degrees C (210 degrees F).
- E. Contractor's option: On pipe sizes 50 mm (2 inch) and smaller, screwed end brass ball valves or dielectric nipples may be used in lieu of dielectric unions.

2.6 SCREWED JOINTS

- A. Pipe Thread: ASME B1.20.1.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.7 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2.4 m (8 feet) or more above the floor or operating platform.
- D. Shut-Off Valves:
 - Ball Valves (Pipe sizes 50 mm (2 inch) and smaller): MSS SP-110, screwed or solder connections, brass or bronze body with chromeplated ball with full port and Teflon seat at 2758 kPa (400 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
 - 2. Butterfly Valves (Pipe Sizes 65 mm (2-1/2 inch) and larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS SP-67, flange lug type rated 1200 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Butterfly valves are prohibited for direct buried pipe applications.
 - a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47/A47M electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
- c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
 - Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
 - 2) Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.
- E. Check Valves:
 - 1. Swing Check Valves:
 - a. 50 mm (2 inches) and smaller: MSS SP-80, bronze, 1035 kPa (150 psig), 45-degree swing disc.
 - b. 65 mm (2-1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP-71 for check valves.
 - 2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
 - a. Body: MSS SP-125 cast iron, ASTM A126, Class B, or steel, ASTM A216/A216M, Class WCB, or ductile iron, ASTM 536, flanged or wafer type.
 - b. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
- F. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size.
 - 1. Ball style valve.
 - 2. A dual-purpose flow balancing valve and adjustable flow meter, with bronze or cast-iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.

23 21 13-9 HYDRONIC PIPING

3. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

2.8 STRAINERS

- А. Ү Туре.
 - Screens: Bronze, Monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations for 100 mm (4 inches) and larger: 3.2 mm (1/8 inch) diameter perforations.

2.9 FLEXIBLE CONNECTORS FOR WATER SERVICE

- A. Flanged Spool Connector:
 - Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
 - 2. Working pressures and temperatures shall be as follows:
 - a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165 psig) at 121 degrees C (250 degrees F).
 - b. Connector sizes 125 mm to 300 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
 - 3. Provide ductile iron retaining rings and control units.

2.10 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association (EJMA) Standards.
- C. Bellows Internally Pressurized Type:
 - 1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
 - 2. Internal stainless-steel sleeve entire length of bellows.
 - External cast iron equalizing rings for services exceeding 345 kPa (50 psig).
 - 4. Welded ends.
 - 5. Design shall conform to standards of EJMA and ASME B31.9.

- External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
- 7. Integral external cover.
- D. Expansion Compensators:
 - Corrugated bellows, externally pressurized, stainless steel or bronze.
 - 2. Internal guides and anti-torque devices.
 - 3. Threaded ends.
 - 4. External shroud.
 - 5. Conform to standards of EJMA.
- E. Expansion Joint (Contractor's Option): 2413 kPa (350 psig) maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with welded or flanged ends, suitable for axial end movement to 75 mm (3 inch).
- F. Expansion Joint Identification: Provide stamped brass or stainlesssteel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.
- G. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.
- H. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.

2.11 HYDRONIC SYSTEM COMPONENTS

A. Automatic Air Vent Valves (where shown on drawings): Cast iron or semisteel body, 1035 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Air outlet shall be piped to the nearest floor drain.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.12 GAUGES, PRESSURE AND COMPOUND

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gauges in water service.
- C. Range of Gauges: Provide range equal to at least 130 percent of normal operating range.
 - For condenser water suction (compound): 101 kPa (30 inches Hg) to 690 kPa (100 psig).

2.13 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gauge test connections shown on the drawings.
- B. Provide one each of the following test items to the COR:
 - 6 mm (1/4 inch) FPT by 3.2 mm (1/8 inch) diameter stainless steel pressure gauge adapter probe for extra-long test plug.
 - 2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gauge, 101 kPa (30 inches Hg) to 690 kPa (100 psig) range.
 - 3. 0 to 104 degrees C (32 to 220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (1 inch) dial, 125 mm (5 inch) long stainless-steel stem, plastic case.

2.14 FIRESTOPPING MATERIAL

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 GENERAL

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

- C. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- D. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (1 inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- F. Locate and orient values to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate value stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end values. Control values usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly values with the value open as recommended by the manufacturer to prevent binding of the disc in the seat.
- G. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- H. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- J. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
 - 1. Water treatment pot feeders and condenser water treatment systems.
 - 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- K. Thermometer Wells: In pipes 65 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.
- L. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.
- M. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1/B2.1M. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- D. Solvent Welded Joints: As recommended by the manufacturer.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

- A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.

3.4 LEAK TESTING ABOVEGROUND PIPING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COR. Tests may be either of those below, or a combination, as approved by the COR.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.5 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
- B. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/s (5.9 f/s), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COR.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- C. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/s (5.9 f/s). Circulate each section for not less than 4 hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.
- D. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean makeup. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.6 WATER TREATMENT

- A. Close and fill system as soon as possible after final flushing to minimize corrosion.
- B. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
- C. Utilize this activity, by arrangement with the COR, for instructing VA operating personnel.

3.7 STARTUP AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. Adjust red set hand on pressure gauges to normal working pressure.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 23 22 13 STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Steam, condensate and vent piping inside buildings.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standard will govern.
- B. American Society of Mechanical Engineers (ASME): B1.20.1-2013Pipe Threads, General Purpose (Inch) B16.5-2017Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard B16.9-2018Factory Made Wrought Buttwelding Fittings B16.11-2016Forged Fittings, Socket-Welding and Threaded B16.42-2016Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300 B31.1-2018Power Piping B31.9-2017Building Services Piping B40.100-2013Pressure Gauges and Gauge Attachments ASME Boiler and Pressure Vessel Code (BPVC) -BPVC Section II-2019 Materials BPVC Section VIII-2019 Rules for Construction of Pressure Vessels, Division 1
 - BPVC Section IX-2019Welding, Brazing, and Fusing Qualifications

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C. American Society for Testing and Materials (ASTM): A53/A53M-2018Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless A106/A106M-2019Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service A216/A216M-2019Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service A285/A285M-2017Standard Specification for Pressure Vessel Plates, Carbon Steel, Low-and Intermediate-Tensile Strength A307-2019Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength A516/A516M-2017Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service A536-1984(R2019)Standard Specification for Ductile Iron Castings B62-2017Standard Specification for Composition Bronze or Ounce Metal Castings D. American Welding Society (AWS): B2.1/B2.1M-2014Specification for Welding Procedure and Performance Qualifications Z49.1-2012Safety in Welding and Cutting and Allied Processes E. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.: SP-80-2019Bronze Gate, Globe, Angle, and Check Valves F. Military Specifications (Mil. Spec.): MIL-S-901E-2017Shock Tests, H.I. (High Impact) Shipboard Machinery, Equipment, and Systems G. National Board of Boiler and Pressure Vessel Inspectors (NB): Relieving Capacities of Safety Valves and Relief Valves H. Tubular Exchanger Manufacturers Association (TEMA): TEMA Standards-201910th Edition

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 22 13, STEAM AND CONDENSATE HEATING PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Pipe and equipment supports
 - 2. Pipe and tubing, with specification, class or type, and schedule.
 - Pipe fittings, including miscellaneous adapters and special fittings.
 - 4. Flanges, gaskets and bolting.
 - 5. Valves of all types.
 - 6. Strainers.
 - 7. Flexible ball joints: Catalog sheets, performance charts, schematic drawings, specifications and installation instructions.
 - 8. All specified steam system components.
- D. Coordination Drawings: Refer to paragraph, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. As-Built Piping Diagrams: Provide drawing as follows for steam and steam condensate piping and other central plant equipment.
 - One wall-mounted stick file for prints. Mount stick file in the chiller plant or adjacent control room along with control diagram stick file.
 - 2. One set of reproducible drawings.
- F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - Include complete diagrams of the internal wiring for each item of equipment.
 - Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.5 QUALITY ASSURANCE

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.
- B. The products and execution of work specified in this section shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.
- C. Welding Qualifications: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
 - Qualify welding processes and operators for piping according to ASME BPVC Section IX, AWS Z49.1 and AWS B2.1/B2.1M.
 - 2. Comply with provisions in ASME B31.9and ASME B31.1.
 - 3. Certify that each welder and welding operator has passed AWS qualification tests for welding processes involved and that certification is current and recent. Submit documentation to the COR.
 - 4. All welds shall be stamped according to the provisions of the American Welding Society.
- D. ASME Compliance: Comply with ASME B31.9and ASME B31.1 for materials, products, and installation. Safety valves and pressure vessels shall bear appropriate ASME labels.

1.6 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be in electronic version on CD or DVD. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:
 - Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD or DVD.
 - 2. As-built drawings are to be provided, with a copy of them on AutoCAD version 2020 provided on CD or DVD. The CAD drawings shall use multiple line layers with a separate individual layer for each system.
- D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.
- E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 2 - PRODUCTS

- 2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES
 - A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2 PIPE AND TUBING

- A. Steam Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; ASTM A106/A106M Grade B, seamless; Schedule 40.
- B. Steam Condensate and Pumped Condensate Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; or ASTM A106/A106M Grade B, seamless, Schedule 80.
- C. Vent Piping: Steel, ASTM A53/A53M, Grade B, seamless or ERW; ASTM A106/A106M Grade B, seamless; Schedule 40, galvanized.

2.3 FITTINGS FOR STEEL PIPE

- A. 50 mm (2 inches) and Smaller: Screwed or welded.
 - Cast iron fittings or piping is not acceptable for steam and steam condensate piping. Bushing reduction or use of close nipples is not acceptable.
 - 2. Forged steel, socket welding or threaded: ASME B16.11, 13,790 kPa (2000 psig) class with ASME B1.20.1 threads. Use Schedule 80 pipe and fittings for threaded joints. Lubricant or sealant shall be oil and graphite or other compound approved for the intended service.
 - 3. Unions: Forged steel, 13,790 kPa (2000 psig) class or 20,685 kPa (3000 psig) class on piping 50 mm (2 inches) and under.
 - Steam line drip station and strainer quick-couple blowdown hose connection: Straight through, plug and socket, screw or cam locking type for 15 mm (1/2 inch) ID hose. No integral shut-off is required.
- B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints.
 - Cast iron fittings or piping is not acceptable for steam and steam condensate piping.
 - Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
 - 3. Welding flanges and bolting: ASME B16.5:
 - a. Steam service: Weld neck or slip-on, raised face, with nonasbestos gasket. Non-asbestos gasket shall either be stainless steel spiral wound strip with flexible graphite filler or compressed inorganic fiber with nitrile binder rated for

23 22 13 - 6 STEAM AND CONDENSATE HEATING PIPING

saturated and superheated steam service 400 degrees C (750 degrees F) and 10,342 kPa (1500 psig).

b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gauge connections.

2.4 DIELECTRIC FITTINGS

- A. Provide where dissimilar metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union.
- C. 65 mm (2-1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 121 degrees C (250 degrees F) for steam condensate and as required for steam service.
- E. Contractor's option: On pipe sizes 50 mm (2 inches) and smaller, screwed end steel gate valves or dielectric nipples may be used in lieu of dielectric unions.

2.5 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2.1 m (7 feet) or more above the floor or operating platform.
- D. Shut-Off Valves:
 - 1. Gate Valves:
 - a. 50 mm (2 inches) and smaller: Forged steel body, rated for 1380 kPa (200 psig) saturated steam, 2758 kPa (400 psig) WOG, bronze wedges and Monel or stainless-steel seats, threaded ends, rising stem, and union bonnet.
 - b. 65 mm (2-1/2 inches) and larger: Flanged, outside screw and yoke.
 - 1) High pressure steam 110 kPa (16 psig) and above system): Cast steel body, ASTM A216/A216M grade WCB, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel solid disc and seats. Provide 25 mm (1 inch) factory installed bypass with globe valve on valves 100 mm (4 inches) and larger.

- 2) All other services: Forged steel body, Class B, rated for 850 kPa (123 psig) saturated steam, 1380 kPa (200 psig) WOG, bronze or bronze face wedge and seats, 850 kPa (123 psig) ASME flanged ends, OS&Y, rising stem, bolted bonnet, and renewable seat rings.
- E. Swing Check Valves:
 - 50 mm (2 inches) and smaller: Cast steel, 1035 kPa (150 psig), 45degree swing disc.
 - 2. 65 mm (2-1/2 inches) and Larger:
 - a. Check valves for high pressure steam 110 kPa (16 psig) and above system: Cast steel body, ASTM A216/A216M grade WCB, flanged, OS&Y, 1035 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
 - b. All other services: 861 kPa (125 psig), flanged, cast steel body, and bronze trim.
- F. Manual Radiator/Convector Valves: Brass, packless, with position indicator.

2.6 STRAINERS

- A. Basket or Y Type. Tee type is acceptable for gravity flow and pumped steam condensate service.
- B. High Pressure Steam: Rated 1035 kPa (150 psig) saturated steam.
 - 50 mm (2 inches) and smaller: Cast steel, rated for saturated steam at 1034 kPa (150 psig) threaded ends.
 - 2. 65 mm (2-1/2 inches) and larger: Cast steel rated for 1034 kPa (150 psig) saturated steam with 1034 kPa (150 psig) ASME flanged ends or forged steel with 1724 kPa (250 psig) ASME flanged ends.
- C. All Other Services: Rated 861 kPa (125 psig) saturated steam.
 - 1. 50 mm (2 inches) and smaller: Cast steel body.
 - 2. 65 mm (2-1/2 inches) and larger: Flanged, cast steel body.
- D. Screens: Bronze, Monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows:
 - 75 mm (3 inches) and smaller: 20 mesh for steam and 1.1 mm (0.045 inch) diameter perforations for liquids.
 - 2. 100 mm (4 inches) and larger: 1.1 mm (0.045) inch diameter perforations for steam and 3.2 mm (1/8 inch) diameter perforations for liquids.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.7 STEAM SYSTEM COMPONENTS

- A. Safety Valves and Accessories: Comply with ASME BPVC Section VIII. Capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors, maximum accumulation 10 percent. Provide lifting lever. Provide drip pan elbow where shown. Valve shall have stainless steel seats and trim.
- B. Steam Trap: Each type of trap shall be the product of a single manufacturer. Provide trap sets at all low points and at 61 m (200 feet) intervals on the horizontal main lines.
 - Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless otherwise indicated on the drawings, traps shall be sized for capacities indicated at minimum pressure drop as follows:
 - a. For equipment with modulating control valve: 1.7 kPa (1/4 psig), based on a condensate leg of 300 mm (12 inches) at the trap inlet and gravity flow to the receiver.
 - b. For main line drip trap sets and other trap sets at steam pressure: Up to 70 percent of design differential pressure. Condensate may be lifted to the return line.
 - 2. Trap bodies: Steel, constructed to permit ease of removal and servicing working parts without disturbing connecting piping. The use of raised face flange is required on pipe sizes 1½ inch and above. The use of unions is acceptable for pipe sizes below 1½ inches. For systems without relief valve traps shall be rated for the pressure upstream of the steam supplying the system.
 - 3. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or Monel metal.
 - 4. Valves and seats: Suitable hardened corrosion resistant alloy.
 - 5. Mechanism: Brass, stainless steel or corrosion resistant alloy.
 - 6. Floats: Stainless steel.

2.8 GAUGES, PRESSURE AND COMPOUND

A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear
VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.

- B. Provide steel, lever handle union cock. Provide steel or stainlesssteel pressure snubber for gauges in water service. Provide steel pigtail syphon for steam gauges.
- C. Pressure gauge ranges shall be selected such that the normal operating pressure for each gauge is displayed near the midpoint of each gauge's range. Gauges with ranges selected such that the normal pressure is displayed at less than 30 percent or more than 70 percent of the gauge's range are prohibited. The units of pressure shall be psig.

2.9 FIRESTOPPING MATERIAL

A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 3 - EXECUTION

3.1 GENERAL

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to the Government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- C. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- D. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping and another surface. Unless shown otherwise, slope steam, condensate and drain piping down in the direction of flow not

23 22 13 - 10 STEAM AND CONDENSATE HEATING PIPING

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

less than 25 mm (1 inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

- F. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.
- G. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- H. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- J. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

3.2 WELDING

- A. The contractor is entirely responsible for the quality of the welding and shall:
 - Conduct tests of the welding procedures used on the project, verify the suitability of the procedures used, verify that the welds made will meet the required tests, and also verify that the welding operators have the ability to make sound welds under standard conditions.
 - Perform all welding operations required for construction and installation of the piping systems.
- B. Qualification of Welders: Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, AWS B2.1/B2.1M, AWS Z49.1, and also as outlined below.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- C. Examining Welder: Examine each welder at job site, in the presence of the COR, to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall be allowed to weld only in the position in which he has qualified and shall be required to identify his welds with his specific code marking signifying his name and number assigned.
- D. Examination Results: Provide the COR with a list of names and corresponding code markings. Retest welders who fail to meet the prescribed welding qualifications. Disqualify welders, who fail the second test, for work on the project.
- E. Beveling: Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.
- F. Alignment: Provide approved welding method for joints on all pipes greater than 50 mm (2 inches) to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe.
- G. Erection: Piping shall not be split, bent, flattened, or otherwise damaged before, during, or after installation. If the pipe temperature falls to 0 degrees C (32 degrees F) or lower, the pipe shall be heated to approximately 38 degrees C (100 degrees F) for a distance of 300 mm (1 foot) on each side of the weld before welding, and the weld shall be finished before the pipe cools to 0 degrees C (32 degrees F).
- H. Non-Destructive Examination of Piping Welds:
 - 1. Perform radiographic examination of 50 percent of the first 10 welds made and 10 percent of all additional welds made. The COR reserves the right to identify individual welds for which the radiographic examination must be performed. All welds will be visually inspected by the COR. The VA reserves the right to require testing on additional welds up to 100 percent if more than 25 percent of the examined welds fail the inspection.
 - An approved independent testing firm regularly engaged in radiographic testing shall perform the radiographic examination of pipe joint welds. All radiographs shall be reviewed and interpreted

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

by an ASNT Certified Level III radiographer, employed by the testing firm, who shall sign the reading report.

- 3. Comply with ASME B31.1. Furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project. The COR and the commissioning agent shall be given a copy of all reports to be maintained as part of the project records and shall review all inspection records.
- I. Defective Welds: Replace and reinspect defective welds. Repairing defective welds by adding weld material over the defect or by peening are prohibited. Welders responsible for defective welds must be requalified prior to resuming work on the project.
- J. Electrodes: Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during the fabrication operations. Discard electrodes that have lost part of their coating.

3.3 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1/B2.1M. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. 125 Pound Cast Steel Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast steel flange.

3.4 STEAM TRAP PIPING

- A. Install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap where modulating control valves are used. Support traps weighing over 11 kg (24 pounds) independently of connecting piping.
 - On pipe size 1 ½ inch and above a raised face flange is required to allow for removal of the steam trap without disturbing surrounding piping.
 - On pipe size below 1 ½ inch raised face flanges or unions may be used to allow for removal of the traps.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.5 LEAK TESTING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COR in accordance with the specified requirements. Testing shall be performed in accordance with the specification requirements.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Avoid excessive pressure on mechanical seals and safety devices.
- D. Prepare and submit test and inspection reports to the COR within 5 working days of test completion and prior to covering the pipe.
- E. All tests shall be witnessed by the COR, their representative, and be documented by each section tested, date tested, and list or personnel present.

3.6 FLUSHING AND CLEANING PIPING SYSTEMS

A. Steam, Condensate and Vent Piping: The piping system shall be flushed clean prior to equipment connection. Cleaning includes pulling all strainer screens and cleaning all scale/dirt legs during startup operation. Contractor shall be responsible for damage caused by inadequately cleaned/flushed systems.

3.7 STARTUP AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. Adjust red set hand on pressure gauges to normal working pressure.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 23 23 00 REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field refrigerant piping for direct expansion HVAC systems.
- B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.

C. Definitions:

- Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
 - a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
 - b. High side means the parts of a refrigerating system subjected to condenser pressure.
- Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 449 degrees C (840 degrees F) but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Section 23 07 11, HVAC, and BOILER PLANT INSULATION.
- D. Section 23 21 13, HYDRONIC PIPING.

1.3 QUALITY ASSURANCE

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.

- C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.
- D. Products shall comply with UL 207 "Refrigerant-Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings:
 - Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with drawings and specifications for components noted below:
 - a. Tubing and fittings
 - b. Valves
 - c. Strainers
 - d. Moisture-liquid indicators
 - e. Filter-driers
 - f. Flexible metal hose
 - g. Liquid-suction interchanges
 - h. Oil separators (when specified)
 - i. Gages
 - j. Pipe and equipment supports
 - k. Refrigerant and oil
 - 1. Pipe/conduit roof penetration cover
 - m. Soldering and brazing materials
 - Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.
- C. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.
- D. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. B. Air Conditioning, Heating, and Refrigeration Institute (ARI/AHRI): 495-2009 Standard for Refrigerant Liquid Receivers 730-2013Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers 750-2016 Thermostatic Refrigerant Expansion Valves 760-2014Performance Rating of Solenoid Valves for Use with Volatile Refrigerants C. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE): 15-2019Safety Standard for Refrigeration Systems (ANSI) 17-2015 Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (ANSI) 63.1-2001Method of Testing Liquid Line Refrigerant Driers (ANSI) 63.2-2010 Method of Testing Liquid Line Filter Drier Filtration Capability (ANSI) D. American National Standards Institute (ANSI): A13.1-2015Scheme for Identification of Piping Systems Z535.1-2017Safety Color Code E. American Society of Mechanical Engineers (ASME): B16.22-2018 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI) B16.24-2016 Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500 (ANSI) B31.5-2119 Refrigeration Piping and Heat Transfer Components (ANSI) B40.100-2013Pressure Gauges and Gauge Attachments B40.200-2008Thermometers, Direct Reading and Remote Reading F. American Society for Testing and Materials (ASTM) A126-2019 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings B32-08Standard Specification for Solder Metal

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 B88-2016 Standard Specification for Seamless Copper Water Tube B88M-2018 Standard Specification for Seamless Copper Water Tube (Metric) B280-2020Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service G. American Welding Society, Inc. (AWS): Brazing Handbook A5.8/A5.8M-2018Standard Specification for Filler Metals for Brazing and Braze Welding H. Underwriters Laboratories (U.L.): U.L.207-2018Standard for Refrigerant-Containing Components

and Accessories, Nonelectrical

U.L.429-2013Standard for Electrically Operated Valves

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer. For piping over 100 mm (4 inch) use A53 Black SML steel.
- B. Water and Drain Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type M or L). Optional drain piping material: Schedule 80 flame retardant Polypropylene plastic.
- C. Fittings, Valves and Accessories:
 - 1. Copper fittings: Wrought copper fittings, ASME B16.22.
 - a. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M,45 percent silver brazing alloy, Class BAg-5.
 - b. Solder Joints, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).
 - 2. Steel fittings: ASTM wrought steel fittings.
 - a. Refrigerant piping Welded Joints.
 - 3. Flanges and flanged fittings: ASME B16.24.
 - 4. Refrigeration Valves:
 - a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.
 - b. Pressure Relief Valves: Comply with ASME Boiler and PressureVessel Code; UL listed. Forged brass with nonferrous, corrosion

23 23 00-4 REFRIGERANT PIPING

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.

- c. Solenoid Valves: Comply with ARI 760 and UL 429, UL-listed, twoposition, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally open or closed holding coil.
- d. Thermostatic Expansion Valves: Comply with ARI 750. Brass body with stainless-steel or non-corrosive nonferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
- e. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.
- 5. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines larger than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
- Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
- Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown on drawings. Conform to ARI Standard 730 and ASHRAE Standard 63.1. Heavy gage steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as

23 23 00-5 REFRIGERANT PIPING

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.

- 8. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.
- 10. Oil Separators: Provide for condensing units, as shown. All welded steel construction with capacity to eliminate a minimum of 95 percent of the oil from the hot gas flowing through it. Provide manufacturer's published ratings for minimum and maximum refrigeration tonnage corresponding to this oil separating efficiency. Separator shall be equipped with a float valve to prevent return of the hot gas to crankcase, and shall have isolating stop valves so it can be opened and services without pumping out any other part of the system. ASME construction or UL listed.

2.2 GAGES

- A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem type temperature gages shall be provided in thermal wells located within 1525 mm (5 feet) of the finished floor. Universal adjustable angle type or remote element type temperature gages shall be provided in thermal wells located 1525 to 2135 mm (5 to 7 feet) above the finished floor. Remote element type temperature gages shall be provided in thermal wells located 2135 mm (7 feet) above the finished floor.
- B. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Each gage range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.
 - Suction: 101 kPa (30 inches Hg) vacuum to 1723 kPa (gage) (250 psig).

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2. Discharge: 0 to 3445 kPa (gage) (0 to 500 psig).

2.4 PIPE SUPPORTS

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.5 REFRIGERANTS AND OIL

A. Provide EPA approved refrigerant and oil for proper system operation.

2.6 PIPE/CONDUIT ROOF PENETRATION COVER

- A. Prefabricated Roof Curb: Galvanized steel or extruded aluminum 300 mm (12 inches) overall height, continuous welded corner seams, treated wood nailer, 38 mm (1-1/2 inch) thick, 48 kg/cu.m (3 lb/cu.ft.) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.
- B. Penetration Cover: Galvanized sheet metal with flanged removable top. Provide 38 mm (1-1/2 inch) thick mineral fiber board insulation.
- C. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

2.7 PIPE INSULATION FOR DX HVAC SYSTEMS

Refer to specification Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5
 - Install piping as short as possible, with a minimum number of joints, elbow and fittings.
 - 2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
 - 3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent

to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.

- 4. Use copper tubing in protective conduit when installed below ground.
- 5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.
- B. Joint Construction:
 - 1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
 - a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
 - b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
 - c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
 - d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.
- C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.
- D. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 lbs) of refrigerant.
- E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, and BOILER PLANT INSULATION.

3.2 PIPE AND TUBING INSULATION

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.3 SIGNS AND IDENTIFICATION

A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer,

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.

- B. Systems containing more than 50 kg (110 lb) of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI Z535.1, having letters not less than 13 mm (1/2 inch) in height designating:
 - Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).
 - Signs on all exposed high pressure and low pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

3.4 FIELD QUALITY CONTROL

- A. Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.
- B. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of Resident Engineer. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.
 - Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
 - 2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

C. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

- A. System Test and Charging: As recommended by the equipment manufacturer or as follows:
 - Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psi) gage. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
 - Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
 - 3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) 665 mPa (2245.6 inches of mercury at 60 degrees F) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

- - - E N D - - -

SECTION 23 31 00 HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Ductwork and accessories for HVAC including the following:
 - Supply air, return air, outside air, exhaust, make-up air, and relief systems.
- B. Definitions:
 - 1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
 - Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
 - Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
 - 4. Exposed Duct: Exposed to view in a finished room.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Section 07 84 00, FIRESTOPPING: Fire Stopping Material.
- C. Section 22 11 00, FACILITY WATER DISTRIBUTION: Plumbing Connections.
- D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General Mechanical Requirements.
- E. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Testing and Balancing of Air Flows.
- F. Section 23 07 11, HVAC, and BOILER PLANT INSULATION: Duct Insulation.
- G. Section 23 82 00, CONVECTION HEATING and COOLING UNITS.

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fire Safety Code: Comply with NFPA 90A.
- C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
- D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.

E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Rectangular ducts:
 - a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
 - b. Duct liner.
 - c. Sealants and gaskets.
 - d. Access doors.
 - 2. Round and flat oval duct construction details:
 - a. Manufacturer's details for duct fittings.
 - b. Duct liner.
 - c. Sealants and gaskets.
 - d. Access sections.
 - e. Installation instructions.
 - 3. Volume dampers, back draft dampers.
 - 4. Upper hanger attachments.
 - 5. Fire dampers, fire doors, and smoke dampers with installation instructions.
 - 7. Flexible ducts and clamps, with manufacturer's installation instructions.
 - 8. Flexible connections.
 - 9. Instrument test fittings.
 - 10 Details and design analysis of alternate or optional duct systems.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11-COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Civil Engineers (ASCE):

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 ASCE7-2017Minimum Design Loads for Buildings and Other Structures C. American Society for Testing and Materials (ASTM): A167-2014Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip A653-2019Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process A1011-2018Standard Specification for Steel, Sheet and Strip, Hot rolled, Carbon, structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength B209-2014Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate C1071-2019Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) E84-2020Standard Test Method for Surface Burning Characteristics of Building Materials D. National Fire Protection Association (NFPA): 90A-2018Standard for the Installation of Air Conditioning and Ventilating Systems 96-2018Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): 3rd Edition -2006HVAC Duct Construction Standards, Metal and Flexible 2nd Edition -2012 HVAC Air Duct Leakage Test Manual 7th Edition -2016Fibrous Glass Duct Construction Standards F. Underwriters Laboratories, Inc. (UL): 181-2013Factory-Made Air Ducts and Air Connectors 555-2006Standard for Fire Dampers 555S-2014Standard for Smoke Dampers

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 2 - PRODUCTS

2.1 DUCT MATERIALS AND SEALANTS

- A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
- B. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.
- D. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards.
 - 1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread, and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally, provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
 - Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
 - 3. Gaskets in Flanged Joints: Soft neoprene.
- E. Approved factory-made joints may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

- A. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate and seal the ductwork in accordance with the following pressure classifications:
- B. Duct Pressure Classification:

0 to 50 mm (2 inch)

> 50 mm to 75 mm (2 inch to 3 inch)

> 75 mm to 100 mm (3 inch to 4 inch)

Show pressure classifications on the floor plans.

- C. Seal Class: All ductwork shall receive Class A Seal
- D. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.

- Elbows: Diameters 80 through 200 mm (3 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
- Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
- Ribbed Duct Option: Lighter gage round/oval duct and fittings may be furnished provided certified tests indicating that the rigidity and performance is equivalent to SMACNA standard gage ducts are submitted.
 - Ducts: Manufacturer's published standard gage, G90 coating, spiral lock seam construction with an intermediate standing rib.
 - b. Fittings: May be manufacturer's standard as shown in published catalogs, fabricated by spot welding and bonding with neoprene base cement or machine formed seam in lieu of continuous welded seams.
- 4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standard S3.13. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the Resident Engineer.
- E. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 500 mm (20 inches) wide by 1200 - 1350 mm (48 - 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.
- F. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.

G. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.

2.3 DUCT LINER (WHERE INDICATED ON DRAWINGS)

- A. Duct sizes shown on drawings for lined duct are clear opening inside lining.
- B. Duct liner is only permitted to be used for return, relief and general exhaust ducts. Duct liner is not permitted for outside air ducts, supply air ducts or any other positive pressure ductwork (provide exterior insulation only).
- C. Rectangular Duct or Casing Liner: ASTM C1071, Type I (flexible), or Type II (board), 25 mm (one inch) minimum thickness, applied with mechanical fasteners and 100 percent coverage of adhesive in conformance with SMACNA, Duct Liner Application Standard.
- D. Round and Oval Duct Liner: Factory fabricated double-walled with two inch) thick sound insulation and inner perforated galvanized metal liner. Construction shall comply with flame and smoke rating required by NFPA 90A. Metal liner shall be 1.0 to 0.60 mm (20 to 24 gage) having perforations not exceeding 2.4 mm (3/32 inch) diameter and approximately 22 percent free area. Metal liner for fittings need not be perforated. Assemblies shall be complete with continuous sheet Mylar liner, 2 mil thickness, between the perforated liner and the insulation to prevent erosion of the insulation. Provide liner couplings/spacer for metal liner. At the end of insulated sections, provide insulation end fittings to reduce outer shell to liner size. Provide liner spacing/concentricity leaving airway unobstructed.

2.4 DUCT ACCESS DOORS, PANELS AND SECTIONS

- A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
 - 1. Each duct mounted coil and humidifier.
 - Each fire damper (for link service), smoke damper and automatic control damper.
 - 3. Each duct mounted smoke detector.
 - For cleaning operating room supply air duct, locate access doors at 6 m (20 feet) intervals and at each change in duct direction.
- B. Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12 inch) minimum where possible. Access sections in

23 31 00 - 6 HVAC DUCTS AND CASINGS

insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.

- For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2-12).
- 2. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

2.5 FIRE DAMPERS

- A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2hour rating, 70 degrees C (160 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.
- B. Fire dampers in wet air exhaust shall be of stainless-steel construction, all others may be galvanized steel.
- C. Minimum requirements for fire dampers:
 - The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9 mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
 - 2. Submit manufacturer's installation instructions conforming to UL rating test.

2.6 SMOKE DAMPERS

- A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 450 m/min (1500 fpm). Maximum static pressure loss: 32 Pa (0.13 inch W.G.).
- B. Maximum air leakage, closed damper: 0.32 cubic meters /min/square meter (4.0 CFM per square foot) at 750 Pa (3-inch W.G.) differential pressure.
- C. Minimum requirements for dampers:
 - Shall comply with requirements of Table 6-1 of UL 555S, except for the Fire Endurance and Hose Stream Test.
 - Frame: Galvanized steel channel with side, top and bottom stops or seals.
 - 3. Blades: Galvanized steel, parallel type preferably, 300 mm (12 inch) maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for

23 31 00 - 7 HVAC DUCTS AND CASINGS

minimum noise generation and pressure drop are preferred for duct mounted dampers.

- 4. Shafts: Galvanized steel.
- 5. Bearings: Nylon, bronze sleeve or ball type.
- 6. Hardware: Zinc plated.
- 7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See drawings for required control operation.
- D. Motor operator (actuator): Provide pneumatic or electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

Combination fire and smoke dampers: Multi-blade type units meeting all requirements of both fire dampers and smoke dampers shall be used where shown and may be used at the Contractor's option where applicable.

2.8 FLEXIBLE AIR DUCT

- A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.
- B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.
- C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).
- D. Application Criteria:
 - Temperature range: -18 to 93 degrees C (0 to 200 degrees F) internal.
 - 2. Maximum working velocity: 1200 m/min (4000 feet per minute).

23 31 00 - 8 HVAC DUCTS AND CASINGS

- 3. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.
- E. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless-steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

2.9 FIRESTOPPING MATERIAL

Refer to Section 07 84 00, FIRESTOPPING.

2.10 INSTRUMENT TEST FITTINGS

- A. Manufactured type with a minimum 50 mm (two inch) length for insulated duct, and a minimum 25 mm (one inch) length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.
- B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.
- B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
 - 1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.

- Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
- 3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
- 4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- C. Install duct hangers and supports in accordance with SMACNA Standards.
- D. Install fire dampers, smoke dampers and combination fire/smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers, smoke dampers and combination fire/smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and where required by the Resident Engineer. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate re-setting of fire dampers and operation of smoke dampers to the Resident Engineer.
- E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- F. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hours. Support ducts SMACNA Standards.
- G. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
- H. Control Damper Installation:

- Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
- Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
- 3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
- 4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- I. Low Pressure Duct Liner: Install in accordance with SMACNA, Duct Liner Application Standard.
- J. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

3.2 DUCT LEAKAGE TESTS AND REPAIR

- A. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor and independent of the Sheet Metal Contractor.
- B. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections. Based upon satisfactory initial duct leakage test results, the scope of the testing may be reduced by the Resident Engineer on ductwork constructed to the 500 Pa (2" WG) duct pressure classification. In no case shall the leakage testing of ductwork constructed above the 500 Pa (2" WG) duct pressure classification or ductwork located in shafts or other inaccessible areas be eliminated.

- C. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
- D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- E. All tests shall be performed in the presence of the Resident Engineer and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the Resident Engineer and identify leakage source with excessive leakage.
- F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Resident Engineer.
- G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.4 TESTING, ADJUSTING AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC. - - - E N D - - -

SECTION 23 81 23 COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies process cooling split systems air conditioning unit.
- B. Definitions:
 - Energy Efficiency Ratio (EER): A ratio calculated by dividing the cooling capacity in Btuh by the power input in watts at any given set of rating conditions, expressed in Watts (Btu/h) per watt.
 - Coefficient of Performance (COP): A ratio calculated by dividing the change in heating or cooling capacity (Btu/h) to the energy consumed by the system (kW), expressed in Btu/kWh.
 - 3. Unitary (AHRI): Consists of one or more factory-made assemblies, which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function.
 - 4. CRAC Units: Computer Room Air Conditioning Units.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- D. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.
- E. Section 22 11 00, FACILITY WATER DISTRIBUTION.
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- I. Section 23 05 93: TESTING, ADJUSTING, and BALANCING FOR HVAC.
- J. Section 23 07 11, HVAC, and BOILER PLANT INSULATION.
- M. Section 23 21 13, HYDRONIC PIPING
- N. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.
- Q. Section 23 23 00, REFRIGERANT PIPING.
- R. Section 23 31 00, HVAC DUCTS and CASINGS.

1.3 QUALITY ASSURANCE

Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data rated capacities (at design indoor and outdoor conditions), EER/COP, operating characteristics, required

specialties and accessories. Submit published catalog selection data showing equipment ratings and compliance with required sensible ratio.

- 1. Indoor Air Conditioning Unit
- 4. Air Cooled Condensing Unit
- C. Submit detailed equipment assemblies with dimensions, operating weights, required clearances.
- D. Submit wiring diagrams for power, alarm and controls.
- E. Certification: Submit, simultaneously with shop drawings, a proof of certification:
- F. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion.

1.5 WARRANTY

The unit shall be warranted against all mechanical defects in material, parts or workmanship and shall be repaired or replaced at the Contractor's expense within the period of one year from final acceptance. Contractor shall adhere to a four-hour service response time to troubles during the warranty period.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed Spec):
 00-A-374C-1999Air-Conditioners with Remote Condensing Units or Remote Air-cooled and Water-Cooled Condenser Units, Unitary
 TT-C-490D-1993Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
 C. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standards: 210/240-2017Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
 340/360-2017Performance Rating of Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment
 410-2001Forced-Circulation Air-Cooling and Air-Heating Coils

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 460-2005Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers 520-2004Performance Rating of Positive Displacement Condensing Units DCPP -2008Directory of Certified Product Performance -Applied Directory of Certified Products D. Air Movement and Control Association (AMCA): 210-2016Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating (ANSI) 410-1996Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans E. American Society of Heating, Refrigerating, and Air-Conditioning Engineers Inc. (ASHRAE): 15-2019Safety Standard for Refrigeration Systems (ANSI) Handbook 2016 HVAC Systems and Equipment Handbook 2018 Refrigeration 52.1-1992Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices used in General Ventilation for Removing Particulate Matter 62-1-2019Ventilation for Acceptable Indoor Air Quality (ANSI) 90.1-2019Energy Standard for Buildings except Low-Rise Residential Buildings (ANSI Approved; IESNA Cosponsored) F. American Society of Testing and Materials (ASTM): B117-2019Standard Practice for Operating Salt Spray (Fog) Apparatus G. National Electrical Manufacturer's Association (NEMA): MG 1-2019 Motors and Generators (ANSI) H. National Fire Protection Association (NFPA) Publications: 70-2020National Electrical Code 90A-2018Standard for the Installation of Air-Conditioning and Ventilating Systems

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 2 - PRODUCTS

2.1 WALL-MOUNTED UNITS

- A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for wall mounting.
- B. Cabinet: Galvanized steel with baked-enamel finish, insulated with 13mm (1/2-inch) thick duct liner.
- C. Integral factory-supplied supply and return grille, with filter.
- D. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Supply-Air Fan:
- Forward-Curved, Centrifugal Fan: Provide with directly driven fan with two-speed motor.
- F. Compressor: Hermetic scroll, (VA: Type) with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
- G. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
- H. Refrigerant: R-410A unless otherwise indicated.
- I. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
 - Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- J. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube Ecoated aluminum-fin coil with propeller fan, direct driven.
- K. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.
- L. Filter: 25-mm (1 inch) thick, disposable, glass-fiber media.
 - 1. Recommended Final Resistance: 0.08 (inches wg).
 - 2. Initial Resistance: 0.04 (inches wg).
 - 3. Arrestance: 90 percent according to ASHRAE 52.1.
 - 4. MERV Rating: 7 according to ASHRAE 52.2.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- M. Provide low ambient outdoor unit control (to -40 $^{\circ}$ F) and associated wind baffle for condensing units located outdoors.
- N. Provide condensate pump and associated controls. Pipe condensate to location shown on the drawings.
- O. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- P. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature- and humidity control modules
- Q. DDC or BAS Interface: Provide connection to the DDC or BAS system.

2.2 FAN MOTORS

- A. Default motor characteristics are specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- D. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 SPECIAL TOOLS

If any part of equipment furnished under these specifications requires a special tool for assembly, adjustment, setting, or maintenance and the tool is not readily available from the commercial tool market, furnish the necessary tools with equipment as a standard accessory

2.4 CORROSION CONTROL

- A. Remote Outdoor Condenser Coils:
 - Epoxy Immersion Coating Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UVresistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:

- a. Salt Spray Resistance (Minimum 6,000 Hours)
- b. Humidity Resistance (Minimum 1,000 Hours)
- c. Water Immersion (Minimum 260 Hours)
- d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
- e. Impact Resistance (Up to 160 Inch/Pound)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Handle and install refrigeration units and accessories in accordance with the instructions and recommendations of the manufacturer.
- B. Field Refrigerant Piping: As specified in specification Section23 23 00, REFRIGERANT PIPING.
- C. Field Piping: Condensate Piping, as specified in specification Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING.
- D. Electrical System Connections and Equipment Ground: As specified in Division 26 Sections.

3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to machine to allow service and maintenance.
- D. Drainage Connections: Comply with applicable requirements in Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING. Provide adequate connections for condensate drain.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

E. Refrigerant Piping: Comply with applicable requirements in Section23 23 00, REFRIGERANT PIPING. Provide shutoff valves and piping.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. After startup service and performance test, change filters.

3.4 STARTUP AND TESTING

A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

3.6 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 05 11 REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, panelboards, and other items and arrangements for the specified items are shown on the drawings.
- C. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. The latest International Building Code (IBC), Underwriters Laboratories, Inc. (UL), Institute of Electrical and Electronics Engineers (IEEE), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Definitions:
 - 1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
 - 2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
 - 3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
 - Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
 - Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
 - The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

- A. Applicable publications listed in all Sections of Division 26 shall be the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new and shall have superior quality and freshness.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - Components of an assembled unit need not be products of the same manufacturer.
 - Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

- E. When Factory Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer and witnessed by the contractor. In addition, the following requirements shall be complied with:
 - The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COR a minimum of thirty (30) days prior to the manufacturer's performing of the factory tests.
 - When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer's certified test reports to the COR fourteen (14) days prior to shipment of the equipment, and not more than ninety (90) days after completion of the factory tests.
 - 3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory retesting.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 MATERIALS AND EQUIPMENT PROTECTION

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 - Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
 - During installation, equipment shall be protected against entry of foreign matter, and be vacuum cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 - 3. Damaged equipment shall be repaired or replaced, as determined by the COR.

- 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
- 5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work shall comply with requirements of the latest NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 99, NFPA 110, OSHA Part 1910 subpart J General Environmental Controls, OSHA Part 1910 subpart K Medical and First Aid, and OSHA Part 1910 subpart S Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. However, energized electrical work may be performed only for the non-destructive and non-invasive diagnostic testing(s), or when scheduled outage poses an imminent hazard to patient care, safety, or physical security. In such case, all aspects of energized electrical work, such as the availability of appropriate/correct personal protective equipment (PPE) and the use of PPE, shall comply with the latest NFPA 70E, as well as the following requirements:
 - Only Qualified Person(s) shall perform energized electrical work. Supervisor of Qualified Person(s) shall witness the work of its entirety to ensure compliance with safety requirements and approved work plan.
 - 2. At least two weeks before initiating any energized electrical work, the Contractor and the Qualified Person(s) who is designated to perform the work shall visually inspect, verify and confirm that the work area and electrical equipment can safely accommodate the work involved.

- 3. At least two weeks before initiating any energized electrical work, the Contractor shall develop and submit a job specific work plan, and energized electrical work request to the COR, and Medical Center's Chief Engineer or his/her designee. At the minimum, the work plan must include relevant information such as proposed work schedule, area of work, description of work, name(s) of Supervisor and Qualified Person(s) performing the work, equipment to be used, procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
- 4. Energized electrical work shall begin only after the Contractor has obtained written approval of the work plan, and the energized electrical work request from the COR, and Medical Center's Chief Engineer or his/her designee. The Contractor shall make these approved documents present and available at the time and place of energized electrical work.
- 5. Energized electrical work shall begin only after the Contractor has invited and received acknowledgment from the COR, and Medical Center's Chief Engineer or his/her designee to witness the work.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.

- C. Inaccessible Equipment:
 - Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
- D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards, panelboards, cabinets, motor controllers, fused and non-fused safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, and motor control assemblies, control devices and other significant equipment.
- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E. Label shall show specific and correct

information for specific equipment based on its arc flash calculations. Label shall show the followings:

- 1. Nominal system voltage.
- Equipment/bus name, date prepared, and manufacturer name and address.
- 3. Arc flash boundary.
- 4. Available arc flash incident energy and the corresponding working distance.
- 5. Minimum arc rating of clothing.
- 6. Site-specific level of PPE.

1.12 SUBMITTALS

- A. Submit to the COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION ".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- E. The submittals shall include the following:
 - Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.

26 05 11 - 8 REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
- 3. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
- F. Maintenance and Operation Manuals:
 - Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
 - 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
 - 3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
 - 4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
 - A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
 - 2. Each type of conduit coupling, bushing, and termination fitting.
 - 3. Conduit hangers, clamps, and supports.
 - 4. Duct sealing compound.
 - 5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 ACCEPTANCE CHECKS AND TESTS

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests for the equipment. Repair, replacement, and re-testing shall be accomplished at no additional cost to the Government.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.15 WARRANTY

A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.16 INSTRUCTION

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent and factory-trained instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be factory-trained in operating theory as well as practical operation and maintenance procedures.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the COR at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END---

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - Electrical ratings and insulation type for each conductor and cable.
 - 2) Splicing materials and pulling lubricant.
 - Certifications: Two weeks prior to final inspection, submit the following.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM): D2301-10Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape D2304-10Test Method for Thermal Endurance of Rigid Electrical Insulating Materials D3005-10Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape C. National Electrical Manufacturers Association (NEMA): WC 70-09Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy D. National Fire Protection Association (NFPA): 70-17National Electrical Code (NEC) E. Underwriters Laboratories, Inc. (UL): 44-14Thermoset-Insulated Wires and Cables 467-13Grounding and Bonding Equipment 486A-486B-13Wire Connectors 486C-13Splicing Wire Connectors 486D-15Sealed Wire Connector Systems 486E-15Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors 493-07 Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables 514B-12Conduit, Tubing, and Cable Fittings

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with ASTM, NEMA, NFPA, UL, as specified herein, and as shown on the drawings.
- B. All conductors shall be copper.
- C. Single Conductor and Cable:
 - 1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
 - 2. No. 8 AWG and larger: Stranded.
 - 3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
 - 4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.
- D. Color Code:
 - 1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
 - 2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75 inches) wide tape.
 - 4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 - 5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	В	Orange
Blue	С	Yellow
White	Neutral	Gray *
* or white with	colored (other	than green) tracer.

- 6. Lighting circuit "switch legs", and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the COR.
- Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 - Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 - 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 - The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
 - Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 - Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.
 - 4. All bolts, nuts, and washers used with splices shall be cadmiumplated steel.
- D. Above Ground Splices for 250 kcmil and Larger:
 - Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 - Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

E. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be cadmiumplated steel.

2.4 CONTROL WIRING

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5 WIRE LUBRICATING COMPOUND

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, and pullboxes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with nonmetallic ties.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:
 - Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
 - 2. Use nonmetallic pull ropes.
 - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 4. All conductors in a single conduit shall be pulled simultaneously.
 - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 SPLICE AND TERMINATION INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.3 CONDUCTOR IDENTIFICATION

A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.4 FEEDER CONDUCTOR IDENTIFICATION

A. In each interior pullbox and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed

26 05 19 - 6

type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.5 EXISTING CONDUCTORS

A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.6 CONTROL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.7 CONTROL WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.8 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests: Inspect physical condition.
 - 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phaseto-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
 - c. Perform phase rotation test on all three-phase circuits.

---END---

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
 - 2. Test Reports:
 - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the COTR.

- 3. Certifications:
 - a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):

B1-13Standard Specification for Hard-Drawn Copper Wire

B3-13Standard Specification for Soft or Annealed Copper Wire

- B8-11Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- - of a Ground System Part 1: Normal Measurements

D. National Fire Protection Association (NFPA): 70-17National Electrical Code (NEC) 70E-15National Electrical Safety Code 99-15Health Care Facilities

E. Underwriters Laboratories, Inc. (UL): 44-14Thermoset-Insulated Wires and Cables 83-14Thermoplastic-Insulated Wires and Cables 467-13Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No.10 AWG and smaller shall be bare solid copper. Bonding conductors

26 05 26 - 2 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS shall be stranded for final connection to motors, transformers, and vibrating equipment.

- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.
- D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND CONNECTIONS

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade:
 - Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 - 2. Connection to Building Steel: Exothermic-welded type connectors.
 - 3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
 - 4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.3 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.4 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with //zinc-plated//cadmium-plated// steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.5 GROUNDING BUS BAR

A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
- D. For patient care area electrical power system grounding, conform to the latest NFPA 70 and 99.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

- A. Switchboards, Panelboards, and other electrical equipment:
 - 1. Connect the equipment grounding conductors to the ground bus.
 - 2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

3.4 RACEWAY

- A. Conduit Systems:
 - Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
 - Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.

- 4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
 - Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 - 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
 - Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
 - Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
 - 3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
 - 4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.
- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

26 05 26 - 5 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- H. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.5 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT

A. Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond the wire to post and the other to bond the wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm x 25 mm (0.375 inch x 1 inch) flexible, braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.6 CORROSION INHIBITORS

A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.7 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.8 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.9 ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

---END---

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets.
- B. Section 07 60 00, FLASHING AND SHEET METAL: Fabrications for the deflection of water away from the building envelope at penetrations.
- C. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- E. Section 09 91 00, PAINTING: Identification and painting of conduit and other devices.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- H. Section 31 20 00, EARTHWORK: Bedding of conduits.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Size and location of main feeders.
 - b. Size and location of panels and pull-boxes.
 - c. Layout of required conduit penetrations through structural elements.
 - d. Submit the following data for approval:
 - 1) Raceway types and sizes.
 - 2) Conduit bodies, connectors and fittings.
 - 3) Junction and pull boxes, types and sizes.
 - Certifications: Two weeks prior to final inspection, submit the following:
 - a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Iron and Steel Institute (AISI): S100-12North American Specification for the Design of Cold-Formed Steel Structural Members
 C. National Electrical Manufacturers Association (NEMA): C80.1-15Electrical Rigid Steel Conduit C80.3-15Steel Electrical Metal Tubing C80.6-05Electrical Intermediate Metal Conduit FB1-14Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 FB2.10-13Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing) FB2.20-14Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable TC-2-13Electrical Polyvinyl Chloride (PVC) Tubing and Conduit TC-3-13PVC Fittings for Use with Rigid PVC Conduit and Tubing D. National Fire Protection Association (NFPA): 70-17National Electrical Code (NEC) E. Underwriters Laboratories, Inc. (UL): 1-05Flexible Metal Conduit 5-16 Surface Metal Raceway and Fittings 6-07Electrical Rigid Metal Conduit - Steel 50-15 Enclosures for Electrical Equipment 360-13Liquid-Tight Flexible Steel Conduit 467-13Grounding and Bonding Equipment 514A-13Metallic Outlet Boxes 514B-12Conduit, Tubing, and Cable Fittings and Covers 651-11Schedule 40 and 80 Rigid PVC Conduit and Fittings 651A-11Type EB and A Rigid PVC Conduit and HDPE Conduit 797-07Electrical Metallic Tubing 1242-14Electrical Intermediate Metal Conduit - Steel PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.

- B. Conduit:
 - 1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
 - 2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and NEMA C80.1.
 - 3. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and NEMA C80.6.
 - 4. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and NEMA C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
 - 5. Flexible Metal Conduit: Shall conform to UL 1.
 - 6. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
 - 7. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
 - 8. Surface Metal Raceway: Shall conform to UL 5.
- C. Conduit Fittings:
 - 1. Rigid Steel and Intermediate Metallic Conduit Fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of casehardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with

blank cover plates having the same finishes as that of other electrical plates in the room.

- 2. Electrical Metallic Tubing Fittings:
 - a. Fittings and conduit bodies shall meet the requirements of UL 514B, NEMA C80.3, and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Compression Couplings and Connectors: Concrete-tight and raintight, with connectors having insulated throats.
 - d. Indent-type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- 3. Flexible Metal Conduit Fittings:
 - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp-type, with insulated throat.
- 4. Liquid-tight Flexible Metal Conduit Fittings:
 - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- 5. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
- 6. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
- 7. Expansion and Deflection Couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.

- d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
 - Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
 - Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
 - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
 - 1. Comply with UL-50 and UL-514A.
 - 2. Rustproof cast metal where required by the NEC or shown on drawings.
 - 3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.
- F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
 - Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR prior to drilling through structural elements.
 - 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the COR where working space is limited.
- B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the

26 05 33 - 6 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

- A. In accordance with NEC, NEMA, UL, as shown on drawings, and as specified herein.
- B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
- C. Install conduit as follows:
 - In complete mechanically and electrically continuous runs before pulling in cables or wires.
 - Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
 - 3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
 - 4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 - 5. Cut conduits square, ream, remove burrs, and draw up tight.
 - 6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
 - 7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
 - 8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
 - 9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
 - 10. Conduit installations under fume and vent hoods are prohibited.
 - 11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.

- 12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
- 13. Conduit bodies shall only be used for changes in direction and shall not contain splices.
- 14. Do not use aluminum conduits.
- D. Conduit Bends:
 - 1. Make bends with standard conduit bending machines.
 - Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
 - 3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
 - Install conduit with wiring, including homeruns, as shown on drawings.
 - Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the COR.

3.3 CONCEALED WORK INSTALLATION

- A. In Concrete:
 - 1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
 - 2. Align and run conduit in direct lines.
 - 3. Install conduit through concrete beams only:
 - a. Where shown on the structural drawings.
 - b. As approved by the COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
 - Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
 - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
 - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.
 - 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground

continuity through the conduits. Tightening setscrews with pliers is prohibited.

- B. Above Furred or Suspended Ceilings and in Walls:
 - Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the same system is prohibited.
 - Align and run conduit parallel or perpendicular to the building lines.
 - 3. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
 - 4. Tightening set screws with pliers is prohibited.
 - 5. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the system is prohibited.
- C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
- G. Surface Metal Raceways: Use only where shown on drawings.
- H. Painting:
 - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 - 2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.5 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only.
- B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.6 WET OR DAMP LOCATIONS

- A. Use rigid steel or IMC conduits unless as shown on drawings.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
- C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be halflapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.
- D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

3.7 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
- C. Provide a green equipment grounding conductor with flexible and liquidtight flexible metal conduit.

3.8 EXPANSION JOINTS

A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.
- C. Install expansion and deflection couplings where shown.

3.9 CONDUIT SUPPORTS

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
 - 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
 - b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
 - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.10 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush-mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.
- C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.
- D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.
- F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surfacestyle flat or raised covers.
- G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.
- H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
- I. On all branch circuit junction box covers, identify the circuits with black marker.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the overcurrent protective device coordination study, related calculations and analysis, indicated as the study in this section.
- B. A short-circuit and selective coordination study, and arc flash calculations and analysis shall be prepared for the electrical overcurrent devices to be installed under this project.
- C. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the individual device up to the utility source.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. The study shall be prepared by the equipment manufacturer and performed by the equipment manufacturer's licensed electrical engineer.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - Product data on the software program to be used for the study. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
 - Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronics Engineers (IEEE):

241-90Recommended Practice Electrical Systems in Commercial Buildings

- 242-03Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
- 399-97Recommended Practice for Industrial and Commercial Power Systems Analysis

1584-02Performing Arc-Flash Hazards Calculations

1584A-04Performing Arc-Flash Hazards Calculations - Amendment 1

1584B-11Performing Arc-Flash Hazards Calculations - Amendment 2

C. National Fire Protection Association (NFPA):

70-17National Electrical Code (NEC)

70E-18Standard for Electrical Safety in the Workplace

99-18Health Care Facilities Code

1.6 STUDY REQUIREMENTS

- A. The study shall be in accordance with IEEE and NFPA standards.
- B. The study shall include one line diagram, short-circuit and ground fault analysis, protective coordination plots for all overcurrent protective devices, and arc flash calculations and analysis.
- C. One Line Diagram:
 - 1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
 - 2. Show the following specific information:
 - Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.

26 05 73 **-** 2

- b. Relay, circuit breaker, and fuse ratings.
- c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
- d. Voltage at each bus.
- e. Identification of each bus, matching the identification on the drawings.
- f. Conduit, conductor, and busway material, size, length, and $\ensuremath{X/R}$ ratios.
- D. Short-Circuit Study:
 - The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in developing the calculations shall be described in the introductory remarks of the study.
 - Calculate the fault impedance to determine the available shortcircuit and ground fault currents at each bus. Incorporate applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.
 - 3. Present the results of the short-circuit study in a table. Include the following:
 - a. Device identification.
 - b. Operating voltage.
 - c. Overcurrent protective device type and rating.
 - d. Calculated short-circuit current.
- E. Coordination Study:
 - Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
 - 2. The following specific information shall also be shown on the coordination curves:
 - a. Device identification.
 - b. Potential transformer and current transformer ratios.

- c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
- d. Applicable circuit breaker or protective relay characteristic curves.
- e. No-damage, melting, and clearing curves for fuses.
- f. Transformer in-rush points.
- 3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
 - a. Device identification.
 - b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.
 - c. Fuse rating and type.
- F. Arc Flash Calculations and Analysis:
 - 1. Arc flash warning labels shall comply with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - Arc flash calculations shall be based on actual over-current protective device clearing time. Maximum clearing time shall be in accordance with IEEE 1584.
 - 3. Arc flash analysis shall be based on the lowest clearing time setting of the over-current protective device to minimize the incident energy level without compromising selective coordination.
 - 4. Arc flash boundary and available arc flash incident energy at the corresponding working distance shall be calculated for all electrical power distribution equipment specified in the project, and as shown on the drawings.
 - 5. Required arc-rated clothing and other PPE shall be selected and specified in accordance with NFPA 70E.

1.7 ANALYSIS

A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose solutions to effectively protect the underrated equipment.

1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS

A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost to the Government.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END---

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF VA PERSONNEL

A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

----- END -----

SECTION 26 09 23 LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of the lighting controls.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 26 24 16, PANELBOARDS: Panelboard enclosure and interior bussing used for lighting control panels.
- E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.
- F. Section 26 51 00, INTERIOR LIGHTING: Luminaire ballast and drivers used in control of lighting systems.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit the following information for each type of lighting controls.
 - b. Material and construction details.
 - c. Physical dimensions and description.
 - d. Wiring schematic and connection diagram.
 - e. Installation details.
 - 2. Manuals:

- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the Contractor that the lighting control systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. National Electrical Manufacturer's Association (NEMA):
 - C136.10-10American National Standard for Roadway and Area Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing ICS-1-15Standard for Industrial Control and Systems General Requirements
 - ICS-2-05Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
 - ICS-6-16Standard for Industrial Controls and Systems Enclosures
- C. National Fire Protection Association (NFPA):

70-17National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

20-10Standard for General-Use Snap Switches

- 98-16 Enclosed and Dead-Front Switches
- 773-16Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

773A-16Nonindustrial Photoelectric Switches for Lighting Control 916-15Standard for Energy Management Equipment Systems 917-06Clock Operated Switches 924-16Emergency Lighting and Power Equipment (for use when controlling emergency circuits).

PART 2 - PRODUCTS

2.1 INDOOR VACANCY SENSOR SWITCH

- A. Wall mounting, solid-state units with integral sensor and switch.
 - Operation: Manually turn lights on with switch and sensor detects vacancy to turn lights off.
 - 2. Switch Rating: 120/277 volt, 1200 watts at 277 volt, 800 watts at 120 volt unit.
 - 3. Mounting:
 - a. Sensor: Suitable for mounting in a standard switch box.
 - b. Time-Delay and Sensitivity Adjustments: Integral with switch and accessible for reprogramming without removing switch.
 - 4. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 - 5. Switch: Manual operation to turn lights on and override lights off.
 - 6. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
- B. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125 volt AC for tungsten filaments and 20 A, 277 volt AC for electronic ballasts, 50,000 cycles at rated capacity.
- C. Control Devices: All occupancy sensors (Ultrasonic, IR and Dual Technology type), photocells, switches and timers shall be provided with system and designed to operate on system network. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions, as shown on the drawings, and as specified.

- B. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer's recommendations.
- C. Set occupancy sensor "on" duration to 10 minutes.
- D. Locate photoelectric sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the available light level at the typical work plane for that area.
- E. Label time switches and contactors with a unique designation.
- F. Program lighting control panels per schedule on drawings.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function in the presence of COR.

3.4 INSTRUCTION

- A. Furnish the services of a factory-trained technician for one 8-hour training period for instructing personnel in the maintenance and operation of the lighting control system on the dates requested by the COR.
- B. Contractor shall submit written instructions on training and maintenance as reviewed in training session.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 12 19

PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the pad-mounted, liquid-filled, medium-voltage transformers, indicated as transformers in this section.

1.2 RELATED WORK

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- D. Section 26 05 13, MEDIUM-VOLTAGE CABLES: Medium-voltage cables.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground currents.
- F. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Manholes, pullboxes, and ducts for underground raceway systems.
- G. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. Factory Tests shall be required.
- B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirement:
 - Transformers shall be thoroughly tested at the factory to ensure that there are no electrical or mechanical defects. Tests shall be conducted as per IEEE Standards. Factory tests shall be certified. The following tests shall be performed:
 - a. Perform insulation-resistance tests, winding-to-winding and each winding-to-ground.
 - b. Perform turns-ratio tests at all tap positions.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.5 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, nameplate data, impedance, outline drawing with dimensions and front, top, and side views, weight, mounting details, decibel rating, termination information, temperature rise, no-load and full-load losses, regulation, overcurrent protection, connection diagrams, and accessories.
 - c. Complete nameplate data, including manufacturer's name and catalog number.
 - 2. Manuals:
 - a. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - Identify terminals on wiring diagrams to facilitate installation, maintenance, and operation.
 - Indicate on wiring diagrams the internal wiring for each piece of equipment and interconnections between the pieces of equipment.
 - Approvals will be based on complete submissions of manuals, together with shop drawings.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 - Update the manual to include any information necessitated by shop drawing approval.
 - 2) Show all terminal identification.
 - Include information for testing, repair, troubleshooting, assembly, disassembly, and recommended maintenance intervals.
 - Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Certifications:
 - Two weeks prior to the final inspection, submit the following certifications.
 - a. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the transformers have been properly installed, connected, and tested.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM): D3487-16.....Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
 C. Institute of Electrical and Electronic Engineers (IEEE): 48-09.....Test Procedures and Requirements for
 - Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5kV Through 765kV or Extruded Insulation Rated 2.5kV Through 500kV 386-16.....Separable Insulated Connector Systems for Power Distribution Systems Above 600 V 592-07.....Exposed Semiconducting Shields on High-Voltage Cable Joints and Separable Connectors
 - C2-17.....National Electrical Safety Code

C37.47-11.....Specification for High Voltage (>1000V) Distribution Class Current-Limiting Fuses and Fuse Disconnecting Switches

C57.12.00-15.....Liquid-Immersed Distribution, Power and

Regulating Transformers

- C57.12.10-13.....Liquid-Immersed Power Transformers
- C57.12.25-90.....Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution-Transformers with Separable Insulated High Voltage Connectors; High Voltage, 34500 Grd Y/19920 Volts and

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

		Below; Low-Voltage 240/120 Volts; 16/ KVA and
		Smaller Requirements
	C57.12.28-14	Pad-Mounted Equipment - Enclosure Integrity
	C57.12.29-14	Pad-Mounted Equipment - Enclosure Integrity for
		Coastal Environments
	C57.12.34-15	Pad-Mounted, Compartmental-Type, Self-Cooled,
		Three-Phase Distribution Transformers, 5 MVA
		and Smaller; High Voltage, 34.5 kV Nominal
		System Voltage and Below; Low Voltage, 15kV
		Nominal System Voltage and Below
	C57.12.90-15	Test Code for Liquid-Immersed Distribution,
		Power, and Regulating Transformers
	C62.11-12	Metal-Oxide Surge Arresters for AC Power
		Circuits
D.	International Code Cound	cil (ICC):
	IBC-15	International Building Code
Ε.	National Electrical Man	afacturers Association (NEMA):
	TR 1-13	Transformers, Regulators, and Reactors
F.	National Fire Protection	n Association (NFPA):
	70-20	National Electrical Code (NEC)

- G. Underwriters Laboratories Inc. (UL): 467-13.....Grounding and Bonding Equipment
- H. United States Department of Energy (DOE): 10 CFR Part 431.....Energy Efficiency Program for Certain Commercial and Industrial Equipment

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Transformers shall be in accordance with ASTM, IEEE, NFPA, UL, as shown on the drawings, and as specified herein. Each transformer shall be assembled as an integral unit by a single manufacturer.
- B. Transformers shall be complete, outdoor type, continuous duty, integral assembly, grounded, tamper-resistant, and with liquid-immersed windings.
- C. Ratings shall not be less than shown on the drawings.
- D. Completely fabricate transformers at the factory so that only the external cable connections are required at the project site.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

E. Thoroughly clean, phosphatize, and finish all the metal surfaces at the factory with a rust-resistant primer and dark green enamel finish coat, except where a different color is specified. All surfaces of the transformer that will be in contact with the concrete pad shall be treated with corrosion-resistant compounds and epoxy resin or a rubberized sealing compound.

2.2 COMPARTMENTS

- A. Construction:
 - 1. Enclosures shall be weatherproof and in accordance with IEEE C57.12.28.
 - The medium- and low-voltage compartments shall be separated with a steel barrier that extends the full height and depth of the compartments.
 - 3. The compartments shall be constructed of sheet steel (gauge to meet ANSI requirements) with bracing and with reinforcing gussets using jig welds to assure rectangular rigidity.
 - 4. All bolts, nuts, and washers shall be zinc-plated steel.
 - 5. Sufficient space shall be provided for equipment, cabling, and terminations within the compartments.
 - 6. Affix transformer nameplate permanently within the low-voltage compartment. Voltage and kVA rating, connection configuration, impedance, date of manufacture, and serial number shall be shown on the nameplate.
- B. Doors:
 - Provide a separate door for each compartment with provisions for a single padlock to secure all doors. Provide each compartment door with open-position doorstops and corrosion-resistant tamperproof hinges welded in place. The medium-voltage compartment door shall be mechanically prevented from opening unless the low-voltage compartment door is open.
 - 2. The secondary compartment door shall have a one-piece steel handle and incorporate three-point locking mechanisms.

2.3 BIL RATING

A. 15 kV class equipment shall have a minimum 95 kV BIL rating.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.4 TRANSFORMER FUSE ASSEMBLY

A. The primary fuse assembly shall be a combination of externally replaceable Bay-O-Net liquid-immersed fuses in series with liquidimmersed current-limiting fuses.

2.5 PRIMARY CONNECTIONS

- A. Primary connections shall be 200 A dead-front load breakwells and inserts for cable sizes shown on the drawings.
- B. Surge Arresters: Distribution class, one for each primary phase, complying with IEEE C62.11, supported from tank wall.

2.6 MEDIUM-VOLTAGE SWITCH

- A. The transformer primary disconnect switch shall be an oil-immersed, internal, gang-operated, load-interrupter type, rated at ampacity and system voltage as shown on the drawings, with a minimum momentary withstand rating of not less than the calculated available fault current shown on the drawings.
- B. For loop feeds, switch shall be a four-position, T-blade manual switch located in the medium-voltage compartment and hot-stick-operated.

2.7 MEDIUM-VOLTAGE TERMINATIONS

- A. Terminate the medium-voltage cables in the primary compartment with 200 A loadbreak premolded rubber elbow connectors, suitable for submersible applications. Elbow connectors shall have a semi-conductive shield material covering the housing. The separable connector system shall include the loadbreak elbow, the bushing insert, and the bushing well. Separable connectors shall comply with the requirements of IEEE 386, and shall be interchangeable between suppliers. Allow sufficient slack in medium-voltage cable, ground, and drain wires to permit elbow connectors to be moved to their respective parking stands.
- B. Ground metallic cable shield with a cable shield grounding adapter, consisting of a solderless connector enclosed in watertight rubber housing covering the entire assembly, bleeder wire, and ground braid.

2.8 LOW-VOLTAGE EQUIPMENT

- A. Mount the low-voltage bushings, and hot stick in the low-voltage compartment.
- B. The low-voltage leads shall be brought out of the tank by epoxy pressure tight bushings, and shall be standard arrangement.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

C. Tin-plate the low-voltage neutral terminal and isolate from the transformer tank. Provide a removable ground strap sized in accordance with the NEC and connect between the secondary neutral and ground pad.

2.9 TRANSFORMERS

- A. Transformer ratings shall be as shown on drawings. kVA ratings shown on the drawings are for continuous duty without the use of cooling fans.
- B. Temperature rises shall not exceed the NEMA TR 1 of 65 $^\circ$ C (149 $^\circ$ F) by resistance.
- C. Transformer insulating material shall be less flammable, edible-seedoil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300° C (600° F) when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- D. Transformer impedance shall be not less than 4-1/2% for sizes 150 kVA and larger. Impedance shall be as shown on the drawings.
- E. Sound levels shall conform to NEMA TR 1 standards.
- F. Primary and Secondary Windings for Three-Phase Transformers:
 - 1. Primary windings shall be delta-connected.
 - Secondary windings shall be wye-connected, except where otherwise indicated on the drawings. Provide isolated neutral bushings for secondary wye-connected transformers.
 - 3. Secondary leads shall be brought out through pressure-tight epoxy bushings.
- G. Primary windings shall have four 2-1/2% full-capacity voltage taps; two taps above and two taps below rated voltage.
- H. Core and Coil Assemblies:
 - Cores shall be grain-oriented, non-aging, silicon steel to minimize losses.
 - Core and coil assemblies shall be rigidly braced to withstand the stresses caused by rough handling during shipment, and stresses caused by any possible short-circuit currents.
 - Coils shall be continuous-winding type without splices except for taps. Material shall be copper.
 - 4. Coil and core losses shall be optimum for efficient operation.
 - 5. Primary, secondary, and tap connections shall be brazed or pressure type.
 - 6. Provide end fillers or tie-downs for coil windings.

- I. The transformer tank, cover, and radiator gauge thickness shall not be less than that required by ANSI.
- J. Accessories:
 - 1. Provide standard NEMA features, accessories, and the following:
 - a. No-load tap changer. Provide warning sign.
 - b. Lifting, pulling, and jacking facilities.
 - c. Globe-type valve for oil filtering and draining, including sampling device.
 - d. Pressure relief valve.
 - e. Liquid level gauge and filling plug.
 - f. A grounding pad in the medium- and low-voltage compartments.
 - g. A diagrammatic nameplate.
 - h. Dial-type liquid thermometer with a maximum reading pointer and an external reset.
 - i. Hot stick. Securely fasten hot stick within low-voltage compartment.
 - 2. The accessories shall be made accessible within the compartments without disassembling trims and covers.
- K. Transformers shall meet the energy conservation standards for transformers per the United States Department of Energy 10 CFR Part 431.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install transformers outdoors, as shown on the drawings, in accordance with the NEC, and as recommended by the manufacturer.
- B. Anchor transformers with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. Mount transformers on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (8 inches) thick, reinforced with a 150 by 150 mm (6 by 6 inches) No. 6 mesh placed uniformly 100 mm (4 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inches) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade shall have 12-1/2 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by

the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

- D. Grounding:
 - Ground each transformer in accordance with the requirements of the NEC. Install ground rods per the requirements of Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS, to maintain a maximum resistance of 5 ohms to ground.
 - Connect the ground rod to the ground pads in the medium- and lowvoltage compartments.
 - 3. Install and connect the cable shield grounding adapter per the manufacturer's instructions. Connect the bleeder wire of the cable shield grounding adapter to the loadbreak or deadbreak elbow grounding point with minimum No. 14 AWG wire, and connect the ground braid to the grounding system with minimum No. 6 AWG bare copper wire. Use soldered or mechanical grounding connectors listed for this purpose.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical and mechanical condition. Check for damaged or cracked bushings and liquid leaks.
 - c. Verify that control and alarm settings on temperature indicators are as specified.
 - d. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections, and perform thermographic survey after energization under load.
 - e. Vacuum-clean transformer interior. Clean transformer enclosure exterior.
 - f. Verify correct liquid level in transformer tank.
 - g. Verify correct equipment grounding per the requirements of Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

- h. Verify the presence and connection of transformer surge arresters, if provided.
- i. Verify that the tap-changer is set at rated system voltage.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the transformers are in good operating condition and properly performing the intended function.

3.4 SPARE PARTS

- A. Deliver the following spare parts for the project to the COR two weeks prior to final inspection:
 - 1. Six insulated protective caps.
 - 2. One spare set of medium-voltage fuses for each size and type of fuse used in the project.

3.5 INSTRUCTION

A. The Contractor shall instruct maintenance personnel, for not less than one 2-hour period, on the maintenance and operation of the equipment on the date requested by the COR.

- - - END - - -

SECTION 26 24 16 PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK

- A. Section 09 91 00, PAINTING: Painting of panelboards.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- G. Section 26 43 13, SURGE PROTECTIVE DEVICES: Surge protective devices integral to panelboards.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.

- 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.
 - Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
 - Include information for testing, repair, troubleshooting, assembly, and disassembly.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC): IBC-15International Building Code
- C. National Electrical Manufacturers Association (NEMA): PB 1-11Panelboards 250-14Enclosures for Electrical Equipment (1,000V

Maximum)

D. National Fire Protection Association (NFPA):

70-17National Electrical Code (NEC)

70E-18Standard for Electrical Safety in the Workplace

E. Underwriters Laboratories, Inc. (UL): 50-15Enclosures for Electrical Equipment 67-09Panelboards

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.
- B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- G. Neutral bus shall be 200% rated, mounted on insulated supports.
- H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V panelboards.
- J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.
- K. Series-rated panelboards are not permitted.

2.2 ENCLOSURES AND TRIMS

A. Enclosures:

- Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
- 2. Enclosures shall not have ventilating openings.
- 3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
- Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
- 5. Include removable inner dead front cover, independent of the panelboard cover.
- B. Trims:
 - 1. Hinged "door-in-door" type.
 - Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
 - Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
 - 4. Inner and outer doors shall open left to right.
 - 5. Trims shall be flush or surface type as shown on the drawings.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
- B. Circuit breakers shall be bolt-on type.
- C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than: 1. 120/208 V Panelboard: 10,000 A symmetrical.
- D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame.
- E. Circuit breaker features shall be as follows:
 - 1. A rugged, integral housing of molded insulating material.
 - 2. Silver alloy contacts.
 - 3. Arc quenchers and phase barriers for each pole.
 - 4. Quick-make, quick-break, operating mechanisms.

26 24 16 - 4 PANELBOARDS

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
- 6. Electrically and mechanically trip free.
- 7. An operating handle which indicates closed, tripped, and open positions.
- 8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
- 9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.
- 10.For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

2.4 SURGE PROTECTIVE DEVICES

A. Furnish panelboards with integral surge protective devices. Refer to Section 26 43 13, SURGE PROTECTIVE DEVICES.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. Install a printed schedule of circuits in each panelboard after approval by the COR. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards
- D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- E. Provide blank cover for each unused circuit breaker mounting space.
- F. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

- 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify appropriate anchorage and required area clearances.
 - d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
 - e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
 - f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

---END---

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 26 00

ZONE POWER DISTRIBUTION UNITS FOR UNINTERRUPTIBLE POWER SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of rack mounted power distribution units.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 33 53, RACK MOUNTED STATIC UNINTERRUPTIBLE POWER SUPPLY.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. Factory Tests shall be required.
- B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and in accordance with UL and ANSI.

1.5 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.

- 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the power distribution units.
 - Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the power distribution units conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the power distribution units have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC): IBC-15International Building Code
- C. National Fire Protection Association (NFPA):

70-17National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA):

PB 1-11Panelboards

250-14 Enclosures for Electrical Equipment (1,000V Maximum)

E. Underwriters Laboratories, Inc. (UL): 50-15Enclosures for Electrical Equipment

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

67-09Panelboards 489-16Molded Case Circuit Breakers and Circuit Breaker Enclosures

1561-11Dry-Type General Purpose and Power Transformers

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide the following components:
 - 1. circuit breaker per phase.
 - 2. Rack mountable.
 - 3. Dual A + B inputs.
 - 4. 208 voly, 3 phase operation at 30, 40 and 60 amps.
 - 5. Intrinsic three-phase load balancing.
- B. Power distribution unit ratings, including transformer kVA, primary and secondary voltage, and primary and secondary circuit breaker amperage shall be as shown on the drawings.
- C. Zonit Z-PDS or pre-approved equal.

2.2 FINISHES

A. Manufacturer's standard finish over corrosion-resistant pretreatment and primer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate installation of power distribution units with Racks specified.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. An authorized representative of the power distribution unit manufacturer shall technically supervise and participate during all of the field adjustments and tests. Field tests shall be witnessed by the COTR. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.
- B. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.

- c. Verify appropriate anchorage, required area clearances, and correct alignment.
- d. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method or performing thermographic survey after energization.
- e. Verify grounding connections.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the power distribution units are in good operating condition and properly performing the intended function.

3.4 INSTRUCTION

A. Provide the services of a factory-trained technician for one 2-hour training period for instructing personnel in the maintenance and operation of the power distribution units, on the date requested by the COTR.

---END---

SECTION 26 27 26 WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
 - 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including

technical data sheets and information for ordering replacement parts.

- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
 - Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
 WD 1-99(R2015)General Color Requirements for Wiring Devices
 WD 6-16Wiring Devices Dimensional Specifications
- C. National Fire Protection Association (NFPA): 70-17National Electrical Code (NEC) 99-18Health Care Facilities
- D. Underwriter's Laboratories, Inc. (UL):
 - 5-16Surface Metal Raceways and Fittings
 - 20-10General-Use Snap Switches
 - 231-16Power Outlets
 - 467-13Grounding and Bonding Equipment
 - 498-17Attachment Plugs and Receptacles
 - 943-16Ground-Fault Circuit-Interrupters
 - 1449-14Surge Protective Devices

1472-15Solid State Dimming Controls

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.
 - Mounting straps shall be nickel plated brass, brass, nickel plated steel or galvanize steel with break-off plaster ears, and shall

include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.

- Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
- B. Duplex Receptacles Hospital-grade: shall be listed for hospital grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.
 - 1. Bodies shall be match existing in color.
 - 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
 - 3. Duplex Receptacles on Emergency Circuit:
 - a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
 - 4. Ground Fault Current Interrupter (GFCI) Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring. GFCI receptacles shall be self-test receptacles in accordance with UL 943.
 - a. Ground fault interrupter shall consist of a differential current transformer, self-test, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.
 - b. Self-test function shall be automatically initiated within 5 seconds after power is activated to the receptacles. Self-test function shall be periodically and automatically performed every 3 hours or less.
 - c. End-of-life indicator light shall be a persistent flashing or blinking light to indicate that the GFCI receptacle is no longer in service.

- C. Duplex Receptacles Non-hospital Grade: shall be the same as duplex receptacles hospital grade in accordance with sections 2.1A and 2.1B of this specification, except for the hospital grade listing.

 Bodies shall match existing in color, nylon.
- D. Receptacles 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.
- E. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.
- F. Surge Protective (TVSS) Receptacles shall have integral surge suppression in line to ground, line to neutral, and neutral to ground modes.
 - TVSS Components: Multiple metal-oxide variators; with a nominal clamp-level rating of 400 Volts, and minimum single transient pulse energy dissipation of 210 Joules.
 - 2. Active TVSS Indication: LED, visible in face of device to indicate device is active or no longer in service.

2.2 TOGGLE SWITCHES

- A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall match existing in color unless otherwise specified or shown on the drawings.
 - 1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.
 - 2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
 - 3. Switches shall be rated 20 amperes at 120-277 Volts AC.

2.3 MANUAL DIMMING CONTROL

A. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.
VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Manual dimming controls shall be fully compatible with fluorescent electronic dimming ballasts and approved by the ballast manufacturer, LED dimming driver and be approved by the driver manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.
- C. Provide single-pole, three-way or four-way, as shown on the drawings.
- D. Manual dimming control and faceplates shall match existing in color unless otherwise specified.

2.4 WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.
- B. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- C. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges. Wall plates shall be type 302 stainless steel, with the word "EMERGENCY" engraved in 6 mm (1/4 inch) red letters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multi-gang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and

26 27 26 - 5 WIRING DEVICES

equipment, the Contractor shall coordinate exact field location of the above items with other trades.

- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.
- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install horizontally mounted receptacles with the ground pin to the right.
- L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.
- M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations, and the latest NFPA 99. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Inspect physical and electrical conditions.
 - b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
 - c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
 - d. Test GFCI receptacles.
 - Receptacle testing in the Patient Care Spaces, such as retention force of the grounding blade of each receptacle, shall comply with the latest NFPA 99.

---END---

SECTION 26 29 11 MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of motor controllers, including all low- and medium-voltage motor controllers and manual motor controllers, indicated as motor controllers in this section, and low-voltage variable speed motor controllers.
- B. Motor controllers, whether furnished with the equipment specified in other sections or otherwise (with the exception of elevator motor controllers specified in Division 14 and fire pump controllers specified in Division 21), shall meet this specification and all related specifications.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, weights, mounting details, materials, overcurrent protection devices, overload

26 29 11 - 1 MOTOR CONTROLLERS

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

relays, sizes of enclosures, wiring diagrams, starting characteristics, interlocking, and accessories.

- 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - 1) Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
 - Wiring diagrams shall indicate internal wiring for each item of equipment and interconnections between the items of equipment.
 - Elementary schematic diagrams shall be provided for clarity of operation.
 - Include the catalog numbers for the correct sizes of overload relays for the motor controllers.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the motor controllers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the motor controllers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE): 519-14Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems C37.90.1-12Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- C. International Code Council (ICC):

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 IBC-15 International Building Code D. National Electrical Manufacturers Association (NEMA): ICS 1-00(R2015)Industrial Control and Systems: General Requirements ICS 1.1-84(R2015)Safety Guidelines for the Application, Installation and Maintenance of Solid State Control ICS 2-00(R2005)Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts ICS 4-15Industrial Control and Systems: Terminal Blocks ICS 6-93(R2016)Industrial Control and Systems: Enclosures ICS 7-14Industrial Control and Systems: Adjustable-Speed Drives ICS 7.1-14Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems E. National Fire Protection Association (NFPA): 70-17National Electrical Code (NEC) F. Underwriters Laboratories Inc. (UL): 508A-13 Industrial Control Panels 508C-16 Power Conversion Equipment 1449-14Surge Protective Devices PART 2 - PRODUCTS 2.1 MOTOR CONTROLLERS

- A. Motor controllers shall comply with IEEE, NEMA, NFPA, UL, and as shown on the drawings.
- B. Motor controllers shall be separately enclosed, unless part of another assembly.
- C. Enclosures:
 - Enclosures shall be NEMA-type rated 1, 3R, or 12 as indicated on the drawings or as required per the installed environment.
 - Enclosure doors shall be interlocked to prevent opening unless the disconnecting means is open. A "defeater" mechanism shall allow for inspection by qualified personnel with the disconnect means closed. Provide padlocking provisions.
 - 3. All metal surfaces shall be thoroughly cleaned, phosphatized, and factory primed prior to applying light gray baked enamel finish.

- D. Motor control circuits:
 - 1. Shall operate at not more than 120 Volts.
 - 2. Shall be grounded, except where the equipment manufacturer recommends that the control circuits be isolated.
 - For each motor operating over 120 Volts, incorporate a separate, heavy duty, control transformer within each motor controller enclosure.
 - Incorporate primary and secondary overcurrent protection for the control power transformers.
- E. Overload relays:
 - 1. Thermal type. Devices shall be NEMA type.
 - 2. One for each pole.
 - 3. External overload relay reset pushbutton on the door of each motor controller enclosure.
 - Overload relays shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - 5. Thermal overload relays shall be tamperproof, not affected by vibration, manual reset, sensitive to single-phasing, and shall have selectable trip classes of 10, 20 and 30.
- F. Provide green (RUN) and red (STOP) pilot lights.
- G. Motor controllers incorporated within equipment assemblies shall also be designed for the specific requirements of the assemblies.
- H. Additional requirements for specific motor controllers, as indicated in other specification sections, shall also apply.

2.2 MANUAL MOTOR CONTROLLERS

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Manual motor controllers shall have the following features:
 - Controllers shall be general-purpose Class A, manually operated type with full voltage controller for induction motors, rated in horsepower.
 - Units shall include thermal overload relays, on-off operator, red, green pilot light.
- C. Fractional horsepower manual motor controllers shall have the following features:

- Controllers shall be general-purpose Class A, manually operated type with full voltage controller for fractional horsepower induction motors.
- 2. Units shall include thermal overload relays, red pilot light, and toggle operator.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motor controllers in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Install manual motor controllers in flush enclosures in finished areas.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify appropriate anchorage, required area clearances, and correct alignment.
 - d. Verify that circuit breaker, motor circuit protector, and fuse sizes and types correspond to approved shop drawings.
 - e. Verify overload relay ratings are correct.
 - f. Vacuum-clean enclosure interior. Clean enclosure exterior.
 - g. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - h. Test all control and safety features of the motor controllers.
 - i. For low-voltage variable speed motor controllers, final programming and connections shall be by a factory-trained technician. Set all programmable functions of the variable speed motor controllers to meet the requirements and conditions of use.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the motor controllers are in good operating condition and properly performing the intended functions.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.4 SPARE PARTS

A. Two weeks prior to the final inspection, provide one complete set of spare fuses for each motor controller.

3.5 INSTRUCTION

A. Furnish the services of a factory-trained technician for two 4-hour training periods for instructing personnel in the maintenance and operation of the motor controllers, on the dates requested by the COTR.
---END---

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 29 21 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
 - 2. Manuals:

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
 - Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
 - Include information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC): IBC-15International Building Code
- C. National Electrical Manufacturers Association (NEMA): FU 1-12Low Voltage Cartridge Fuses KS 1-13Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)
- D. National Fire Protection Association (NFPA):

70-17National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL): 98-16Enclosed and Dead-Front Switches 248 1-11Low Voltage Fuses 489-13Molded Case Circuit Breakers and Circuit Breaker Enclosures

26 29 21 - 2

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 2 - PRODUCTS

2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
- C. Shall be horsepower (HP) rated.
- D. Shall have the following features:
 - 1. Switch mechanism shall be the quick-make, quick-break type.
 - 2. Copper blades, visible in the open position.
 - 3. An arc chute for each pole.
 - External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
 - 5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
 - 6. Fuse holders for the sizes and types of fuses specified.
 - 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
 - 8. Ground lugs for each ground conductor.
 - 9. Enclosures:
 - a. Shall be the NEMA types shown on the drawings.
 - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
 - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

A. Shall be the same as fused switches, but without provisions for fuses.

2.3 MOTOR RATED TOGGLE SWITCHES

- A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.
- B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.4 CARTRIDGE FUSES

- A. Shall be in accordance with NEMA FU 1.
- B. Feeders: Class J, time delay.

C. Motor Branch Circuits: Class RK1, Class RK5, time delay.

2.6 SEPARATELY-ENCLOSED CIRCUIT BREAKERS

- A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.
- B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the COR.

---END---

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 26 33 53.01 STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the static uninterruptible power supply, indicated in this section as UPS.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- F. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: For low-voltage switchboard required for maintenance bypass of multiple module UPS.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. UPS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.
- B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - UPS shall be factory full-load tested to meet the requirements specified using a test battery (not the battery to be supplied with the system) with AC input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Should a malfunction occur, the problem shall be corrected and the test shall

be repeated. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings.

1.5 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, plan, front, side, and rear elevations, accessories, and device nameplate data.
 - c. Provide detailed and project-specific system diagram, showing maintenance bypass, UPS module(s), battery cabinet(s) and batteries, major circuit protective devices, interconnecting power and control wiring, key-type mechanical interlocks, and connections to power sources and loads, as applicable. Indicate whether interconnections are factory-provided/factory-installed, factory-provided/field-installed, or field-provided/field installed.
 - 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - 1) Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
 - Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
 - Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the UPS, including but not limited to bypass switchboard, UPS,

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

key-type mechanical interlocks, remote devices, emergency power off buttons, fire alarm interface, and other components as applicable.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

- Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
- Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
- The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
- 3. Test Reports:
 - a. Submit certified factory design and production test reports for approval.
 - b. Two weeks prior to the final inspection, submit certified field test reports and data sheets to the COR.
- Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the UPS conforms to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the UPS has been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. Institute of Engineering and Electronic Engineers (IEEE): C57.110-08.....Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents C62.41.1-02....Surge Environment in Low-Voltage (1000 V and

Less) AC Power Circuits

C62.41.2-02.....Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

450-10......Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications

485-10.....Sizing Lead-Acid Batteries for Stationary

Applications

- C. International Code Council (ICC): IBC-15.....International Building Code
- E. National Fire Protection Association (NFPA): 70-17.....National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. System Capacity: Unless stated otherwise, the parameters listed are under full rated output load at a minimum of 0.9 power factor, with batteries fully charged and floating on the DC bus and with nominal input voltage. Overall size as indicated, , N+1 redundant, at 40 °C.
- B. Battery Capacity: Discharge time to end voltage: 10 minutes, at 25 °C (77 °F). Battery shall be capable of delivering 125 percent of full rated output load at initial start-up.
- C. System Bus Bracing: Braced for amperes symmetrical interrupting capacity as shown on drawings.
- D. AC Input:
 - 1. Voltage 480 volts line-to-line.
 - 2. Number of phases: 3-phase, 3-wire, plus ground.
 - 3. Voltage Range: Plus 10 percent, minus 15 percent, without affecting battery float voltage or output voltage.
 - 4. Frequency: 60 Hz, plus or minus 5 percent.
 - 5. Total harmonic current distortion (THD) reflected into the primary line: 5 percent maximum.
- E. AC Output:
 - 1. Voltage 208 volts line-to-line, 120 volts line-to-neutral.
 - 2. Number of phases: 3-phase, 4-wire, plus ground.

- 3. Voltage regulation:
 - a. Balanced load: Plus or minus 1.0 percent.
 - b. 100 percent load imbalance, phase-to-phase: Plus or minus 3
 percent.
- 4. Frequency: 60 Hz.
- 5. Frequency regulation: Plus or minus 0.05 percent.
- Harmonic content (RMS voltage): 5 percent maximum total harmonic distortion with 100% nonlinear load.
- 7. Load power factor operating range: 1.0 to 0.8 lagging.
- 8. Phase displacement:
 - a. Balanced load: Plus or minus 1 degree of bypass input.
- 9. Overload capability (at full voltage) (excluding battery):
 - a. 125 percent load for 10 minutes.
 - b. 150 percent load for 1 minute.
- F. Voltage Transient Response:
 - 1. 100 percent load step: Plus or minus 5 percent.

2.2 UPS

- A. General Description: UPS module shall consist of a rectifier/charger unit and a 3-phase inverter module unit with their associated transformers, synchronizing equipment, input and output circuit breakers, and accessories as required for operation.
- B. Rectifier/Charger Unit: Rectifier/charger unit shall be solid state and shall provide direct current to the DC bus.
 - Input Circuit Breaker: Rectifier/charger unit shall be provided with an input circuit breaker. The circuit breaker shall be sized to accept simultaneously the full-rated load and the battery recharge current.
 - Sizing: Rectifier/charger unit shall be sized for the following two simultaneous operating conditions:
 - a. Supplying the full rated load current to the inverter.
 - b. Recharging a fully-discharged battery to 95 percent of rated ampere-hour capacity within ten times the discharge time after normal AC power is restored, with the input protective device closed.
- C. Inverter Unit: Inverter unit shall be a solid-state device capable of accepting power from the DC bus and providing AC power within specified limits.

- Output Overload: The inverter shall be able to sustain an overload as specified across its output terminals.
- 2. Synchronism: The inverter shall normally operate in phase-lock and synchronism with the bypass source.
- Modular Construction: Each control logic printed circuit board shall be electrically and physically packaged on an individual plug-in module with separate indication and adjustments.
- 4. Output Circuit Breaker: The output circuit breaker shall be capable of shunt tripping and shall have interrupting capacity as specified. Circuit breaker shall have provision for locking in the "off" position.
- 5. Output Transformer: The inverter output transformer shall be similar to the input transformer and shall be capable of handling up to K-13 nonlinear loads as described in IEEE C57.110.
- 6. Modular Inverter Isolation: Each inverter in the UPS shall have fault sensing and static isolation as well as an output protective device, to remove a faulted module from the system without affecting the critical load bus beyond the stated limits. The protection system shall have control logic capable of isolating only the faulted module, and shall not shut down the entire UPS upon a fault in one module. Open protective devices shall be indicated by an alarm and indicator light.
- D. External Protection: UPS module shall have built-in self-protection against undervoltage, overvoltage, overcurrent and surges introduced on the AC input source and/or the bypass source. The UPS system shall sustain input surges without damage in accordance with IEEE C62.41.1 and IEEE C62.41.2. The UPS shall also have built-in self-protection against overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching, or circuit breaker operation in the critical load distribution system.
- E. Internal Protection: UPS module shall be self-protected against overcurrent, sudden changes in output load and short circuits at the output terminals. UPS module shall be provided with output reverse power detection which shall cause that module to be disconnected from the critical load bus when output reverse power is present. UPS module shall have built-in protection against permanent damage to itself and

the connected load for predictable types of failure within itself and the connected load. At the end of battery discharge limit, the module shall shut down without damage to internal components.

2.3 STATIC BYPASS TRANSFER SWITCH

- A. A static bypass transfer switch shall be provided as an integral part of the UPS and shall consist of a static switch and a bypass protective device or bypass switch. The control logic shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions and provides an uninterrupted transfer of the load to the bypass AC power source, without exceeding the transient limits specified herein, when a malfunction occurs in the UPS or when an external overload condition occurs.
 - Static Bypass Transfer Switch Disconnect: A disconnect shall be incorporated to isolate the static bypass transfer switch assembly so it can be removed for servicing. The disconnect shall be equipped with auxiliary contacts and provision for padlocking in either the "on" or "off" position.

2.4 MAINTENANCE BYPASS

- A. A maintenance bypass switch shall be provided as an integral part of the UPS and located within the UPS module. The maintenance bypass switch shall provide the capability to continuously support the load from the bypass AC power source while the UPS is isolated for maintenance. The maintenance bypass switch shall be housed in an isolated compartment inside the UPS cabinet. Switch shall contain a maintenance bypass protective device and a module isolation protective device.
- B. The maintenance bypass switch shall provide the capability of transferring the load from the UPS static bypass transfer switch to maintenance bypass and then back to the UPS static bypass transfer switch with no interruption to the load.

2.5 SYSTEM CONTROL CABINET - MULTI-MODULE UPS

A. The UPS shall be provided with a LCD control/indicator panel. Meters, controls, alarms, system diagnostics, mimic screen showing one-line diagram of the system, and indicators for operation of the UPS shall be on this panel. The system control cabinet shall communicate with each

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

UPS module, the static bypass transfer switch and its bypass disconnect, the UPS input and output circuit breakers, and the UPS maintenance bypass switchboard.

- 1. Module Meters:
 - a. Meters shall have 1 percent accuracy.
 - b. The following functions shall be monitored and displayed:
 - 1) Input voltage, phase-to-phase (all three phases).
 - 2) Input current, all three phases.
 - 3) Input frequency.
 - 4) Battery voltage.
 - 5) Battery current (charge/discharge).
 - Output voltage, phase-to-phase and phase-to-neutral (all three phases).
 - 7) Output current, all three phases.
 - 8) Output frequency.
 - 9) Output kilowatts.
 - 10) Elapsed time meter to indicate hours of operation, 6 digits.
 - 11) Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).
 - 12) Output kilovars.
 - 13) Output kilowatt hours, with 15-minute interval.
- 2. Module Controls:
 - a. Module shall have the following controls:
 - 1) Alarm test/reset function.
 - 2) Module input protective device trip function.
 - 3) Module output protective device trip function.
 - 4) Battery protective device trip function.
 - 5) Emergency Power Off (EPO) pushbutton, with guard.
 - 6) Control power off switch.
 - 7) Static bypass transfer switch enable/disable selector switch.
- 3. Module Alarm Indicators:
 - a. Module shall have indicators for the following alarm items. Any one of these conditions shall turn on an audible alarm and the appropriate summary indicator. Each new alarm shall register without affecting any previous alarm.
 - 1) Input AC power source failure.
 - 2) Input protective device open.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 3) Output protective device open.
- 4) Overload.
- 5) Overload shutdown.
- 6) DC overvoltage.
- 7) DC ground fault.
- 8) Low battery.
- 9) Battery discharged.
- 10) Battery protective device open.
- 11) Cooling fan failure.
- 12) Equipment overtemperature.
- 13) Control power failure.
- 14) Charger off.
- 15) Inverter off.
- 16) Emergency off.
- 17) UPS on battery.
- 18) Load on static bypass.
- 19) Static bypass transfer switch disabled.
- Inverter output overvoltage, undervoltage, overfrequency, and underfrequency.
- Bypass source overvoltage, undervoltage, overfrequency, and underfrequency.
- 22) Bypass source to inverter out of synchronization.
- 24) Inverter transformer overtemperature.

2.6 BATTERY SYSTEM

- A. General: A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module.
- B. Battery Type: Lead calcium.
- C. Battery Construction: The battery shall be of the valve-regulated, sealed, non-gassing, recombinant type.
- D. Battery Cabinet: The batteries shall be furnished in a battery cabinet matching the UPS. The battery cabinet shall be provided with smoke and high temperature alarms.
- E. Battery Cables: Battery-to-battery connections shall be stranded cable with proper cable supports.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

F. Battery Disconnect: Each battery cabinet or rack shall have a fused disconnect switch or circuit breaker, lockable in the "off" position, provided in a NEMA 1 enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The UPS shall be set in place, wired, and connected in accordance with the approved shop drawings and manufacturer's instructions.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. An authorized representative of the UPS manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.
- B. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify appropriate anchorage, required area clearances, and correct alignment.
 - d. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
 - e. Verify grounding connections.
 - f. Vacuum-clean enclosure interior. Clean enclosure exterior.
 - g. Verify the correct operation of all alarms and indicating devices.
 - h. Attach a phase rotation meter to the UPS input, output, and bypass buses, and observe proper phase sequences.
 - i. Check and test controls for proper operation.
 - j. Check doors for proper alignment and operation.
 - k. Check and test each protective device for proper mechanical and electrical operation.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Verify protective device overcurrent trip settings against approved coordination study.
- m. Confirm correct operation and sequencing of key-type mechanical interlock systems.
- 2. Load Test: The UPS shall be load tested for a continuous 24 hour period by means of resistive load banks, sized for full rated output load and provided by the UPS manufacturer. The UPS shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour for the following:
 - a. Input voltage and current (all three phases, for each module).
 - b. Input and output frequency.
 - c. Battery voltage for each module.
 - d. Output voltage and current (all three phases, for each module).
 - e. Output kilowatts for each module.
 - f. Output voltage and current (all three phases).
 - g. Output kilowatts.
- 3. Full Load Burn In Test: The UPS shall undergo an additional full load burn-in period of 24 continuous hours by means of resistive load banks, sized for full rated output load and provided by the UPS manufacturer. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. The following tests shall be performed: a. With the UPS carrying full rated output load and supplied from the normal source, switch 100 percent of load bank capacity on and off a minimum of five times within the burn-in period.
- 4. Full Load Battery Burn In Test: The UPS shall undergo a full load battery test by means of resistive load banks, sized for full rated output load and provided by the UPS manufacturer. If a failure occurs during the battery discharge time, the tests shall be repeated. Instrument readings shall be recorded every half hour as above.
 - a. With the UPS carrying full rated output load and operating on battery power, switch 100 percent of load bank capacity on and off a minimum of five times within the battery discharge time.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 5. Battery Discharge and Recharge Test: With the battery fully charged, the UPS shall undergo a complete battery discharge test to full depletion followed by a full recharge. Instrument readings shall be recorded every minute during discharge for the following: a. Battery voltage and current for each module.
 - b. Output voltage and current (all three phases) for each module.
 - c. Output kilowatts for each module.
 - d. Output voltage and current (all three phases).
 - e. Output kilowatts (system).
 - f. Output frequency.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the UPS is in good operating condition and properly performing the intended function.

3.4 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

- A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted near the UPS.
- B. Furnish a written sequence of operation for the UPS and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass, and installed in a frame mounted near the UPS.
- C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COR.

3.5 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the UPS, on the dates requested by the COR.

- - - END - - -

VSECTION 26 33 53 RACK MOUNTED UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the rack mounted uninterruptible power supply, indicated in this section as UPS.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- F. Section 26 26 00, ZONE POWER DISTRIBUTION UNITS FOR UNINTERRUPTIBLE POWER SYSTEMS.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. UPS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.
- B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - UPS shall be factory full-load tested to meet the requirements specified using a test battery (not the battery to be supplied with the system). Should a malfunction occur, the problem shall be corrected and the test shall be repeated. The tests shall encompass all aspects of operation, such as module failure, static bypass

operation, battery failure, input power failure and overload ratings.

1.5 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, plan, front, side, and rear elevations, accessories, and device nameplate data.
 - c. Provide detailed and project-specific system diagram, showing maintenance bypass, UPS module(s), battery cabinet(s) and batteries, major circuit protective devices, interconnecting power and control wiring, key-type mechanical interlocks, and connections to power sources and loads, as applicable. Indicate whether interconnections are factory-provided/factory-installed, factory-provided/field-installed, or field-provided/field installed.
 - 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
 - Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
 - 3) Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the UPS, including but not limited to bypass switchboard, UPS, key-type mechanical interlocks, remote devices, emergency power off buttons, fire alarm interface, and other components as applicable.

- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 - Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
 - Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
 - The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
- 3. Test Reports:
 - a. Submit certified factory design and production test reports for approval.
 - b. Two weeks prior to the final inspection, submit certified field test reports and data sheets to the COR.
- Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the UPS conforms to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the UPS has been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. Institute of Engineering and Electronic Engineers (IEEE): C57.110-08Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents C62.41.1-02Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits C62.41.2-02Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 450-10Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 485-10Sizing Lead-Acid Batteries for Stationary Applications C. International Code Council (ICC): IBC-15International Building Code D. National Electrical Manufacturers Association (NEMA): PE 1-12Uninterruptible Power Systems - Specification and Performance Verification E. National Fire Protection Association (NFPA): 70-17National Electrical Code (NEC) PART 2 - PRODUCTS 2.1 GENERAL REQUIREMENTS A. System Capacity: Unless stated otherwise, the parameters listed are under full rated output load at a minimum of 0.9 power factor, with nominal input voltage. Overall, 5 kW, or as shown on drawings at 40 $^{\circ}\mathrm{C}.$ B. Battery Run Time: 23 minutes at 50% load. C. AC Input: 1. Input Voltage 208 volts line-to-line. 2. Number of phases: 3-phase, 4-wire, plus ground. 3. Voltage Range: Plus 20 percent, minus 13 percent, without affecting battery float voltage or output voltage. 4. Frequency: 60 Hz, plus or minus 5 percent. 5. Total harmonic current distortion (THD) reflected into the primary line: 5 percent maximum. E. AC Output 1. Voltage 208 volts line-to-neutral. 2. Number of phases: 3-phase, 4-wire, plus ground. 3. Voltage regulation: a. Balanced load: Plus or minus 1.0 percent. b. 100 percent load imbalance, phase-to-phase: Plus or minus 3 percent. 4. Frequency: 60 Hz. 5. Frequency regulation: Plus or minus 0.05 percent. 6. Harmonic content (RMS voltage): 5 percent maximum total harmonic distortion with 100% nonlinear load. 7. Load power factor operating range: .9 leading, .7 lagging.

F. Eaton BladeUPS or pre-approved equal.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.2 UPS

- A. General Description: UPS module shall consist of a rectifier/charger unit and a 3-phase inverter module unit with their associated transformers, synchronizing equipment, input and output circuit breakers, and accessories as required for operation. Unit shall have front LCD display screen.
- B. Rectifier/Charger: Rectifier/charger unit shall be solid state and shall provide direct current to the DC bus.
 - Rectifier/charger, and bypass protection shall be provided through individual fusing of each phase.
 - Sizing: Rectifier/charger unit shall be sized for the following two simultaneous operating conditions:
 - a. Supplying the full rated load current to the inverter.
 - b. Recharging a fully-discharged battery to 95 percent of rated ampere-hour capacity within ten times the discharge time after normal AC power is restored, with the input protective device closed.
- C. Inverter: Inverter unit shall be a solid-state device
 - The inverter shall be capable of providing the specified quality output power while operating from any DC source, rectifier or battery.
 - 2. The modular design of the UPS shall permit safe and fast removal and replacement.
 - 3. Output Circuit Breaker.
 - 4. Input Connection: L21-20P, three phase, four wire + ground.
 - 5. Output Connection: L21-20R.

2.3 BATTERY SYSTEM

- A. General: A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module.
- B. Battery Type: VRLA-AGM.
- C. Battery Test: Automatic battery test. Manual battery test from front display.
- D. Battery alarm for low battery condition.
- E. ABM three-stage charging technology.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The UPS shall be set in place, wired, and connected in accordance with the approved shop drawings and manufacturer's instructions.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. An authorized representative of the UPS manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.
- B. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify appropriate anchorage, required area clearances, and correct alignment.
 - d. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
 - e. Verify grounding connections.
 - f. Check and test controls for proper operation.
 - 2. Load Test: The UPS shall be load tested for battery rated period. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour for the following:
 - a. Input voltage and current.
 - b. Input and output frequency.
 - c. Battery voltage for each module.
 - d. Output voltage and current
 - e. Output voltage and current.
 - f. Output kilowatts.
 - 3. Battery Discharge and Recharge Test: With the battery fully charged, the UPS shall undergo a complete battery discharge test to

full depletion followed by a full recharge. Instrument readings
shall be recorded every minute during discharge for the following:
a. Battery voltage and current.

- b. Output voltage and current (all three phases).
- c. Output kilowatts.
- d. Output voltage and current (all three phases).
- e. Output frequency.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the UPS is in good operating condition and properly performing the intended function.

3.4 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the UPS, on the dates requested by the COR.

---END---

SECTION 26 36 23 AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of open-transition automatic transfer switches with bypass isolation, indicated as automatic transfer switches or ATS in this section.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- F. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General communications requirements that are common to more than one section in Division 27.
- G. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATION SYSTEMS: Raceways for communications cabling.
- H. SECTION 27 15 00, COMMUNICATIONS HORIZONTAL CABLING: Communications media for interconnecting automatic transfer switches and remote control and annunciation components.

1.3 QUALITY ASSURANCE

- A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.

C. Automatic transfer switch, bypass/isolation switch, and annunciation control panels shall be products of the same manufacturer.

1.4 FACTORY TESTS

- A. ATS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.
- B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Perform visual inspection to verify that each ATS is as specified.
 - Perform mechanical test to verify that ATS sections are free of mechanical defects.
 - 3. Perform insulation resistance test to ensure electrical integrity and continuity of entire system.
 - 4. Perform main switch contact resistance test.
 - 5. Perform electrical tests to verify complete system electrical operation.

1.5 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include voltage rating, continuous current rating, number of phases, withstand and closing rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.
 - c. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and annunciation components, and interconnecting communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.

- d. Complete nameplate data, including manufacturer's name and catalog number.
- e. A copy of the markings that are to appear on the automatic transfer switches when installed.
- 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the automatic transfer switches.
 - Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
 - 3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 - Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
 - Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
 - 3) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
- 3. Certifications:
 - a. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 prototype testing.
 - b. Two weeks prior to final inspection, submit the following.
 - 1) Certification by the manufacturer that the ATS conform to the requirements of the drawings and specifications.
 - Certification by the Contractor that transfer switches have been properly installed, adjusted, and tested.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only. B. Institute of Electrical and Electronic Engineers (IEEE): 446-95 Emergency and Standby Power Systems for Industrial and Commercial Applications C37.90.1-12Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus C62.41.1-02Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits C62.41.2-02Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits C. International Code Council (ICC): IBC-15 International Building Code D. National Electrical Manufacturers Association (NEMA): 250-14Enclosures for Electrical Equipment (1000 Volts Maximum) ICS 6-06Enclosures ICS 4-15Application Guideline for Terminal Blocks MG 1-16Motors and Generators E. National Fire Protection Association (NFPA): 70-17National Electrical Code (NEC) 99-15Health Care Facilities 110-16 Emergency and Standby Power Systems F. Underwriters Laboratories, Inc. (UL): 50-15 Enclosures for Electrical Equipment 508-99 Industrial Control Equipment 891-05Switchboards 1008-14Transfer Switch Equipment

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Automatic transfer switches shall comply with IEEE, NEMA, NFPA, UL, and have the following features:
 - Automatic transfer switches shall be open transition switches, 3 OR 4- pole, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.
 - Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
 - 3. Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.
 - 4. Ratings:
 - a. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as shown on the drawings.
 - b. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
 - c. Maximum automatic transfer switch rating: 800 A.
 - 5. Markings:
 - a. Markings shall be in accordance with UL 1008.
 - 6. Tests:
 - a. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
 - 7. Surge Withstand Test:
 - a. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.
 - 8. Housing:
 - a. Enclose automatic transfer switches in wall- or floor-mounted steel cabinets, with metal gauge not less than No. 14, in
accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings.

- b. Enclosure shall be constructed so that personnel are protected from energized bypass-isolation components during automatic transfer switch maintenance.
- c. Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.
- d. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.
- e. Viewing Ports: Provide viewing ports so that contacts may be inspected without disassembly.
- 9. Operating Mechanism:
 - a. Actuated by an electrical operator.
 - b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal and emergency position.
 - c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
 - d. Contact transfer time shall not exceed six cycles.
 - e. Operating mechanism components and mechanical interlocks shall be insulated or grounded.
- 10. Contacts:
 - a. Main contacts: Silver alloy.
 - b. Neutral contacts: Silver alloy, with current rating not less than twice the rating of the phase contacts.
 - c. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.
 - d. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
- 11. Manual Operator:
 - Capable of operation by one person in either direction under no load.
- 12. Replaceable Parts:

- a. Include the main and arcing contacts individually or as units, as well as relays, and control devices.
- b. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.
- 13. Sensing Features:
 - a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.
 - b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 - c. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
 - d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 - e. Test Switch: Simulate normal-source failure.
 - f. Switch-Position Indication: Indicate source to which load is connected.
 - g. Source-Available Indication: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
 - h. Normal Power Indication: Indicate "Normal Source Available."
 - i. Emergency Power Indication: Indicate "Emergency Source Available."
 - j. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Control panel shall indicate override status.
 - k. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.

- Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
- m. Engine-Generator Exerciser: Programmable exerciser starts enginegenerator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.
- 14. Controls:
 - a. Controls shall provide indication of switch status and be equipped with alarm diagnostics.
 - b. Controls shall control operation of the automatic transfer switches.
- 15. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.
- 16. Annunciation, Control, and Programming Interface Components: Devices for communicating with remote programming devices, annunciators, or control panels shall have open-protocol communication capability matched with remote device.

2.2 BYPASS-ISOLATION SWITCH

- A. Provide each automatic transfer switch with two-way bypass-isolation manual type switch. The bypass-isolation switch shall permit load bypass to either normal or emergency power source and complete isolation of the automatic transfer switch, independent of transfer switch position. Bypass and isolation shall be possible under all conditions including when the automatic transfer switch is removed from service.
- B. Operation: The bypass-isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds. Provide a lock, which must energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.

- Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design, or provide separate load interrupter contacts to momentarily interrupt the load.
 - Ensure continuity of auxiliary circuits necessary for proper operation of the system.
 - b. A red indicating lamp shall light when the automatic transfer switch is bypassed.
 - c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.
- Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.
 - a. Interlocking: Provide interlocking as part of the bypassisolation switch to eliminate personnel-controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.
 - b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.
 - c. Visual verification: The isolation blades shall be visible in the isolated position.
- 3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine-generator(s) with the isolation contacts closed and the load bypassed without interruption of power to the load.
- C. Ratings: The electrical capabilities and ratings of the bypassisolation switch shall be compatible with those of the associated automatic transfer switch, including any required additional withstand tests.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install automatic transfer switches and associated remote components in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Anchor automatic transfer switches with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. Mount automatic transfer switches on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. An authorized representative of the automatic transfer switch manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Confirm correct application of manufacturer's recommended lubricants.
 - d. Verify appropriate anchorage, required area clearances, and correct alignment.

- e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
- f. Verify grounding connections.
- g. Verify ratings of sensors.
- h. Vacuum-clean enclosure interior. Clean enclosure exterior.
- i. Exercise all active components.
- j. Verify that manual transfer warning signs are properly placed.
- k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
- 2. Electrical tests:
 - a. Perform insulation-resistance tests.
 - b. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.
 - Test bypass-isolation unit functional modes and related automatic transfer switch operations.
 - Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
 - 3) Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
 - Low phase-to-ground voltage shall be simulated for each phase of normal source.
 - 5) Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
 - Verify pickup and dropout voltages by data readout or inspection of control settings.
 - 7) Verify that bypass and isolation functions perform correctly, including the physical removal of the automatic transfer switch while in bypass mode.

c. When any defects are detected, correct the defects and repeat the tests as requested by the COR at no additional cost to the Government.

3.3 FIELD SETTINGS VERIFICATION

A. The automatic transfer switch settings shall be verified in the field by an authorized representative of the manufacturer.

3.4 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition and properly performing the intended function.

3.5 INSTRUCTION

A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the automatic transfer switches, on the dates requested by the COR.

---END---

SECTION 26 43 13 SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of Type 2 Surge Protective Devices, as defined in NFPA 70, and indicated as SPD in this section.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 24 16, PANELBOARDS: For factory-installed or external SPD.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Include electrical ratings and device nameplate data.
 - 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
 - Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturer that the SPD conforms to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that the SPD has been properly installed.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplement and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. Institute of Engineering and Electronic Engineers (IEEE): IEEE C62.41.2-02Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
 - IEEE C62.45-08Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- C. National Fire Protection Association (NFPA):
 - 70-17National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
 - UL 1283-15Electromagnetic Interference Filters
 - UL 1449-14Surge Protective Devices

PART 2 - PRODUCTS

2.1 PANELBOARD SPD

- A. General Requirements:
 - 1. Comply with UL 1449 and IEEE C62.41.2.
 - Modular design with field-replaceable modules, or non-modular design.
 - 3. Fuses, rated at 200 kA interrupting capacity.
 - 4. Bolted compression lugs for internal wiring.
 - 5. Integral disconnect switch.
 - 6. Redundant suppression circuits.
 - 7. LED indicator lights for power and protection status.
 - 8. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device.
 - 10. Four-digit transient-event counter.
- B. Surge Current per Phase: Minimum 120kA per phase.

2.2 ENCLOSURES

A. Enclosures: NEMA 1.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and manufacturer's instructions.
- B. Factory-installed SPD: Switchgear, switchboard, or panelboard manufacturer shall install SPD at the factory.
- C. Field-installed SPD: Contractor shall install SPD with conductors or buses between SPD and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - Provide a circuit breaker as a dedicated disconnecting means for TVSS as shown on drawings.
- D. Do not perform insulation resistance tests on switchgear, switchboards, panelboards, or feeders with the SPD connected. Disconnect SPD before conducting insulation resistance tests, and reconnect SPD immediately after insulation resistance tests are complete.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify that disconnecting means and feeder size and maximum length to SPD corresponds to approved shop drawings.
 - d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - e. Vacuum-clean enclosure interior. Clean enclosure exterior.
 - Verify the correct operation of all sensing devices, alarms, and indicating devices.

3.3 FOLLOW-UP VERIFICATION

A. After completion of acceptance checks and tests, the Contractor shall show by demonstration in service that SPD are in good operating condition and properly performing the intended function.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.4 INSTRUCTION

A. Provide the services of a factory-trained technician for one 2-hour training period for instructing personnel in the maintenance and operation of the SPD, on the date requested by the COR.

`---END---

SECTION 26 51 00 INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.

1.2 RELATED WORK

- A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT: Disposal of lamps.
- B. Section 02 41 00, DEMOLITION: Removal and disposal of lamps and ballasts.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
 - b. Material and construction details, include information on housing and optics system.
 - c. Physical dimensions and description.
 - d. Wiring schematic and connection diagram.

- e. Installation details.
- f. Energy efficiency data.
- g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
- h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
- i. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.
- 2. Manuals:
 - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM): C635/C635M REV A-13Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-

in Panel Ceilings

- C. Environmental Protection Agency (EPA):
 40 CFR 261Identification and Listing of Hazardous Waste
- D. Federal Communications Commission (FCC): CFR Title 47, Part 15 ..Radio Frequency Devices CFR Title 47, Part 18 ..Industrial, Scientific, and Medical Equipment

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 E. Illuminating Engineering Society of North America (IESNA): LM-79-08Electrical and Photometric Measurements of Solid-State Lighting Products LM-80-15Measuring Lumen Maintenance of LED Light Sources LM-82-12Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature F. Institute of Electrical and Electronic Engineers (IEEE): C62.41-91(R1995)Surge Voltages in Low Voltage AC Power Circuits G. International Code Council (ICC): IBC-15 International Building Code H. National Electrical Manufacturer's Association (NEMA): C78.376-14Chromaticity of Fluorescent Lamps C82.1-04(R2015)Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts C82.2-02(R2016)Method of Measurement of Fluorescent Lamp Ballasts C82.4-17 Lamp Ballasts - Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type) C82.11-17 Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts LL 9-11Dimming of T8 Fluorescent Lighting Systems SSL 1-16Electronic Drivers for LED Devices, Arrays, or Systems I. National Fire Protection Association (NFPA): 70-17National Electrical Code (NEC) 101-18Life Safety Code J. Underwriters Laboratories, Inc. (UL): 496-17Lampholders 542-05 Fluorescent Lamp Starters Locations 924-16 Emergency Lighting and Power Equipment 935-01 Fluorescent-Lamp Ballasts

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1029A-06.....Ignitors and Related Auxiliaries for HID Lamp

Ballasts

1598-08Luminaires
1574-04.....Track Lighting Systems
2108-15....Low-Voltage Lighting Systems
8750-15...Light Emitting Diode (LED) Light Sources for
Use in Lighting Products

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

- A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.
- B. Sheet Metal:
 - Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
 - Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - 3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
 - 4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.
- C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.
- D. Lamp Sockets:
 - Fluorescent: Single slot entry type, requiring a one-quarter turn of the lamp after insertion. Lampholder contacts shall be the biting edge type.
 - 2. Compact Fluorescent: 4-pin.
 - 3. High Intensity Discharge (HID): Porcelain.
- E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

- F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- G. Metal Finishes:
 - 1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
 - Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
 - 3. Exterior finishes shall be as shown on the drawings.
- H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

2.2 LAMPS

A. Lamps shall comply with EPA Toxicity Characteristic Leachate Procedure (TCLP) requirements.

2.3 LED EXIT LIGHT FIXTURES

- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
- B. Housing and door shall be die-cast aluminum.
- C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
- D. Finish shall be satin or fine-grain brushed aluminum.
- E. There shall be no radioactive material used in the fixtures.
- F. Fixtures:
 - Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.

26 51 00 - 5 INTERIOR LIGHTING

- 2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
- 3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
- G. Voltage: Multi-voltage (120 277V).

2.4 LED LIGHT FIXTURES

- A. General:
 - 1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
 - LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
 - 3. LED drivers shall include the following features unless otherwise indicated:
 - a. Minimum efficiency: 85% at full load.
 - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - c. Input Voltage: 120 277V (±10%) at 60 Hz.
 - d. Integral short circuit, open circuit, and overload protection.
 - e. Power Factor: \geq 0.95.
 - f. Total Harmonic Distortion: ≤ 20%.
 - g. Comply with FCC 47 CFR Part 15.
 - LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 3000° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: 50,000 hours per IES L70.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
- B. LED Downlights:
 - 1. Housing, LED driver, and LED module shall be products of the same manufacturer.
- C. LED Troffers:
 - LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.

2. Housing, LED driver, and LED module shall be products of the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
- B. Align, mount, and level the lighting fixtures uniformly.
- C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20 gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
- D. Lighting Fixture Supports:
 - Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
 - 4. Surface mounted lighting fixtures:
 - a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.
 - b. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.
 - Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.

- The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.
- The outlet box is supported vertically from the building structure.
- c. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.
- 5. Single or double pendant-mounted lighting fixtures:
 - a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.
- E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.
- F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.
- G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.
- I. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT, and Section 02 41 00, DEMOLITION.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform the following:
 - 1. Visual Inspection:
 - a. Verify proper operation by operating the lighting controls.
 - b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.
 - 2. Electrical tests:
 - Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s)

in the presence of the COTR. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.

b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

---END---

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 27 05 11

REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes common requirements to communications installations and applies to all sections of Division 27.
- B. Provide completely functioning communications systems.
- C. Comply with VAAR 852.236.91 and FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

1.2 REFERENCES

- A. Abbreviations and Acronyms
 - Refer to http://www.cfm.va.gov/til/sdetail.asp for Division 00, ARCHITECTURAL ABBREVIATIONS.
 - 2. Additional Abbreviations and Acronyms:

А	Ampere	
AC	Alternating Current	
AE	Architect and Engineer	
AFF	Above Finished Floor	
AHJ	Authority Having Jurisdiction	
ANSI	American National Standards Institute	
AWG	American Wire Gauge (refer to STP and UTP)	
AWS	Advanced Wireless Services	
BCT	Bonding Conductor for Telecommunications (also	
	Telecommunications Bonding Conductor (TBC))	
BDA	Bi-Directional Amplifier	
BICSI	Building Industry Consulting Service International	
BIM	Building Information Modeling	
BOM	Bill of Materials	
BTU	British Thermal Units	
BUCR	R Back-up Computer Room	
BTS	Base Transceiver Station	
CAD	AutoCAD	
CBOPC	Community Based Outpatient Clinic	

CBC	Coupled Bonding Conductor	
CBOC	Community Based Outpatient Clinic (refer to CBOPC,	
	OPC, VAMC)	
CCS	TIP's Cross Connection System (refer to VCCS and	
	HCCS)	
CFE	Contractor Furnished Equipment	
CFM	US Department of Veterans Affairs Office of	
	Construction and Facilities Management	
CFR	Consolidated Federal Regulations	
CIO	Communication Information Officer (Facility, VISN or	
	Region)	
CM	Centimeters	
CO	Central Office	
COR	Contracting Officer Representative	
CPU	Central Processing Unit	
CSU	Customer Service Unit	
CUP	Conditional Use Permit(s) - Federal/GSA for VA	
dB	Decibel	
dBm	Decibel Measured	
dBmV	Decibel per milli-Volt	
DC	Direct Current	
DEA	United States Drug Enforcement Administration	
DSU	Data Service Unit	
EBC	Equipment Bonding Conductor	
ECC	Engineering Control Center (refer to DCR, EMCR)	
EDGE	Enhanced Data (Rates) for GSM Evolution	
EDM	Electrical Design Manual	
EMCR	Emergency Management Control Room (refer to DCR, ECC)	
EMI	Electromagnetic Interference (refer to RFI)	
EMS	Emergency Medical Service	
EMT	Electrical Metallic Tubing or thin wall conduit	

ENTR	Utilities Entrance Location (refer to DEMARC, POTS,	
	LEC)	
EPBX	Electronic Digital Private Branch Exchange	
ESR	Vendor's Engineering Service Report	
FA	Fire Alarm	
FAR	Federal Acquisition Regulations in Chapter 1 of Title	
	48 of Code of Federal Regulations	
FMS	VA's Headquarters or Medical Center Facility's	
	Management Service	
FR	Frequency (refer to RF)	
FTS	Federal Telephone Service	
GFE	Government Furnished Equipment	
GPS	Global Positioning System	
GRC	Galvanized Rigid Metal Conduit	
GSM	Global System (Station) for Mobile	
HCCS	TIP's Horizontal Cross Connection System (refer to	
	CCS & VCCS)	
HDPE	High Density Polyethylene Conduit	
HDTV	Advanced Television Standards Committee High-	
	Definition Digital Television	
HEC	Head End Cabinets (refer to HEIC, PA)	
HEIC	Head End Interface Cabinets (refer to HEC, PA)	
HF	High Frequency (Radio Band; Re FR, RF, VHF & UHF)	
HSPA	High Speed Packet Access	
ΗZ	Hertz	
IBT	Intersystem Bonding Termination (NEC 250.94)	
IC	Intercom	
ICRA	Infectious Control Risk Assessment	
IDEN	Integrated Digital Enhanced Network	
IDC	Insulation Displacement Contact	
IDF	Intermediate Distribution Frame	
ILSM	Interim Life Safety Measures	

IMC	Rigid Intermediate Steel Conduit	
IRM	Department of Veterans Affairs Office of Information	
	Resources Management	
ISDN	Integrated Services Digital Network	
ISM	Industrial, Scientific, Medical	
IWS	Intra-Building Wireless System	
LAN	Local Area Network	
LBS	Location Based Services, Leased Based Systems	
LEC	Local Exchange Carrier (refer to DEMARC, PBX & POTS)	
LED	Light Emitting Diode	
LMR	Land Mobile Radio	
LTE	Long Term Evolution, or 4G Standard for Wireless Data	
	Communications Technology	
М	Meter	
MAS	Medical Administration Service	
MATV	Master Antenna Television	
MCR	Main Computer Room	
MCOR	Main Computer Operators Room	
MDF	Main Distribution Frame	
MH	Manholes or Maintenance Holes	
MHz	Megaherts (10 ⁶ Hz)	
mm	Millimeter	
MOU	Memorandum of Understanding	
MW	Microwave (RF Band, Equipment or Services)	
NID	Network Interface Device (refer to DEMARC)	
NEC	National Electric Code	
NOR	Network Operations Room	
NRTL	OSHA Nationally Recognized Testing Laboratory	
NS	Nurse Stations	
NTIA	U.S. Department of Commerce National	
	Telecommunications and Information Administration	
OEM	Original Equipment Manufacturer	

OI&T	Office of Information and Technology	
OPC	VA's Outpatient Clinic (refer to CBOC, VAMC)	
OSH	Department of Veterans Affairs Office of Occupational	
	Safety and Health	
OSHA	United States Department of Labor Occupational Safety	
	and Health Administration	
OTDR	Optical Time-Domain Reflectometer	
PA	Public Address System (refer to HE, HEIC, RPEC)	
PBX	Private Branch Exchange (refer to DEMARC, LEC, POTS)	
PCR	Police Control Room (refer to SPCC, could be	
	designated SCC)	
PCS	Personal Communications Service (refer to UPCS)	
PE	Professional Engineer	
PM	Project Manager	
PoE	Power over Ethernet	
POTS	Plain Old Telephone Service (refer to DEMARC, LEC,	
	PBX)	
PSTN	Public Switched Telephone Network	
PSRAS	Public Safety Radio Amplification Systems	
PTS	Pay Telephone Station	
PVC	Poly-Vinyl Chloride	
PWR	Power (in Watts)	
RAN	Radio Access Network	
RBB	Rack Bonding Busbar	
RE	Resident Engineer or Senior Resident Engineer	
RF	Radio Frequency (refer to FR)	
RFI	Radio Frequency Interference (refer to EMI)	
RFID	RF Identification (Equipment, System or Personnel)	
RMC	Rigid Metal Conduit	
RMU	Rack Mounting Unit	
RPEC	Radio Paging Equipment Cabinets (refer to HEC, HEIC,	
	PA)	

RTLS	Real Time Location Service or System
RUS	Rural Utilities Service
SCC	Security Control Console (refer to PCR, SPCC)
SMCS	Spectrum Management and Communications Security
	(COMSEC)
SFO	Solicitation for Offers
SME	Subject Matter Experts (refer to AHJ)
SMR	Specialized Mobile Radio
SMS	Security Management System
SNMP	Simple Network Management Protocol
SPCC	Security Police Control Center (refer to PCR, SMS)
STP	Shielded Balanced Twisted Pair (refer to UTP)
STR	Stacked Telecommunications Room
TAC	VA's Technology Acquisition Center, Austin, Texas
TCO	Telecommunications Outlet
TER	Telephone Equipment Room
TGB	Telecommunications Grounding Busbar (also Secondary
	Bonding Busbar (SBB))
TIP	Telecommunications Infrastructure Plant
TMGB	Telecommunications Main Grounding Busbar (also
	Primary Bonding Busbar (PBB))
TMS	Traffic Management System
TOR	Telephone Operators Room
TP	Balanced Twisted Pair (refer to STP and UTP)
TR	Telecommunications Room (refer to STR)
TWP	Twisted Pair
UHF	Ultra-High Frequency (Radio)
UMTS	Universal Mobile Telecommunications System
UPCS	Unlicensed Personal Communications Service (refer to
	PCS)
UPS	Uninterruptible Power Supply
USC	United States Code

UTP	Unshielded Balanced Twisted Pair (refer to TP and		
	STP)		
UV	Ultraviolet		
V	Volts		
VAAR	Veterans Affairs Acquisition Regulation		
VACO	Veterans Affairs Central Office		
VAMC	VA Medical Center (refer to CBOC, OPC, VACO)		
VCCS	S TIP's Vertical Cross Connection System (refer to CCS		
	and HCCS)		
VHF	Very High Frequency (Radio)		
VISN	Veterans Integrated Services Network (refers to		
	geographical region)		
VSWR	Voltage Standing Wave Radio		
W	Watts		
WEB	World Electronic Broadcast		
WiMAX	Worldwide Interoperability (for MW Access)		
WI-FI	Wireless Fidelity		
WMTS	Wireless Medical Telemetry Service		
WSP	Wireless Service Providers		

B. Definitions:

- BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.
- Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
- 3. Bundled Microducts: All forms of jacketed microducts.
- 4. Conduit: Includes all raceway types specified.
- 5. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 6. DEMARC, Extended DMARC or ENTR: Service provider's main point of demarcation owned by LEC or service provider and establishes a physical point where service provider's responsibilities for service and maintenance end. This point is called NID, in data networks.
- 7. Effectively Grounded: Intentionally bonded to earth through connections of low impedance having current carrying capacity to prevent buildup of currents and voltages resulting in hazard to equipment or persons.
- 8. Electrical Supervision: Analyzing a system's function and components (i.e., cable breaks / shorts, inoperative stations, lights, LEDs and states of change, from primary to backup) on a 24/7/365 basis; provide aural and visual emergency notification signals to minimum two remote designated or accepted monitoring stations.
- 9. Electrostatic Interference (ESI) or Electrostatic Discharge Interference: Refer to EMI and RFI.
- 10. Project 25 (2014) (P25 (TIA-102 Series)): Set of standards for local, state and Federal public safety organizations and agencies digital LMR services. P25 is applicable to LMR equipment authorized or licensed under the US Department of Commerce National Telecommunications and Information Administration or FCC rules and regulations, and is a required standard capability for all LMR equipment and systems.
- 11. Grounding Electrode Conductor: (GEC) Conductor connected to earth grounding electrode.
- 12. Grounding Electrode System: Electrodes through which an effective connection to earth is established, including supplementary, communications system grounding electrodes and GEC.
- 13. Grounding Equalizer or Backbone Bonding Conductor (BBC): Conductor that interconnects elements of telecommunications grounding infrastructure.
- 14. Head End (HE): Equipment, hardware and software, or a master facility at originating point in a communications system designed for centralized communications control, signal processing, and distribution that acts as a common point of connection between equipment and devices connected to a network of interconnected equipment, possessing greatest authority for allowing information to be exchanged, with whom other equipment is subordinate.

- 15. Microducts: All forms of air blown fiber pathways.
- 16. Ohm: A unit of restive measurement.
- 17. Received Signal Strength Indication (RSSI): A measurement of power present in a received RF signal.
- 18. Service Provider Demarcation Point (SPDP): Not owned by LEC or service provider, but designated by Government as point within facility considered the DEMARC.
- 19. Sound (SND): Changing air pressure to audible signals over given time span.
- 20. System: Specific hardware, firmware, and software, functioning together as a unit, performing task for which it was designed.
- 21. Telecommunications Bonding Backbone (TBB): Conductors of appropriate size (minimum 53.49 mm2 [1/0 AWG]) stranded copper wire, that connect to Grounding Electrode System and route to telecommunications main grounding busbar (TMGB) and circulate to interconnect various TGBs and other locations shown on drawings.
- 22. Voice over Internet Protocol (VoIP): A telephone system in which voice signals are converted to packets and transmitted over LAN network using Transmission Control Protocol (TCP)/Internet Protocol (IP). VA'S VOIP is not listed or coded for life and public safety, critical, emergency or other protection functions. When VoIP system or equipment is provided instead of PBX system or equipment, each TR (STR) and DEMARC requires increased AC power provided to compensate for loss of PBX's telephone instrument line power; and, to compensate for absence of PBX's UPS capability.
- 23. Wide Area Network (WAN): A digital network that transcends localized LANs within a given geographic location. VA'S WAN/LAN is not nationally listed or coded for life and public safety, critical, emergency or other safety functions.

1.3 APPLICABLE PUBLICATIONS

- A. Applicability of Standards: Unless documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into the documents to extent referenced. Such standards are made a part of these documents by reference.
 - 1. Each entity engaged in construction must be familiar with industry standards applicable to its construction activity.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. Obtain standards directly from publication source, where copies of standards are needed to perform a required construction activity.
- B. Government Codes, Standards and Executive Orders: Refer to http://www.cfm.va.gov/TIL/cPro.asp:
 - 1. Federal Communications Commission, (FCC) CFR, Title 47:
 - Part 15 Restrictions of use for Part 15 listed RF Equipment in Safety of Life Emergency Functions and Equipment Locations
 - Part 47 Chapter A, Paragraphs 6.1-6.23, Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment
 - Part 58 Television Broadcast Service
 - Part 73 Radio and Television Broadcast Rules
 - Part 90 Rules and Regulations, Appendix C
 - Form 854 Antenna Structure Registration
 - Chapter XXIII National Telecommunications and Information Administration (NTIA, P/O Commerce, Chapter XXIII) the 'Red Book'- Chapters 7, 8 & 9 compliments CFR, Title 47, FCC Part 15, RF Restriction of Use and Compliance in "Safety of Life" Functions & Locations
 - 2. US Department of Agriculture, (Title 7, USC, Chapter 55, Sections 2201, 2202 & 2203:RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction: RUS Bull 1751F-630 Design of Aerial Cable Plants RUS Bull 1751F-640 Design of Buried Cable Plant, Physical Considerations RUS Bull 1751F-643 Underground Plant Design RUS Bull 1751F-815 Electrical Protection of Outside Plants, RUS Bull 1753F-201 Acceptance Tests of Telecommunications Plants (PC-4) RUS Bull 1753F-401 Splicing Copper and Fiber Optic Cables (PC-2) RUS Bull 345-50 Trunk Carrier Systems (PE-60) RUS Bull 345-65 Shield Bonding Connectors (PE-65) RUS Bull 345-72 Filled Splice Closures (PE-74) RUS Bull 345-83 Gas Tube Surge Arrestors (PE-80)

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.	US Department of Comm	merce/National Institute of Standards
	Technology, (NIST):	
	FIPS PUB 1-1	Telecommunications Information Exchange
	FIPS PUB 100/1	Interface between Data Terminal Equipment (DTE)
		Circuit Terminating Equipment for operation
		with Packet Switched Networks, or Between Two
		DTEs, by Dedicated Circuit
	FIPS PUB 140/2	Telecommunications Information Security
		Algorithms
	FIPS PUB 143	General Purpose 37 Position Interface between
		DTE and Data Circuit Terminating Equipment
	FIPS 160/2	Electronic Data Interchange (EDI),
	FIPS 175	Federal Building Standard for
		Telecommunications Pathway and Spaces
	FIPS 191	Guideline for the Analysis of Local Area
		Network Security
	FIPS 197	Advanced Encryption Standard (AES)
	FIPS 199	Standards for Security Categorization of
		Federal Information and Information Systems
4. US Department of Defense, (DoD):		ense, (DoD):
	MIL-STD-188-110	Interoperability and Performance Standards for
		Data Modems
	MIL-STD-188-114	Electrical Characteristics of Digital Interface
		Circuits
	MIL-STD-188-115	Communications Timing and Synchronizations
		Subsystems
	MIL-C-28883	Advanced Narrowband Digital Voice Terminals
	MIL-C-39012/21	Connectors, Receptacle, Electrical, Coaxial,
		Radio Frequency, (Series BNC (Uncabled), Socket
		Contact, Jam Nut Mounted, Class 2)
5.	US Department of Heal	lth and Human Services:
	The Health Insurance	Portability and Accountability Act of 1996

(HIPAA) Privacy, Security and Breach Notification Rules6. US Department of Justice:2010 Americans with Disabilities Act Standards for Accessible Design (ADAAD).

- 7. US Department of Labor, (DoL) Public Law 426-62 CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards): Approved NRTLs; obtain a copy at Subpart 7 https://www.osha.gov/dts/otpca/nrtl/nrtllist.ht ml Compliance with NFPA 101, Life Safety Code Subpart 35 Subpart 36 Design and Construction Requirements for Exit Routes Subpart 268 Telecommunications Wiring Methods, Components, and Equipment for Subpart 305 General Use Subpart 508 Americans with Disabilities Act Accessibility Guidelines; technical requirement for accessibility to buildings and facilities by individuals with disabilities
- 8. US Department of Transportation, (DoT):
 - Public Law 85-625, CFR, Title 49, Part 1, Subpart C Federal Aviation Administration (FAA):AC 110/460-ID & AC 707 / 460-2E -Advisory Circulars Standards for Construction of Antenna Towers, and 7450 and 7460-2 - Antenna Construction Registration Forms.
- 9. US Department of Veterans Affairs (VA): Office of Telecommunications (OI&T), MP-6, PART VIII, TELECOMMUNICATIONS, CHAPTER 5, AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS: Spectrum Management and COMSEC Service (SMCS), AHJ for:
 - a. CoG, "Continuance of Government" communications guidelines and compliance.

 - c. COOP, "Continuance of Operations" emergency communications guidelines and compliance.
 - d. FAA, FCC, and US Department of Commerce National Telecommunications and Information Administration, "VA wide RF Co-ordination, Compliance and Licensing."
 - e. Handbook 6100 Telecommunications: Cyber and Information
 Security Office of Cyber and Information Security, and Handbook
 6500 Information Security Program.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- f. Low Voltage Special Communications Systems "Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance and Life Safety Certifications for CFM and VA Facility Low Voltage Special Communications Projects (except Fire Alarm, Telephone and Data Systems)."
- g. SATCOM, "Satellite Communications" guidelines and compliance, and Security and Law Enforcement Systems - "Coordinates the Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance, DEA and Public Safety Certification(s) for CFM and VA Facility Security Low Voltage Special Communications and Physical Security Projects.
- h. VHA's National Center for Patient Safety Veterans Health Administration (VHA) Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
- i. VA's CEOSH, concurrence with warning identified in VA Directive 7700.
- j. Wireless and Handheld Devices, "Guidelines and Compliance,"
- k. Office of Security and Law Enforcement: VA Directive 0730 and Health Special Presidential Directive (HSPD)-12.
- C. NRTL Standards: Refer to https://www.osha.gov/lawsregs/regulations/standardnumber/1926
 - 1. Canadian Standards Association (CSA); same tests as presented by UL
 - Communications Certifications Laboratory (CEL); same tests as presented by UL.
 - Intertek Testing Services NA, Inc., (ITSNA), formerly Edison Testing Laboratory (ETL) same tests as presented by UL).
 - 4. Underwriters Laboratory (UL):

1-2005	Flexible Metal Conduit
5-2011	Surface Metal Raceway and Fittings
6-2007	Rigid Metal Conduit
44-010	Thermoset-Insulated Wires and Cables
50-1995	Enclosures for Electrical Equipment
65-2010	Wired Cabinets
83-2008	Thermoplastic-Insulated Wires and Cables

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

96-2005	Lightning Protection Components
96A-2007	Installation Requirements for Lightning
	Protection Systems
360-2013	Liquid-Tight Flexible Steel Conduit
444-2008	Communications Cables
467-2013	Grounding and Bonding Equipment
486A-486B-2013	Wire Connectors
486C-2013	Splicing Wire Connectors
486D-2005	Sealed Wire Connector Systems
486E-2009	Standard for Equipment Wiring Terminals for Use
	with Aluminum and/or Copper Conductors
493-2007	Thermoplastic-Insulated Underground Feeder and
	Branch Circuit Cable
497/497A/497B/497C	
497D/497E	Protectors for Paired Conductors/Communications
	Circuits/Data Communications and Fire Alarm
	Circuits/coaxial circuits/voltage
	protections/Antenna Lead In
510-2005	Polyvinyl Chloride, Polyethylene and Rubber
	Insulating Tape
514A-2013	Metallic Outlet Boxes
514B-2012	Fittings for Cable and Conduit
514C-1996	Nonmetallic Outlet Boxes, Flush-Device Boxes
	and Covers
651-2011	Schedule 40 and 80 Rigid PVC Conduit
651A-2011	Type EB and A Rigid PVC Conduit and HDPE
	Conduit
797-2007	Electrical Metallic Tubing
884-2011	Underfloor Raceways and Fittings
1069-2007	Hospital Signaling and Nurse Call Equipment
1242-2006	Intermediate Metal Conduit
1449-2006	Standard for Transient Voltage Surge
	Suppressors
1479-2003	Fire Tests of Through-Penetration Fire Stops
1480-2003	Speaker Standards for Fire Alarm, Emergency,
	Commercial and Professional use

D.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

	1666-2007	Standard for Wire/Cable Vertical (Riser) Tray
		Flame Tests
	1685-2007	Vertical Tray Fire Protection and Smoke Release
		Test for Electrical and Fiber Optic Cables
	1861-2012	Communication Circuit Accessories
	1863-2013	Standard for Safety, communications Circuits
		Accessories
	1865-2007	Standard for Safety for Vertical-Tray Fire
		Protection and Smoke-Release Test for
		Electrical and Optical-Fiber Cables
	2024-2011	Standard for Optical Fiber Raceways
	2024-2014	Standard for Cable Routing Assemblies and
		Communications Raceways
	2196-2001	Standard for Test of Fire Resistive Cable
	60950-1 ed. 2-2014	Information Technology Equipment Safety
Ind	dustry Standards:	
1.	Advanced Television	Systems Committee (ATSC):
	A/53 Part 1: 2013	ATSC Digital Television Standard, Part 1,
		Digital Television System
	A/53 Part 2: 2011	ATSC Digital Television Standard, Part 2,
		RF/Transmission System Characteristics
	A/53 Part 3: 2013	ATSC Digital Television Standard, Part 3,
		Service Multiplex and Transport System
		Characteristics
	A/53 Part 4: 2009	ATSC Digital Television Standard, Part 4, MPEG-
		2 Video System Characteristics
	A/53 Part 5: 2014	ATSC Digital Television Standard, Part 5, AC-3
		Audio System Characteristics
	A/53 Part 6: 2014	ATSC digital Television Standard, Part 6,
		Enhanced AC-3 Audio System Characteristics
2.	American Institute o	f Architects (AIA): 2006 Guidelines for Design &
	Construction of Heal	th Care Facilities.
3.	American Society of N	Mechanical Engineers (ASME):
	A17.1 (2013)	Safety Code for Elevators and Escalators
		Includes Requirements for Elevators,

Escalators, Dumbwaiters, Moving Walks, Material

VAMC St. Cloud, MN EHRM Infrastructure Upgrades 4801 Veterans Drive St. Cloud, MN 56303	VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding
	Lifts, and Dumbwaiters with Automatic Transfer
	Devices
17.3 (2011)	Safety Code for Existing Elevators and
	Escalators
17.4 (2009)	Guide for Emergency Personnel
17.5 (2011)	Elevator and Escalator Electrical Equipment
4. American Society for	Testing and Materials (ASTM):
B1 (2001)	Standard Specification for Hard-Drawn Copper
	Wire
B8 (2004)	Standard Specification for Concentric-Lay-
	Stranded Copper Conductors, Hard, Medium-Hard,
	or Soft
D1557 (2012)	Standard Test Methods for Laboratory Compaction
	Characteristics of Soil Using Modified Effort
	56,000 ft-lbf/ft3 (2,700 kN-m/m3)
D2301 (2004)	Standard Specification for Vinyl Chloride
	Plastic Pressure Sensitive Electrical
	Insulating Tape
B258-02 (2008)	Standard Specification for Standard Nominal
	Diameters and Cross-Sectional Areas of AWG
	Sizes of Solid Round Wires Used as Electrical
	Conductors
D709-01(2007)	Standard Specification for Laminated
	Thermosetting Materials
D4566 (2008)	Standard Test Methods for Electrical
	Performance Properties of Insulations and
	Jackets for Telecommunications Wire and Cable
5. American Telephone an	nd Telegraph Corporation (AT&T) - Obtain
following AT&T Public	cations at https://ebiznet.sbc.com/sbcnebs/
ATT-TP-76200 (2013)	Network Equipment and Power Grounding,
	Environmental, and Physical Design Requirements
ATT-TP-76300(2012)	Merged AT&T Affiliate Companies Installation
	Requirements
ATT-TP-76305 (2013)	Common Systems Cable and Wire Installation and
	Removal Requirements - Cable Racks and Raceways
ATT-TP-76306 (2009)	Electrostatic Discharge Control
ATT-TP-76400 (2012)	Detail Engineering Requirements
VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 ATT-TP-76402 (2013) AT&T Raised Access Floor Engineering and Installation Requirements ATT-TP-76405 (2011) Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments ATT-TP-76416 (2011) Grounding and Bonding Requirements for Network Facilities ATT-TP-76440 (2005) Ethernet Specification ATT-TP-76450 (2013) Common Systems Equipment Interconnection Standards for AT&T Network Equipment Spaces ATT-TP-76461 (2008) Fiber Optic Cleaning ATT-TP-76900 (2010) AT&T Installation Testing Requirement ATT-TP-76911 (1999) AT&T LEC Technical Publication Notice 6. British Standards Institution (BSI): BS EN 50109-2 Hand Crimping Tools - Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications - All Parts & Sections. October 1997 7. Building Industry Consulting Service International (BICSI): ANSI/BICSI 002-2011 Data Center Design and Implementation Best Practices ANSI/BICSI 004-2012 Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities ANSI/NECA/BICSI 568-2006 Standard for Installing Commercial Building Telecommunications Cabling NECA/BICSI 607-2011 Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings ANSI/BICSI 005-2013 Electronic Safety and Security (ESS) System Design and Implementation Best Practices 8. Electronic Components Assemblies and Materials Association, (ECA). ECA EIA/RS-270 (1973) Tools, Crimping, Solderless Wiring Devices -Recommended Procedures for User Certification EIA/ECA 310-E (2005) Cabinets, and Associated Equipment 9. Facility Guidelines Institute: 2010 Guidelines for Design and

27 05 11 - 17

Construction of Health Care Facilities.

VAMC St. Cloud, MN EHRM Infrastructure Upgrades 4801 Veterans Drive St. Cloud, MN 56303	VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding		
10. Insulated Cable Engin	neers Association (ICEA):		
ANSI/ICEA			
S-80-576-2002	Category 1 & 2 Individually Unshielded Twisted-		
	Pair Indoor Cables for Use in Communications		
	Wiring Systems		
ANSI/ICEA			
S-84-608-2010	Telecommunications Cable, Filled Polyolefin		
	Insulated Copper Conductor, S-87-640(2011)		
	Optical Fiber Outside Plant Communications		
	Cable		
ANSI/ICEA			
S-90-661-2012	Category 3, 5, & 5e Individually Unshielded		
	Twisted-Pair Indoor Cable for Use in General		
	Purpose and LAN Communication Wiring Systems		
S-98-688 (2012)	Broadband Twisted Pair Cable Aircore,		
	Polyolefin Insulated, Copper Conductors		
S-99-689 (2012)	Broadband Twisted Pair Cable Filled, Polyolefin		
	Insulated, Copper Conductors		
ICEA S-102-700			
(2004)	Category 6 Individually Unshielded Twisted Pair		
	Indoor Cables (With or Without an Overall		
	Shield) for use in Communications Wiring		
	Systems Technical Requirements		
11. Institute of Electric	Institute of Electrical and Electronics Engineers (IEEE):		
ISSN 0739-5175	March-April 2008 Engineering in Medicine and		
	Biology Magazine, IEEE (Volume: 27, Issue:2)		
	Medical Grade-Mission Critical-Wireless		
	Networks		
IEEE C2-2012	National Electrical Safety Code (NESC)		
C62.41.2-2002/			
Cor 1-2012 IEEE	Recommended Practice on Characterization of		
	Surges in Low-Voltage (1000 V and Less) AC		
	Power Circuits 4)		
C62.45-2002	IEEE Recommended Practice on Surge Testing for		
	Equipment Connected to Low-Voltage (1000 V and		
	Less) AC Power Circuits		

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 81-2012 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 100 - 1992IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms IEEE Recommended Practice for Electric Systems 602-2007 in Health Care Facilities 1100-2005 IEEE Recommended Practice for Powering and Grounding Electronic Equipment 12. International Code Council: AC193 (2014) Mechanical Anchors in Concrete Elements 13. International Organization for Standardization (ISO): ISO/TR 21730 (2007) Use of Mobile Wireless Communication and Computing Technology in Healthcare Facilities -Recommendations for Electromagnetic Compatibility (Management of Unintentional Electromagnetic Interference) with Medical Devices 14. National Electrical Manufacturers Association (NEMA): NEMA 250 (2008) Enclosures for Electrical Equipment (1,000V Maximum) ANSI C62.61 (1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits ANSI/NEMA FB 1 (2012) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable ANSI/NEMA OS 1 (2009) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports NEMA SB 19 (R2007) NEMA Installation Guide for Nurse Call Systems TC 3 (2004) Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing NEMA VE 2 (2006) Cable Tray Installation Guidelines 15. National Fire Protection Association (NFPA): 70E-2015 Standard for Electrical Safety in the Workplace 70-2014 National Electrical Code (NEC) 72-2013 National Fire Alarm Code

	75-2013	Standard for the Fire Protection of Information
		Technological Equipment
	76-2012	Recommended Practice for the Fire Protection of
		Telecommunications Facilities
	77-2014	Recommended Practice on Static Electricity
	90A-2015	Standard for the Installation of Air
		Conditioning and Ventilating Systems
	99-2015	Health Care Facilities Code
	101-2015	Life Safety Code
	241	Safeguarding construction, alternation and
		Demolition Operations
	255-2006	Standard Method of Test of Surface Burning
		Characteristics of Building Materials
	262 - 2011	Standard Method of Test for Flame Travel and
		Smoke of Wires and Cables for Use in Air-
		Handling Spaces
	780-2014	Standard for the Installation of Lightning
		Protection Systems
	1221-2013	Standard for the Installation, Maintenance, and
		Use of Emergency Services Communications
		Systems
	5000-2015	Building Construction and Safety Code
16.	Society for Protection	ve Coatings (SSPC):
	SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
17.	Society of Cable Tel	ecommunications Engineers (SCTE):
	ANSI/SCTE 15 2006	Specification for Trunk, Feeder and
		Distribution Coaxial Cable
18.	Telecommunications I	ndustry Association (TIA):
	TIA-120 Series	Telecommunications Land Mobile communications
		(APCO/Project 25) (January 2014)
	TIA TSB-140	Additional Guidelines for Field-Testing Length,
		Loss and Polarity of Optical Fiber Cabling
		Systems (2004)
	TIA-155	Guidelines for the Assessment and Mitigation of
		Installed Category 6 Cabling to Support
		10GBASE-T (2010)

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

TIA TSB-162-A Telecommunications Cabling Guidelines for Wireless Access Points (2013) TIA-222-G Structural Standard for Antenna Supporting Structures and Antennas (2014) Electrical Characteristics of Unbalanced TIA/EIA-423-B Voltage Digital Interface Circuits (2012) TIA-455-C General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (August 2014) TIA-455-53-A FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length) (September 2001) FOTP-61 Measurement of Fiber of Cable TIA-455-61-A Attenuation Using an OTDR (July 2003) ТІА-472D000-В Fiber Optic Communications Cable for Outside Plant Use (July 2007) ANSI/TIA-492-B 62.5-µ Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers (November 2009) ANSI/TIA-492AAAB-A 50-um Core Diameter/125-um Cladding Diameter Class IA Graded-Index Multimode Optically Optimized American Standard Fibers (November 2009 TIA-492CAAA Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers (September 2002) TIA-492E000 Sectional Specification for Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1,550 nm Window (September 2002) TIA-526-7-B Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant - OFSTP-7 (December 2008)

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

TIA-526.14-A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant - SFSTP-14 (August 1998) TIA-568 Revision/Edition: C Commercial Building Telecommunications Cabling Standard Set: (TIA-568-C.0-2 Generic Telecommunications Cabling for Customer Premises (2012), TIA-568-C.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (2012), TIA-568-C.2 Commercial Building Telecommunications Cabling Standard-Part 2: Balanced Twisted Pair Cabling Components (2009), TIA-568-C.3-1 Optical Fiber Cabling Components Standard, (2011) AND TIA-568-C.4 Broadband Coaxial Cabling and Components Standard (2011) with addendums and erratas TIA-569 Revision/Edition C Telecommunications Pathways and Spaces (March 2013) TIA-574 Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange (May 2003) TIA/EIA-590-A Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant (July 2001) TIA-598-D Optical Fiber Cable Color Coding (January 2005) TIA-604-10-B Fiber Optic Connector Intermateability Standard (August 2008) ANSI/TIA-606-B Administration Standard for Telecommunications Infrastructure (2012) TIA-607-B Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013) TIA-613 High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005)

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

ANSI/TIA-758-B	Customer-owned Outside Plant Telecommunications
	Infrastructure Standard (April 2012)
ANSI/TIA-854	A Full Duplex Ethernet Specification for 1000
	Mb/s (1000BASE-TX) Operating over Category 6
	Balanced Twisted-Pair Cabling (2001)
ANSI/TIA-862-A	Building Automation Systems Cabling Standard
	(April 2011)
TIA-942-A	Telecommunications Infrastructure Standard for
	Data Centers (March 2014)
TIA-1152	Requirements for Field Testing Instruments and
	Measurements for Balanced Twisted Pair Cabling
	(September 2009)
TIA-1179	Healthcare Facility Telecommunications
	Infrastructure Standard (July 2010)

1.4 SINGULAR NUMBER

A. Where any device or part of equipment is referred in singular number (such as " rack"), reference applies to as many such devices as are required to complete installation.

1.5 RELATED WORK

- A. Specification Order of Precedence: FAR Clause 52.236-21, VAAR Clause 852.236-71.
 - 1. Field Cutting and Patching: Section 09 91 00, PAINTING.
 - 2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
 - 3. Availability and source of references and standards specified in applicable publications: Section 01 42 19, REFERENCE STANDARDS.
 - 4. Control of environmental pollution and damage for air, water, and land resources: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
 - 5. Requirements for non-hazardous building construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
 - General requirements and procedures to comply with various federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable design: Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
 - 7. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction: Section 07 84 00, FIRESTOPPING.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Sealant and caulking materials and their application: Section 07 92 00, JOINT SEALANTS.
- General electrical requirements that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- 10. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 0519, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- 11. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- 12. Conduit and boxes: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
- 13. Wiring devices: Section 26 27 26, WIRING DEVICES.
- 14. Underground ducts, raceways, precast manholes and pull boxes: Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.
- B. Be proactive in scheduling work.
 - 1. Use of premises is restricted at times directed by COR.
 - Movement of materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.
 - Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work.
 - 5. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies; provide required connection for each service.
 - 6. Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- C. Contact the Office of Telecommunications, Special Communications Team (0050P2H3) (202)461-5310 to have a Government-accepted Telecommunications COR assigned to project for telecommunications review, equipment and system approval and coordination with other VA personnel.
- D. Communications Project Manager Responsibilities:
 - Assume responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and authorized system installers.
 - 2. Coordinate with related work indicated on drawings or specified.
 - Manage work related to telecommunications system installation in a manner approved by manufacturer.

1.7 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Provide parts list including quantity of spare parts.
- C. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.
- D. Provide Source Quality Control Submittal:
 - Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of warranty maintenance are authorized representatives of OEM. Include individual's legal name, contact information and OEM credentials in certification.
 - 2. Submit written certification from OEM that wiring and connection diagrams meet Government Life Safety Guidelines, NFPA, NEC, NRTL, these specifications, and Joint Commission requirements and instructions, requirements, recommendations, and guidance set forth by OEM for the proper performance of system.
 - 3. Pre-acceptance Certification: Certification in accordance with procedure outlined in Section 01 00 00, GENERAL REQUIREMENTS and specific Division 27 qualification documentation.
- E. Installer Qualifications: Submit three installations of similar size and complexity furnished and installed by installer; include:
 - 1. Installation location and name.

- Owner's name and contact information including, address, telephone and email.
- 3. Date of project start and date of final acceptance.
- 4. System project number.
- 5. Three paragraph description of each system related to this project; include function, operation, and installation.
- F. Provide delegated design submittals (e.g. seismic support design).
- G. Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on seismic design categories per section 4.0 of VA seismic design requirements H-18-8 dated August 2013.
- H. Test Equipment List:
 - Supply test equipment of accuracy better than parameters to be tested.
 - 2. Submit test equipment list including make and model number:
 - a. ANSI/TIA-1152 Level IIIe twisted pair cabling test instrument.
 - b. Fiber optic insertion loss power meter with light source.
 - c. Optical time domain reflectometer (OTDR).
 - d. Volt-Ohm meter.
 - e. Digital camera.
 - f. Bit Error Test Set (BERT).
 - 3. Supply only test equipment with a calibration tag from Governmentaccepted calibration service dated not more than 12 months prior to test.
 - 4. Provide sample test and evaluation reports.
- I. Submittal Drawings:
 - Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:
 - a. Telecommunications rooms.
 - b. Building Entrance Facility/Demarcation rooms.
 - c. Server rooms/Data Center.

- d. Equipment rooms.
- e. Antenna Head End rooms.
- Logical Drawings: Provide logical riser or schematic drawings for all systems.
 - a. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections.
- 3. Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.
- J. Provide sustainable design submittals.
- K. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

1.8 CLOSEOUT SUBMITTALS

- A. Provide following closeout submittals prior to project closeout date:
 - 1. Warranty certificate.
 - 2. Evidence of compliance with requirements such as low voltage certificate of inspection.
 - 3. Project record documents.
 - 4. Instruction manuals and software that are a part of system.
- B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
 - 1. Prepare a manual for each system and equipment specified.
 - 2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
 - 3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.
 - 4. Furnish remaining manuals prior to final completion.
 - 5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
 - Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
 - Provide a Table of Contents and assemble files to conform to Table of Contents.
 - 8. Operation and Maintenance Data includes:
 - a. Approved shop drawing for each item of equipment.

- b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
- c. A control sequence describing start-up, operation, and shutdown.
- d. Description of function of each principal item of equipment.
- e. Installation and maintenance instructions.
- f. Safety precautions.
- g. Diagrams and illustrations.
- h. Test Results and testing methods.
- i. Performance data.
- j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.
- k. Warranty documentation indicating end date and equipment protected under warranty.
- Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.
- C. Record Wiring Diagrams:
 - Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction meetings or field inspections.
 - 2. General Drawing Specifications: Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm (24" x 36") with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 1' 0 inch).
 - 3. Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 4. Floor plans to include:
 - a. Final room numbers and actual backbone cabling and pathway locations and labeling.
 - b. Inputs and outputs of equipment identified according to labels installed on cables and equipment
 - c. Device locations with labels.
 - d. Conduit.
 - e. Head-end equipment.
 - f. Wiring diagram.
 - g. Labeling and administration documentation.
- 5. Submit Record Wiring Diagrams within five business days after final cable testing.
- 6. Deliver Record Wiring Diagrams as CAD files in .dwg or .rvt formats as determined by COR.
- Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.
- D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within four hours of receipt of notification service is needed.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. After approval and prior to installation, furnish COR with the following:
 - 1. A 300 mm (12 inch) length of each type and size of wire and cable along with tag from coils of reels from which samples were taken.
 - One coupling, bushing and termination fitting for each type of conduit.
 - 3. Samples of each hanger, clamp and supports for conduit and pathways.
 - 4. Duct sealing compound.

1.10 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer must produce, as a principal product, the equipment and material specified for this project, and have manufactured item for at least three years.
- B. Product and System Qualification:
 - OEM must have three installations of equipment submitted presently in operation of similar size and type as this project, that have continuously operated for a minimum of three years.

- 2. Government reserves the right to require a list of installations where products have been in operation before approval.
- 3. Authorized representative of OEM must be responsible for design, satisfactory operation of installed system, and certification.
- C. Trade Contractor Qualifications: Trade contractor must have completed three or more installations of similar systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identify these installations as a part of submittal.
- D. System Supplier Qualifications: System supplier must be authorized by OEM to warranty installed equipment.
- E. Telecommunications technicians assigned to system must be trained, and certified by OEM on installation and testing of system; provide written evidence of current OEM certifications for installers.
- F. Manufactured Products:
 - 1. Comply with FAR clause 52.236-5 for material and workmanship.
 - When more than one unit of same class of equipment is required, units must be product of a single manufacturer.
 - 3. Equipment Assemblies and Components:
 - a. Components of an assembled unit need not be products of same manufacturer.
 - b. Manufacturers of equipment assemblies, which include components made by others, to assume complete responsibility for final assembled unit.
 - c. Provide compatible components for assembly and intended service.
 - d. Constituent parts which are similar must be product of a single manufacturer.
 - Identify factory wiring on equipment being furnished and on wiring diagrams.
- G. Testing Agencies: Government reserves the option of witnessing factory tests. Notify COR minimum 15 working days prior to manufacturer performing the factory tests.
 - When equipment fails to meet factory test and re-inspection is required, contractor is liable for additional expenses, including expenses of Government.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
 - 1. Government's approval of submittals must be obtained for equipment and material before delivery to job site.
 - Deliver and store materials to job site in OEM's original unopened containers, clearly labeled with OEM's name and equipment catalog numbers, model and serial identification numbers for COR to inventory cable, patch panels, and related equipment.
- B. Storage and Handling Requirements:
 - Equipment and materials must be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
 - a. Store and protect equipment in a manner that precludes damage or loss, including theft.
 - b. Protect painted surfaces with factory installed removable heavy kraft paper, sheet vinyl or equivalent.
 - c. Protect enclosures, equipment, controls, controllers, circuit protective devices, and other like items, against entry of foreign matter during installation; vacuum clean both inside and outside before testing and operating.
- C. Coordinate storage.

1.12 FIELD CONDITIONS

- A. Where variations from documents are requested in accordance with GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, connecting work and related components must include additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. A contract adjustment or additional time will not be granted because of field conditions pursuant to FAR 52.236-2 and FAR 52.236-3; a contract adjustment or additional time will not be granted for additional work required for complete and usable construction and systems pursuant to FAR 52.246-12.

1.13 WARRANTY

A. Comply with FAR clause 52.246-21.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Provide communications spaces and pathways conforming to TIA 569, at a minimum.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.2 EQUIPMENT IDENTIFICATION

- A. Provide laminated black phenolic resin with a white core nameplates with minimum 6 mm (1/4 inch) high engraved lettering.
- B. Nameplates furnished by manufacturer as standard catalog items, unless other method of identification is indicated.

2.3 UNDERGROUND WARNING TAPE

A. Underground Warning: Standard 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type; red with black letters imprinted with "CAUTION BURIED ELECTRIC LINE BELOW", orange with black letters imprinted with "CAUTION BURIED TELEPHONE LINE BELOW" or orange with black letters imprinted with "CAUTION BURIED FIBER OPTIC LINE BELOW", as applicable.

2.4 WIRE LUBRICATING COMPOUND

A. Provide non-hardening or forming adhesive coating cable lubricants suitable for cable jacket material and raceway.

2.5 FIREPROOFING TAPE

- A. Provide flexible, conformable fabric tape of organic composition and coated one side with flame-retardant elastomer.
- B. Tape must be self-extinguishing and cannot support combustion; arcproof and fireproof.
- C. Tape cannot deteriorate when subjected to water, gases, salt water, sewage, or fungus; and tape must be resistant to sunlight and ultraviolet light.
- D. Application must withstand a 200-ampere arc for minimum 30 seconds.
- E. Securing Tape: Glass cloth electrical tape minimum 0.18 mm (7 mils) thick and 19 mm (3/4 inch) wide.

2.6 UNDERGROUND CABLES

- A. Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound.
- B. Provide closure of adequate strength to protect splice and maintain cable shield electrical continuity in buried environment.
- C. Provide re-enterable encapsulating compound maintaining chemical stability of closure.
- D. Provide filled splice cases in accordance with RUS Bull 345-72.
- E. Provide gel filled cable meeting requirements of ICEA S-99-689 and RUS 1755.390.

- F. In Vault or Manhole:
 - Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound
 - Closure must be suitable thermoplastic, thermo-set, or stainless steel material supplying structural strength to pass mechanical and electrical requirements in a vault or maintenance hole (manhole) environment.
- G. Re-Enterable Encapsulating Compound: Product maintaining chemical stability of closure.
- H. Provide gel-filled splice cases in accordance with RUS Bull 345-72.

2.7 ACCESS PANELS

- A. Panels: 304 mm x 304 mm (12 inches by 12 inches), or size allowed by location to provide optimum access to equipment for maintenance and service.
- B. Provide access panels and doors as required to allow service of materials and equipment that require inspection, replacement, repair or service.
- C. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling; ceilings consisting of lay-in or removable splined tiles do not require access panels.
- D. Provide access panels with same fire rating classification as surface penetrated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Penetrations and Sleeves:
 - Lay out penetration and sleeve openings in advance, to permit provision in work.
 - 2. Set sleeves in forms before concrete is poured.
 - Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.
 - Provide sleeves and packing materials at penetrations of foundations, walls, slabs, partitions, and floors.
 - Make sleeves that penetrate outside walls, basement slabs, footings, and beams waterproof.

- Fill slots, sleeves and other openings in floors or walls if not used.
 - a. Fill spaces in openings after installation of conduit or cable.
 - b. Provide fill for floor penetrations to prevent passage of water, smoke, fire, and fumes.
 - c. Provide fire resistant fill in rated floors and walls, to prevent passage of air, smoke and fumes.
- Install sleeves through floors watertight and extend minimum 50.8 mm
 (2 inches) above floor surface.
- Match and set sleeves flush with adjoining floor, ceiling, and wall finishes where raceways passing through openings are exposed in finished rooms.
- 9. Annular space between conduit and sleeve must be minimum 6 mm (1/4 inch).
- Do not provide sleeves for slabs-on-grade, unless specified or indicated otherwise.
- 11. Comply with requirements for firestopping, for sleeves through rated fire walls and smoke partitions.
- 12. Do not support piping risers or conduit on sleeves.
- 13. Identify unused sleeves and slots for future installation.
- 14. Provide core drilling if walls are poured or otherwise constructed without sleeves and wall penetration is required; do not penetrate structural members.
- B. Core Drilling:
 - 1. Avoid core drilling whenever possible.
 - Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement.
 - Investigate existing conditions in vicinity of required opening prior to coring, including an x-ray of floor if determined necessary by competent person or COR.
 - 4. Protect areas from damage.
- C. Verification of In-Place Conditions:
 - Verify location, use and status of all material, equipment, and utilities that are specified, indicated, or determined necessary for removal.
 - a. Verify materials, equipment, and utilities to be removed are inactive, not required, or in use after completion of project.

- b. Replace with equivalent any material, equipment and utilities that were removed by contractor that are required to be left in place.
- 2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
 - a. Notify COR in writing at least 14 days in advance of proposed utility interruptions.
 - b. Do not proceed with utility interruptions without Government's written permission.
- D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall and ceiling mounting of equipment as required.
- E. Provide steel supports and hardware for installation of hangers, anchors, guides, and other support hardware.
- F. Obtain and analyze catalog data, weights, and other pertinent data required for coordination of equipment support provisions and installation.
- G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

3.2 INSTALLATION - GENERAL

- A. Coordinate systems, equipment, and materials installation with other building components.
- B. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.
- C. Conform to VAAR 852.236.91 arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items because of variances in manufacturers' methods of achieving specified results.
- D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.
- E. Install equipment according to manufacturers' written instructions.
- F. Install wiring and cabling between equipment and related devices.
- G. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect

equipment for ease of disconnecting, with minimum interference of adjacent other installations.

- H. Provide access panel or doors where units are concealed behind finished surfaces.
- I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.
- J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.
- K. Install systems, materials, and equipment giving priority to systems required to be installed at a specified slope.
- L. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of COR and code requirements.
- M. Install equipment and cabling to distribute equipment loads on building structural members provided for equipment support under other sections; install and support roof-mounted equipment on structural steel or roof curbs as appropriate.
- N. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

3.3 EQUIPMENT INSTALLATION

- A. Locate equipment as close as practical to locations shown on drawings.
- B. Note locations of equipment requiring access on record drawings.
- C. Access and Access Panels: Verify access panel locations and construction with COR.
- D. Inaccessible Equipment:
 - Where Government determines that contractor has installed equipment not conveniently accessible for operation and maintenance, equipment must be removed and reinstalled as directed and without additional cost to Government.
 - 2. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for communication equipment cabinet assembly.
 - 3. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for equipment labeling.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.4 EQUIPMENT IDENTIFICATION

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Secure identification signs with screws.

3.5 CUTTING AND PATCHING

- A. Perform cutting and patching according to contract general requirements and as follows:
 - 1. Remove samples of installed work as specified for testing.
 - Perform cutting, fitting, and patching of equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace non-conforming work.
- B. Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.
- C. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.
- D. Protect adjacent installations during cutting and patching operations.
- E. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- F. Patch finished surfaces and building components using new materials specified for original installation and experienced installers.

3.6 FIELD QUALITY CONTROL

- A. Provide work according to VAAR 852.236.91 and FAR clause 52.236-5.
- B. Provide minimum clearances and work required for compliance with NFPA 70, National Electrical Code (NEC), and manufacturers' instructions; comply with additional requirements indicated for access and clearances.
- C. Verify all field conditions and dimensions that affect selection and provision of materials and equipment, and provide any disassembly, reassembly, relocation, demolition, cutting and patching required to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment.
 - 1. Protect facility, equipment, and wiring from damage.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- D. Submit written notice that:
 - 1. Project has been inspected for compliance with documents.

2. Work has been completed in accordance with documents.

- E. Non-Conforming Work: Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.
- F. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by COR or design professional to verify project compliance for same material or equipment, Government reserves right to obtain compensation from contractor to defray cost of additional site visits that result from project construction or testing deficiencies and incompleteness, incorrect information, or noncompliance with project provisions.
 - COR will notify contractor, of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits.
 - Contractor is not eligible for extensions of project schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.
- G. Tests:
 - Interim inspection is required at approximately 50 percent of installation.
 - Request inspection ten working days prior to interim inspection start date by notifying COR in writing; this inspection must verify equipment and system being provided adheres to installation, mechanical and technical requirements of construction documents.
 - Inspection to be conducted by OEM and factory-certified contractor representative, and witnessed by COR, facility and SMCS 0050P2H3 representatives.
 - 4. Check each item of installed equipment to ensure appropriate NRTL listing labels and markings are fixed in place.

- 5. Verify cabling terminations in DEMARC, MCR, TER, SCC, ECC, TRs and head end rooms, workstation locations and TCO adhere to color code for T568B pin assignments and cabling connections are in compliance with TIA standards.
- 6. Visually confirm minimum Category 6 for existing cabling and Category 6A for new cabling cable marking at TCOs, CCSs locations, patch cords and origination locations.
- Review entire communications circulating ground system, each TGB and grounding connection, grounding electrode and outside lightning protection system.
- 8. Review cable tray, conduit and path/wire way installation practice.
- 9. OEM and contractor to perform:
 - a. Fiber optical cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
 - b. Coaxial cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
 - c. Baseband cable field inspection tests via attenuation measurements on factory reels and provide results along with OEM certification for factory reel tests.
- 10. Relocate failed cable reels to a secured location for inventory, as directed by COR, and then remove from project site within two working days; provide COR with written confirmation of defective cable reels removal from project site.
- 11. Provide results of interim inspections to COR.
- 12. If major or multiple deficiencies are discovered, additional interim inspections could be required until deficiencies are corrected, before permitting further system installation.
 - a. Additional inspections are scheduled at direction of COR.
 - Re-inspection of deficiencies noted during interim inspections, must be part of system's Final Acceptance Proof of Performance Test.
 - c. The interim inspection cannot affect the system's completion date unless directed by COR.
- Facility COR will ensure test documents become a part of system's official documentation package.

- H. Pretesting: Re-align, re-balance, sweep, re-adjust and clean entire system and leave system working for a "break-in" period, upon completing installation of system and prior to Final Acceptance Proof of Performance Test. System RF transmitting equipment must not be connected to keying or control lines during "break-in" period.
 - 1. Pretesting Procedure:
 - a. Verify systems are fully operational and meet performance requirements, utilizing accepted test equipment and spectrum analyzer.
 - b. Pretest and verify system functions and performance requirements conform to construction documents and, that no unwanted physical, aural and electronic effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise are present.
 - Measure and record signal, aural and control carrier levels of each DAS RF, voice and data channel, at each of the following minimum points in system:
 - a. Utility provider entrance.
 - b. Buried conduit duct locations.
 - c. Maintenance Holes (Manholes) and hand holes.
 - d. ENTR or DEMARC.
 - e. PBX interconnections.
 - f. MCR interconnections.
 - g. MCOR interconnections.
 - h. TER interconnections.
 - i. TOR interconnections.
 - j. Control room interconnections.
 - k. TR interconnections.
 - 1. System interfaces in locations listed herein.
 - m. HE interconnections.
 - n. Communications circulating ground system.
 - o. UPS areas.
 - p. Emergency generator interconnections.
 - q. Each general floor areas.
 - r. Others as required by AHJ (SMCS 0050P2H3).
 - 3. Provide recorded system pretest measurements and certification that the system is ready for formal acceptance test to COR.

- I. Acceptance Test:
 - Schedule an acceptance test date after system has been pretested, and pretest results and certification submitted to COR.
 - Give COR fifteen working days written notice prior to date test is expected to begin; include expected duration of time for test in notification.
 - 3. Test in the presence of the following:
 - a. COR.
 - b. OEM representatives.
 - c. VACO:
 - 1) CFM representative.
 - 2) AHJ-SMCS 0050P2H3, (202)461-5310.
 - d. VISN-CIO, Network Officer and VISN representatives.
 - e. Facility:
 - FMS Service Chief, Bio-Medical Engineering and facility representatives.
 - 2) OI&T Service Chief and OI&T representatives.
 - Safety Officer, Police Chief and facility safety representatives.
 - f. Local Community Safety Personnel:
 - 1) Fire Marshal representative.
 - 2) Disaster Coordinator representative.
 - EMS Representatives: Police, Sherriff, City, County or State representatives.
 - Test system utilizing accepted test equipment to certify proof of performance and Life and Public Safety compliance, FCC, NRTL, NFPA and OSHA compliance.
 - a. Rate system as acceptable or unacceptable at conclusion of test; make only minor adjustments and connections required to show proof of performance.
 - Demonstrate and verify that system complies with performance requirements under operating conditions.
 - Failure of any part of system that precludes completion of system testing, and which cannot be repaired within four hours, terminates acceptance test of that portion of system.

- Repeated failures that result in a cumulative time of eight hours to affect repairs is cause for entire system to be declared unacceptable.
- If system is declared unacceptable, retesting must be rescheduled at convenience of Government and costs borne by the contractor.
- J. Acceptance Test Procedure:
 - Physical and Mechanical Inspection: The test team representatives must tour major areas to determine system and sub-systems are completely and properly installed and are ready for acceptance testing.
 - 2. A system inventory including available spare parts must be taken at this time.
 - Each item of installed equipment must be re-checked to ensure appropriate NRTL (i.e., UL) certification listing labels are affixed.
 - 4. Confirm that deficiencies reported during Interim Inspections and Pretesting are corrected prior to start of Acceptance Test.
 - Inventory system diagrams, record drawings, equipment manuals, pretest results.
 - Failure of system to meet installation requirements of specifications is grounds for terminating testing and to schedule re-testing.
- K. Operational Test:
 - 1. Government's Condition of Acceptance of System Language:
 - a. Without Acceptance: Until system fully meets conditions of construction documents, system's ownership, use, operation and warranty commences at Government's final acceptance date.
 - b. With Conditional Acceptance: Stating conditions that need to be addressed by contractor or OEM and stating system's use and operation to commence immediately while its warranty commences only at Government's agreed final extended acceptance date.
 - c. With Full Acceptance: Stating system's ownership, use, operation and warranty to immediately commence at Government's agreed to date of final acceptance.
- L. Acceptance Test Conclusion: Reschedule testing on deficiencies and shortages with COR, after COR and SMCS AHJ jointly agree to results of

the test, using the generated punch list or discrepancy list. Perform
retesting to comply with these specifications at contractor's expense.
M. Proof of Performance Certification:

- If system is declared acceptable, AHJ (SMCS 0050P2H3) provides COR notice stating system processes to required operating standards and functions and is Government accepted for use by facility.
- 2. Validate items with COR needing to be provided to complete project contract (i.e., charts & diagrams, manuals, spare parts, system warranty documents executed, etc.). Once items have been provided, COR contacts FMS service chief to turn over system from CFM oversight for beneficial use by facility.
- 3. If system is declared unacceptable without conditions, rescheduled testing expenses are to be borne by contractor.

3.7 CLEANING

- A. Remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and clean work area, prior to final inspection and acceptance of work.
- B. Put building and premises in neat and clean condition.
- C. Remove debris on a daily basis.
- D. Remove unused material, during progress of work.
- E. Perform cleaning and washing required to provide acceptable appearance and operation of equipment to satisfaction of COR.
- F. Clean exterior surface of all equipment, including concrete residue, dirt, and paint residue, after completion of project.
- G. Perform final cleaning prior to project acceptance by COR.
- H. Remove paint splatters and other spots, dirt, and debris; touch up scratches and mars of finish to match original finish.
- Clean devices internally using methods and materials recommended by manufacturer.
- J. Tighten wiring connectors, terminals, bus joints, and mountings, to include lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. In absence of published connection or terminal torque values, comply with torque values specified in UL 486A-486B.

3.8 TRAINING

A. Provide training in accordance with subsection, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

- B. Provide training for equipment or system as required in each associated specification.
- C. Develop and submit training schedule for approval by COR, at least 30 days prior to planned training.

3.9 PROTECTION

- A. Protection of Fireproofing:
 - Install clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed, if possible, prior to start of spray fireproofing work.
 - Install conduits and other items that would interfere with proper application of fireproofing after completion of spray fire proofing work.
 - Patch and repair fireproofing damaged due to cutting or course of work must be performed by installer of fireproofing and paid for by trade responsible for damage.
- B. Maintain equipment and systems until final acceptance.
- C. Ensure adequate protection of equipment and material during installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

- - - E N D - - -

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section identifies common and general grounding and bonding requirements of communication installations and applies to all sections of Divisions 27.

1.2 RELATED WORK

A. Low voltage wiring: Section 27 10 00, STRUCTURED CABLING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Provide plan indicating location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
- C. Closeout Submittals: In addition to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide the following:
 - 1. Certified test reports of ground resistance.
 - Certifications: Two weeks prior to final inspection, submit following to COR:
 - a. Certification materials and installation is in accordance with construction documents.
 - b. Certification complete installation has been installed and tested.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Grounding and Bonding Conductors:
 - Provide UL 83 insulated stranded copper equipment grounding conductors, with the exception of solid copper conductors for sizes 6 mm² (10 AWG) and smaller. Identify all grounding conductors with continuous green insulation color, except identify wire sizes 25 mm² (4 AWG) and larger per NEC.
 - Provide ASTM B8 bare stranded copper bonding conductors, with the exception of ASTM B1 solid bare copper for wire sizes 6 mm² (10 AWG) and smaller.

- B. Splices and Termination Components: Provide components meeting or exceeding UL 467 and clearly marked with manufacturer's name, catalog number, and permitted conductor sizes.
- C. Telecommunication System Ground Busbars:
 - 1. Telecommunications Main Grounding Busbar (TMGB):
 - a. 6.4 mm (1/4 inch) thick solid copper bar.
 - b. Minimum 100 mm (4 inches) high and length sized in accordance application requirements and future growth of minimum 510 mm (20 inches) long.
 - c. Minimum thirty predrilled attachment points (two rows of fifteen each) for attaching standard sized two-hole grounding lugs.
 - 1) 27 lugs with 15.8 mm (5/8 inch) hole centers.
 - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
 - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
 - e. Listed as grounding and bonding equipment.
 - 2. Telecommunications Grounding Busbar (TGB):
 - a. 6.4 mm (1/4 inch) thick solid copper bar.
 - b. Minimum 50 mm (2 inches) high and length sized in accordance application requirements and future growth of minimum 300 mm long (12 inches) long.
 - c. Minimum nine predrilled attachment points (one row) for attaching standard sized two-hole grounding lugs.
 - 1) 6 lugs with 15.8 mm (5/8 inch) hole centers.
 - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
 - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
 - e. Listed as grounding and bonding equipment.
- D. Equipment Rack and Cabinet Ground Bars:
 - Solid copper ground bars designed for horizontal mounting to framework of open racks or enclosed equipment cabinets:
 - a. 4.7 mm (3/16 inch) thick by 19.1 mm (3/4 inch) high hard-drawn electrolytic tough pitch 110 alloy copper bar.
 - b. 482 mm (19 inches) or 584 mm (23 inches) EIA/ECA-310-E rack mounting width (as required) for mounting on racks or cabinets.

- c. Eight 6-32 tapped ground mounting holes on 25.4 mm (1 inch) intervals.
- d. Four 7.1 mm (0.281 inch) holes for attachment of two-hole
 grounding lugs.
- e. Copper splice bar of same material to transition between adjoining racks.
- f. Two each 12-24 x 19.1 mm (3/4 inch) copper-plated steel screws and flat washers for attachment to rack or cabinet.
- g. Listed as grounding and bonding equipment.
- 2. Solid copper ground bars designed for vertical mounting to framework of open racks or enclosed equipment cabinets:
 - a. 1.3 mm (0.05 inch) thick by 17 mm (0.68 inch) wide tinned copper strip.
 - b. 1997 mm (78 inches) high for mounting vertically on full height racks.
 - c. Holes punched on 15.875 mm-15.875 mm-12.7 mm (5/8"-5/8"-1/2") alternating vertical centers to match EIA/ECA-310-E Universal Hole Pattern for a 45 RMU rack.
 - d. Three #12-24 zinc-plated thread forming hex washer head installation screws, an abrasive pad and antioxidant joint compound.
 - e. NRTL listed as grounding and bonding equipment.
- E. Ground Terminal Blocks: Provide screw lug-type terminal blocks at equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted.
 - 1. Electroplated tin aluminum extrusion.
 - 2. Accept conductors ranging from #14 AWG through 2/0.
 - 3. Hold conductors in place by two stainless steel set screws.
 - Two 6 mm (1/4 inch) holes spaced on 15.8 mm (5/8 inch) centers to allow secure two-bolt attachment.
 - 5. Listed as a wire connector.
- F. Splice Case Ground Accessories: Provide splice case grounding and bonding accessories manufactured by splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

G. Irreversible Compression Lugs:

- 1. Electroplated tinned copper.
- 2. Two holes spaced on 15.8 mm (5/8 inch) or 25.4 mm (1 inch) centers.
- 3. Sized to fit the specific size conductor.
- 4. Listed as wire connectors.
- H. Antioxidant Joint Compound: Oxide inhibiting joint compound for copperto-copper, aluminum-to-aluminum, or aluminum-to-copper connections.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Exterior Equipment Grounding: Bond exterior metallic components (including masts and cabinets), antennas, satellite dishes, towers, raceways, primary telecommunications protector/arresters, secondary surge protection, waveguides, cable shields, down conductors and other conductive items to directly to Intersystem Bonding Termination.
- B. Install telecommunications bonding backbone conductor throughout building via telecommunications backbone pathways effectively bonding all interior telecommunications grounding busbars in telecommunications rooms and main computer room to telecommunications main grounding busbar in Demarc room after testing bond to verify bonding conductor for telecommunications from grounding electrode conductor is installed per NEC. Size telecommunications bonding backbone conductor as specified in TIA-607-B.
- C. Inaccessible Grounding Connections: Utilize exothermic welding for bonding of buried or otherwise inaccessible connections with the exception of connections requiring periodic testing.
- D. Conduit Systems:
 - 1. Bond ferrous metallic conduit to ground.
 - Bond grounding conductors installed in ferrous metallic conduit at both ends of conduit using grounding bushing with #6 AWG conductor.
- E. Boxes, Cabinets, and Enclosures:
 - Bond each pull box, splice box, equipment cabinet, and other enclosures through which conductors pass (except for special grounding systems for intensive care units and other critical units shown) to ground.

- F. Corrosion Inhibitors: Apply corrosion inhibitor for protecting connection between metals used to contact surfaces, when making ground and ground bonding connections.
- G. Telecommunications Grounding System:
 - Bond telecommunications grounding systems and equipment to facility's electrical grounding electrode at Intersystem Bonding Termination.
 - Provide hardware as required to effectively bond metallic cable shields communications pathways, cable runway, and equipment chassis to ground.
 - 3. Install bonding conductors without splices using shortest length of conductor possible to maintain clearances required by NEC.
 - Provide paths to ground that are permanent and continuous with a resistance of 1 ohm or less from each raceway, cable tray, and equipment connection to telecommunications grounding busbar.
 - 5. Below-Grade Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with manufacturer's recommendations. After welds have been made and cooled, brush slag from weld area and thoroughly clean joint areas. Notify COR prior to backfilling at ground connections.
 - 6. Above-Grade Bolted or Screwed Grounding Connections:
 - a. Remove paint to expose entire contact surface by grinding.
 - b. Clean all connector, plate and contact surfaces.
 - c. Apply corrosion inhibitor to surfaces before joining.
 - 7. Bonding Jumpers:
 - a. Assemble bonding jumpers using insulated ground wire of size and type shown on drawings or use a minimum of 16 mm² (6 AWG) insulated copper wire terminated with compression connectors of proper size for conductors.
 - b. Use connector manufacturer's compression tool.
 - 8. Bonding Jumper Fasteners:
 - a. Conduit: Connect bonding jumpers using lugs on grounding bushings or clamp pads on push-type conduit fasteners. Where appropriate, use zinc-plated external tooth lockwashers or Belleville Washers.

- b. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers or Belleville washers and nuts. Install protective cover, e.g., zinc-plated acorn nuts, on bolts extending into wireway or cable tray to prevent cable damage.
- c. Grounding Busbars: Fasten bonding conductors using two-hole compression lugs. Use 300 series stainless steel bolts, Belleville Washers, and nuts.
- d. Slotted Channel Framing and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and Belleville washers or external tooth lock washers.
- H. Telecommunications Room Bonding:
 - 1. Telecommunications Grounding Busbars:
 - a. Install busbar hardware no less than 950 mm (18 inches) A.F.F.
 - b. Where other grounding busbars are located in same room, e.g., electrical panelboard for telecommunications equipment, bond busbars together as indicated on grounding riser diagrams.
 - c. Make conductor connections with two-hole compression lugs sized to fit busbar and conductors.
 - d. Attach lugs with stainless steel hardware after preparing bond according to manufacturer recommendations and treating bonding surface on busbar with antioxidant to help prevent corrosion.
 - 2. Telephone-Type Cable Rack Systems:
 - a. Aluminum pan installed on telephone-type cable rack serves as primary ground conductor within communications room.
 - b. Make ground connections by installing bonding jumpers:
 - Install minimum 16 mm² (6 AWG) bonding between telecommunications ground busbars and the aluminum pan installed on cable rack.
 - Install 16 mm² (6 AWG) bonding jumpers across aluminum pan junctions.
- I. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
 - Install rack-mount horizontal busbar or vertical busbar to provide multiple bonding points,
 - At each rack or cabinet containing active equipment or shielded cable terminations:
 - a. Bond busbar to ground as part of overall telecommunications bonding and grounding system.

- b. Bond copper ground bars together using solid copper splice plates manufactured by same ground bar manufacturer, when ground bars are provided at rear of lineup of bolted together equipment racks.
- c. Bond non-adjacent ground bars on equipment racks and cabinets with 16 mm² (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
- d. Provide 16 mm² (6 AWG) bonding jumpers between rack and cabinet ground busbars and overhead cable runway or raised floor stringers, as appropriate.
- J. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near top of backboards used for communications cross-connect systems. Connect backboard ground terminals to cable runway using an insulated 16 mm² (6 AWG) bonding jumper.
- K. Other Communication Room Ground Systems: Ground metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray or telecommunications ground busbar, whichever is closer, using insulated 16 mm² (6 AWG) ground wire bonding jumpers.
- L. Communications Cable Grounding:
 - Bond all metallic cable sheaths in multi-pair communications cables together at each splicing or terminating location to provide 100 percent metallic sheath continuity throughout communications distribution system.
 - Install a cable shield bonding connector with a screw stud connection for ground wire, at terminal points. Bond cable shield connector to ground.
 - 3. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or splice case manufacturer's splice case grounding and bonding accessories. When an external ground connection is provided as part of splice closure, connect to an effective ground source and bond all other metallic components and equipment at that location.
- M. Communications Cable Tray Systems:
 - Bond metallic structures of cable tray to provide 100 percent electrical continuity throughout cable tray systems.

- 2. Where metallic cable tray systems are mechanically discontinuous:
 - a. Install splice plates provided by cable tray manufacturer between cable tray sections so resistance across a bolted connection is 0.010 ohms or less, as verified by measuring across splice plate connection.
 - b. Install 16 mm² (6 AWG) bonding jumpers across each cable tray splice or junction where splice plates cannot be used.
- 3. Bond cable tray installed in same room as telecommunications grounding busbar to busbar.
- N. Communications Raceway Grounding:
 - Conduit: Use insulated 16 mm² (6 AWG) bonding jumpers to bond metallic conduit at both ends and intermediate metallic enclosures to ground.
 - Cable Tray Systems: Use insulated 16 mm² (6 AWG) grounding jumpers to bond cable tray to column-mounted building ground plates (pads) at both ends and approximately 16 meters (50 feet) on centers.
- O. Ground Resistance:
 - 1. Install telecommunications grounding system so resistance to grounding electrode system measures 5 ohms or less.

3.2 FIELD QUALITY CONTROL

- A. Perform tests per BICSI's Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
- B. Perform two-point bond test using trained installers qualified to use test equipment.
- C. Conduct continuity test to verify that metallic pathways in telecommunications spaces are bonded to TGB or TMGB.
- D. Conduct electrical continuity test to verify that TMGB is effectively bonded to grounding electrode conductor.
- E. Visually inspect to verify that screened and shielded cables are bonded to TGB or TMGB.
- F. Perform a resistance test to ensure patch panel, rack and cabinet bonding connection resistance measures less than 5 Ohms to TGB or TMGB.

- - - E N D - - -
SECTION 27 05 33

RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for communications cabling unless shown or specified otherwise.

1.2 RELATED WORK

- A. Bedding of conduits: Section 31 20 00, EARTH MOVING.
- B. Mounting board for Telecommunication Rooms: Section 06 10 00, ROUGH CARPENTRY.
- C. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- D. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.
- F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- G. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

- A. In accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit the following:
 - 1. Size and location of cabinets, splice boxes and pull boxes.
 - 2. Layout of required conduit penetrations through structural elements.
 - Catalog cuts marked with specific item proposed and area of application identified.
- B. Certification: Provide letter prior to final inspection, certifying material is in accordance with construction documents and properly installed.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Minimum Conduit Size: 25 mm (1 inch).

- B. Conduit:
 - 1. Rigid Galvanized Steel: Conform to UL 6, ANSI C80.1.
 - Rigid Intermediate Steel Conduit (IMC): Conform to UL 1242, ANSI C80.6.
 - 3. Electrical Metallic Tubing (EMT):
 - a. Maximum Size: 105 mm (4 inches).
 - b. Install only for cable rated 600 volts or less.
 - c. Conform to UL 797, ANSI C80.3.
 - 4. Flexible Galvanized Steel Conduit: Conform to UL 1.
 - 5. Liquid-tight Flexible Metal Conduit: Conform to UL 360.
 - 6. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high-density polyethylene (HDPE).
 - 7. Surface Metal Raceway: Conform to UL 5.
 - Wireway, Approved "Basket": Provide "Telecommunications Service" rated with approved length way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
- C. Conduit Fittings:
 - Rigid Galvanized Steel and Rigid Intermediate Steel Conduit Fittings:
 - a. Provide fittings meeting requirements of UL 514B and ANSI/ NEMA FB 1.
 - b. Sealing: Provide threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water and vapor. In concealed work, install sealing fittings in flush steel boxes with blank cover plates having same finishes as other electrical plates in room.
 - c. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - d. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
 - e. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into metallic body of fitting. Bushings made entirely of metal or nonmetallic material are not permitted.

f. Erickson (union-type) and Set Screw Type Couplings:

- 1) Couplings listed for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete.
- Use set screws of case-hardened steel with hex head and cup point to seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
- g. Provide OEM approved fittings.
- 2. Electrical Metallic Tubing Fittings:
 - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
 - b. Couplings and Connectors: Concrete tight and rain tight, with connectors having insulated throats.
 - Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
 - Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
 - 3) Use set screws of case-hardened steel with hex head and cup point to seat in wall of conduit for positive grounding.
 - c. Indent type connectors or couplings are not permitted.
 - d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
 - e. Provide OEM approved fittings.
- 3. Flexible Steel Conduit Fittings:
 - a. Conform to UL 514B; only steel or malleable iron materials are acceptable.
 - b. Provide clamp type, with insulated throat.
 - c. Provide OEM approved fittings.
- 4. Liquid-tight Flexible Metal Conduit Fittings:
 - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
 - b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
 - c. Provide connectors with insulated throats to prevent damage to cable jacket.
 - d. Provide OEM approved fittings.

- 5. Direct Burial Plastic Conduit Fittings: Provide fittings meeting requirements of UL 514C and NEMA TC3, and as recommended by conduit manufacturer.
- 6. Surface Metal Raceway: Conform to UL 5 and "telecommunications service" rated with approved length-way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
- 7. Surface Metal Raceway Fittings: As recommended by raceway manufacturer.
- 8. Expansion and Deflection Couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
 - c. Include internal flexible metal braid sized to ensure conduit ground continuity and fault currents in accordance with UL 467, and NEC code tables for ground conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- 9. Wireway Fittings: As recommended by wireway OEM.
- D. Conduit Supports:
 - 1. Parts and Hardware: Provide zinc-coat or equivalent corrosion protection.
 - Individual Conduit Hangers: Designed for the purpose, having a preassembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.78 mm (12 gage) steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.
 - Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Splice, and Pull Boxes:
 - 1. Conform to UL-50 and UL-514A.
 - 2. Cast metal where required by NEC or shown, and equipped with rustproof boxes.
 - 3. Sheet Metal Boxes: Galvanized steel, except where otherwise shown.

- 4. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with wall.
- 5. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".
- H. Flexible Nonmetallic Communications Raceway (Innerduct) and Fittings:
 - General: Provide UL 910 listed plenum, riser, and general purpose corrugated pliable communications raceway for optical fiber cables and communications cable applications; select in accordance with provisions of NEC Articles 770 and 800.
 - Provide Communications Raceway with a factory installed 567 kg (1250 lb.) tensile pre-lubricated pull tape.
 - 3. Use only metallic straps, hangers, and fittings to support raceway from building structure. Cable ties are not permitted for securing raceway to building structure.
 - 4. Provide fittings to be installed in spaces used for environmental air made of materials that do not exceed flammability, smoke generation, ignitibility, and toxicity requirements of environmental air space.
 - 5. Size: Metric Designator 53 (trade size 2) or smaller.
 - Outside Plant: Plenum-rated where each interduct is 75 mm (3 inches) and larger.
 - 7. Inside Plant: Listed and marked for installation in plenum airspaces and minimum 25 mm (1 inch) inside diameter.
 - 8. Plenum: Non-metallic communications raceway.
 - a. Constructed of low smoke emission, flame retardant PVC with corrugated construction.
 - b. UL 94 V-O rating for flame spreading limitation.
 - 9. Provide innerduct reel lengths as necessary to ensure ducts are continuous; one piece runs from ENTR to MH; MH to MH; DEMARC to MCR/TER; TR to TR. Innerduct connectors are not permitted between rooms.

- Provide pulling accessories used for innerduct including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (blown air) compatible with materials being pulled.
- I. Outlet Boxes:
 - Flush wall mounted minimum 11.9 cm (4-11/16 inches) square, 9.2 cm (3-5/8 inches) deep pressed galvanized steel.
 - 2. 2-Gang Tile Box:
 - a. Flush backbox type for installation in block walls.
 - b. Minimum 92 mm (3-5/8 inches) deep.
- J. Weatherproof Outlet Boxes: Surface mount two gang, 67 mm (2-5/8 inches) deep weatherproof cast aluminum with powder coated finish internal threads on hubs 19 mm (3/4 inch) minimum.
- K. Cable Tray:
 - Provide wire basket type of sizes indicated; with all required splicing and mounting hardware.
 - 2. Materials and Finishes:
 - a. Electro-plated zinc galvanized (post plated) made from carbon steel and plated to ASTM B 633, Type III, SC-1.
 - b. Remove soot, manufacturing residue/oils, or metallic particles after fabrication.
 - c. Rounded edges and smooth surfaces.
 - Provide continuous welded top side wire to protect cable insulation and installers.
 - 4. High strength steel wires formed into a 50 x 100 mm (2 inches by 4 inches) wire mesh pattern with intersecting wires welded together.
 - 5. Wire Basket Sizes:
 - a. Wire Diameter: 5 mm (0.195 inch) minimum on all mesh sections.
 - b. Usable Loading Depth: 105 mm (4 inch) // 150 mm (6 inches) // .
 - c. Width: As shown on plans.
 - 6. Fittings: Field-formed, from straight sections, in accordance with manufacturer's instructions.
 - 7. Provide accessories to protect, support and install wire basket tray system.
- L. Cable Duct: Equip with hinged covers, except where removable covers are accepted by COR.
- M. Cable Duct Fittings: As recommended by cable duct OEM.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Raceways typically required for cabling systems unless otherwise indicated:

System	Specification Section	Installed Method
Grounding	27 05 26	Conduit Not Required
Control, Communication and Signal Wiring	27 10 00	Complete Conduit Allowed in Non-Partitioned Cable Tray or Cable Ladders
Communications Structured Cabling	27 15 00	Conduit to Cable Tray Partitioned Cable Tray
Master Antenna Television Equipment and Systems	27 41 31	Conduit to Cable Tray, Partitioned Cable Tray
Security Emergency Call, Duress Alarm, and Telecommunications	27 52 31	Conduit to Cable Tray, Partitioned Cable Tray
Grounding and Bonding for Electronic Safety and Security	28 05 26	Conduit Not Required Unless Required by Code
Physical Access Control System	28 13 00	Conduit to Cable Tray Partitioned Cable Tray
Security Access Detection	28 13 53	Complete Conduit
Intrusion Detection System	28 16 00	Conduit to Cable Tray, Partitioned Cable Tray
Video Surveillance	28 23 00	Complete Conduit
Fire Detection and Alarm	28 31 00	Complete Conduit

- B. Penetrations:
 - 1. Cutting or Holes:
 - a. Locate holes in advance of installation. Where they are proposed in structural sections, obtain approval of structural engineer and COR prior to drilling through structural sections.
 - b. Make holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not permitted; COR may grant limited permission by request, in condition of limited working space.

- c. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.
 - Fill and seal clearances between raceways and openings with fire stop material.
 - Install only retrofittable, non-hardening, and reusable firestop material that can be removed and reinstalled to seal around cables inside conduits.
- d. Waterproofing at Floor, Exterior Wall, and Roof Conduit Penetrations:
 - Seal clearances around conduit and make watertight as specified in Section 07 92 00, JOINT.
- C. Conduit Installation:
 - Minimum conduit size of 25 mm (1 inch), but not less than size required for 40 percent fill.
 - 2. Install insulated bushings on all conduit ends.
 - Install pull boxes after every 180 degrees of bends (two 90 degree bends). Size boxes per TIA 569.
 - Extend vertical conduits/sleeves through floors minimum 75 mm (3 inches) above floor and minimum 75 mm (3 inches) below ceiling of floor below.
 - 5. Terminate conduit runs to and from a backboard in a closet or interstitial space at top or bottom of backboard. Install conduits to enter telecommunication rooms next to wall and flush with backboard.
 - Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections.
 - Seal empty conduits located in telecommunications rooms or on backboards with a standard non-hardening putty compound to prevent entrance of moisture and gases and to meet fire resistance requirements.

Sizes of Conduit Trade Size	Radius of Conduit Bends
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

8. Minimum radius of communication conduit bends:

- 9. Provide 19 mm (3/4 inch) thick fire-retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on wall of communication closets where shown on drawings. Mount plywood with bottom edge 300 mm (12 inches) above finished floor and top edge 2.74 m (9 feet) A.F.F.
- Provide pull wire in all empty conduits; sleeves through floor are exceptions.
- 11. Complete each entire conduit run installation before pulling in cables.
- 12. Flattened, dented, or deformed conduit is not permitted.
- Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
- 14. Cut conduit square with a hacksaw, ream, remove burrs, and draw tight.
- 15. Install conduit mechanically continuous.
- 16. Independently support conduit at 2.44 m (8 feet) on center; do not use other supports (i.e., suspended ceilings, suspended ceiling supporting members, luminaires, conduits, mechanical piping, or mechanical ducts).
- 17. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
- Close ends of empty conduit with plugs or caps to prevent entry of debris, until cables are pulled in.
- 19. Attach conduits to cabinets, splice cases, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit

installations, provide a locknut on inside of enclosure, made up wrench tight. Do not make conduit connections to box covers.

- 20. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors, and ceilings.
- 21. Conduit Bends:
 - a. Make bends with standard conduit bending machines; observe minimum bend radius for cable type and outside diameter.
 - b. Conduit hickey is permitted only for slight offsets, and for straightening stubbed conduits.
 - c. Bending of conduits with a pipe tee or vise is not permitted.
- 22. Layout and Homeruns Deviations: Make only where necessary to avoid interferences and only after drawings showing proposed deviations have been submitted and approved by COR.
- D. Concealed Work Installation:
 - 1. In Concrete:
 - a. Conduit: Rigid steel or IMC.
 - b. Align and run conduit in direct lines.
 - c. Install conduit through concrete beams only when the following occurs:
 - 1) Where shown on structural drawings.
 - As accepted by COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
 - d. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
 - Conduit outside diameter larger than 1/3 of slab thickness is prohibited.
 - Space between Conduits in Slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
 - Install conduits approximately in center of slab to ensure a minimum of 19 mm (3/4 inch) of concrete around conduits.
 - e. Make couplings and connections watertight. Use thread compounds that are NRTL listed conductive type to ensure low resistance ground continuity through conduits. Tightening set screws with pliers is not permitted.

- E. Furred or Suspended Ceilings and in Walls:
 - 1. Rigid steel. Different type conduits mixed indiscriminately in same system is not permitted.
 - 2. Align and run conduit parallel or perpendicular to building lines.
 - 3. Tightening set screws with pliers is not permitted.
- F. Exposed Work Installation:
 - Unless otherwise indicated on drawings, exposed conduit is only permitted in telecommunications rooms.
 - a. Provide rigid steel, IMC, or rigid aluminum.
 - b. Different type of conduits mixed indiscriminately in system is not permitted.
 - 2. Align and run conduit parallel or perpendicular to building lines.
 - 3. Install horizontal runs close to ceiling or beams and secure with conduit straps.
 - Support horizontal or vertical runs at not over 2400 mm (96 inches) intervals.
 - 5. Surface Metal Raceways: Use only where shown on drawings.
 - 6. Painting:
 - a. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
 - b. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color.
 - c. Provide labels where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.
- G. Expansion Joints:
 - Conduits 75 mm (3 inches) and larger, that are secured to building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install couplings in accordance with manufacturer's recommendations.
 - Provide conduits smaller than 75 mm (3 inches) with pull boxes on both sides of expansion joint. Connect conduits to expansion and deflection couplings as specified.
 - 3. Install expansion and deflection couplings where shown.
- H. Conduit Supports, Installation:
 - Select AC193 code listed mechanical anchors or fastening devices with safe working load not to exceed 1/4 of proof test load.

- Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- 3. Support multiple conduit runs with trapeze hangers. Use trapeze hangers designed to support a load equal or greater than sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other accepted fasteners.
- 4. Support conduit independent of pull boxes, luminaires, suspended ceiling components, angle supports, duct work, and similar items.
- 5. Fastenings and Supports in Solid Masonry and Concrete:
 - a. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing concrete.
 - b. Existing Construction:
 - Code AC193 listed wedge type steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.
 - 2) Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).
 - Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- 6. Fastening to Hollow Masonry: Toggle bolts are permitted.
- 7. Fastening to Metal Structures: Use machine screw fasteners or other devices designed and accepted for application.
- Bolts supported only by plaster or gypsum wallboard are not acceptable.
- Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- 10. Do not support conduit from chain, wire, or perforated strap.
- 11. Spring steel type supports or fasteners are not permitted except horizontal and vertical supports/fasteners within walls.
- 12. Vertical Supports:
 - a. Install riser clamps and supports for vertical conduit runs in accordance with NEC.
 - b. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

- I. Box Installation:
 - 1. Boxes for Concealed Conduits:
 - a. Flush mounted.
 - b. Provide raised covers for boxes to suit wall or ceiling, construction, and finish.
 - 2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables during pulling.
 - 3. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
 - 4. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams; for example, "SIG-FA JB No. 1".
 - Outlet boxes mounted back-to-back in same wall are not permitted. A minimum 600 mm (24 inches) center-to-center lateral spacing must be maintained between boxes.
- J. Flexible Nonmetallic Communications Raceway (Innerduct), Installation:
 - 1. Install supports from building structure for horizontal runs at intervals not to exceed 900 mm (3 feet) and at each end.
 - Install supports from building structure for vertical runs at intervals not to exceed 1.2 m (4 feet) and at each side of joints.
 - 3. Install only in accessible spaces not subject to physical damage or corrosive influences.
 - Make bends manually to assure internal diameter of tubing is not effectively reduced.
 - 5. Extend each segment of innerduct minimum 300 mm (12 inches) beyond end of service conduit tie or cable tray. Restrain innerduct ends with wall mount clamps and seal when cable is installed.

3.2 TESTING

- A. Examine fittings and locknuts for secureness.
- B. Test RMC, IMC and EMT systems for electrical continuity.
- C. Perform simple continuity test after cable installation.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes requirements for commissioning facility communications systems, related subsystems, and related equipment. This Section supplements general requirements specified in Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Complete list of equipment and systems to be commissioned is specified in Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and Specification 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Commissioned Systems:
 - Commissioning of systems specified in Division 27 is part of project's construction process including documentation and proof of performance testing of these systems, as well as training of VA's Operation and Maintenance personnel in accordance with requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and Division 27, in cooperation with Government and Commissioning Agent.
 - The facility exterior closure systems commissioning includes communications systems listed in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS and 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

1.2 RELATED WORK

- A. System tests: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Commissioning process requires review of selected submittals that pertain to systems to be commissioned: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Construction phase commissioning process and procedures including roles and responsibilities of commissioning team members and user training: Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

1.3 COORDINATION

- A. Commissioning Agent will provide a list of submittals that must be reviewed by Commissioning Agent simultaneously with engineering review; do not proceed with work of sections identified without engineering and Commissioning Agent's review completed.
- B. Commissioning of communications systems require inspection of individual elements of communications system construction throughout

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

construction period. Coordinate with Commissioning Agent in accordance with Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and commissioning plan to schedule communications systems inspections as required to support the commissioning process.

1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.
- B. Pre-Functional Checklists:
 - Complete pre-functional checklists provided by commissioning agent to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing.
 - 2. Submit completed checklists to COR and to Commissioning Agent. Commissioning Agent can spot check a sample of completed checklists. If Commissioning Agent determines that information provided on the checklist is not accurate, Commissioning Agent then returns the marked-up checklist to Contractor for correction and resubmission.
 - 3. If Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, Commissioning Agent can select a broader sample of checklists for review.
 - 4. If Commissioning Agent determines that a significant number of broader sample of checklists is also inaccurate, all checklists for the type of equipment will be returned to Contractor for correction and resubmission.
- C. Submit training agendas and trainer resumes in accordance with requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Contractor's Tests:
 - Scheduled tests required by other sections of Division 27 must be documented in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Incorporate all testing into project schedule. Provide minimum seven calendar days' notice of testing for Commissioning Agent to witness selected Contractor tests at sole discretion of Commissioning Agent.
- 3. Complete tests prior to scheduling Systems Functional Performance Testing.
- B. Systems Functional Performance Testing:
 - Commissioning process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions.
 - 2. Commissioning Agent prepares detailed Systems Functional Performance Test procedures for review and acceptance by COR.
 - 3. Provide required labor, materials, and test equipment identified in test procedure to perform tests.
 - 4. Commissioning Agent must witness and document the testing.
 - a. Provide test reports to Commissioning Agent. Commissioning Agent will sign test reports to verify tests were performed.

3.2 TRAINING

- A. Training of Government's operation and maintenance personnel is required in cooperation with COR and Commissioning Agent.
- B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning location, operation, and troubleshooting of installed systems.
- C. Schedule instruction in coordination with COR after submission and approval of formal training plans.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 27 10 00 CONTROL, COMMUNICATION AND SIGNAL WIRING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes control, communication, and signal wiring for a comprehensive systems infrastructure.
- B. This section applies to all sections of Divisions 27.

1.2 RELATED WORK

- A. Excavation and backfill for cables that are installed in conduit: Section 31 20 00, EARTH MOVING.
- B. Sealing around penetrations to maintain integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- C. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Submit written certification from OEM:
 - Indicate wiring and connection diagrams meet National and Government Life Safety Guidelines, NFPA, NEC, NRTL, Joint Commission, OEM, this section and Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
 - Include instructions, requirements, recommendations, and guidance for proper performance of system as described herein.
 - Government will not approve any submittal without this certification.
- C. Identify environmental specifications on technical submittals; identify requirements for installation.
 - 1. Minimum floor space and ceiling heights.
 - 2. Minimum size of doors for cable reel passage.

- D. Power: Provide specific voltage, amperage, phases, and quantities of circuits.
- E. Provide conduit size requirements.
- F. Closeout Submittals:
 - Provide contact information for maintenance personnel to contact contractor for emergency maintenance and logistic assistance, and assistance in resolving technical problems at any time during warranty period.
 - 2. Provide certified OEM sweep test tags from each cable reel to COR.
 - Furnish spare or unused wire and cable with appropriate connectors (female types) for installation in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.
 - Turn over unused and opened installation kit boxes, coaxial, fiber optic, and twisted pair cable reels, conduit, cable tray, cable duct bundles, wire rolls, physical installation hardware to COR.
 - 5. Documentation: Include any item or quantity of items, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide system documentation required herein.

PART 2 - PRODUCTS

2.1 CONTROL WIRING

- A. Provide control wiring large enough so voltage drop under in-rush conditions does not adversely affect operation of controls.
- B. Provide cable meeting specifications for type of cable.
- C. Outside Location (i.e., above ground, underground in conduit, ducts, pathways, etc.): Provide cables filled with a waterproofing compound between outside jacket (not touching any provided armor) and inter conductors to seal punctures in jacket and protect conductors from moisture.
- D. Remote Control Cable:
 - Multi-conductor with stranded conductors able to handle power and voltage required to control specified system equipment, from a remote location.
 - 2. NRTL listed and pass VW-1 vertical wire flame test (UL 83) (formerly FR-1).

- Color-coded Conductors: Combined multi-conductor and coaxial cables are acceptable for this installation, on condition system performance standards are met.
- 4. Technical Characteristics:
 - a. Length: As required, in 1K (3,000 ft.) reels minimum.
 - b. Connectors: As required by system design.
 - c. Size:
 - 1) 18 AWG, minimum, Outside.
 - 2) 20 AWG, minimum, Inside.
 - d. Color Coding: Required, EIA industry standard.
 - e. Bend Radius: 10 times cable outside diameter.
 - f. Impedance: As required.
 - g. Shield Coverage: As required by OEM specification.
 - h. Attenuation:

Frequency in MHz	dB per 305 Meter (1,000 feet), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
50.0	52.0

- E. Distribution System Signal Wires and Cables:
 - Provide in same manner, and use construction practices, as Fire Protective and other Emergency Systems identified and defined in NFPA 101, Life Safety Code, Chapters 7, 12, and 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions.
 - 2. Provide system able to withstand adverse environmental conditions without deterioration, in their respective location.
 - Provide entering of each equipment enclosure, console, cabinet, or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of cables.
 - 4. Terminate on an item of equipment by direct connection.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.2 COMMUNICATION AND SIGNAL WIRING

- A. Provide communications and signal wiring conforming to recommendations of manufacturers of systems; provide not less than TIA Performance Category 6A.
- B. Wiring shown is for typical systems; provide wiring as required for systems being provided.
- C. Provide color-coded conductor insulation for multi-conductor cables.
- D. Connectors:
 - Provide connectors for transmission lines, and signal extensions to maintain uninterrupted continuity, ensure effective connection, and preserve uniform polarity between all points in system.
 - a. Provide AC barrier strips with a protective cover to prevent accidental contact with wires carrying live AC current.
 - b. Provide punch blocks for signal connection, not AC power. AC power twist-on wire connectors are not permitted for signal wire terminations.
 - 2. Cables: Provide connectors designed for specific size cable and conductors being installed with OEM's approved installation tool. Typical system cable connectors include:
 - a. Audio spade lug.
 - b. Punch block.
 - c. Wirewrap.

2.3 INSTALLATION KIT

- A. Include connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, cable tray, etc., required to accomplish a neat and secure installation.
- B. Terminate conductors in a spade lug and barrier strip, wire wrap terminal or punch block, so there are no unfinished or unlabeled wire connections.
- C. Minimum required installation sub-kits:
 - 1. System Grounding:
 - a. Provide required cable and installation hardware for effective ground path, including the following:
 - 1) Control Cable Shields.
 - 2) Data Cable Shields.

27 10 00 - 4

- 3) Equipment Racks.
- 4) Equipment Cabinets.
- 5) Conduits.
- 6) Ducts.
- 7) Cable Trays.
- 8) Power Panels.
- 9) Connector Panels.
- 10) Grounding Blocks.
- b. Bond radio equipment to earth ground via internal building wiring, according to NEC.
- Wire and Cable: Provide connectors and terminals, punch blocks, tie wraps, hangers, clamps, labels, etc. required to accomplish termination in an orderly installation.
- 3. Conduit, Cable Duct, and Cable Tray: Provide conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, cable tray installation in accordance with NEC and documents.
- 4. Equipment Interface: Provide any items or quantity of equipment, cable, mounting hardware and materials to interface systems with identified sub-systems, according to OEM requirements and construction documents.
- 5. Labels: Provide any item or quantity of labels, tools, stencils, and materials to label each subsystem according to OEM requirements, asinstalled drawings, and construction documents.
- D. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:
 - Connector Panels: Flat smooth 3.175 mm (1/8 inch) thick solid aluminum, custom designed, fitted and installed in cabinet. Install bulkhead equipment connectors on panel to enable cabinet equipment's signal, control, and coaxial cables to be connected through panel. Match panel color to cabinet installed.
 - a. Voice (or Telephone) and Digital or High-Speed Data:
 - Provide 480 mm (19 inches) horizontal EIA/ECA 310 rack mountable patch panel with EIA/ECA 310 standard spaced vertical mounting holes for digital or high-speed data service CSS, with modular female Category 6A for specialized powered

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

systems accepted by SMCS 0050P2H3, (202) 461-5310, OI&T and FMS Services, and COR) RJ45 jacks designed for size and type of UTP or F/UTP cable installed in rows.

- 2) Technical Characteristics:
 - a) Number of Horizontal Rows: Minimum 2.
 - b) Number of Jacks Per Row: Minimum 24.
 - c) Type of Jacks: RJ45.
 - d) Terminal Protector: Required for each used or unused jack.
 - e) Insulation: Required between each row of jacks.

2.4 EXISTING WIRING

- A. Reuse existing wiring only where indicated on plans and accepted by SMCS 0050P2H3.
- B. Only existing wiring that conforms to specifications and applicable codes can be reused; existing wiring that does not meet these requirements cannot be reused and must be removed by contractor.
- C. Existing wiring must be Category 6 or above to be reused.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install wiring in cable tray or raceway.
 - Seal cable entering a building from underground, between wire and conduit where cable exits conduit, with non-hardening approved compound.
 - 3. Wire Pulling:
 - a. Provide installation equipment that prevents cutting or abrasion of insulation during pulling of cables.
 - b. Use ropes made of nonmetallic material for pulling feeders.
 - c. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached to conductors, as accepted by COR.
 - d. Pull multiple cables into a single conduit together.
- B. Installation in Maintenance or Manholes:
 - Install and support cables in maintenance holes on steel racks with porcelain or equal insulators.
 - Train cables around maintenance hole walls, but do not bend to a radius less than six times overall cable diameter.

- C. Control, Communication and Signal Wiring Installation:
 - Unless otherwise specified in other sections, provide wiring and connect to equipment/devices to perform required functions as indicated.
 - Install separate cables for each system so that malfunctions in any system does not affect other systems, except where otherwise required.
 - Group wires and cables according to service (i.e., AC, grounds, signal, DC, control, etc.); DC, control and signal cables can be included with any group.
 - 4. Form wires and cables to not change position in group throughout the conduit run. Bundle wires and cables in accepted signal duct, conduit, cable ducts, or cable trays neatly formed, tied off in 600 mm to 900 mm (24 inch to 36 inch) lengths to not change position in group throughout run.
 - 5. Concealed splices are not allowed.
 - Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure.
 - 7. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC and speaker wires or cables on the left; coaxial, control, microphone and line level audio and data wires or cables, on the right.
 - Provide ties and fasteners that do not damage or distort wires or cables. Limit spacing between tied points to maximum 150 mm (6 inches).
 - 9. Install wires or cables outside of buildings in conduit, secured to solid building structures.
 - 10. Wires or cables must be specifically accepted, on a case-by-case basis, to be installed outside of conduit. Bundled wires or cables must be tied at minimum 460 mm (18 inches) intervals to a solid building structure; bundled wires or cables must have ultraviolet protection and be waterproof (including all connections).
 - Laying wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not permitted.

- 12. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.:
 - a. Only when authorized, can wires or cables be identified and approved to be installed outside of conduit.
 - b. Provide wire or cable rated plenum and OEM certified for use in air plenums.
 - c. Provide wires and cables hidden, protected, fastened, and tied at maximum 600 mm (24 inches) intervals, to building structure.
 - d. Provide closer wire or cable fastening intervals to prevent sagging, maintain clearance above suspended ceilings.
 - e. Remove unsightly wiring and cabling from view and discourage tampering and vandalism.
 - f. Sleeve and seal wire or cable runs, not installed in conduit, that penetrate outside building walls, supporting walls, and twohour fire barriers, with an approved fire-retardant sealant.
- D. AC Power:
 - Bond to ground contractor-installed equipment and identified Government-furnished equipment, to eliminate shock hazards and to minimize ground loops, common mode returns, noise pickup, crosstalk, etc. for total ground resistance of 0.1 Ohm or less.
 - 2. Use of conduit, signal duct or cable trays as system or electrical ground is not permitted; use these items only for dissipation of internally generated static charges (not to be confused with externally generated lightning) that can be applied or generated outside mechanical and physical confines of system to earth ground. Discovery of improper system grounding is grounds to declare system unacceptable and termination of all system acceptance testing.
 - 3. Cabinet Bus: Extend a common ground bus of at least #10 AWG solid copper wire throughout each equipment cabinet and bond to system ground. Provide a separate isolated ground connection from each equipment cabinet ground bus to system ground. Do not tie equipment ground busses together.
 - 4. Equipment: Bond equipment to cabinet bus with copper braid equivalent to at least #12 AWG. Self-grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternatives.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.2 EQUIPMENT IDENTIFICATION

- A. Control, Communication and Signal System Identification:
 - 1. Install a permanent wire marker on each wire at each termination.
 - Identify cables with numbers and letters on the labels corresponding to those on wiring diagrams used for installing systems.
 - 3. Install labels retaining their markings after cleaning.
 - 4. In each maintenance hole (manhole) and handhole, install embossed brass tags to identify system served and function.

B. Labeling:

- 1. Industry Standard: ANSI/TIA-606-B.
- 2. Print lettering for voice and data circuits using laser printers or thermal ink transfer process; handwritten labels are not acceptable.
- 3. Cable and Wires (hereinafter referred to as "cable"): Label cables at both ends in accordance with industry standard. Provide permanent labels in contrasting colors. Identify cables matching system Record Wiring Diagrams.
- Equipment: Permanently labeled system equipment with contrasting plastic laminate or bakelite material. Label system equipment on face of unit corresponding to its source.
- 5. Conduit, Cable Duct, and Cable Tray: Label conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying system. Label each enclosure according to this standard.
- Termination Hardware: Label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with industry standard and Record Wiring Diagrams.

3.3 TESTING

- A. Minimum test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on cables in frequency ranges specified.
- B. Tests required for data cable must be made to confirm operation of this cable at minimum 10 Mega (M) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of 10-6 at maximum rate of speed.
- C. Provide cable installation and test records at acceptance testing to COR and thereafter maintain in facility's telephone switch room.

- D. Record changes (used pair, failed pair, etc.) in these records as change occurs.
- E. Test cables after installation and replace any defective cables.

- - - E N D - - -

SECTION 27 11 00 TELECOMMUNICATIONS ROOM FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies equipment cabinets, interface enclosures, relay racks, and associated hardware in service provider DEMARC, computer and telecommunications rooms.
- B. Telephone system is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Adhere to Seismic reference standards for systems connecting to or extending telephone system and cabling.

1.2 RELATED WORK

- A. Wiring devices: Section 26 27 26, WIRING DEVICES.
- B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- E. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.

1.3 SUBMITTALS

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATION.
- B. Separate submittal into sections for each subsystem containing the following:
 - Pictorial layouts of each Telecommunications Room and Cross Connection Space (VCCS, and HCCS termination cabinets), each distribution cabinet layout, and TCO as each is expected to be installed and configured.
 - 2. Equipment technical literature detailing electrical and technical characteristics of each item of equipment to be furnished.
- C. Environmental Requirements: Identify environmental specifications for housing system as initial and expanded system configurations.
 - 1. Floor loading for batteries and cabinets.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. Minimum floor space and ceiling height.
- 3. Minimum door size for equipment passage.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Provide components of cabinet system (cabinet, thermal, cable and power management accessories) from a single manufacturer.
- B. Equipment Standards and Testing:
 - Equipment must be listed by a NRTL where a UL standard is in existence; active and passive equipment must conform with each UL standard in effect for equipment, on the submittal date.
 - Each item of electronic equipment must be labeled by a NRTL that warrants equipment has been tested in accordance with and conforms to specified standards.
- C. Equipment Cabinets (Enclosures):
 - 1. Fully enclose and physically secure internally mounted and connected, active and passive equipment.
 - Types of Equipment Enclosures accepted for specific VA Spectrum Management, FMS and OI&T applications in CFM and Facility Projects:

CABINET	FUNCTION
Communications	FMS Special Communications Equipment
Server / Router	OI&T Data/LAN/WAN Equipment
Seismic	Either FMS or OI&T use, specify need
Environmental	Either FMS or OI&T use, specify need

- 3. Each cabinet to be:
 - a. Provided in head end, and MCR at a minimum.
 - b. Fabricated with minimum 1.59 mm (16 gauge) steel.
 - c. Provided with manufacturer's standard painted finish in a color accepted by COR with concurrence from FMS Service Chief.
 - d. Mounted on floor.
 - e. Lockable; tubular locks keyed alike. Provide six keys to COR for each cabinet.
- Provide equipment mounting shelves; attach to front and rear mounting rails and allowing equipment to be secured to respective mounting rails.
- 5. Each enclosure to include:
 - a. Floor mounting.

- b. Knock out holes for conduit connections or cable entrance.
- c. Front and rear locking doors; wall mounted cabinets require only front locking door.
- d. Power outlet strips.
- 6. Provide quiet ventilation fan with non-disposable locally cleanable air filter.
- 7. Size each cabinet in order to contain and maintain internal mounted equipment items.
- 8. Provide OEM's fully assembled unit.
- 9. Provide OEM assembled side-by-side enclosures in a single unit, at locations requiring more than two enclosures.
- 10. Provide minimum one cabinet with blank rack space, for additional system expansion equipment.
- 11. Bond to communications circulating grounding system.
- 12. Technical Characteristics:
 - a. External:
 - 1) Overall Height:
 - a) Communications/Server: Maximum 2,184 mm (86 inches).
 - 2) Overall Depth:
 - a) Communications/Server: Maximum 1219 mm (48 inches).
 - 3) Overall Width All: Maximum 864 mm (34 inches).
 - b. Front Panel Openings:
 - 1) Width:

a) Server: 483 mm (19 inches), per EIA/ECA 310.
 610 mm (24 inches), per EIA/ECA 310.
 1016mm (40 inches), per EIA/ECA 310.

- 2) Height:
 - a) Communications/Server: Maximum 2,000 mm (78-3/4 inches or 45 Rack Units [RU]), per EIA/ECA 310.
- c. Heavy Duty Cycle: Maximum 544 kilograms (1,200 pounds) capacity.
- d. Certification:
- 1) NRTL (i.e., UL): For communications and server cabinets.
- 13. Cabinet Internal Components:
 - a. AC Outlet Strips:
 - 1) Power Capacity: 20 Ampere, three-phase, 208y/120 VAC continuous duty.
 - 2) Wire Gauge: Minimum #12 AWG, solid copper.

- 3) Number of AC Power Outlets: (30) C13 and (6) C19.
- 4) Enclosure: Fully self-contained; typically metal.
- 5) Connecting Wire: Minimum 2 m (6 feet) long, with NEMA L21-20R plug connected to busway receptacle.
- 6) Number of Strips: 2.
- 7) Certification: NRTL (i.e., UL).
- 14. Ground Interconnection: Bond cabinet's common grounding lug to room's communications circulating ground busbar with a minimum #6 AWG stranded copper wire.
- 15. Blank Panels: Provide at every unused rack space.
 - a. Match cabinet color.
 - b. Provide panels of 3 mm (1/8 inch) thick aluminum with vertical dimensions in increments of one rack unit (RMU) or 45 mm (1-3/4 inch) with mounting holes spaced to correspond to EIA/ECA 310-E Standard 483 mm (19 inch) rack dimensions.
 - c. Fill large unused openings with single standard large panel instead of numerous types.
 - d. Leave one blank rack space (RMU), covered with a blank panel, between each item of equipment, for minimum internal air flow.
 - e. Leave 356 mm (14 inches) (8.0 RMU) open space, covered with blank cover panel, for additional expansion equipment.
 - f. Wire Management: System that connects each item of installed equipment to room wire management system.
 - g. Knock-out Holes: Provide for cable entrance/exits via conduits, cable duct/trays.
- D. Environmental Cabinet:
 - Enclosure must fully contain installed equipment, including electronics, in same manner as standard cabinet. Provide climate control for installed equipment as if they were in a standalone air handling area, regardless of local area air handling capabilities.
 - 2. Provide an OEM's fully assembled unit enclosure.
 - 3. If more than two enclosures are required in any system location, provide OEM-assembled enclosures, in a single unit, side-by-side.
 - 4. Technical Characteristics:
 - a. Environmental Control: Automatic, heating and cooling as required.

- b. Temperature Conditions (rated at 1,300 W of install equipment heat generation):
 - Internal Range: Maintains 26.67 degree to 37.78 degree C (80 degree to 100-degree F) of internal heat conditions.
 - 2) External Range: Maximum 37.78 degrees + -3.89 degrees C (100 degrees + 25 degrees F).
- c. Forced Air Unit: Required with non-disposable air filter; unobstructed and uninterruptible.
- d. Air Conditioning: As required; fully internal mounted.
- e. Heater: As required; fully internal mounted.
- f. UPS: Required; fully internal mounted.
- g. Front Door: Full length, see through, EMI resistant and lockable, keyed alike with 7-pin tubular lock.
- h. Rear door: Full length, see through, EMI resistant, and lockable keyed alike with 7-pin tubular lock.
- i. Conduit Wiring Entrance: Top or bottom; fully sealed.
- j. Input Power: Minimum 2 each; maximum 120 VAC at 20A, independent circuit, conduit for fixed or armored cable for moveable installations.
- k. Dimensions:
 - 1) Height: Maximum 1980 mm (78 inches).
 - 2) Width: Maximum 635 mm (25 inches).
 - 3) Depth: Maximum 965 mm (38 inches).
 - Front Panel Opening: 480 mm (19 inches), w/ EIA/ECA 310 mounting hole spacing.
- E. Wall Mounted Distribution or System Interface Cabinet:
 - Construct of minimum 1.59 mm (16 gauge) cold rolled steel, with top, side and bottom panels.
 - Provide double-hinged front door and main cabinet body allowing access to all internal equipment and wiring; mount to solid walls or internal studs.
 - 3. Provide baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using FMS Chief or COR.
 - 4. Provide integral and adjustable EIA/ECA 310 standard predrilled rack mounting rails to allow front panel equipment mounting and access.
 - 5. After equipment, doors and panels are installed, snap-in-place chrome trim strip covers all front panel screw fasteners.

- 6. Provide full-length vertical piano hinge to allow entire front portion of cabinet to "swing out" from wall for access to installed equipment, wires and cable; maintain minimum OSHA Safety clearances and NFPA operational functions.
- 7. Provide an OEM's fully assembled unit enclosure.
- Equip these cabinets same as equipment cabinets, except mount UPS on floor below cabinet with AC power connection in conduit to AC service panel.
- F. Stand Alone Open Equipment Rack:
 - Construct of minimum 1.59 mm (16 gauge) cold rolled steel with manufacturer's standard paint finish, in a color to be selected by COR with concurrence from facility's FMS Service Chief.
 - Floor-mount as directed by COR with concurrence from facility's FMS Service Chief.
 - Equip rack same as equipment cabinet, except mount UPS with additional support for weight and AC power connection in conduit to AC service panel.
 - 4. Provide an OEM fully assembled unit.
 - 5. Technical Characteristics:
 - a. Overall Height: Maximum 2,180 mm (85-7/8 inches).
 - b. Overall Width: Maximum 535 mm (21-1/16 inches).
 - c. Front Panel Opening: 483 mm (19 inches), EIA/ECA 310 horizontal width.
 - d. Hole Spacing: Per EIA/ECA 310.
 - e. Load Capacity: Maximum 680.4 kg (1,500 lbs).
 - f. Certifications:
 - 1) EIA/ECA: 310-E.
 - 2) NRTL (i.e., UL): OEM specific.
- G. Wire Management Equipment:
 - Provide an orderly horizontal and vertical interface between outside and inside wires and cables, distribution and interface wires and cables, interconnection wires and cables and associated equipment, jumper cables, and provide an uniform connection media for system fire-retardant wires and cables and other subsystems.
 - Interface to each cable tray, duct, wireway, or conduit used in the system.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 3. Interconnection or distribution wires and cables must enter system at top (or from a wireway in the floor) via overhead protection system and be uniformly routed down both sides at same time, of the frames side protection system, then laterally for termination on rear of each respective terminating assembly.
- H. Vertical Cable Managers:
 - Use same make, style and size of vertical cable manager on rack/frame or in between racks/frames when more than one cable manager is used on a rack/frame or group of racks/frames.
 - 2. Match color and cover style of racks/frames and cable managers.
- I. Horizontal Cable Managers:
 - Use same make and style of cable manager on rack/frame or racks/frames, when more than one horizontal cable manager is used on a rack/frame or group of racks/frames.
 - 2. Match color of racks/frames and cable managers.
- J. Provide installation hardware when enclosures or racks are attached to structural floor.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate cabinet installation such that doors fully close and lock, with active and passive equipment installed and connected.
- B. Verify equipment dimensions and brackets allow mounting with cabinet doors closed. Front door or rear door of any cabinet that does not close and lock may result in immediate cancellation of inspections or tests.

3.2 INSTALLATION

- A. Equipment Cabinets:
 - Install cabinets in a manner that complies with OEM instructions, requirements of this specification, and in a manner which does not constitute a safety hazard.
 - Provide weatherproof equipment installed outdoors or install in NEMA
 3S rated enclosures with hinged doors and locks with two keys.
 - 3. Install equipment indoors in NEMA 4 rated metal cabinets with hinged doors and locks with two keys.
- B. Grounding:
 - Bond equipment, including identified Government furnished equipment, to ground so total ground resistance measures maximum 0.1 Ohm.

- a. Install lightning arrestors and grounding in accordance with NFPA.
- b. Do not use AC neutral, including in power panel or receptacle outlet, for system control, subcarrier, or audio reference ground.
- c. Use of conduit, signal duct or cable trays as system or electrical ground is not permitted.
- Connect each equipment grounding terminal to a separate mounting hole on equipment mounting rail, to right as one looks at it from rear, with a minimum #12 AWG stranded copper wire with protective green jacket.
- 3. Extend common ground bus of minimum #10 AWG solid copper wire throughout each equipment cabinet and bond to TGB. Provide a separate isolated ground connection from each equipment cabinet ground bus to system ground. Do not tie equipment ground buses together.
- 4. Bond equipment to cabinet bus with copper braid equivalent to #12 AWG. Self-grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternatives.
- 5. Bond cable shields to cabinet ground bus with minimum #12 AWG stranded copper wire at only one end of cable run. Insulate cable shields from each other, faceplates, equipment racks, consoles, enclosures, or cabinets, except at system common ground point. Bond coaxial and audio cables only at source; in all cases, keep cable shield ground connections to a minimum.
- C. Equipment Assembly:
 - 1. Cabinets:
 - a. Install and adjust cabinet/frame accessories to position, including thermal management accessories, vertical cable managers, vertical power managers and equipment-mounting rails, using manufacturer's installation instructions prior to baying or placing cabinet for attachment to building and before installing any rack-mount equipment into cabinet. Shelves, horizontal cable managers and filler panels (rack-mount accessories), if used, may be installed after cabinet is placed.

- b. When used in a multi-cabinet bay, attach cabinets side-by-side using baying kits according to manufacturer's instructions.
- c. Attach overhead ladder rack or cable tray to ceiling or top of cabinet. Maintain minimum 75 mm (3 inches) clearance between top of cabinet and bottom of ladder rack/cable tray. Position ladder rack/cable tray so that it does not interfere with hot air exhaust through cabinet's top panel. Use radius drops where cable enters or exits ladder rack/cable tray.
- d. Install ladder rack with side stringers facing rack or cabinet so that ladder forms an inverted U-shape and so that welds between stringers (sides) and cross members (middle) face away from cables.
- e. Secure ladder rack to tops of equipment racks or cabinets using manufacturer's recommended supports and appropriate hardware.
- f. Attach bonding conductor sized per TIA-607-B between telecommunications grounding busbar and cabinet. Attach bonding conductor to cabinet using a ground terminal block according to manufacturer's installation instructions.
- g. Provide bonding conductor and other hardware required to make connections between cabinet and telecommunications grounding busbar.
- h. Install rack mounted equipment normally requiring adjustment or observation so operational adjustments can be conveniently made.
- i. Mount heavy equipment with rack slides or rails to allow servicing from front of enclosure. Provide support in addition to front panel mounting screws for heavy equipment.
- j. Provide with cable slack to permit servicing by removal of installed equipment from front of enclosure.
- k. Install color-matched blank panel spacer 44 mm (1.75 inches) high between each piece of active and passive equipment to ensure adequate air circulation for efficient equipment cooling and air ventilation.
- Provide quiet fans and non-disposable air filters at each console or cabinet.
- m. Install enclosures and racks plumb and square, permanently attached to building structure and held in place.

- n. Provide 381 mm (15 inches) of front vertical space opening for additional equipment.
- o. Install equipment located indoors in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
- p. Cables must enter equipment racks or enclosures in such a manner to allow doors or access panels to open and close without disturbing or damaging cables.
- q. Mount distribution hardware in a manner that allows access to connections for testing and provides room for doors or access panels to open and close without disturbing the cables.
- 2. Racks:
 - a. Assemble racks according to manufacturer's instructions.
 - b. Verify that equipment mounting rails are sized properly for rackmount equipment before attaching rack to floor.
 - c. Attach assembled racks to floor in four places using appropriate floor mounting anchors. When placed over a raised floor, threaded rods should pass through raised floor tile and be secured in structural floor below.
 - d. Bond racks to telecommunications grounding busbar using appropriate hardware provided by contractor.
 - e. Ladder rack may be attached to top of rack to deliver cables to rack. Do not drill rack to attach; use appropriate hardware from rack manufacturer.
 - f. Provide radius drops to guide cable where cable exits or enters side of overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet, or termination field.
 - g. Evenly distribute equipment load on rack. Place large and heavy equipment towards bottom of rack. Secure equipment to rack with equipment mounting screws.
- 3. Vertical Cable Managers:
 - Provide vertical managers so number of cables in each manager does not exceed OEM fill capacity.
 - b. Attach vertical cable managers to side of rack/frame using manufacturer's installation instructions and hardware.
 - c. Attach vertical cable manager to both racks/frames when a single vertical cable manager is used between two racks/frames.
- d. Dress cables through openings in between T-shaped guides on manager so that cables make gradual bends as they exit or enter cable manager into rack-mount space (RMU). Do not twist, coil or make sharp bends in cables.
- e. Attach doors to cable manager in closed position after cabling is complete.
- 4. Horizontal Cable Managers:
 - Attach horizontal cable managers to rack/frame with minimum four screws according to manufacturer's installation instructions.
 Center each cable manager within allocated rack-mount space (RMU).
 - b. Provide horizontal managers located so number of cables each manager supports is less than cable manager's cable fill capacity.
 - c. Dress cables through openings in between T-shaped guides on cable manager so that cables make gradual bends as they exit or enter cable manager into rack-mount space (RMU). Do not twist, coil or make sharp bends in cables.
 - d. Attach covers to cable manager in closed position after cabling is complete.
- D. Labeling: Permanently label each enclosure in accordance with TIA-606-B using laser printers or thermal ink transfer process; handwritten labels are not acceptable.
 - 1. Equipment: Label system equipment with contrasting plastic laminate or bakelite material on face of unit corresponding to its source.
 - Conduit, Cable Duct, and/or Cable Tray: Label conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 m (10 feet), identifying system.

- - - E N D - - -

SECTION 27 15 00 COMMUNICATIONS STRUCTURED CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies a complete and operating voice and digital structured cabling distribution system and associated equipment and hardware to be installed in VA Medical Center here-in-after referred to as the "facility".

1.2 RELATED WORK

- A. Wiring devices: Section 26 27 26, WIRING DEVICES.
- B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- E. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- F. High Definition (HDTV) Master Antenna Television (MATV) system and associated equipment: Section 27 41 31, MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS.

1.3 SUBMITTALS

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide:
 - Pictorial layout drawing of each main computer room, voice (telephone) equipment room, network operations room, Demarc room, telecommunications room, showing termination cabinets, each distribution cabinet and rack, as each is expected to be installed and configured.
 - 2. List of test equipment as per 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Certifications:
 - 1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of contract

maintenance are authorized representatives of OEM. Include individual's legal name and address and OEM warranty credentials in the certification.

- 2. Pre-acceptance Certification: Submit in accordance with test procedures.
- Test system cables and certify to COR before proof of performance testing can be conducted. Identify each cable as labeled on asinstalled drawings.
- Provide current and qualified test equipment OEM training certificates and product OEM installation certification for contractor installation, maintenance, and supervisory personnel.
- C. Closeout Submittal: Provide document from OEM certifying that each item of equipment installed conforms to OEM published specifications.

1.4 WARRANTY

A. Work subject to terms of Article "Warranty of Construction," FAR clause 52.246-21.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Provide complete system including "punch down" and cross-connector blocks voice and data distribution sub-systems, and associated hardware including telecommunications outlets (TCO); copper and fiber optic distribution cables, connectors, "patch" cables, "break out" devices and equipment cabinets, interface cabinets, and radio relay equipment rack.
- B. Industry Standards:
 - Cable distribution systems provided under this section are connected to systems identified as critical care performing life support functions.
 - Conform to National and Local Life Safety Codes (whichever are more stringent), NFPA, NEC, this section, Joint Commission Life Safety Accreditation requirements, and OEM recommendations, instructions, and guidelines.
 - Provide supplies and materials listed by a nationally recognized testing laboratory where such standards are established for supplies, materials, or equipment.

- Refer to industry standards and minimum requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and guidelines listed.
- 5. Active and passive equipment required by system design and approved technical submittal; must conform to each UL standard in effect for equipment, when technical submittal was reviewed and approved by Government or date when COR accepted system equipment to be replaced. Where a UL standard is in existence for equipment to be used in completion of this contract, equipment must bear approved NRTL label.
- C. System Performance: Provide complete system to meet or exceed TIA Category 6A requirements.
- D. Provide continuous inter- and/or intra-facility voice, data, and analog service.
 - Provide voice and data cable distribution system based on a physical "Star" topology.
 - 2. Provide separate cable distribution system for emergency, safety, and protection systems (i.e., emergency bypass phones; police emergency voice communications from parking lots and stairwells personal protection, duress alarms and annunciation systems; etc.)
 - 3. Contact SMCS 0050P2H3 (202-462-5310) for specific technical assistance and approvals.
- E. Specific Subsystem Requirements: Provide products necessary for a complete and functional voice, data, analog and video telecommunications cabling system, including backbone cabling system, patch panels and cross-connections, horizontal cabling systems, jacks, faceplates, and patch cords.
- F. Coordinate size and type of conduit, pathways and firestopping for maximum 40 percent cable fill with subcontractors.
- G. Terminate all interconnecting twisted pair, fiber-optic or coaxial cables on patch panels or punch blocks. Terminate unused or spare conductors and fiber strands. Do not leave unused or spare twisted pair wire, fiber-optic or coaxial cable unterminated, unconnected, loose or unsecured.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- H. Color code distribution wiring to conform to ANSI/TIA 606-B and construction documents, whichever is more stringent. Label all equipment, conduit, enclosures, jacks, and cables on record drawings, to facilitate installation and maintenance.
- I. In addition to requirements in Section 27 05 11, REQUIREMENTS FOR COMMUNICATION INSTALLATIONS, provide stainless steel faceplates with plastic covers over labels.

2.2 EQUIPMENT AND MATERIALS

- A. Cable Systems Twisted Pair, Fiber optic, Coaxial and Analog:
 - 1. General:
 - a. Provide cable (i.e., backbone, outside plant, and horizontal cabling) conforming to accepted industry standards with regards to size, color code, and insulation.
 - b. Some areas can be considered "plenum". Comply with all codes pertaining to plenum environments. It is contractor's responsibility to review the VA's cable requirements with COR and OI&T Service prior to installation to confirm type of environment present at each location.
 - c. Provide proper test equipment to confirm that cable pairs meet each OEM's standard transmission requirements, and ensure cable carries data transmissions at required speeds, frequencies, and fully loaded bandwidth.
 - 2. Telecommunications Rooms (TR):
 - a. In TR's served with UTP fiber optic, coaxial and analog backbone cables, terminate UTP cable on RJ-45, 8-pin connectors of separate 48-port modular patch panels.
 - b. Provide fiber optic modular patch panels with "LC" couplers dedicated for voice, data and FMS applications.
 - c. Provide connecting cables required to extend backbone cables (i.e., patch cords, twenty-five pair, etc.), to ensure complete and operational distribution systems.
 - 3. Backbone Copper Cables:
 - a. Riser Cable:
 - Provide communication riser cables listed in NEC Table 800, 154(a) for the purpose and suited for electrical connection to a communication network.

- 2) Provide STP or Unshielded Twisted Pair (UTP), minimum 24 American Wire Gauge (AWG) solid, thermoplastic insulated conductors for communication (analog RF coaxial cable is not to be provided in riser systems) riser cables with a thermoplastic outer jacket.
- 3) Label and test complete riser cabling system.
- 4. Horizontal Cable: Installed from TCO jack to the TR patch panel.
 - a. Tested to ANSI/TIA-568-C.2 Category 6A requirements including NEXT, ELFEXT (Pair-to-Pair and Power Sum), Insertion Loss (attenuation), Return Loss, and Delay Skew.
 - b. Minimum Transmission Parameters: 500 MHz
 - c. Provide four pair 0.205 mm2 (24 AWG) or 0.326 mm2 (22 AWG) cable
 - d. Terminate all four pairs on same port at patch panel in TR.
 - e. Terminate all four pairs on same jack, at work area Telecommunication Outlets (TCO):
 - Jacks: Minimum three eight-pin RJ-45 ANSI/TIA-568-C.2 Category
 6A Type jacks at TCO.
 - a) Top Port: RJ-45 jack compatible with RJ-11 plug for voice.
 - b) Bottom Two Ports: Unkeyed RJ-45 jacks for data.
- 5. Fiber Optics Backbone Cable:
 - a. Provide 50/125 micron OM4 multi-mode cable, containing at minimum
 24 strands of fiber, unless otherwise specified.
 - b. Provide loose tube cable, which separates individual fibers from the environment, or indoor/outdoor cables, for outdoor runs or any area that includes an outdoor run.
 - c. Provide tight buffered fiber cable or indoor/outdoor cables for indoor runs.
 - d. Terminate multimode fibers at both ends with LC type female connectors installed in an appropriate patch or breakout panel and secured with a cable management system. Provide minimum 610 mm (2 ft.) cable loop at each end.
 - e. Provide single mode fiber optic cable 8.3 mm containing at minimum 12 strands of fiber, unless otherwise specified.
 Terminate single mode fibers at both ends with LC type female connectors installed in an appropriate patch or breakout panel and secured with a cable management system. Provide minimum 610 mm (2 feet) cable loop at each end to allow for future movement.

- f. Install fiber optic cables in TR's, Voice (Telephone) Switch Room, and Main Computer Room, in rack mounted fiber optic patch panels. Provide female LC couplers in appropriate panel for termination of each strand.
- g. Test all fiber optic strands' cable transmission performance in accordance with TIA standards. Measure attenuation in accordance with fiber optic test procedures TIA-455-C ('-61', or -53). Provide written results to COR for review and approval.
- B. Cross-Connect Systems (CCS):
 - 1. Copper Cables: Provide copper CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
 - Maximum DC Resistance per Cable Pair: 28.6 Ohms per 305 m (1,000 feet).
 - 3. Fiber Optic Cables:
 - a. Provide fiber CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
 - b. Install fiber optic cable slack in protective enclosures.
- C. Telecommunication Room (TR):
 - Terminate backbone and horizontal, copper, fiber optic, coaxial and analog cables on appropriate cross-connection systems (CCS) containing patch panels, punch blocks, and breakout devices provided in enclosures and tested, regardless of installation method, mounting, termination, or cross-connecting used. Provide cable management system as a part of each CCS.
 - Coordinate location in TR with FMS equipment (i.e., fire alarm, nurse call, code blue, video, public address, radio entertainment, intercom, and radio paging equipment).
- D. Coaxial and Analog Cables: Bond equipment to ground per TIA standards, such that all grounding systems comply with all applicable National, Regional, and Local Building and Electrical codes.
 - Provide current arrester for each copper or coaxial cable that enters from outside of a building regardless of if cable is installed underground or aerial.
 - 2. Provide a gas surge protector/module and bond to earth ground.

- E. Main Cross-connection Subsystem (MCCS): MCCS is common point of distribution for inter- and intra-building copper and fiber optic backbone system cables, and connections to the voice (telephone) and data cable systems.
- F. Voice and Data Cross-Connection Subsystems:
 - Provide patch panels with modular RJ45 female to 110 connectors for cross-connection of copper data cable terminations with cable management system.
 - 2. Provide patch panels conforming to EIA/ECA 310-E dimensions and suitable for mounting in standard equipment racks, with 48 RJ45 jacks aligned in two horizontal rows per panel. Provide RJ45 jacks of modular design and capable of accepting and functioning with other modular (i.e., RJ11) plugs without damaging jack.
 - a. Provide system inputs from servers, data LAN, bridge, or interface distribution systems on top row of jacks of appropriate patch panel.
 - b. Provide backbone cable connections on bottom row of jacks of same patch panel.
 - c. Provide patch cords for each system pair of connection jacks with modular RJ45 connectors provided on each end to match panel's modular RJ45 female jack's being provided.
- G. Fiber-Optic Cross-Connection Subsystems: Provide rack mounted patch or distribution panels installed inside a lockable cabinet or "breakout enclosure" that accommodate minimum 12 strands multimode fiber and 12 strand single mode fiber - these counts do not include 50 percent spare requirement. Provide cable management system for each panel.
 - Provide panels for minimum 24 female LC connectors, able to accommodate splices and field mountable connectors and have capacity for additional connectors to be added up to OEM's maximum standard panel size for this type of use. Protect patch panel sides, including front and back, by a cabinet or enclosure.
 - 2. Provide panels that conform to EIA/ECA 310-E dimensions suitable for installation in standard racks, cabinets, and enclosures.

- 3. Provide patch panels with highest OEM approved density of fiber LC termination's (maximum of 72 each), while maintaining a high level of manageability. Provide proper LC couplers installed for each pair of fiber optic cable LC connectors.
 - a. Provide system inputs from interface equipment or distribution systems on top row of connectors of appropriate patch panel.
 - b. Provide backbone cable connections on bottom row of connectors of same patch panel.
 - c. Provide patch cords for each pair of fiber optic strands with connector to match couplers.
- 4. Provide field installable connectors that are pre-polished.
 - a. Terminate every fiber cable with appropriate connector, and test to ensure compliance to specifications and industry standards for fiber optic LC female connector terminated with a fiber optic cable.
 - b. Install a terminating cap for each unused LC connector.
- H. Copper Outside Plant Cable: Minimum of UTP, 22 AWG solid conductors, solid PVC insulation, and filled core (flex gel - waterproof Rural Electric Association (REA) listed PE 39 code) between outer armor or jacket and inner conductors protective lining.
 - 1. Provide copper cable system as a Star Topology.
- I. Horizontal Cabling (HC):
 - Horizontal cable length to farthest system outlet to be maximum of 90 m (295 ft).
 Splitting of pairs within a cable between different jacks is not permitted.

2.3 DISTRIBUTION EQUIPMENT AND SYSTEMS

- A. Telecommunication Outlet:
 - 1. TCO consists of RJ45 jacks mounted in a separate steel outlet box 100 mm (4 inches) x 100 mm (4 inches) x 63 mm (2-1/2 inches) minimum with a labeled stainless steel faceplate. Where shown on drawings, provide a second steel outlet box minimum 100 mm (4 inches) x 100 mm (4 inches) x 63 mm (2-1/2 inches), with a labeled faceplate, adjacent to first box to ensure system connections and expandability requirements are met.
 - 2. Provide RJ-45/11 compatible female type voice (telephone) multi-pin connections. Provide RJ-45 female type data multi-pin connections.

- 3. Provide wall outlet with a stainless steel face plate and sufficient ports to fit voice (telephone) multi-pin jack, data multi- pin jacks and plastic covers for labels when mounted on outlet box provided (minimum 100mm (4 inches) x 100mm (4 inches) for single and 100mm (4 inches) x 200mm (8 inches) for dual outlet box applications. Install stainless steel face plate, for prefabricated bedside patient unit installations.
- B. Backbone Distribution Cables:
 - Meet TIA transmission performance requirements of Voice Grade Category 5E.
 - 2. Provide cable listed for environments where it is installed.
 - 3. Technical Characteristics:
 - a. Length: As required, in minimum 1-kilometer (3,000 ft.) reels.
 - b. Size:
 - 1) Minimum 0.326 mm2 (22 AWG) outside plant installation.
 - 2) Minimum 0.205 mm2 (24 AWG) interior installations.
 - c. Color Coding: American Telephone and Telegraph Company Standard; Bell System Practices Outside Plant Construction and Maintenance Section G50.607.3, Issue 2, February 1959.
 - d. Minimum Bend Radius: 10X cable outside diameter.
 - e. Impedance: 120 Ohms + 15 percent.
 - f. DC Resistance: Maximum 8.00 ohms/100 m
 - g. Shield Coverage: As required by drawing notes.
 - h. Maximum attenuation for 100m at 20° C:

Frequency (MHz)	Category 5e (dB)
.772	_
1	2.0
4	4.1
8	5.8
10	6.5
16	8.2
20	9.3
25	10.4
31.25	11.7
62.5	17.0

Frequency (MHz)	Category 5e (dB)
100	22.0
200	
250	
300	
400	
500	

- 4. Data Multi-Conductor:
 - a. Unshielded cable with solid conductors.
 - b. Able to handle the power and voltage used over the distance required.
 - c. Meets TIA transmission performance requirements of Category 6A.
 - d. Technical Characteristics:
 - 1) 0.205 mm2 (24 AWG) 0.326 mm2 (22 AWG) cable
 - 2) Bend Radius: 10 times cable outside diameter.
 - 3) Impedance: 100 Ohms + 15%, BAL.
 - 4) Bandwidth: 500 MHz .
 - 5) DC Resistance: Maximum 9.38 Ohms/100m (328 ft.) at 20 degrees C.
 - 6) Maximum Mutual Capacitance: 5.6 nF per 100 m (328 ft.).
 - 7) Shield Coverage:
 - a) Overall Outside (if OEM specified): 100 percent.
 - b) Individual Pairs (if OEM specified): 100 percent.
 - 8) Maximum attenuation for 100m (328 ft.) at 20° C:

Frequency (MHz)	Category 6A (dB)
1	2.1
4	3.8
8	5.3
10	5.9
16	7.5
20	8.4
25	9.4

Frequency (MHz)	Category 6A (dB)
31.25	10.5
62.5	15.0
100	19.1
200	27.6
250	31.1
300	34.3
400	40.1
500	45.3

- 5. Fiber Optic:
 - a. Multimode Fiber:
 - Provide OM4 Type general purpose multimode fiber optic cable installed in conduit for system locations with load-bearing support braid surrounding inner tube for strength during cable installation.
 - 2) Technical Characteristics:
 - a) Bend Radius: Minimum 152 mm (6 inches); outer jacket as required.
 - b) Fiber Diameter: 50 microns.
 - c) Cladding: 125 microns.
 - d) Attenuation:
 - 1) 850 nanometer: Maximum 4.0 dB per kilometer.
 - 2) 1,300 nanometer: Maximum 2.0 dB per kilometer.
 - e) Bandwidth:
 - 1) 850 nanometer: Minimum 160 MHz.
 - 2) 1,300 nanometer: Minimum 500 MHz.
 - f) Connectors: Stainless steel.

b. Single mode Fiber:

- Provide OS1 Type general purpose single mode fiber optic cable installed in conduit for all system locations with loadbearing support braid surrounding inner tube for strength during cable installation.
- 2) Technical Characteristics:
 - a) Bend Radius: Minimum 100 mm (4 inches).
 - b) Outer Jacket: PVC.

- c) Fiber Diameter: 8.7 microns.
- d) Cladding: 125 microns.
- e) Attenuation at 850 nanometer: 1.0 dBm per kilometer.
- f) Connectors: Ceramic.
- C. Outlet Connection Cables:
 - 1. Voice (Telephone):
 - a. Provide a connection cable for each TCO voice (telephone) jack in system with 10 percent spares able to connect voice (telephone) connection cable from voice (telephone) instrument to TCO voice (telephone) jack. Do not provide voice (telephone) instruments or equipment.
 - b. Technical Characteristics:
 - 1) Length: Minimum 1.8 m (6 feet).
 - 2) Cable: Voice Grade.
 - 3) Connector: RJ-11/45 compatible male on each end.
 - 4) Size: Minimum 24 AWG.
 - 5) Color Coding: Required, telephone industry standard.
 - 2. Data:
 - a. Provide a connection cable for each TCO data jack in system with
 10 percent spares to connect a data instrument to TCO data jack.
 Do not provide data terminals/equipment.
 - b. Technical Characteristics:
 - 1) Length: Minimum 1.8 m (6 feet).
 - 2) Cable: Data grade Category 5E or on a case-by-case basis.
 - 3) Connector: RJ-45 male on each end.
 - 4) Color Coding: Required, data industry standard.
 - 5) Size: Minimum 24 AWG.
 - 3. Fiber Optic:
 - a. Provide a connection cable for each TCO fiber optic connector in system with 10 percent spares. Provide data connection cable to connect a fiber optic instrument to TCO fiber optic jack. Do not provide fiber optic instruments/equipment.
 - b. Technical Characteristics:
 - 1) Length: Minimum 1.8 m (6 feet).
 - 2) Cable: Flexible single conductor with jacket.
 - 3) Connector: LC male on each end.
 - 4) Size: To fit OM4 multimode cable.

- D. System Connectors:
 - Modular (RJ-45/11 and RJ-45): Provide voice and high-speed data transmission applications type modular plugs compatible with voice (telephone) instruments, computer terminals, and other type devices requiring linking through modular telecommunications outlet to the system compatible with UTP cables.
 - a. Technical Characteristics:
 - 1) Number of Pins:
 - a) RJ-45: Eight.
 - b) RJ-11/45: Compatible with RJ-45.
 - 2) Dielectric: Surge.
 - 3) Voltage: Minimum 1,000V RMS, 60 Hz at one minute.
 - 4) Current: 2.2A RMS at 30 minutes or 7.0A RMS at 5.0 seconds.
 - 5) Leakage: Maximum 100 µA.
 - 6) Connections:
 - a) Initial contact resistance: Maximum 20 milli-Ohms.
 - b) Insulation displacement: Maximum 10 milli-Ohms.
 - c) Interface: Must interface with modular jacks from a variety of OEMs. RJ-11/45 plugs provide connection when used in RJ-45 jacks.
 - d) Durability: Minimum 200 insertions/withdrawals.
- E. Fiber Optic Terminators:
 - 1. Pre-polished crimp on type that has proper ferrule to terminate fiber optic cable.
 - 2. Technical Characteristics:
 - a. Frequency: Light wave.
 - b. Power Blocking: As required.
 - c. Return Loss: 25 dB.
 - d. Connectors: LC.
 - e. Construction: Ceramic.
- F. Conduit and Signal Ducts:
 - 1. Conduit:
 - Provide conduit or sleeves for cables penetrating walls, ceilings, floors, interstitial space, fire barriers, etc.
 - b. Minimum Conduit Size: 19 mm (3/4 inch).
 - c. Provide separate conduit and signal ducts for each cable type installation.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- d. When metal (plastic covered, flexible cable protective armor, etc.) systems are authorized to be provided for use in system, follow installation guidelines and standard specified in Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS and NEC.
 e. Maximum 40 percent conduit fill for cable installation.
- 2. Signal Duct, Cable Duct, or Cable Tray: Use existing signal duct, cable duct, and cable tray, when identified and accepted by COR.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install for ease of operation, maintenance, and testing.
- B. Install system to comply with NFPA 70 National Electrical Code, NFPA 99 Health Care Facilities, NFPA 101 Life Safety Code, Joint Commission Manual for Health Care Facilities, and original equipment manufacturers' (OEM) installation instructions.
- C. Cable Systems Installation:
 - Install system cables in cable duct, cable tray, cable runway, conduit or when specifically approved, flexible NEC Article 800 communications raceway. Confirm drawings show sufficient quantity and size of cable pathways. If flexible communications raceway is used, install in same manner as conduit.
 - Coordinate outside plant and backbone cables to furnish number of cable pairs for system requirements and obtain approval of COR and IT Service prior to installation.
 - Bond to ground metallic cable sheaths, etc. (i.e., risers, underground, horizontal, etc.).
 - 4. Install temporary cable to not present a pedestrian safety hazard and be responsible for all work associated with removal. Temporary cable installations are not required to meet Industry Standards; but must be reviewed and accepted by COR, IT Service, FMS and SMCS 0050P2H3 (202-461-5310) prior to installation.
- D. Labeling:
 - Industry Standard: Provide labeling in accordance with ANSI/TIA-606-B.
 - Print lettering of labels with laser printers or thermal ink transfer process; handwritten labels are not acceptable.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 3. Label both ends of all cables in accordance with industry standard. Provide permanent Labels in contrasting colors and identify according to system "Record Wiring Diagrams".
- Termination Hardware: Label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with industry standard and record on "Record Wiring Diagrams".

3.2 FIELD QUALITY CONTROL

- A. Interim Inspection:
 - Verify that equipment provided adheres to installation requirements of this section. Interim inspection must be conducted by a factorycertified representative and witnessed by COR.
 - 2. Check each item of installed equipment to ensure appropriate NRTL label.
 - Verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568B pin assignments and cabling connections comply with TIA standards.
 - Visually confirm marking of cables, faceplates, patch panel connectors and patch cords.
 - 5. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
 - 6. Notify COR of the estimated date the contractor expects to be ready for interim inspection, at least 20 working days before requested inspection date, so interim inspection does not affect systems' completion date.
 - Provide results of interim inspection to COR. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting contractor to continue with system installation.
 - Do not proceed with installation until COR determines if an additional inspection is required. In either case, re-inspection of deficiencies noted during interim inspections must be part of the proof of performance test.
- B. Pretesting:
 - 1. Pretest entire system upon completion of system installation.

- Verify during system pretest, utilizing the accepted equipment, that system is fully operational and meets system performance requirements of this section.
- Provide COR four copies of recorded system pretest measurements and the written certification that system is ready for formal acceptance test.
- C. Acceptance Test:
 - After system has been pretested and the contractor has submitted pretest results and certification to COR, then schedule an acceptance test date and give COR 30 days' written notice prior to date acceptance test is expected to begin.
 - 2. Test only in presence of a COR.
 - 3. Test utilizing approved test equipment to certify proof of performance.
 - 4. Verify that total system meets the requirements of this section.
 - 5. Include expected duration of test time, with notification of the acceptance test.
- D. Verification Tests:
 - Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test cables after termination and prior to cross-connection.
 - Multi-mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with TIA-568-B.3 and TIA-526-14A using Method A, Optical Power Meter and Light Source and Method B, OTDR. Perform verification acceptance test.
 - 3. Single mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with TIA-568-B.3 and TIA-526-7 using Method A, Optical Power Meter and Light Source and Method B, OTDR. Perform verification acceptance test.
- E. Performance Testing:
 - Perform Category 6A tests in accordance with TIA-568-B.1 and TIA-568-B.2. Include the following tests - wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
 - 2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with TIA-568-B.3.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

F. Total System Acceptance Test: Perform verification tests for UTP copper cabling systems a multi-mode and single mode fiber optic cabling systems after complete telecommunication distribution system and workstation outlet are installed.

3.3 MAINTENANCE

- A. Accomplish the following minimum requirements during one year warranty period:
 - Respond and correct on-site trouble calls, during standard work week:
 - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.
 - b. Standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
 - Respond to an emergency trouble call within six hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at any time.
 - Respond on-site to a catastrophic trouble call within four hours of its report. A catastrophic trouble call is considered total system failure.
 - a. If a system failure cannot be corrected within four hours (exclusive of standard work time limits), provide alternate equipment, or cables within four hours after four-hour trouble shooting time.
 - B. Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) are also be deemed as a catastrophic trouble.
 - 4. Provide COR written report itemizing each deficiency found and the corrective action performed during each official reported trouble call. Provide COR with sample copies of reports for review and approval at beginning of total system acceptance test.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 28 05 00

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.
- B. Furnish and install fully functional electronic safety and security cabling system(s), equipment, and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.
- C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, duress alarms, elevator control interface, video assessment and surveillance, video recording and storage, delayed egress, personal protection system, intercommunication system, fire alarm interface, equipment cabinetry, dedicated photo badging system and associated live camera, report printer, photo badge printer, and uninterruptible power supplies (UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

- E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.
- F. Section Includes:
 - 1. Description of Work for Electronic Security Systems,
 - 2. Electronic security equipment coordination with relating Divisions,
 - 3. Submittal Requirements for Electronic Security,
 - Miscellaneous Supporting equipment and materials for Electronic Security,
 - 5. Electronic security installation requirements.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 26 05 11 REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- D. Section 26 05 21 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- E. Section 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.

- F. Section 26 05 41 UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.
- G. Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- H. Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- I. Section 28 05 28.33 CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- J. Section 28 16 00 INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.

1.3 DEFINITIONS

- A. AGC: Automatic Gain Control.
- B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- C. BICSI: Building Industry Consulting Service International.
- D. CCD: Charge-coupled device.
- E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
- F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- H. CPU: Central processing unit.
- I. Credential: Data assigned to an entity and used to identify that entity.
- J. DGP: Data Gathering Panel component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.
- K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- L. EMI: Electromagnetic interference.
- M. EMT: Electric Metallic Tubing.
- N. ESS: Electronic Security System.

- O. File Server: A PC in a network that stores the programs and data files shared by users.
- P. GFI: Ground fault interrupter.
- Q. IDC: Insulation displacement connector.
- R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- S. I/O: Input/Output.
- T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- V. LAN: Local area network.
- W. LCD: Liquid-crystal display.
- X. LED: Light-emitting diode.
- Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling powerlimited circuits.
- AA. M-JPEG: Motion Joint Photographic Experts Group.
- BB. MPEG: Moving Picture Experts Group.
- CC. NEC: National Electric Code
- DD. NEMA: National Electrical Manufacturers Association
- EE. NFPA: National Fire Protection Association
- FF. NTSC: National Television System Committee.
- GG. NRTL: Nationally Recognized Testing Laboratory.
- HH. Open Cabling: Passing telecommunications cabling through open space
 (e.g., between the studs of a wall cavity).

- II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space
- JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- LL. PDF (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- MM. RCDD: Registered Communications Distribution Designer.
- NN. RFI: Radio-frequency interference.
- OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
- PP. RS-232: A TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- QQ. RS-485: A TIA/EIA standard for multipoint communications.
- RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- SS. SMS: Security Management System A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- VV. UPS: Uninterruptible Power Supply
- WW. UTP: Unshielded Twisted Pair
- XX. Workstation: A PC with software that is configured for specific limited security system functions.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
 - Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 - The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Contractor Qualification:
 - 1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

- The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
- 3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- D. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 GENERAL ARANGEMENT OF CONTRACT DOCUMENTS

- A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.
- B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION ".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- D. The submittals shall include the following:
 - Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 - 2. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- E. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to

ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows:

- The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - Design Submittal Procedures, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
- The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
- 3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
- 4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
- 5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
- Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders,

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

sized to receive 8.5×11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.

- Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Crossreferencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
- Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
- b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
- c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
- d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches, 20-pound white bond paper.
- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
 - Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
 - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a typewritten page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

- Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
- 2) Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
- 3) The manuals shall include:
 - a) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b) A control sequence describing start-up, operation, and shutdown.
 - c) Description of the function of each principal item of equipment.
 - d) Installation and maintenance instructions.
 - e) Safety precautions.
 - f) Diagrams and illustrations.
 - g) Testing methods.
 - h) Performance data.
 - i) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - j) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type of written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
- Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.

- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
- n. Calculations: Provide a section for circuit and panel calculations.
- o. Loading Sheets: Provide a section for DGP Loading Sheets.
- p. Certifications: Provide section for Contractor's manufacturer certifications.
- 7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return nonconforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.
- Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
- 9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

- F. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:
 - 1. Section I Drawings:
 - a. General Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
 - b. Cover Sheet Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
 - c. General Information Sheets General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
 - d. Floor Plans Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
 - 1) Security devices by symbol,
 - The associated device point number (derived from the loading sheets),
 - 3) Wire & cable types and counts
 - 4) Conduit sizing and routing
 - 5) Conduit riser systems
 - 6) Device and area detail call outs
 - e. Architectural details Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, vibration, microwave Motion Sensor and Camera mounting,

- f. Riser Diagrams Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
- g. Block Diagrams Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
- h. Interconnection Diagrams Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
- i. Security Details:
 - Panel Assembly Detail For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
 - Panel Details Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
 - 3) Device Mounting Details Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
 - 4) Details of connections to power supplies and grounding
 - 5) Details of surge protection device installation
 - Sensor detection patterns Each system sensor shall have associated detection patterns.
 - Equipment Rack Detail For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCI wire management standards shall be

employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.

- Equipment Room Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.
- j. Electrical Panel Schedule Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
 - 1) Item Number
 - 2) Door Number (Derived from A/E Drawings)
 - 3) Floor Plan Sheet Number
 - 4) Standard Detail Number
 - 5) Door Description (Derived from Loading Sheets)
 - 6) Data Gathering Panel Input Number
 - 7) Door Position or Monitoring Device Type & Model Number
 - 8) Lock Type, Model Number & Power Input/Draw (standby/active)
 - 9) Card Reader Type & Model Number
 - 10) Shunting Device Type & Model Number
 - 11) Sounder Type & Model Number
 - 12) Manufacturer
 - 13) Misc. devices as required
 - a) Delayed Egress Type & Model Number
 - b) Intercom
 - c) Camera
 - d) Electric Transfer Hinge
 - e) Electric Pass-through device
 - 14) Remarks column indicating special notes or door configurations

- 2. Section II Data Gathering Panel Documentation Package
 - a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
 - b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.
 - c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.
 - d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
 - e. The DGP spreadsheet shall include an entry section for the following information:
 - 1) DGP number
 - 2) First Reader Number
 - 3) First Monitor Point Number
 - 4) First Relay Number
 - 5) DGP, input or output Location
 - 6) DGP Chain Number
 - 7) DGP Cabinet Tamper Input Number
 - 8) DGP Power Fail Input Number

- 9) Number of Monitor Points Reserved for Expansion Boards
- Number of Control Points (Relays) Reserved For Expansion Boards
- f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
 - 1) System Numbers for Card Readers
 - 2) System Numbers for Monitor Point Inputs
 - 3) System Numbers for Control Points (Relays)
 - 4) Next DGP or input module First Monitor Point Number
 - 5) Next DGP or output module First Control Point Number
- g. The DGP spreadsheet shall provide the following information for each card reader:
 - 1) DGP Reader Number
 - 2) System Reader Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
 - 6) Description Field
 - 7) DGP Input Location
 - 8) Date Test
 - 9) Date Passed
 - 10) Cable Type
 - 11) Camera Numbers (of cameras viewing the reader location)
- h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
 - 1) DGP Monitor Point Input Number
 - 2) System Monitor Point Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
 - 6) DGP or input module Input Location
 - 7) Date Test
 - 8) Date Passed
- 9) Cable Type
- 10) Camera Numbers (of associated alarm event preset call-ups)
- i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
 - 1) DGP Control Point (Relay) Number
 - 2) System (Control Point) Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device: Lock Control, Local Sounder, etc.)
 - 6) Description Field
 - 7) DGP or OUTPUT MODULE Output Location
 - 8) Date Test
 - 9) Date Passed Cable Type
 - 10) Camera Number (of associated alarm event preset call-ups)
- j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
 - 1) Header
 - a) DGP Input and Output Worksheet
 - b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
 - 2) Footer
 - a) File Name
 - b) Date Printed
 - c) Page Number
- 3. Section III Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
- 4. Section IV System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
 - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.

- b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
- c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
- Section V Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".
- G. Group II Technical Data Package
 - 1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
 - System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
 - a. Baseline configuration
 - b. Access levels
 - c. Schedules (intrusion detection, physical access control, holidays, etc.)
 - d. Badge database
 - e. System monitoring and reporting (unit level and central control)
 - f. Naming conventions and descriptors

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- H. Group III Technical Data Package:
 - Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.
- I. Group IV Technical Data Package
 - 1. Performance Verification Test
 - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.
 - 2. Training Documentation
 - a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
 - The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.

- 2) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
- 3) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal selfdiagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.
- 4) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.
- 3. System Configuration and Data Entry:
 - a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
 1) Physical Access control system components,

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2) All intrusion detection system components,

3) All other security subsystems shown in the contract documents.

- b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
- c. Refer to Part 3 for system programming requirements and planning guidelines.
- 4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.
- J. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after

completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

- Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
- Equipment Manual: A manual describing all equipment furnished including:
 - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
- 3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
- 4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
 - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use

of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.

- 5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
- 6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
- 7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
- 8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
 - a. Equipment and/or system function.
 - b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and test.
 - f. Complete nomenclature and number of replacement parts.
 - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
 - h. Provide information detailing essential maintenance procedures including the following: routine operations, troubleshooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
 - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal

operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.

- j. Manufacturer equipment and systems maintenance manuals are permissible.
- 9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".
- 10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions,

selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at any time.

- 11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
- 12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include a minimum of the following:
 - a. Certificates received instead of labels on bulk products.
 - b. Testing and qualification of tradesmen. ("Contractor's
 Qualifications")
 - c. Documented qualification of installation firms.
 - d. Load and performance testing.
 - e. Inspections and certifications.
 - f. Final inspection and correction procedures.
 - g. Project schedule

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 13. Record Construction Documents (Record As-Built)
 - a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
 - b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "asbuilt" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.
 - c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, subcontractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact infield conduit placement/routings shall be shown. All conduits

shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

- K. FIPS 201 Compliance Certificates
 - 1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
 - a. Card Readers
 - b. PIV Middleware
 - c. Template Matcher
 - d. Electromagnetically Opaque Sleeve
 - e. Certificate Management
 - 1) CAK Authentication System
 - 2) PIV Authentication System
 - 3) Certificate Validator
 - 4) Cryptographic Module
- L. Approvals will be based on complete submission of manuals together with shop drawings.
- M. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:
 - A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
 - 2. Each type of conduit and pathway coupling, bushing and termination fitting.
 - 3. Conduit hangers, clamps and supports.
 - 4. Duct sealing compound.
- N. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- O. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. B. American National Standards Institute (ANSI) / International Code Council (ICC): A117.1.....Standard on Accessible and Usable Buildings and Facilities C. American National Standards Institute (ANSI) / Security Industry Association (SIA): AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards CP-01-00......Control Panel Standard-Features for False Alarm Reduction PIR-01-00.....Passive Infrared Motion Detector Standard -Features for Enhancing False Alarm Immunity TVAC-01..... CCTV to Access Control Standard - Message Set for System Integration D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA): 330-09..... Electrical Performance Standards for CCTV Cameras 375A-76.....Electrical Performance Standards for CCTV Monitors E. American National Standards Institute (ANSI): ANSI S3.2-99.....Method for measuring the Intelligibility of Speech over Communications Systems F. American Society for Testing and Materials (ASTM) B1-07......for Hard-Drawn Copper Wire B3-07.....Standard Specification for Soft or Annealed Copper Wire B8-04..... Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C1238-97 (R03).....Standard Guide for Installation of Walk-Through Metal Detectors D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape G. Architectural Barriers Act (ABA), 1968 H. Department of Justice: American Disability Act (ADA) 28 CFR Part 36-2010 ADA Standards for Accessible Design I. Department of Veterans Affairs: VHA National CAD Standard Application Guide, 2006 VA BIM Guide, V1.0 10 J. Federal Communications Commission (FCC): (47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems K. Federal Information Processing Standards (FIPS): FIPS-201-1.....Personal Identity Verification (PIV) of Federal Employees and Contractors L. Federal Specifications (Fed. Spec.): A-A-59544-08.....Cable and Wire, Electrical (Power, Fixed Installation) M. Government Accountability Office (GAO): GAO-03-8-02.....Security Responsibilities for Federally Owned and Leased Facilities N. Homeland Security Presidential Directive (HSPD): HSPD-12.....Policy for a Common Identification Standard for Federal Employees and Contractors O. Institute of Electrical and Electronics Engineers (IEEE): 81-1983..... EEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System 802.3af-08.....Power over Ethernet Standard 802.3at-09Power over Ethernet (PoE) Plus Standard C2-07.....National Electrical Safety Code C62.41-02.....IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C95.1-05.....Standards for Safety Levels with Respect to Human Exposure in Radio Frequency Electromagnetic Fields P. International Organization for Standardization (ISO): 7810..... Identification cards - Physical characteristics 7811.....Physical Characteristics for Magnetic Stripe Cards 7816-1.....Identification cards - Integrated circuit(s) cards with contacts - Part 1: Physical characteristics 7816-2.....Identification cards - Integrated circuit cards - Part 2: Cards with contacts -Dimensions and location of the contacts 7816-3.....Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols 7816-4.....Identification cards - Integrated circuit cards - Part 11: Personal verification through biometric methods 7816-10.....Identification cards - Integrated circuit cards - Part 4: Organization, security and commands for interchange 14443.....Identification cards - Contactless integrated circuit cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 inches distance 15693.....Identification cards -- Contactless integrated circuit cards - Vicinity cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance 19794..... Information technology - Biometric data interchange formats Q. National Electrical Contractors Association 303-2005..... Tinstalling Closed Circuit Television (CCTV) Systems

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 R. National Electrical Manufactures Association (NEMA): 250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum) TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable S. National Fire Protection Association (NFPA): 70-11..... National Electrical Code (NEC) 731-08.....Standards for the Installation of Electric Premises Security Systems 99-2005.....Health Care Facilities T. National Institute of Justice (NIJ) 0601.02-03.....Standards for Walk-Through Metal Detectors for use in Weapons Detection 0602.02-03.....Hand-Held Metal Detectors for Use in Concealed Weapon and Contraband Detection U. National Institute of Standards and Technology (NIST): IR 6887 V2.1.....Government Smart Card Interoperability Specification (GSC-IS) Special Pub 800-37.....Guide for Applying the Risk Management Framework to Federal Information Systems Special Pub 800-63.....Electronic Authentication Guideline Special Pub 800-73-3....Interfaces for Personal Identity Verification (4 Parts)Pt. 1- End Point PIV Card Application Namespace, Data Model & RepresentationPt. 2- PIV Card Application Card Command InterfacePt. 3- PIV Client Application Programming InterfacePt. 4- The PIV Transitional Interfaces & Data Model Specification Special Pub 800-76-1....Biometric Data Specification for Personal Identity Verification

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 Special Pub 800-78-2....Cryptographic Algorithms and Key Sizes for Personal Identity Verification Special Pub 800-79-1....Guidelines for the Accreditation of Personal Identity Verification Card Issuers Special Pub 800-85B-1...DRAFTPIV Data Model Test Guidelines Special Pub 800-85A-2...PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance) Special Pub 800-96.....PIV Card Reader Interoperability Guidelines Special Pub 800-104A....Scheme for PIV Visual Card Topography V. Occupational and Safety Health Administration (OSHA): 29 CFR 1910.97.....Nonionizing radiation W. Section 508 of the Rehabilitation Act of 1973 X. Security Industry Association (SIA): AG-01Security CAD Symbols Standards Y. Underwriters Laboratories, Inc. (UL): 1-05.....Flexible Metal Conduit 5-04.....Surface Metal Raceway and Fittings 6-07.....Rigid Metal Conduit 44-05......Thermoset-Insulated Wires and Cables 50-07.....Enclosures for Electrical Equipment 83-08.....Thermoplastic-Insulated Wires and Cables 294-99.....The Standard of Safety for Access Control System Units 305-08..... Standard for Panic Hardware 360-09.....Liquid-Tight Flexible Steel Conduit 444-08..... Safety Communications Cables 464-09.....Audible Signal Appliances 467-07..... Electrical Grounding and Bonding Equipment 486A-03............Wire Connectors and Soldering Lugs for Use with Copper Conductors 486C-04.....Splicing Wire Connectors 486D-05..... Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations 486E-00..... Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors 493-07..... Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

514A-04.....Metallic Outlet Boxes 514B-04.....Fittings for Cable and Conduit 51-05.....Schedule 40 and 80 Rigid PVC Conduit 609-96.....Local Burglar Alarm Units and Systems 634-07..... Standards for Connectors with Burglar-Alarm Systems 636-01..... Units and Systems 639-97.....Detection Units 651-05.....Schedule 40 and 80 Rigid PVC Conduit 651A-07.....Type EB and A Rigid PVC Conduit and HDPE Conduit 752-05.....Standard for Bullet-Resisting Equipment 797-07.....Electrical Metallic Tubing 827-08.....Central Station Alarm Services 1037-09.....Standard for Anti-theft Alarms and Devices 1635-10......Digital Alarm Communicator System Units 1076-95..... Brandards for Proprietary Burglar Alarm Units and Systems 1242-06.....Intermediate Metal Conduit 1479-03.....Fire Tests of Through-Penetration Fire Stops 1981-03.....Central Station Automation System 2058-05..... High Security Electronic Locks 60950.....Safety of Information Technology Equipment 60950-1..... Information Technology Equipment - Safety -Part 1: General Requirements Z. Uniform Federal Accessibility Standards (UFAS) 1984 AA. United States Department of Commerce:

Special Pub 500-101Care and Handling of Computer Magnetic Storage Media

1.8 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

- 3. To allow right of way for piping and conduit installed at required slope.
- So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.9 MAINTENANCE & SERVICE

- A. General Requirements
 - The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.
- B. Description of Work
 - The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.
- C. Personnel
 - 1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

- D. Schedule of Work
 - 1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays.
- E. System Inspections
 - 1. These inspections shall include:
 - a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
 - Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
 - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.
- F. Emergency Service
 - The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and noncatastrophic system failures within parameters stated in General Project Requirements.
 - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.

- b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.
- G. Operation
 - Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.
- H. Records & Logs
 - The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.
- I. Work Request
 - 1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.
- J. System Modifications
 - The Contractor shall make any recommendations for system modification in writing to the Resident Engineer. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Resident Engineer. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.
- K. Software
 - The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.10 MINIMUM REQUIREMENTS

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.11 DELIVERY, STORAGE, & HANDLING

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
 - During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 - Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 - 3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
 - 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

- B. Central Station, Workstations, and Controllers:
 - Store in temperature and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
 - Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
 - 3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.
 - Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.12 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.
 - Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 4X enclosures.
 - 3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.
- C. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

1.13 EQUIPMENT AND MATERIALS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - Components of an assembled unit need not be products of the same manufacturer.
 - Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
 - Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.14 ELECTRICAL POWER

- A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of these contract documents. Primary power for the security system shall be configured to switch to emergency backup sources automatically if interrupted without degradation of any critical system function. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the PACS and the Uninterruptible Power Supply (UPS) system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.
- B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for [8] <insert hours> hours of operation at actual connected load. Requirements for additional power or locations shall be included with the contract to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.
 - 1. Emergency Generator
 - a. Lights: Unit Control Room, Equipment Rooms, & Security Offices
 - b. Outlets: Security Outlets dedicated to security equipment racks or security enclosure assemblies.
 - c. Security Device Power Supplies (DGP, VASS, Card Access, Lock Power, etc.) powered from the security closets or remotely: various locations
 - d. Telephone/Radio Recording Equipment: Unit Control Room.
 - e. Fiber Optic Receivers/Transmitters
 - 2. Uninterruptible Power Supply (UPS) on Emergency Power
 - a. The following 120VAC circuits shall be provided by others. The Security Contractor shall coordinate exact locations with the Electrical Contractor:
 - 1) CPU: Control Equipment Room
 - 2) All equipment Room racked equipment.
 - 3) Network switches

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.15 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPLESION, & GROUNDING

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.
 - 1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 - An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 - Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
 - 4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.
- B. Grounding and Surge Suppression
 - The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
 - Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
 - 3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.
 - Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
- 6. AC power receptacles are not to be used as a ground reference point.
- Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
- 8. Protection should be provided at both ends of cabling.

1.16 COMPONENT ENCLOSURES

- A. Construction of Enclosures
 - Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
 - Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
 - 3. Doors and covers shall be flanged. Enclosures shall not have prepunched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
 - 4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
 - 5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall

be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).

- B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.
 - 1. Vertical Equipment Racks:
 - a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.
 - b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.
 - c. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.
 - 2. Console racks:
 - a. Forced air fans shall be installed in the top rear of each console bay. The forced air fan shall consist of one fan rated at 105 CFM mounted to a 133mm vented blank panel the noise level of each fan shall not exceed 55 decibels. The fans shall be installed so air is pulled from the bottom of the rack or cabinet and exhausted out the top.
 - b. Console racks are to be provided with flush mounted hinged rear doors with recessed locking latch on the bottom and middle sections of the consoles. Provide code access to support wiring for devices located on the work surfaces.
- C. Tamper Provisions and Tamper Switches:
 - Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches.
 - 2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after opening or removing the cover. The enclosure and

tamper switch shall function together in such a manner as to prohibit direct line of sign to any internal component before the switch activates.

- 3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 " tolerance. The tamper device or its components shall not be visible or accessing with common tools to bypass when the enclosure is in the secured mode.
- 4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
- 5. All enclosures over 305 square mm shall be hinged with an enclosure lock.
- 6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
- Provide one (1) enclosure tamper switch for each 609 linear mm of enclosure lock side opening evenly spaced.
- 8. All security screws shall be Torx-Post Security Screws.
- 9. The contractor shall provide the owner with two (2) torx-post screwdrivers.

1.17 ELECTRONIC COMPONENTS

A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and currentcarrying capacity.

1.18 SUBSTITUTE MATERIALS & EQUIPMENT

- A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The Resident Engineer shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the Resident Engineer stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:
 - 1. Identity of the material or devices specified for which there is a proposed substitution.
 - Description of the segment of the specification where the material or devices are referenced.
 - Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
 - 4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-byfeature, between specification requirements and the material or devices called for in the specification; and Price differential.
- C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein. Depending on the manufacturers selected by the COTR, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the Resident Engineer shall be given the opportunity to approve the additional equipment,

hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The Resident Engineer shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.

D. Response to Specification: The Contractor shall submit a point-bypoint statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a pointby-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

1.19 LIKE ITEMS

A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer.All equipment provided shall be complete, new, and free of any defects.

1.20 WARRANTY

A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contactor received written notification of final acceptance from the COTR. Demonstration and training shall be

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COTR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COTR on conditions and findings of the system and device(s). In addition, the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of it's failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

1.21 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
- B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment

shall have a back-up source of power that will provide a minimum of [8] <insert hours> hours of run time in the event of a loss of primary power to the facility.

- C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All equipment and materials for the system will be compatible to ensure correct operation.

2.2 EQUIPMENT ITEMS

- A. The Security Management System shall provide full interface with all components of the security subsystem as follows:
 - Shall allow for communication between the Physical Access Control System and Database Management and all subordinate work and monitoring stations, enrollment centers for badging and biometric devices as part of the PACS, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.
 - 2. Shall provide automatic continuous communication with all systems that are monitored by the SMS, and shall automatically annunciate any communication failures or system alarms to the SMS operator providing identification of the system, nature of the alarm, and location of the alarm.
 - 3. Controlling devices shall be utilized to interface the SMS with all field devices.
 - The Security control room and security console will be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
 - 5. The Security Equipment room, Security Control Room, and Security Operator Console shall house the following equipment i.e. refer to individual master specifications for each security subsystem's specific requirements:
 - a. Security Console Bays and Equipment Racks
 - b. Security Network Server and Workstation
 - c. PACS Monitoring and Controlling Equipment
 - d. IDS Monitoring and Controlling Equipment
 - e. Security Access Detection Monitoring Equipment
 - f. EPPS Monitoring and Controlling Equipment

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- g. Main Panels for all Security Systems
- h. Power Supply Units (PSU) for all field devices
- i. Life safety and power monitoring equipment
- j. All other building systems deemed necessary by the VA to include, but not limited to, heating, ventilation and air conditioning (HVAC), elevator control, portable radio, fire alarm monitoring, and other potential systems.

2.3 FIBER OPTIC EQUIPMENT

- A. 8-Channel Fiber Optic Transceivers (Video and PTZ Control)
 - The field-located and central-located fiber optic transceivers shall utilize wave division multiplexing to transmit and receive video and data pan-tilt-zoom control signals over two standard 62.5/125 multimode fibers.
 - 2. The units shall be capable of operating over a range of 2 km.
 - 3. The units shall be NTSC color compatible.
 - 4. The units shall support data rates up to 64 Kbps.
 - 5. The units shall be surface or rack mountable.
 - 6. The units shall be UL listed.
 - 7. The units shall meet or exceed the following specifications:
 - a. Video
 - 1) Input/Output: 1-volt pk-pk (75 ohms)
 - 2) Input/Output Channels: 8
 - 3) Bandwidth: 10 Hz 6.5 MHZ per channel
 - 4) Differential Gain: <2%
 - 5) Differential Phase: <0.7°
 - 6) Tilt: <1%
 - 7) Signal to Noise Ratio: 60 dB
 - b. Data (Control)
 - 1) Data Channels: 2
 - 2) Data Format: RS-232, RS-422, 2 wire or 4 wire RS-485 with Tri-State Manchester Bi-Phase and Sensornet
 - 3) Data Rate: DC 100 kbps (NRZ)
 - 4) Bit Error Rate: < 1 in 10-9 @ Maximum Optical Loss Budget
 - 5) Operating Mode: Simplex or Full-Duplex
 - 6) Wavelength: 1310/1550 nm, Multimode or Single-mode
 - 7) Optical Emitter: Laser Diode
 - 8) Number of Fibers: 1

- c. Connectors
 - 1) Optical: ST
 - 2) Power and Data: Terminal Block with Screw Clamps
 - 3) Video: BNC (Gold Plated Center-Pin)
- d. Electrical and Mechanical
 - 1) Power: 12 VDC @ 500 mA (stand-alone)
 - Current Protection: Automatic Resettable Solid-State Current Limiters
- e. Environmental
 - 1) MTBF: > 100,000 hours
 - 2) Operating Temp: -40 to 74 deg C (-40 to 165 deg F)
 - 3) Storage Temp: -40 to 85 deg C (-40 to 185 deg F)
 - 4) Relative Humidity 0% to 95% (non-condensing)
- B. Fiber Optic Transmitters: The central-located fiber optic transmitters shall utilize wave division multiplexing to transmit video and signals over standard 62.5/125 multimode fibers.
 - 1. The units shall be capable of operating over a range of 4.8 km.
 - 2. The units shall be NTSC color compatible.
 - 3. The units shall support data rates up to 64 Kbps.
 - 4. The units shall be surface or rack mountable.
 - 5. The units shall be UL listed.
 - 6. The units shall meet or exceed the following specifications:
 - a. Video
 - 1) Input: 1-volt pk-pk (75 ohms)
 - 2) Bandwidth: 5H2 10 MHZ
 - 3) Differential Gain: <5%
 - 4) Tilt: <1%
 - 5) Signal-Noise: 60db
 - 6) Wavelength: 850nm
 - 7) Number of Fibers: 1
 - 8) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
 - 9) Connectors:
 - a) Power: Female plug with screw clamps
 - b) Video: BNC
 - c) Optical: ST
 - 10) Power: 12 VDC

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C. Fiber Optic Receivers: The field-located fiber optic receivers shall utilize wave division multiplexing to receive video signals over standard 62.5/125 multimode fiber. 1. The units shall be capable of operating over a range of 4.8 km. 2. The units shall be NTSC color compatible. 3. The units shall support data rates up to 64 Kbps. 4. The units shall be surface or rack mountable. 5. The units shall be UL listed. 6. The units shall meet or exceed the following specifications: a. Video 1) Output: 1-volt pk-pk (75 ohms) 2) Bandwidth: 5H2 - 10 MHZ 3) Differential Gain: <5% 4) Tilt: <1% 5) Signal-Noise: 60dB 6) Wavelength: 850nm 7) Number of Fibers: 1 8) Surface Mount: 106.7 x 88.9 x 25.4 mm (4.2 x 3.5 x 1 in) 9) Operating Temp: -20 to 70 deg C (-4 to 158 deg F) 10) Connectors: a) Power: Female plug block with screw clamps b) Video: BNC c) Optical: ST 11) Power: 12 VAC8 Channel Fiber Optic Transceivers (Video & PTZ Control) D. Fiber Optic Sub Rack with Power Supply 1. The Card Cage Rack shall provide high-density racking for fiberoptic modules. The unit shall be designed to mount in standard 483 mm (19 in) instrument racks and to accommodate the equivalent of 15 1-inch modules. a. Specifications 1) Card Orientation: Vertical 2) Construction: Aluminum 3) Current Consumption: 0.99 A 4) Humidity: 95.0 % RH 5) Input Power: 100-240 VAC, 60/50 Hz

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 6) Mounting: Mounts in standard 483 mm (19 in) rack using four (4) screws (optional wall brackets purchased separately) 7) Number of Outputs: 1.0 8) Number of Slots: 15.0 9) Operating Temperature: -40 to +75 deg C (-40.0 to 167.0 deg F) 10) Output Voltage: 13.5 V 11) Output Current: 6.0 A 12) Power Dissipation: 28.0 W 13) Power Factor: 48.0 14) Power Supply: (built-in) 15) Rack Units: 3RU 16) Redundant Capability: Yes

- 17) Weight: 2.43 kg (5.35 lb)
- 18) Width: 483 mm (19.0 in)

2.4 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESION

- A. Transient Voltage Surge Suppression
 - 1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:
 - A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 - b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 - c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
- d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, noncondensing.
- B. Physical Access Control Systems
 - Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:
 - a. UL1449 2nd Edition, 2007, listed
 - b. UL1449 S.V.R. of 400 Volts or lower
 - c. Status Indicator Light(s)
 - d. Minimum Surge Current Capacity: 40,000 Amps (8 x 20 µsec)
 - e. Maximum Continuous Current: 15 Amps
 - f. MCOV: 125 VAC
 - g. Service Voltage: 110-120 VAC
 - 2. Suppressors shall be installed on the Low Voltage circuit at both the point of entrance and exit of the building. Suppressors shall meet the following criteria:
 - a. UL 497B
 - b. Minimum Surge Current Capacity: 2,000 Amps per pair
 - c. Maximum Continuous Current: 5 Amps
 - d. MCOV: 33 Volts
 - e. Service Voltage: 24Volts
 - 3. Suppressors shall be installed on the communication circuit between the access controller and card reader at both the entrance and exit of the building. Suppressors shall meet the following criteria:
 - a. Conforms with UL497B standards (where applicable)
 - b. Clamp level for 12 and 24V power: 18VDC / 38VDC
 - c. Clamp level for Data/LED: 6.8VDC
 - d. Service Voltage for Power: 12VDC/24VDC
 - e. Service Voltage for Data/LED: <5VDC
 - f. Clamp level PoE Access Power: 72V
 - g. Clamp level PoE Access Data: 7.9V
 - h. Service Voltage PoE Access: 48VAC 54VAC
 - i. Service Voltage PoE Data: <5VDC
- C. Intrusion Detection Systems
 - Suppressors shall be installed on AC at the point of service and shall meet the following criteria:
 a. UL 1449, 2nd Edition 2007, listed

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 b. UL 1449 S.V.R. of 400 Volts or lower c. Status Indicator Lights d. Center screw for terminating Class II transformers e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20 µSec) 2. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria: a. UL 497A Listed b. Multi Stage protection design c. Surge Current Capacity: 9,000 Amps (8x20 µSec) d. Clamp Voltage: 130Vrms e. Auto reset current protection not to exceed 150 milliAmps 3. Suppressors shall be installed on all burglar alarm initiating and signaling loops and addressable circuits which enter or leave separate buildings. The following criteria shall be met: a. UL 497B for data communications or annunciation (powered loops) b. Fail-short/fail-safe mode. c. Surge Current Capacity: 9,000 Amps (8x20 µSec) d. Clamp Voltage: 15 Vrms e. Joule Rating: 76 Joules per pair (10x1000 µSec) f. Auto-reset current protection not to exceed 150 milliAmps for UL 497A devices. D. Grounding and Surge Suppression 1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, undergroundfault conditions. 2. The Contractor shall engineer, provide, ad install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document. 3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service

4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.

equipment.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
- 6. AC power receptacles are not to be used as a ground reference point.
- 7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufactures' installation instructions.
- E. 120 VAC Surge Suppression
 - 1. Continuous Current: Unlimited (parallel connection)
 - 2. Max Surge Current: 13,500 Amps
 - 3. Protection Modes: L N, L G, N G
 - 4. Warranty: Ten Year Limited Warranty
 - 5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
 - 6. Weight: 2.88 g (0.18 lbs)
 - 7. Housing: ABS

2.5 INSTALLATION KIT

- A. General:
 - 1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:
 - 2. System Grounding:
 - a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
 - b. This includes, but is not limited to:1) Coaxial Cable Shields

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2) Control Cable Shields
- 3) Data Cable Shields
- 4) Equipment Racks
- 5) Equipment Cabinets
- 6) Conduits
- 7) Cable Duct blocks
- 8) Cable Trays
- 9) Power Panels
- 10) Grounding
- 11) Connector Panels
- 3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
- 4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
- 5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
- 6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
- 7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
- 8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Equipment location shall be as close as practical to locations shown on the drawings.
- G. Inaccessible Equipment:
 - Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

3.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 00 "Firestopping."

3.3 COMMISIONING

A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 - COMMISIONIN OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 28 08 00 -COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 DEMONSTRATION AND TRAINING

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the Resident Engineer at least 30 days prior to the planned training.
- D. Provide services of manufacturer's technical representative for <insert hours> hours to instruct VA personnel in operation and maintenance of units.

3.5 WORK PERFORMANCE

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

3.6 SYSTEM PROGRAMMING

- A. General Programming Requirements
 - 1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems [(e.g., video matrix switch, intercoms, digital video recorders, intrusion devices, including integration of

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

subsystems to the SMS (e.g., camera call up, time synchronization, intercoms). System programming for existing or new SMS servers shall not be conducted at the project site.

- B. Level of Effort for Programming
 - 1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the SMS software. The Contractor's copy of the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the Resident Engineer on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the Resident Engineer has provided written approval. The Contractor is responsible for backing up the system prior to uploading new programming data. Additional programming requirements are provided as follows:
 - a. Programming for New SMS Server: The contractor shall provide all other system related programming. The contractor will be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings) along with coordinating with Resident Engineer for device configurations, standards, and groupings. VA shall provide database to support Contractor's data entry tasks. The contractor shall anticipate a weekly coordination meeting and working with Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss.
 - b. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.

- The Contractor shall identify and request from the Resident Engineer, any additional data needed to provide a complete and operational system as described in the contract documents.
- 3. Contractor and Resident Engineer coordination on programming requires a high level of coordination to ensure programming is performed in accordance with VA requirements and programming uploads do not disrupt existing systems functionality. The contractor shall anticipate a minimum a weekly coordination meeting. Contractor shall ensure data uploading is performed without incident of loss of function or data loss. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on VA ESS projects. Calculations to determine actual levels of effort shall be confirmed by the contractor before project award.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

	Description of Tasks						
Description of Systems	Develop System Loading Sheets	Coordination	Initial Set-up Configurati on	Graphic Maps	System Programming	Final Checks	Level of Effort (Typical Tasks)
SMS Setup & Configurati on	e.g., program monitoring stations, programming networks, interconnecti ons between CCTV, intercoms, time synchronizati on	e.g., retrieve IP addresses, naming conventions, standard event descriptions , programming templates, coordinate special system needs	e.g., Load system Operating System and Application software, general system configurati ons	e.g., develop naming convention s, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file	e.g., program monitoring stations, programming networks, interconnecti ons between CCTV, intercoms, time synchronizati on	e.g., check all system diagnos tics (e.g., clients , panels)	Load and set-up 4-6 CDs and configure servers (to configure Loading and Configuring software Administrative account, audit log, Keystrokes, mouse clicks, multi-screen configuration

Electronic Entry Control Systems	e.g., setup of device, door groups & schedules, REX, Locks, link graphics	e.g., confirming device configuratio ns, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., setup of device, door groups & schedules, REX, Locks, link graphics	e.g., perform ing entry testing to confirm correct set-up and configu ration	e.g., creating a door, door configuration, adding request to exit, door monitors and relays, door timers, door related events (e.g., access, access denied, forced open, held open), linkages, controlled areas, advanced door monitoring, time zones, sequence of operations
---	--	--	--	--	--	---	---

Intrusion Detection Systems	e.g., enter door groups & schedules, link devices - REX, lock, & graphics	e.g., confirming device configuratio ns, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics	actor's deve	e.g., enter door groups & schedules, link devices - REX, lock, & graphics	e.g., walk test, device positio n, and masking	e.g., setting up monitoring and control points (e.g., motion sensors, glassbreaks, vibration sensor, strobes, sounders) creating intrusion zones, creating arm/disarm panel, timed sequences, time zones, icon placements on graphic maps, clearance levels, events (e.g., armed, disarmed, zone violation, device alarm activations), LCD reader messages,
Data Package Submittals.							

 Table 1 Contractor Level of Effort

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.7 TESTING AND ACCEPTANCE

- A. Performance Requirements
 - 1. General:
 - a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Resident Engineer at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.
 - b. The COTR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the Resident Engineer before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Resident Engineer at the conclusion of each phase of testing and prior to Resident Engineer approval of the test.
 - 2. Test Procedures and Reports: The test procedures, compliant w/ VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the Resident Engineer within seven (7) calendar days after completion of each test.
- B. Pre-Delivery Testing
 - 1. The purpose of the pre-delivery test is to establish that a system is suitable for installation. As such, pre-delivery test shall be a mock-up of the system as planned in the contract documents. The Contractor shall assemble the Security Test System at the Contractors local project within 50-miles of the project site, and perform tests to demonstrate the performance of the system complies with the contract requirements in accordance with the approved predelivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of all data produced during pre-delivery testing,

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

including results of each test procedure, shall be documented and delivered to the Resident Engineer at the conclusion of pre-delivery testing and prior to Resident Engineer's approval of the test. The test report shall be arranged so all commands, stimuli, and responses are correlated to allow logical interpretation. For Existing System modifications, the contractor shall provide their own server with loaded applicable software to support PDT.

- 2. Test Setup: The pre-delivery test setup shall include the following:
 - a. All console equipment.
 - 1) At least one of each type of data transmission media (DTM) and associated equipment to provide a fully integrated PACS.
 - The number of local processors shall equal the amount required by the site design.
 - 3) Enough sensor simulators to provide alarm signal inputs to the system equal to the number of sensors required by the design. The alarm signals shall be manually, or software generated.
 - Contractor to prove to owner all systems are appropriately sized and configured as sized.
 - 5) Integration of VASS, intercom systems, other subsystems.
- 3. During the bidding process the contractor shall submit a request for information to the Owner to determine if a pre-delivery test will be required. If a pre-delivery test is not required, the contractor shall provide a written notification that the Pre-delivery Test is not required in their shop drawings submission.
- C. Intermediate Testing
 - After completion of 30-50 percent of the installation of ESS cabinet(s) and equipment, one local and remote-control stations and prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate FCC listing & UL certification labels are affixed, NFPA, Emergency, Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
 - D. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

The results of the inspection will be officially recorded by a designated Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results.

- E. Contractor's Field Testing (CFT)
 - 1. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this Contractor within the base of camera poles shall be tested as specified in IEEE STD 142. The Contractor shall test all security systems and equipment and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting complete testing to Resident Engineer approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor's fieldtesting procedures shall be identical to the Resident Engineer's acceptance testing procedures. The Contractor shall provide the Resident Engineer with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the Resident Engineer stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by contractor is received certifying that a contractor's field test was successful.

F. Performance Verification Test (PVT)

- 1. Test team:
 - a. After the system has been pretested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test to date and give the Resident Engineer written, notice as described herein, prior to the date the acceptance test is

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

expected to begin. The system shall be tested in the presence of a Government Representative, an OEM certified representative, representative of the Contractor and other approved by the Resident Engineer. The system shall be tested utilizing the approved test equipment to certify proof of performance, FCC, UL and Emergency Service compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

- 2. The Contractor shall demonstrate the completed Physical Access Control System PACS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for all travel and lodging expenses incurred for outof-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
- 3. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the Resident Engineer or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.
- Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the Resident Engineer prior to commencing the endurance test.
- 5. Additional Components of the PVT shall include:
 - a. System Inventory
 - 1) All Device equipment
 - 2) All Software

- 3) All Logon and Passwords
- 4) All Cabling System Matrices
- 5) All Cable Testing Documents
- 6) All System and Cabinet Keys
- b. Inspection
 - Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for Resident Engineers approval.
 - 2) As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.
- 6. Partial PVT At the discretion of Resident engineer, the Performance Verification Test may be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The contractor shall perform a test of each procedure on select devices or equipment.
- G. Endurance Test
 - 1. The Contractor shall demonstrate the specified probability of detection and false alarm rate requirements of the completed system. The endurance test shall be conducted in phases as specified below. The endurance test shall not be started until the Resident Engineer notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. VA shall operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing. VA will maintain a log of all system deficiencies. The Resident Engineer may terminate testing at any time the system fails to perform as specified. Upon termination of testing, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test, the Contractor shall verify the appropriate operation of the system. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Resident Engineer prior to acceptance of the system.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the Resident Engineer. If the system experiences no failures, the Contractor may proceed directly to Phase III testing after receiving written permission from the Resident Engineer.
- 3. Phase II (Assessment):
 - a. After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Resident Engineer. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
 - b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Resident Engineer. The meeting shall not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase I be repeated.
- 4. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the COTR.
- 5. Phase IV (Assessment):
 - After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the COTR. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the COTR. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the COTR. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions for the performance verification test. Based on the review meeting the test should not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As a part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the Resident Engineer may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.
- H. Exclusions
 - 1. The Contractor will not be held responsible for failures in system performance resulting from the following:
 - a. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the PACS performed as specified.
 - b. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
 - c. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 28 05 13

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the finishing, installation, connection, testing and certification the conductors and cables required for a fully functional for electronic safety and security (ESS) system.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- D. Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 28 05 28.33 CONDUITS AND BOXES FOR ELECTRONIC SECURITY AND SAFETY. Requirements for infrastructure.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling powerlimited circuits.
- F. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- G. RCDD: Registered Communications Distribution Designer.
- H. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

- I. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- J. UTP: Unshielded twisted pair.

1.4 QUALITY ASSURANCE

A. See section 28 05 00, Paragraph 1.4.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - Manufacturer's Literature and Data: Showing each cable type and rating.
 - Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and diagrams for cable management system.
 - 3. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 - e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
 - Wiring Diagrams. Show typical wiring schematics including the following:
 - a. Workstation outlets, jacks, and jack assemblies.
 - b. Patch cords.
 - c. Patch panels.
 - 5. Cable Administration Drawings: As specified in Part 3 "Identification" Article.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 6. Project planning documents as specified in Part 3.
- Maintenance Data: For wire and cable to include in maintenance manuals.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):

D2301-04..... Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical

Insulating Tape

C. Federal Specifications (Fed. Spec.): A-A-59544-08.....Cable and Wire, Electrical (Power, Fixed

Installation)

D. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

- E. Underwriters Laboratories, Inc. (UL):
 - 44-05..... Thermoset-Insulated Wires and Cables
 - 83-08.....Thermoplastic-Insulated Wires and Cables
 - 467-07.....Electrical Grounding and Bonding Equipment
 - 486A-03.....Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - 486C-04.....Splicing Wire Connectors
 - 486D-05.....Systems for
 - Underground Use or in Damp or Wet Locations
 - 486E-00.....Equipment Wiring Terminals for Use with
 - Aluminum and/or Copper Conductors
 - 493-07.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
 - 514B-04.....Fittings for Cable and Conduit
 - 1479-03.....Fire Tests of Through-Penetration Fire Stops

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - Test optical fiber cable to determine the continuity of the strand end to end. Use optical-fiber flashlight or optical loss test set.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
- 3. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 GENERAL

- A. General: All cabling locations shall be in conduit systems as outlined in Division 28 unless a waiver is granted in writing, or an exception is noted on the construction drawings.
- B. Support of Open Cabling: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars and spools.
 - 3. Straps and other devices.
- C. Cable Trays:
 - Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick.
 - Basket Cable Trays: Size as shown on plans. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
 - Ladder Cable Trays: Size as shown on plans <, with a rung spacing of 12 inches (305 mm).
- D. Conduit and Boxes: Comply with requirements in Division 28 Section "Conduits and Backboxes for Electrical Systems."
 - Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

2.3 UTP CABLE

- A. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 6A.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG; or MPP, CMP, MPR, CMR, MP, or MPG.
 - b. Communications, Plenum Rated: Type CMP; or MPP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG.
 - e. Multipurpose: Type MP or MPG; or MPP or MPR.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- B. Connecting Blocks: 110-style for Category 6A. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

- A. Description: Multimode, 50/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.

28 05 13 - 5

- 2. Comply with TIA/EIA-568-B.3 for performance specifications.
- 3. Comply with TIA/EIA-492AAAA-for detailed specifications.
- 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
 - e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
- 5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
- 6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- B. Jacket:
 - 1. Jacket Color: Aqua for 50/125-micrometer cable.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

- A. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 - 1. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss shall be not more than 0.75 dB.
 - 2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

A. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. RG-11/U: NFPA 70, Type CATV.
 - 1. No. 14 AWG, solid, copper-covered steel conductor.
 - 2. Gas-injected, foam-PE insulation.
 - 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
 - 4. Jacketed with sunlight-resistant, black PVC or PE.
 - 5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- C. RG-6/U: NFPA 70, Type CATV or CM.
 - No. 16 <Insert size> AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 - 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 - 3. Jacketed with black PVC or PE.
 - 4. Suitable for indoor installations.
- D. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
 - 1. CATV Cable: Type CATV, or CATVP or CATVR.
 - 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 - 3. CATV Riser Rated: Type CATVR; or CATVP, CATVR, or CATV, complying with UL 1666.
 - 4. CATV Limited Rating: Type CATVX.

2.8 COAXIAL CABLE HARDWARE

A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Polypropylene insulation.
 - Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 4. PVC jacket.
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - 6. Flame Resistance: Comply with UL 1581.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Plastic insulation.
 - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 - 4. Plastic jacket.
 - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - 6. Flame Resistance: Comply with NFPA 262.

2.10 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM or CMG.
 - 1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Fluorinated ethylene propylene jacket.
 - 5. Flame Resistance: NFPA 262, Flame Test.

2.11 LOW-VOLTAGE CONTROL CABLE

- A. Paired Lock Cable: NFPA 70, Type CMG.
 - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
 - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 - 2. PVC insulation.

VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 3. Unshielded. 4. PVC jacket. 5. Flame Resistance: Comply with NFPA 262. C. Paired Lock Cable: NFPA 70, Type CMG. 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors. 2. PVC insulation. 3. Unshielded. 4. PVC jacket. 5. Flame Resistance: Comply with UL 1581. D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP. 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors. 2. Fluorinated ethylene propylene insulation. 3. Unshielded. 4. Plastic jacket. 5. Flame Resistance: NFPA 262, Flame Test. 2.12 CONTROL-CIRCUIT CONDUCTORS A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83. B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway or power-limited cable, concealed in building finishes complying with UL 83. C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83. 2.13 FIRE ALARM WIRE AND CABLE A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760. B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer. 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating. C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation. 1. Low-Voltage Circuits: No. 16 AWG, minimum.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. Line-Voltage Circuits: No. 12 AWG, minimum.
- 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.14 IDENTIFICATION PRODUCTS

A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.15 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

2.16 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

2.17 FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 9. Pulling Cable:
 - a. Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 - b. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - c. Use ropes made of nonmetallic material for pulling feeders.

- d. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer/COTR.
- e. Pull in multiple cables together in a single conduit.
- C. Splice cables and wires where necessary only in outlet boxes, junction boxes, or pull boxes.
 - 1. Splices and terminations shall be mechanically and electrically secure.
 - 2. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.
- D. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- E. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- F. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- G. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- H. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- I. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.
- J. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- K. Optical Fiber Cable Installation:
 - 1. Comply with TIA/EIA-568-B.3.
 - Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- L. Open-Cable Installation:
 - Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- M. Installation of Cable Routed Exposed under Raised Floors:
 - 1. Install plenum-rated cable only.
 - Install cabling after the flooring system has been installed in raised floor areas.
 - Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than 12 inches (300 mm) in diameter below each feed point.
- N. Outdoor Coaxial Cable Installation:
 - Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors to keep out moisture.
 - Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- O. Separation from EMI Sources:
 - Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

- 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
- 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6
 inches (150 mm).
- Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
- Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.2 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Division 28 Section CONDUITS AND BACKBOXES FOR ELECTRICAL SYSTEMS."
 - Install plenum cable in environmental air spaces, including plenum ceilings.
 - Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
 - Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarmindicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONTROL CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.4 CONNECTIONS

A. Comply with requirements in Division 28 Section, PHYSICAL ACCESS CONTROL for connecting, terminating, and identifying wires and cables.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Comply with requirements in Division 28 Section "INTRUSION DETECTION" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "FIRE DETECTION AND ALARM" for connecting, terminating, and identifying wires and cables.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING."
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY."

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Install a permanent wire marker on each wire at each termination.
- C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- D. Wire markers shall retain their markings after cleaning.
- E. In each handhole, install embossed brass tags to identify the system served and function.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

bars in connection blocks. Test cables after termination but not cross connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- 4. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."
- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.9 EXISITNG WIRING

A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 28 05 26

GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing and certification of the grounding and bonding required for a fully functional Electronic Safety and Security (ESS) system.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS. For General Requirements.
- B. Section 28 05 00 REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS. For general electrical requirements, quality assurance, coordination, and project conditions that are common to more than one section in Division 28.
- C. Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for low voltage power and lighting wiring.

1.3 SUBMITTALS

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Shop Drawings:
 - Clearly present enough information to determine compliance with drawings and specifications.
 - Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COTR:
 - Certification that the materials and installation are in accordance with the drawings and specifications.
 - 2. Certification by the contractor that the complete installation has been properly installed and tested.
VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM): B1-07.....Standard Specification for Hard-Drawn Copper Wire B3-07....Standard Specification for Soft or Annealed

Copper Wire

- B8-04.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- - C2-07.....National Electrical Safety Code
- D. National Fire Protection Association (NFPA): 70-11.....National Electrical Code (NEC) 99-2005.....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):

44-05Thermoset-Insulated Wires and Cables 83-08Thermoplastic-Insulated Wires and Cables 467-07Grounding and Bonding Equipment 486A-486B-03Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.2 GROUND RODS

- A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.3 SPLICES AND TERMINATION COMPONENTS

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).2.4 ground connections
- B. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- C. Below Grade: Exothermic-welded type connectors.
- D. Above Grade:
 - Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - 2. Connection to Building Steel: Exothermic-welded type connectors.
 - 3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
 - 4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.
 - 5. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - a) Pipe Connectors: Clamp type, sized for pipe.
 - Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide $(3/8-inch \times \frac{3}{4} inch)$.

2.5 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.
- B. System Grounding:
 - Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 CORROSION INHIBITORS

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.4 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.5 COMPUTER ROOM/SECURITY EQUIPMENT ROOM GROUNDING

- A. Conduit: Ground and bond metallic conduit systems as follows:
 - Ground metallic service conduit and any pipes entering or being routed within the computer room at each end using 16 mm² (6AWG) bonding jumpers.
 - 2. Bond at all intermediate metallic enclosures and across all joints using 16 $\rm mm^2$ (6 AWG) bonding jumpers.

3.6 WIREWAY GROUNDING

- A. Ground and Bond Metallic Wireway Systems as follows:
 - Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.

- Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
- 3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
- 4. Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

3.7 LIGHTNING PROTECTION SYSTEM

A. Bond the lightning protection system to earth ground externally to the building. Under no condition shall the electrical system's third of fourth ground electrode system, or the telecommunications system circulating ground system be connected to the lightning protection system. The Facility's structural steel may be used to connected the lightning protection system at the direction of the Resident Engineer certified by an independent certified grounding contractor.

3.8 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the COTR prior to backfilling. The contractor shall notify the COTR 24 hours before the connections are ready for inspection.

3.9 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

3.10 LABELING

- A. Comply with requirements in Division 26 Section "ELECTRICAL IDENTIFICATION" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer.
 - Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - Power Distribution Units or Panel boards Serving Electronic Equipment: 3 ohm(s).
 - 2. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

- - - E N D - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 28 05 28.33

CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing certification of the conduit, fittings, and boxes to form a complete, coordinated, raceway system(s). Conduits and when approved separate UL Certified and Listed partitioned telecommunications raceways are required for a fully functional Electronic Safety and Security (ESS) system. Raceways are required for all electronic safety and security cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS. For General Requirements.
- B. Section 06 10 00 ROUGH CARPENTRY. Requirements for mounting board for communication closets.
- C. Section 07 84 00 FIRESTOPPING. Requirements for sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 60 00 FLASHING AND SHEET METAL. Requirements for fabrications for the deflection of water away from the building envelope at penetrations.
- E. Section 07 92 00 JOINT SEALANTS. Requirements for sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- F. Section 09 91 00 PAINTING. Requirements for identification and painting of conduit and other devices.
- G. Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general electrical requirements, general arrangement of the contract documents, coordination, quality assurance, project conditions, equipment and materials, and items that is common to more than one section of Division 28.
- H. Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

- I. Section 28 08 00 COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.
- J. Section 31 20 00 EARTH MOVING. For bedding of conduits.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. NBR: Acrylonitrile-butadiene rubber.
- H. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE

A. Refer to Paragraph 1.4 Quality Assurance, in Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

1.5 SUBMITTALS

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Furnish the following:
- B. Shop Drawings:
 - 1. Size and location of main feeders.
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - The specific item proposed, and its area of application shall be identified on the catalog cuts.
- C. Certification: Prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.
- D. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- E. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- F. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- G. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- H. Source quality-control test reports.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing

C. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

1-05.....Flexible Metal Conduit

- 5-04.....Surface Metal Raceway and Fittings
- 6-07.....Rigid Metal Conduit
- 50-07.....Enclosures for Electrical Equipment
- 360-09.....Liquid-Tight Flexible Steel Conduit

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

467-07.....Grounding and Bonding Equipment
514A-04.....Metallic Outlet Boxes
514B-04.....Fittings for Cable and Conduit
514C-02....Nonmetallic Outlet Boxes, Flush-Device Boxes
and Covers
651-05....Schedule 40 and 80 Rigid PVC Conduit
651A-07....Type EB and A Rigid PVC Conduit and HDPE
Conduit
797-07....Electrical Metallic Tubing
1242-06.....Intermediate Metal Conduit

PART 2 - PRODUCTS

2.1 GENERAL

A. Conduit Size: In accordance with the NEC, but not less than 20 mm (3/4 inch) unless otherwise shown.

2.2 CONDUIT

- A. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
- B. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
- C. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.
- D. Flexible galvanized steel conduit: Shall Conform to UL 1.
- E. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
- F. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high-density polyethylene (PE).

2.3 WIREWAYS AND RACEWAYS

A. Surface metal raceway: Shall Conform to UL 5.

2.4 CONDUIT FITTINGS

- A. Rigid steel and IMC conduit fittings:
 - 1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - 3. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
- 5. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
- 6. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
- B. Electrical metallic tubing fittings:
 - 1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - 2. Only steel or malleable iron materials are acceptable.
 - 3. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - 4. Indent type connectors or couplings are prohibited.
 - Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- C. Flexible steel conduit fittings:
 - 1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - 2. Clamp type, with insulated throat.
- D. Liquid-tight flexible metal conduit fittings:
 - 1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - 2. Only steel or malleable iron materials are acceptable.
 - Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- E. Direct burial plastic conduit fittings:
 - 1. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 - 2. As recommended by the conduit manufacturer.
- F. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- G. Expansion and deflection couplings:
 - 1. Conform to UL 467 and UL 514B.
 - Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections.
 - 3. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
 - 4. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

2.5 CONDUIT SUPPORTS

- A. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
- B. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
- C. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
- D. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

2.6 OUTLET, JUNCTION, AND PULL BOXES

- A. UL-50 and UL-514A.
- B. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.
- E. Sheet metal boxes: Galvanized steel, except where otherwise shown.
- F. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.7 CABINETS

- A. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- B. Hinged door in front cover with flush latch and concealed hinge.
- C. Key latch to match panelboards.
- D. Metal barriers to separate wiring of different systems and voltage.
- E. Accessory feet where required for freestanding equipment.

2.8 WIREWAYS

A. Equip with hinged covers, except where removable covers are shown.

2.9 WARNING TAPE

A. Standard, 4-Mil polyethylene 76 mm (3 inches) wide tape non-detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRONIC SAFETY AND SECURITY CABLE BELOW".

2.10 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, as indicated for each service. <Insert legend.>
 - Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 300 mm wide by 600 mm long (2 inches wide by 24 inches long) <Insert dimensions> and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

2.11 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 84 00 "FIRESTOPPING."

2.12 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - Pressure Plates: Stainless steel. Include two for each sealing element.
 - Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.13 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
 - Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Resident Engineer/COTR prior to drilling through structural sections.
 - 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Resident Engineer/COTR as required by limited working space.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Fire Stop: Where conduits, wireways, and other electronic safety and security raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, "JOINT SEALANTS".

3.2 INSTALLATION, GENERAL

- A. Install conduit as follows:
 - 1. In complete runs before pulling in cables or wires.
 - 2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
 - 3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 - 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
 - 5. Mechanically continuous.
 - 6. Independently support conduit at 2.4 m (8 foot) on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
 - 7. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
 - 8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
 - 9. Conduit installations under fume and vent hoods are prohibited.
 - 10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
 - 11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, "FLASHING AND SHEET METAL".
 - 12. Do not use aluminum conduits in wet locations.

- 13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.
- B. Conduit Bends:
 - 1. Make bends with standard conduit bending machines.
 - 2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
 - 3. Bending of conduits with a pipe tee or vise is prohibited.
- C. Layout and Homeruns:
 - 1. Install conduit with wiring, including homeruns, as shown.
 - Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer/COTR.
- D. Fire Alarm:
 - Fire alarm conduit shall be painted red (a red "top-coated" conduit from the conduit manufacturer may be used in lieu of painted conduit) in accordance with the requirements of Section 28 31 00, "FIRE DETECTION AND ALARM".

3.3 CONCEALED WORK INSTALLATION

- A. In Concrete:
 - 1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
 - 2. Align and run conduit in direct lines.
 - 3. Install conduit through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the Resident Engineer/COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
 - Installation of conduit in concrete that is less than 75 mm (3 inch) thick is prohibited.
 - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
 - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.

- c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
- 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.
- B. Furred or Suspended Ceilings and in Walls:
 - 1. Conduit for conductors above 600 volts:
 - a. Rigid steel or rigid aluminum.
 - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
 - 2. Conduit for conductors 600 volts and below:
 - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
 - Align and run conduit parallel or perpendicular to the building lines.
 - Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from a junction box to the fixture.
 - 5. Tightening set screws with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 volts and below:
 - Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
 - 1. Paint exposed conduit as specified in Section09 91 00, "PAINTING".

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, "PAINTING" for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.

3.6 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. Existing Construction:
 - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
 - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.7 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes).

- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example, "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

3.8 ELECTRONIC SAFETY AND SECURITY CONDUIT

- A. Install the electronic safety and security raceway system as shown on drawings.
- B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.
- F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.
- G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- H. All empty conduits located in communications closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends
34	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

- J. Furnish and install 19 mm (3/4 inch) thick fire-retardant plywood specified in on the wall of communication closets where shown on drawings. Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.
- K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

3.9 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 - "COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS" for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00, "COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS" and related sections for contractor responsibilities for system commissioning.

- - - E N D - - -

SECTION 28 16 00 INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide and install a complete Intrusion Detection System, hereinafter referred to as IDS, as specified in this section.
- B. This Section includes the following:
 - Intrusion detection with [hard-wired] [multiplexed], modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
 - Responsibility for integrating electronic and electrical systems and equipment is specified in the following Sections, with Work specified in this Section:
 - a. Division 08 Section "DOOR HARDWARE".
 - e. Division 28 Section "FIRE DETECTION AND ALARM".
- C. Related Sections include the following:
 - Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY" for cabling between central-station control units and field-mounted devices and controllers.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 26 05 11 REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- D. Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- E. Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- F. Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- G. Section 28 05 28.33 CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

- H. Section 28 08 00 COMMISIONING OF ELECTRONIC SAFETY AND SECURITY. Requirements for commissioning - systems readiness checklists, and training.
- I. Section 28 31 00 FIRE DETECTION AND ALARM. Requirements for integration with fire detection and alarm system.

1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the IDS as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

1.4 DEFINITIONS

- A. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- B. I/O: Input/Output.
- C. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- D. LED: Light-emitting diode.
- E. NEC: National Electric Code
- F. NEMA: National Electrical Manufacturers Association
- G. NFPA: National Fire Protection Association
- H. NRTL: Nationally Recognized Testing Laboratory.
- I. SMS: Security Management System A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- J. PIR: Passive infrared.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- K. RF: Radio frequency.
- L. Standard Intruder: A person who weighs 45 kg (100 lb.) or less and whose height is 1525 mm (60 in) or less; dressed in a long-sleeved shirt, slacks, and shoes.
- M. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
- N. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- O. UPS: Uninterruptible Power Supply
- P. UTP: Unshielded Twisted Pair

1.5 SUBMITTALS

A. Refer to Section 28 05 00, Part 1.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/Security Industry Association (SIA):

PIR-01-00..... Passive Infrared Motion Detector Standard -

Features for Enhancing False Alarm Immunity

- CP-01-00.....Control Panel Standard-Features for False Alarm Reduction
- C. Department of Justice American Disability Act (ADA) 28 CFR Part 36.....2010 ADA Standards for Accessible Design
- D. Federal Communications Commission (FCC): (47 CFR 15) Part 15....Limitations on the Use of Wireless

Equipment/Systems

E. National Electrical Manufactures Association (NEMA): 250-08......Enclosures for Electrical Equipment (1000 Volts Maximum)

F. National Fire Protection Association (NFPA): 70-11.....National Electrical Code

731-08..... Standards for the Installation of Electric Premises Security Systems

- G. Underwriters Laboratories, Inc. (UL): 464-09.....Audible Signal Appliances 609-96....Local Burglar Alarm Units and Systems 634-07....Standards for Connectors with Burglar-Alarm Systems 639-07....Standards for Intrusion Detection Units 1037-09....Standard for Anti-theft Alarms and Devices 1635-10....Digital Alarm Communicator System Units
- H. Uniform Federal Accessibility Standards (UFAS), 19841.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of intrusion detection system equipment:
 - To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - To allow right of way for piping and conduit installed at required slope.
 - So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.8 EQUIPMENT AND MATERIALS

- A. General
 - All equipment associated within the IDS shall be rated for continuous operation. Environmental conditions (i.e., temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
 - All equipment shall operate on 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in

subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 96 hours of run time in the event of a loss of primary power to the facility.

- 3. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- 4. All equipment and materials for the system will be compatible to ensure functional operation in accordance with requirements.

1.9 WARRANTY OF CONSTRUCTION.

- A. Warrant IDS work subject to the Article "Warranty of Construction" of FAR 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

PART 2 - PRODUCTS

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
 - 1. Alarm Signal: Display at central-station control unit and actuate audible and visual alarm devices.
 - Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
 - Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or controller.
- B. System Control: Central-station control unit shall directly monitor intrusion detection units and connecting wiring.
- C. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

- D. Operator Commands:
 - Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
 - 2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
 - Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
 - 4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
 - 5. Protected Zone Test: Initiate operational test of a specific protected zone.
 - 6. System Test: Initiate system-wide operational test.
 - 7. Print Reports.
- E. Timed Control at Central-Station Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
- F. Response Time: 2 seconds between actuation of any alarm and its indication at central-station control unit.
- G Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from central-station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at central-station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- H. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

I. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.2 SYSTEM COMPONENT REQUIREMENTS

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
 - Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS.
 - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements in Division 26 Section TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS as recommended by manufacturer for type of line being protected.
- B. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.
- C. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to central-station control unit.

2.3 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.

2.4 EQUIPMENT ITEMS

- A. General:
 - 1. All requirements listed below are the minimum specifications that need to be met in order to comply with the IDS.
 - 2. All IDS sensors shall conform to UL 639, Intrusion Detection Standard.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 3. Ensure that IDS is fully integrated with other security subsystems as required to include, but not limited to, the CCTV, PACS, EPPS, and Physical Access Control System and Database Management. The IDS provided shall not limit the expansion and growth capability to a single manufacturer and shall allow modular expansion with minimal equipment modifications.
- B. IDS Components: The IDS shall consist of, but not be limited to, the following components:
 - 1. Control Panel
 - 2. Interior Detection Devices (Sensors)
 - 3. Power Supply
 - 4. Enclosures

2.5 CONTROL PANEL

- A. The Control panel shall be the main point of programming, monitoring, accessing, securing, and troubleshooting the IDS. Refer to American National Standards Institute (ANSI) CP-01 Control Panel Standard-Features for False Alarm Reduction.
- B. The Control Panel shall provide a means of reporting alarms to a Physical Access Control System and Database Management via a computer interface or direct connection to an alarm control monitoring panel.
- C. The Control panel shall utilize a Multifunctional Keypad, Input and Output Modules for expansion of alarm zones, interfacing with additional security subsystems, programming, monitoring and controlling the IDS.
- D. The Control panel shall meet or exceed the following minimum functional requirements for programming outputs, system response, and user interface:
 - 1. Programming Outputs:
 - a. 2 Amps alarm power at 12 VDC
 - b. 1.4 Amps auxiliary power at 12 VDC
 - c. Four alarm output patterns
 - d. Programmable bell test
 - e. Programmable bell shut-off timer
 - 2. System Response:
 - a. Selectable point response time
 - b. Cross point capability

- c. Alarm verification
- d. Watch mode
- e. Scheduled events arm, disarm, bypass and un-bypass points, control relays, and control authority levels
- 3. User Interface:
 - a. Supervises up to eight command points (e.g., Up to 16 unsupervised keypads can be used)
 - b. Provides custom keypad text
 - c. Addresses full function command menu including custom functions
 - d. Allows user authority by defined area and 16-character name
 - e. Provides for 14 custom authority control levels allowing user's authority to change, add, delete pass codes, disarm, bypass points, and start system tests.
- The Control panel shall meet or exceed the following technical characteristics:

Input Voltage via 110 VAC or 220 VAC Step-down Transformer	16 or 18 VAC
Operating Voltage	12 VDC
Output Voltage	12 VDC @ 2 A max
Direct Hardwire Zones	7
Partitions	8
Multifunctional Keypads	16 (2 per partition)
Communications Port	RJ-11

- E. A multifunctional keypad shall be utilized as a user interface for arming, disarming, monitoring, troubleshooting, and programming the alarm control panel.
- F. Keypads shall have the following features:
 - Multiple function keypads suitable for remote mounting, no greater than 1333 m (4000 ft), shall be provided from the control panel and have a light emitting diode (LED) readout of alarm and trouble conditions by zone.
 - 2. An alphanumeric English language display, with keypad programmability, and EE-PROM memory, shall also be provided.
 - Trouble alarm indicators shall be distinguishable from intrusion alarms.

- 4. A minimum of four (4) zones selectable as entry and exit with programmable time delay.
- 5. Complete system test activated capability at the keypad.
- 6. Capability for opening and closing reports to a remote monitoring location.
- 7. Adjustable entry and exit delay times.
- 8. Capability for a minimum of two (2) multiple function keypads.
- 9. Capability to shunt or bypass selected interior zones while arming perimeter protection and remaining interior zones.
- Capability for a minimum of seven assignable passcodes that are keypad programmable from a suppressed master code.
- 11. The control panel shall have a communications port that will allow for communications with a computer for programming, monitoring, and troubleshooting purposes. The communications port will be, at a minimum, and RJ-11 or better.
- 12. The control panel will have a systems success probability of 95% or better, and shall include the following success considerations:
 - a. False Alarm: Shall not exceed one (1) false alarm per 30 days per sensor zone.
 - b. Nuisance Alarm: Shall not exceed a rate of one (1) alarm per seven (7) days per zone within the first 60 days after installation and acceptance. Sensor adjustments will be made and then shall not exceed one (1) alarm per 30 days.
- 13. The Control Panel will be able to detect either a line fault or power loss for all supervised data cables.
 - a. Line Fault Detection: Communication links of the IDS shall have an active mode for line fault detection. Fault isolation at the systems level shall have the same geographic resolutions as provided for intrusion detection. The line fault alarm shall be clearly distinguishable from other alarms.
 - b. Power Loss Detection: Provide the capability to detect when critical components experience temporary or permanent loss of power and annunciate to clearly identify the component experiencing power loss.

2.6 KEYPADS

A. Keypads shall meet or exceed the following technical characteristics:

Connections	4-wire flying lead for data and power
Operating Temperature	0°C to +50°C (+32°F to +122°F)
Display Window	8-point LED
Indicators: Illuminated keys	Armed Status-LED
	Point Status-LED
	Command Mode-LED
	Power-LED
Voltage	Nominal 12 VDC

2.7 INPUT MODULE

A. An input module shall be utilized to connect additional detection devices to the control panel. This module will meet or exceed the following technical characteristics:

Operating Voltage	8.5 to 14.5 VDC Nominal
Zone Inputs	Style A (Class B) Supervised
Operating Temperature	0 to 40 degrees C (32 to 140 degrees F)

2.8 OUTPUT MODULE

A. An output module shall be utilized to interface the control panel with other security subsystems. The output module shall meet or exceed the following technical characteristics:

Operating Voltage	8.5 to 14.5 VDC Nominal
Output Relays	"Form C" Dry Relay Contracts
Relay Contact Rating	4A @ 24 VDC
	4A @ 24 VAC
	1A @ 70 VAC
Operating Temperature	0 to 40 degrees C F (32 to 140 degrees)

2.9 INTERIOR DETECTION DEVICES (SENSORS)

- A. The IDS shall consist of interior, exterior, and other detection devices that are capable of:
 - Locating intrusions at individually protected asset areas or at an individual portal;
 - 2. Locating intrusions within a specific area of coverage;
 - 3. Locating failures or tampering of individual sensors or components.

- B. Provide and adjust for devices so that coverage is maximized in the space or area it is installed in. For large rooms where multiple devices are required, ensure device coverage is overlapping.
- C. Detection sensitivity shall be set up to ensure maximum coverage of the secure area is obtained while at the same time limiting excessive false alarms due to the environment and impact of small animals. All detection devices shall be anti-masking with exception of video motion detection.
- D. Dual sensor technology shall be used when possible. Sensor technology shall not be of the same type that is easily defeated by a single method. This will reduce the amount of false alarms.
- E. Interior Environmental Conditions: Systems shall be able to operate in environmentally protected interior areas and shall meet operational performance requirements for the following ambient conditions:
 - 1. If components are installed in unheated areas they shall be able to operate in temperatures as low as -17 C (0 F);

Temperatures	0 to 50 C (32F to 120 F)
Pressure	Sea Level to 4573m (15,000 ft.) above sea level
Humidity	5% - 95%
Fungus	Components of non-fungus nutrient materials
Acoustical Noise	Suitable for high noise environments above 100db

2. Interior Sensor Environmental Characteristics:

- F. Balanced Magnetic Switches (BMS)
 - BMS switches shall be surface or recessed mounted according to manufacturer's instructions. Recessed mounted is the preferred method to reduce tampering or defeating of the system. Switches shall activate when a disturbance in the balanced magnetic field occurs.
 - 2. Switches shall have a minimum of two (2) encapsulated reed switches.
 - 3. Contractor shall provide each BMS with a current protective device, rated to limit current to 80% of the switch capacity.
 - Surface Mounted BMS: For exterior application, components shall be housed in weatherproof enclosures.

- 5. BMS field adjustments in the fixed space between magnet and switch housing shall not be possible. Attempts to adjust or disturb the magnetic field shall cause a tamper alarm.
- 6. BMS Technical Characteristics:

Maximum current	.25 amperes
Maximum voltage	30 VDC
Maximum power	3.0 W (without internal terminating resistors). 1.0 W (with internal terminating resistors).
Components	Three (3) pre-adjusted reed switches Three (3) pre-adjusted magnets
Output contacts	Transfer type SPDT
Contact rating	0.5 amperes, 28 VDC
Switch mechanism	Internally adjustable ¼ - ½ in. (6-13 mm)
Wiring	Two (2) wires #22 American Wire Gauge (AWG), three (3) or 11-foot attached cable
Activation lifetime	1,000,000 activations
Enclosure	Nonferrous materials
Tamper alarm activation	Cover opened 3 mm (1/8 in.) and inaccessible until actuated

- G. Passive Infrared Motion Sensors (PIR)
 - These sensors shall detect an intruder presence by monitoring the level of infrared energy emitted by objects within a protected zone and meet ANSI PIR-01 Passive Infrared Motion Detector Standards Features for Enhancing False Alarm Immunity. An alarm shall be initiated when motion and temperature changes within set patterns are detected as follows.
 - 2. The detector shall provide multiple detection zones distributed at a variety of angles and distance.
 - 3. Sensors shall be passive in nature; no transmitted energy shall be required for detection.
 - Sensors shall be sensitive to infrared energy emitted at wavelengths corresponding to human body and other objects at ambient temperatures.

- 5. Sensors shall not alarm in response to general area thermal variations and shall be immune to radio frequency interference.
- 6. Sensors shall not be susceptible to changes in temperature due to an air conditioner being turned on or off.
- 7. Sensors shall be housed in a tamper-alarmed enclosure.
- Sensor detectors shall include motion analyzer processing, adjustable lens, and walk test LED's visible from any angle.
- 9. Sensors shall provide some means of indicating an alarm condition during installation and calibration. A means of disabling the indication shall be provided within the sensor enclosure.
- 10. Sensor detectors shall include a motion monitoring verification circuit that will signal trouble or alarm if the detector fails to detect motion for an extended period.
- 11. PIR Technical Characteristics:

Power	Six (6) - 12 VDC
	25 mA continuous current draw
	38 mA peaks
Alarm Velocity	<pre>1500 mm (Five (5) ft.) at a velocity of 30 mm (0.1 ft.) per second, and one (1) step per second, assuming 150 mm (6 in.) per step. Also, faster than 30 mm (1 foot) per second, up to 3000 mm (10 feet) per second</pre>
Maximum detection range	10.6 m (35 ft.)
Frequency range- non activation or setup use	26 to 950 MHz using a 50-watt transmitter located 1 ft. from the unit or attached wiring
Infrared detection	1 1/2°C (3°F) different from the background temperature
Detection Pattern	180 degrees for volumetric units, non PIR 360
PIR 360°Detection Pattern	Programmable 60 detection zones including one directly below
Mounting	Ceiling and walls
Ceiling heights	2.4 m (Eight (8) ft.) - 5.4 m (18 ft)
Sensitivity adjustments	Three (3) levels

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.10 POWER SUPPLY

- A. A power supply shall only be utilized if the control panel is unable to support the load requirements of the IDS system.
- B. All power supplies shall be UL rated and able to adequately power two entry control devices on a continuous base without failure.
- C. Power supplies shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ 2 amp
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC)
	24 VDC Nominal (27.6 VDC)
	Filtered and Regulated
BATTERY	Shall provide at least 96 hours of runtime, rechargeable
OUTPUT CURRENT	4 amp max. @ 13.8 VDC
	3 amp max. @ 27.6 VDC
BATTERY FUSE SIZE	3.5 A @ 250 VAC
CHARGING CIRCUIT	Built-in standard

2.11 AUDIBLE AND VISUAL ALARM DEVICES

- A. Bell: Central-station control unit 10 inches (254 mm) in diameter, rated to produce a minimum sound output of 84 dB at 10 feet (3 m) from central-station control unit.
 - Enclosure: Weather-resistant steel box equipped with tamper switches on cover and on back of box.
- B. Weatherproof Motor-Driven Hooter: UL listed, rated to produce a minimum sound output of 120 dB at 3 feet (1 m), plus or minus 3 dB, at a frequency of 470 Hz. Rated for intermittent use: two minutes on and five minutes off.
 - Designed for use in industrial areas and in high noise, severe weather marine environments.
- C. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet (3 m) from central-station control unit.
 - Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.
- D. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.
 - 1. Light Output: 115 cd, minimum.
 - 2. Flash Rate: 60 per minute.

2.12 SECURITY FASTENERS

- A. Security fasteners shall be operable only by tools produced for use on specific type of fastener-by-fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
- B. Drive System Types: Pinned Torx or pinned hex (Allen).
- C. Protective Coatings for Heat-Treated Alloy Steel:
 - 1. Zinc chromate, ASTM F 1135, Grade 3 or 4; for exterior applications and interior applications where indicated.
 - 2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. IDS installation shall be in accordance with Underwriters Laboratories (UL) 639 Standards for Intrusion Detection Units and UL 634 Standards for Connectors with Burglar Alarm Systems, and appropriate manufacture's installation manuals for each type of IDS.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including VA furnished equipment, and appurtenances in accordance with the manufacturer's instructions and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.
- D. The IDS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a standalone or designed as a computer network.
- E. The IDS shall be able to be integrated with other security subsystems. Integration with these security subsystems shall be achieved by computer programming and the direct hardwiring of the systems. Determination for methodology shall be outlined when the system(s) is/are being designed and engineered. For installation purposes, the

IDS shall utilize an output module for integration with other security subsystems. The Contractor will ensure all connections are per the OEM and that any and all software upgrades required to integrate the systems are installed prior to system start-up.

- F. For programming purposes, the Contractor shall refer to the manufacturer's requirements and Contracting Officer instructions for correct system operations. This includes ensuring computers being utilized for system integration meet or exceeds the minimum system requirements outlined in the IDS software packages.
- G. Lightening and power surges to the central alarm reporting and display unit shall be protected at both ends against excessive voltages. This requirement shall apply for circuits that are routed both in underground conduits and overhead runs.
- H. At a minimum, the Contractor shall install primary detection devices, such as three electrode gas-type surge arresters, and secondary protectors to reduce dangerous voltages to levels that will cause no damage. Fuses shall not be permitted as protection devices.
- I. The Contractor shall provide fail-safe gas tube type surge arresters on exposed IDS data circuits. In addition, transient protection shall protect against spikes up to 1000 volts peak voltage with a onemicrosecond rise time and 100-microsecond decay time, without causing false alarms. The protective device shall be automatic and selfrestoring. Also, circuits shall be designed or selected assuming a maximum of 25 ohms to ground.
- J. Product Delivery, Storage and Handling:
 - Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name, equipment model and serial identification numbers, and UL logo. The Contracting Officer may inventory the IDS equipment at the time of delivery and reject items that do not conform to this requirement.
 - Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the Contracting Officer.
- K. Cleaning and Adjustments:
 - Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or synchronization. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.
- L. Unique IDS Installation Components:
 - 1. BMS Surface Mounted:
 - a. Surface mounted BMS housing for the switch element shall have the capability to receive threaded conduit. Housing covers for surface mounted BMS, if made of cast aluminum, shall be secured by stainless steel screws. Magnet housing cover shall not be readily removable and BMS housings shall be protected from unauthorized access by a cover operated, corrosion-resistant tamper device.
 - b. Conductors running from a door to alarm circuits shall be contained within a flexible armored cord constructed from corrosion-resistant metal. Each end of the armored cord shall terminate in a junction box or other enclosure. Armored cord ends shall be mechanically secured to the junction boxes by clamps or bushings. Conductors within the armored cord shall be provided with lug terminals at each end. Conductors and the armored cord shall experience no mechanical strain as the door is removed from fully open to closed position. Switch circuits shall initiate an alarm if a short circuit is applied to the door cord.
 - c. For exterior application on double gates, both BMS elements must be mounted on the gate. Flexible armored cord constructed from corrosion-resistant metal shall be used to provide electrical connection.
 - 2. BMS Recessed Mounted:
 - a. Ball bearing door trips shall be mounted within vault door headers such that when the locking mechanism is secured, the door bolt engages an actuator, mechanically closing the switch.
 - b. Door bolt locking mechanisms shall be fully engaged before the ball bearing door trip is activated. Also, circuit jumpers from the door shall be provided if steel conduit or electrical metallic tubing (EMT).

- 3. Passive Infrared Detectors: (PIR)
 - a. The protective beam shall be focused in a straight line.
 - b. Installed beam distance from transmitter to receiver shall not exceed 80% of the manufacturer's maximum recommended rating.
 - c. Mirrors may be used to extend the beam or to establish a network of beams. Each mirror used shall not lower the rated maximum system range by more than 50%.
 - d. Mirrors and photoelectric sources used in outdoor applications shall have self-heating capability to eliminate condensation and shall be housed in weatherproof enclosures.

3.2 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceways according to Section 28 05 28.33 "CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (20 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring Method: Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (20 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- C. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

- E. Wires and Cables:
 - 1. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.
 - 120-V Power Wiring: Install according to Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES," unless otherwise indicated.
 - 3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
 - 4. Computer and Data-Processing Cables: Install according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- G. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.
- H. Identify components with engraved, laminated-plastic or metal nameplate for central-station control unit and each terminal cabinet, mounted with corrosion-resistant screws.

3.3 GROUNDING

- A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS."

3.4 STARTUP AND TESTING

A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.5 TESTS AND TRAINING

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- B. Provide services of manufacturer's technical representative for 4 hours to instruct VA personnel in operation and maintenance of units.

- - - END - - -

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

SECTION 28 31 00 FIRE DETECTION AND ALARM



VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified. The fire alarm system shall not be combined with other systems such as building automation, energy management, security, etc.
- B. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the COTR or his authorized representative. Installers shall have a minimum of 2 years experience installing fire alarm systems.
- C. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

1.2 SCOPE

A. an extension of an existing fire alarm system shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.

- B. All existing fire alarm equipment, wiring, devices and sub-systems that are not shown to be reused shall be removed. All existing fire alarm conduit not reused shall be removed.
- C. Existing fire alarm bells, chimes, door holders, 120VAC duct smoke detectors, valve tamper switches and waterflow/pressure switches may be reused only as specifically indicated on the drawings and provided the equipment:
 - 1. Meets this specification section
 - 2. Is UL listed or FM approved
 - 3. Is compatible with new equipment being installed
 - 4. Is verified as operable through contractor testing and inspection
 - 5. Is warranted as new by the contractor.
- D. Existing 120 VAC duct smoke detectors, waterflow/pressure switches, and valve tamper switches reused by the Contractor shall be equipped with an addressable interface device compatible with the new equipment being installed.
- E. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.
- F. Basic Performance:
 - Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
 - Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed 5 seconds.
 - 3. The signaling line circuits (SLC) between building fire alarm control units shall be wired Style 7 in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
 - 4. Initiating device circuits (IDC) shall be wired Style C in accordance with NFPA 72.
 - 5. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet (2,090 square meters) of floor space or 3 floors whichever is less.
 - 6. Notification appliance circuits (NAC) shall be wired Style Y in accordance with NFPA 72.

1.3 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Requirements for procedures for submittals.
- B. Section 07 84 00 FIRESTOPPING. Requirements for fire proofing wall penetrations.
- C. Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- D. Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- E. Section 28 05 28.33 CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- F. Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- G. Section 28 08 00, COMMISIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.

1.4 SUBMITTALS

- A. General: Submit 5 copies in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Drawings:
 - Prepare drawings using AutoCAD Release 14 software and include all contractors' information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (COTR). Bid drawing files on AutoCAD will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.

- 2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
- 3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
- 4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
- 5. Two weeks prior to final inspection, the Contractor shall deliver to the COTR 3 sets of as-built drawings and one set of the as-built drawing computer files using AutoCAD 2007 or later). As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- C. Manuals:
 - Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
 - a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
 - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
 - c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
 - d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
 - e. Complete listing of all digitized voice messages.
 - f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
 - g. Include information indicating who will provide emergency service and perform post contract maintenance.
 - h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
 - i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A printout of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.

- j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
- k. A printout for all devices proposed on each signaling line circuit with spare capacity indicated.
- 2. Two weeks prior to final inspection, deliver 4 copies of the final updated maintenance and operating manual to the COTR.
 - a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.
 - b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
 - c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
 - d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.
 - e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:

- Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
- Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
- 3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

1.5 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer.

1.6 NOT USED

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publications shall be applicable.
- B. National Fire Protection Association (NFPA):

NFPA 13Standard for the Installation of Sprinkler Systems, 2010 edition
NFPA 14Standard for the Installation of Standpipes and Hose Systems, 2010 edition
NFPA 20Standard for the Installation of Stationary Pumps for Fire Protection, 2010 edition
NFPA 70National Electrical Code (NEC), 2010 edition
NFPA 72National Fire Alarm Code, 2010 edition
NFPA 90AStandard for the Installation of Air Conditioning and Ventilating Systems, 2009 edition

NFPA 101Life Safety Code, 2009 edition

- C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory
- D. Factory Mutual Research Corp (FM): Approval Guide, 2007-2011
- E. American National Standards Institute (ANSI): S3.41Audible Emergency Evacuation Signal, 1990 edition, reaffirmed 2008
- F. International Code Council, International Building Code (IBC), 2009 edition

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

- A. All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.
- B. EST to match existing in buildings.

2.2 CONDUIT, BOXES, AND WIRE

- A. Conduit shall be in accordance with Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY and as follows:
 - 1. All new conduits shall be installed in accordance with NFPA 70.
 - Conduit fill shall not exceed 40 percent of interior cross sectional area.
 - 3. All new conduits shall be 3/4 inch (19 mm) minimum.
- B. Wire:
 - Wiring shall be in accordance with NEC article 760, Section 28 05

 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, and as
 recommended by the manufacturer of the fire alarm system. All wires
 shall be color coded. Number and size of conductors shall be as
 recommended by the fire alarm system manufacturer, but not less than
 18 AWG for initiating device circuits and 14 AWG for notification
 device circuits.
 - 2. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
 - 3. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- C. Terminal Boxes, Junction Boxes, and Cabinets:
 - 1. Shall be galvanized steel in accordance with UL requirements.
 - 2. All boxes shall be sized and installed in accordance with NFPA 70.
 - 3. covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.
 - 4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
 - Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COTR.

2.3 STANDBY POWER SUPPLY

A. Shall be continuously supervised for operational status.

2.4 ALARM INITIATING DEVICES

- A. Smoke Detectors:
 - Smoke detectors shall be photoelectric type and UL listed for use with the fire alarm control unit being furnished.
 - Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
 - 3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.

- 4. All spot type and duct type detectors installed shall be of the photoelectric type.
- 5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
- 6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.
- B. Heat Detectors:
 - Heat detectors shall be of the addressable restorable rate compensated fixed-temperature spot type.
 - Detectors shall have a minimum smooth ceiling rating of 2,500 square feet (230 square meters).
 - 3. Ordinary temperature (135 degrees F (57 degrees C)) heat detectors shall be utilized in elevator shafts and elevator mechanical rooms. Intermediate temperature rated (200 degrees F (93 degrees C)) heat detectors shall be utilized in all other areas.
 - Provide a remote indicator lamp, key test station and identification nameplate (e.g. "Heat Detector") for each elevator group. Locate key test station in plain view on elevator machine room wall.
- C. Provide spare and replacement parts as follows:
 - 1. Smoke detectors 5
- D. Spare and replacement parts shall be in original packaging and submitted to the COTR. strips shall be labeled as specified or as approved by the COTR.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with, Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.
- B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
- C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.
- D. All existing accessible fire alarm conduit not reused shall be removed.
- E. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.
- F. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations are to be approved by the COTR.

3.2 TESTS

A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.

- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.
 - Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 - Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
 - Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
 - 4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
 - 5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.3 FINAL INSPECTION AND ACCEPTANCE

- A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.
- B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition, the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.4 INSTRUCTION

- A. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose-leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.
- B. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

- - END - -

SECTION 31 20 00 EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:
 - 1. Site preparation.
 - 2. Excavation.
 - 4. Filling and backfilling.
 - 5. Grading.
 - 6. Soil Disposal.
 - 7. Clean Up.

1.2 DEFINITIONS:

- A. Unsuitable Materials:
 - 1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D698.
 - 2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
 - 3. Existing Subgrade (Footings Only Including subgrades under utility structures): Same as paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to Resident Engineer's approval.
 - 4. Per specification section 01 57 19 Temporary Environmental Controls Contractor is responsible for maintaining positive drainage away from excavations throughout construction. Suitable materials that have been made unsuitable as a result of runoff entering excavations, or from rainfall, shall be restored to suitable

condition or removed and replaced with suitable fill material at no cost to the owner.

- B. Building Earthwork: Earthwork operations required in area enclosed by a line located 1500 mm (5 feet) outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.
- C. Trench Earthwork: Trenchwork required for utility lines.
- D. Site Earthwork: Earthwork operations required in area outside of a line located 1500 mm (5 feet) outside of principal building perimeter and within new construction area with exceptions noted above.
- E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D6938.
- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.
- G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- H. Unauthorized excavation: Removal of materials beyond indicated subgrade elevations or indicated lines and dimensions without written authorization by the Resident Engineer. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
- I. Authorized additional excavation: Removal of additional material authorized by the Contracting Officer's Representative (COR) based on the determination by an independent soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.

- K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.
- O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
- P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.
- R. Contaminated soils: Soil that contains contaminates as defined and determined by the Resident Engineer or the Government's testing agency.

1.3 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- E. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, and Section 32 90 00, PLANTING.
- F. Site preparation: Section 31 23 19, DEWATERING, and Section 02 41 00, DEMOLITION.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

G. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

1.4 CLASSIFICATION OF EXCAVATION:

A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

1.5 MEASUREMENT AND PAYMENT FOR EXCAVATION:

A. Measurement: Excavation will be incidental to the contract prices for the project work. No additional payment will be made for excavation required for open trench installation, or other excavation work required to complete the project work.

1.7 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Furnish to the COR:
 - Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and on-site Engineer. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size and scope.
 - 2. Record of Soil samples.
 - a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
 - b. Laboratory compaction curve in accordance with ASTM D698 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
 - c. Test reports for compliance with ASTM D2940 requirements for subbase material.
 - d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.
 - 3. Contractor shall submit procedure and location for disposal of unused satisfactory material. Proposed source of borrow material.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

1.8 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):

T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop

T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb)

Rammer and a 457 mm (18 inch) Drop

C. American Society for Testing and Materials (ASTM):

C33-03.....Concrete Aggregate

D448-08.....Standard Classification for Sizes of Aggregate for Road and Bridge Construction

- D698-07e1.....Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft³ (600 kN m/m³))
- D1140-00.....Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve D1556-07....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
- D1557-09.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2700 kN m/m³))
- D2167-08..... Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- D2487-11.....Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

D2940-09.....Standard Specifications for Graded Aggregate Material for Bases or Subbases for Highways or Airports D6938-10.....Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by

Nuclear Methods (Shallow Depth

D. Society of Automotive Engineers (SAE): J732-07.....Specification Definitions - Loaders J1179-08.....Hydraulic Excavator and Backhoe Digging Forces

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off-site sources having a minimum dry density of 1760 kg/m3 (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.
- C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75-µm (No. 200) sieve.
- E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.
- F. Granular Fill:

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 1. Under concrete slab, granular fill shall consist of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Fine aggregate grading shall conform to ASTM C 33 with a maximum of 3 percent by weight passing ASTM D 1140, 75 micrometers (No. 200) sieve, 100 percent passing the 37.5 mm (1-1/2 inches) and no more than 2 percent by weight passing the 4.75 mm (No. 4) sieve or coarse aggregate Size 67.
- 2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No 4), per ASTM D2940.
- G. Requirements for Offsite Soils: Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toleune, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCLP test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA SW-846.3-3a Method 5030/8020. TCLP shall be performed in accordance with EPA SW-846.3-3a Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site.
- H. Buried Warning and Identification Tape: Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil. Warning tape color codes:

Red:	Electric		
Yellow:	Gas, Oil,	Dangerous	Materials
Orange:	Telephone	and Other	Communications

Blue:	Water	Systems
Green:	Sewer	Systems
White:	Steam	Systems
Gray:	Compre	essed Air

I. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076 mm (0.003 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise, and 8.6 MPa (1250 psi) crosswise, with a maximum 350 percent elongation.

- J. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m (3 feet) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.
- K. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.
- L. Filter Fabric:
 - Nonwoven geosynthetic fabric with apparent maximum opening size per ASTM D4451, less than or equal to a No. 70 US Std. Sieve. Provide minimum 70% strength retained at 500 hours, per ASTM D4355.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

- A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Medical Center.
- B. Grubbing: Remove all stumps, and roots 75 mm (3 inch) and larger diameter. Roots up to 75 mm (3 inch) diameter, and nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.

- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines when removal is approved in advance by the COR. Remove materials from Medical Center.
- D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the COR. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m3 (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed.
- E. Concrete Slabs and Paving: Saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Medical Center property.
- F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.
 - Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.

- 2. Locations of existing and proposed elevations indicated on plans are approximate. From a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Contractor is responsible to notify the COR of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify the COR of any differences between existing or constructed grades, as compared to those shown on the plans.
- 3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
- 4. Finish grading is specified in Section 32 90 00, PLANTING.
- G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION:

- A. Shoring, Sheeting and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
 - 1. Design of the temporary support of excavation system is the responsibility of the Contractor. The Contractor shall submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.
 - Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Resident Engineer.

- 3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
- 4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall underpin the existing foundation, per Section 3.3, and provide a new concrete fill support under disturbed foundations, as directed by the COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by the COR.
- 5. The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and the COR of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the COR at any time throughout the contract duration.
- B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from the COR. Approval by the COR is also required before placement of the permanent work on all subgrades. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation. French drains, sumps, ditches or trenches will not be permitted within 0.9 m (3 feet) of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been

made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 300 mm (1 foot) below the working level. As required, operate dewatering system continuously until construction work below existing water levels is complete. Relieve hydrostatic head in pervious zones below subgrade elevation in layered soils to prevent uplift.

- C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, disturbed materials shall be removed to firm undisturbed material after water is brought under control at no additional cost to the government. Replace disturbed subgrade in trenches with concrete or material approved by the COR.
- E. Proofrolling:
 - After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.
 - 2. Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade with six passes of a dump truck loaded with 6 cubic meters (4 cubic yards) of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour (2 1/2 to 3 1/2 mph). When proof rolling, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Proof rolling shall be performed in the presence of the geotechnical engineer, and a report of the geotechnical engineer's observations shall be furnished to the COR no more than seven days following the proofroll. Notify the COR a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the sevence of the sevence of the sevence of the proof proof rolling.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

COR or the COR's designated representative. Rutting or pumping of material shall be undercut as directed by the geotechnical engineer and approved by the COR and replaced with backfill material. Maintain subgrade until succeeding operation has been accomplished.

- F. Building Earthwork:
 - Excavation shall be accomplished as required by drawings and specifications.
 - 2. Excavate foundation excavations to solid undisturbed subgrade.
 - 3. Remove loose or soft materials to a solid bottom.
 - Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete poured separately from the footings.
 - 5. Do not tamp earth for backfilling in footing bottoms, except as specified.
 - Slope grades to direct water away from excavations and to prevent ponding.
 - 7. Capillary water barrier (granular fill) under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.
 - 8. Ensure that footing subgrades have been inspected and approved by the Resident Engineer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Resident Engineer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.
- G. Trench Earthwork:
 - 1. Utility trenches (except sanitary and storm sewer):
 - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
 - c. Support piping on suitable undisturbed earth unless a mechanical support is shown. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.

- d. Length of open trench in advance of piping laying shall not be greater than is authorized by Resident Engineer.
- e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
- f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.
- g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe.
 - Class I: Angular, 6 to 40 mm (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
 - Class II: Coarse sands and gravels with maximum particle size of 40 mm (1.5 inches), including various graded sands and gravels containing small percentages of fines, generally

granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

- H. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm (1 inch). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by Resident Engineer as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the contractor shall obtain samples of the material, under the direction of the COR or the COR's designated representative, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. Should the independent testing laboratory determine that materials have been made unsuitable as a result of exposure to precipitation or runoff during construction, the materials shall either be restored to suitable condition; or removed and replaced with suitable material as directed by the geotechnical engineer and approved by the COR. Such efforts shall be made at no additional cost to the government. When unsuitable material is encountered and removed, but is not resulting from exposure to precipitation or runoff, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.
 - 1. Site Grading:
 - a. Provide a smooth transition between adjacent existing grades and new grades.
 - b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

- c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
 - 1) Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).
 - 2) Walks: Plus or minus 25 mm (1 inch).
 - 3) Pavements: Plus or minus 13 mm (1 inch).
- d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with a 3000 mm (10 foot) straightedge.

3.3 UNDERPINNING:

- A. Design of the underpinning system is the responsibility of the Contractor and should be designed by a registered professional engineer and is subject to review and approval by the COR. Underpinning of existing building foundations, as indicated on structural drawings, or where excavation undermines existing foundations, shall be accomplished in the following manner:
 - Make general excavation for new construction, where new foundations are to be below existing foundations, to elevation of new foundations (or sized stone subbase), maintaining a 45 degree sloped berm.
 - For underpinning pits, underpin existing wall foundations by excavating 1200 mm (4 feet) wide pits to depth shown on drawings skipping 3 sections at any one time so as to maintain support for wall at all times.
 - 3. Underpin intervening sections one at a time; no adjacent sections shall be underpinned until concrete in adjacent sections shall have reached 20 MPa (2500 psi) strength and have been dry packed with non-shrink grout to obtain positive bearing. Sheet and brace underpinning pits if soil will not stand on a vertical cut during this operation, or as required for safety of workmen. Repack any voids behind sheeting to prevent sloughing which could cause settlement of existing foundations. Contractor performing this portion of work shall have been prequalified by Resident Engineer as having previously performed successfully this type of work or will demonstrate his capability for successfully performing this work. It shall be sole responsibility of the Contractor to guard against
objectionable movement or settlement and to preserve integrity of existing structures.

- The tip elevation of the underpinning pits shall be a minimum of 900 mm (3 feet) below the adjacent excavation elevation.
- 5. Subgrades at the tip of the underpinning pit shall be clean, dry, and free of debris and shall be observed by the Resident Engineer prior to concrete placement.
- 6. Concrete shall not be free fall greater than 3000 mm (10 feet) into the pit.

3.4 FILLING AND BACKFILLING:

- A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by Resident Engineer.
- B. Placing: Place materials in horizontal layers not exceeding 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm (4 inches) in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Use approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of the COR. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or

95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:

- 1. Fills, Embankments, and Backfill
 - a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 300 mm (12 inches) of existing subgrade and each layer of backfill or fill material in accordance with ASTM D698 Method A, 95 percent.
 - b. Curbs, curbs and gutters, ASTM D698 Method A, 95 percent.
 - c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material in accordance with ASTM D698 Method A, 95 percent.
 - d. Landscaped areas, top 400 mm (16 inches), ASTM D698 Method A, 85 percent.
 - e. Landscaped areas, below 400 mm (16 inches) of finished grade, ASTM D698 Method A, 90 percent.
- 2. Natural Ground (Cut or Existing)
 - a. Under building slabs, steps and paved areas, top 150 mm (6 inches), ASTM D698 Method A, 95 percent.
 - b. Curbs, curbs and gutters, top 150 mm (6 inches), ASTM D698 MethodA, 95 percent.
 - c. Under sidewalks, top 150 mm (6 inches), ASTM D698 Method A, 95 percent.
- D. Borrow Material: Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas within the limits of the project site, selected by the Contractor and approved by the COR or from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be

obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

E. Opening and Drainage of Excavation and Borrow Pits: The Contractor shall notify the Resident Engineer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 GRADING:

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside building away from building walls for a minimum distance of 1800 mm (6 feet).
- D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.
- E. Finished grade shall be at least 150 mm (6 inches) below bottom line of window or other building wall openings unless greater depth is shown.
- F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 150 mm (6 inches) unless otherwise shown.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- G. Finish subgrade in a condition acceptable to Resident Engineer at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.
- H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/-6 mm (0.25 inches) of indicated grades.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
 - Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- B. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- C. Segregate all excavated contaminated soil designated by the Resident Engineer from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.7 CLEAN UP:

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Medical Center Property.

----- E N D -----

SECTION 31 23 19 DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.2 SUMMARY:

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
 - 1. Implementation of the Erosion and Sedimentation Control Plan.
 - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

1.3 REQUIREMENT:

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated, and concrete placed in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
- 2. Erosion is controlled.
- 3. Flooding of excavations or damage to structures does not occur.
- 4. Surface water drains away from excavations.
- 5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.
- G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

1.4 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Excavation, backfilling, site grade and utilities: Section 31 20 11, EARTH MOVING (Short Form).

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Drawings and Design Data:
 - Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
 - Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of

dewatering methods to be employed to convey the water from site to adequate disposal.

- 3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
- 4. Capacities of pumps, prime movers, and standby equipment.
- 5. Design calculations proving adequacy of system and selected equipment. The dewatering system shall be designed using accepted and professional methods of design and engineering consistent with the best modern practice. The dewatering system shall include the deep wells, wellpoints, and other equipment, appurtenances, and related earthwork necessary to perform the function.
- 6. Detailed description of dewatering procedure and maintenance method.
- 7. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.
- C. Inspection Reports.
- D. All required permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 300 mm (1 foot) below prevailing excavation surface at all times.

3.2 OPERATION:

A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.

> 31 23 19 - 3 DEWATERING

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL:

- A. Dispose of water removed from the excavations in such a manner as:
 - 1. Will not endanger portions of work under construction or completed.
 - 2. Will cause no inconvenience to Government or to others working near site.
 - 3. Will comply with the stipulations of required permits for disposal of water.
 - 4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
- B. Excavation Dewatering:
 - The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
 - Drainage features shall have sufficient capacity to avoid flooding of work areas.
 - Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
 - 4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.
- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.4 STANDBY EQUIPMENT:

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain dewatering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION:

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure or damages to work in place resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

3.6 DAMAGES:

Immediately repair damages to adjacent facilities caused by dewatering operations.

3.7 REMOVAL:

Insure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

---- E N D -----

SECTION 32 05 23 CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Subbase for concrete pavements.
 - 2. Curbs, gutters, and combination curbs and gutters.
 - 3. Pedestrian Pavement: Walks, and wheelchair curb ramps
 - 4. Vehicular Pavement: Driveways, parking lots, and loading docks.
 - 5. Equipment Pads

1.2 RELATED REQUIREMENTS

- A. Field Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation and Subbase Compaction: Section 31 20 00, EARTHWORK.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - M147-65-UL-04 Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
 - M233-86 Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
- C. American Concrete Institute (ACI):
 - 1. 305R-10 Guide to Hot Weather Concreting.
 - 2. 306R-10 Guide to Cold Weather Concreting.
- D. American National Standards Institute (ANSI):
 - B101.3 Wet DOCF of Common Hard Surface Floor Materials (Including Action and Limit Thresholds for the Suitable Assessment of the Measured Values).
- E. ASTM International (ASTM):
 - A615/A615M-16 Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 - A996/A996M-15 Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

- A1064/A1064M-16 Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- 4. C33/C33M-16 Concrete Aggregates.
- 5. C94/C94M-16 Ready Mixed Concrete.
- 6. C143/C143M-15a Slump of Hydraulic Cement Concrete.
- 7. C150/C150M-16 Portland Cement.
- 8. C171-16 Sheet Materials for Curing Concrete.
- 9. C260/C260M-10a Air Entraining Admixtures for Concrete.
- 10. C309-11 Liquid Membrane Forming Compounds for Curing Concrete.
- 11. C494/C494M-15a Chemical Admixtures for Concrete.
- 12. C618-15 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- 13. C979/C979M-16 Pigments for Integrally Colored Concrete.
- 14. C989/C989M-14 Slag Cement for Use in Concrete and Mortars.
- 15. C1240-15 Silica Fume Used in Cementitious Mixtures.
- 16. D1751-04(2013)e1 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- 17. D5893/D5893M-10 Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
- 18. D6690-15 Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
 - 1. Required Participants:
 - a. Contracting Officer's Representative.
 - b. Inspection and Testing Agency.
 - c. Contractor.
 - d. Installer.
 - e. Other installers responsible for adjacent and intersecting work, including excavation, plantings, and traffic markings.
 - Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- c. Preparatory work.
- d. Protection before, during, and after installation.
- e. Installation.
- f. Terminations.
- g. Transitions and connections to other work.
- h. Inspecting and testing.
- i. Other items affecting successful completion.
- 3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show size, configuration, and fabrication and installation details.
 - 2. Show reinforcing.
 - 3. Include jointing plan for concrete pavements, curbs and gutters.
- C. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Installation instructions.
- D. Samples:
 - Exposed Aggregate Concrete Panel: 0.4 sq. m by 50 mm (4 sq. ft. by 2 inches) thick, 2 required, each color and finish.
 - 2. Colored Concrete Panel: see drawings.
- E. Test reports: Certify products comply with specifications.
 - 1. Concrete materials.
 - 2. Select subbase materials.
 - 3. Field test reports.
- F. Certificates: Certify products comply with specifications.
 - 1. Expansion joint filler.
 - 2. Reinforcement.
 - 3. Curing materials.
 - 4. Concrete protective coating.
- G. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer with project experience list.
 - 2. Land surveyor.
- H. Concrete mix design.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- I. Select subbase job-mix design.
- J. Proposed hot and cold weather concreting methods.
- K. Land surveyor's construction staking notes, before placing concrete.
 - 1. Identify discrepancies between field conditions and Drawings.
- L. Receipt of Delivery (Delivery Tickets)
 - Collect and retain all receipts of delivery on site for the duration of the project.
 - At the request of the COR receipts of delivery shall be made available to review no less than seven (7) days after the request has been made.
 - 3. Receipts of Delivery shall contain the following information:
 - a. Approved Job Mix / Material
 - b. Ticket Number
 - c. Date and Time of Departure from Plant
 - d. Date and Time of Delivery to Site
 - e. Name and Address of Manufacturer
 - f. Plant Name
 - g. Design Concrete Slump
 - h. Design Concrete Air Entrainment
 - i. Number of Cylinders Taken

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Regularly installs specified products.
 - Installed specified products with satisfactory service on five similar installations.
 - a. Project Experience List: Provide contact names and addresses for completed projects.
- B. Land Surveyor: Professional land surveyor or engineer registered to provide land surveys in jurisdiction where project is located.
- C. Preconstruction Testing:
 - Engage independent testing laboratory to perform tests and submit reports.
 - Deliver samples to laboratory in number and quantity required for testing.
 - 2. Concrete mix design.
 - 3. Select subbase job-mix design. Report the following:

- a. Material sources.
- b. Gradation.
- c. Plasticity index.
- d. Liquid limit.
- e. Laboratory compaction curves indicating maximum density at optimum moisture content.

1.7 DELIVERY

- A. Deliver steel reinforcement to prevent damage.
- B. Before installation, return or dispose of distorted or damaged steel reinforcement.
- C. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.

1.8 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

1.9 FIELD CONDITIONS

- A. Hot Weather Concreting Procedures: ACI 305R.
- B. Cold Weather Concreting Procedures: ACI 306R.
 - 1. Use non-corrosive, non-chloride accelerator admixture.
 - Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.

1.10 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type II.
- B. Coarse Aggregate: ASTM C33/C33M; size to suit application.
- C. Fine Aggregate: ASTM C33/C33M.
- D. Mixing Water: Fresh, clean, and potable.
- E. Air-Entraining Admixture: ASTM C260/C260M.
- F. Chemical Admixtures: ASTM C494/C494M.

- G. Reinforcing Steel: ASTM A615/A615M or ASTM A996/A996M, Grade 420 (60); deformed.
- H. Welded Wire Fabric: ASTM A1064/A1064M, deformed; Grade 485 (70).
- I. Expansion Joint Filler: ASTM D1751.
- J. Sheet Materials for Curing Concrete: ASTM C171.
- K. Color Pigment: ASTM C979/C979M, colored and white powder pigments.

2.2 SELECT SUBBASE

- A. Subbase: AASHTO M147; Grade F.
 - Select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials.

SUBBASE GRADING REQUIREMENTS								
Sieve Size		Percentage Passing by Mass						
		Grades						
(mm)	(in)	A	В	С	D	Е	F	
50	2	100	100					
25	1		75-95	100	100	100	100	
9.5	3/8	30-65	40-75	50-85	60-100			
4.47	No. 4	25-55	30-60	35-65	50-85	55-100	70-100	
2.00	No. 10	15-40	20-45	25-50	40-70	40-100	55-100	
0.425	No. 40	8-20	15-30	15-30	25-45	20-50	30-70	
0.075	No. 200	2-8	5-20	5-15	5-20	6-20	8-25	

B. Other Acceptable Gradations: Materials within three to five percent, plus or minus, of specified gradation, or as recommended by the geotechnical engineer and approved by the Contracting Officer's Representative.

2.3 FORMS

- A. Forms: Wood, plywood, metal, or other materials, approved by Contracting Officer's Representative, of grade or type suitable to obtain type of finish specified.
 - Plywood: Exterior grade, free of defects and patches on contact surface.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Lumber: Sound, grade-marked, S4S stress graded softwood, minimum
 50 mm (2 inches) thick, free from warp, twist, loose knots, splits, or other defects.
- 3. Form Coating: As recommended by Architect/Engineer.
- B. Provide forms suitable in cross-section, depth, and strength to resist springing during depositing and consolidating concrete.
 - Do not use forms varying from straight line more than 3 mm in 3000 mm (1/8 inch in 10 feet), horizontally and vertically.
- C. Provide flexible or curved forms for forming radii.

2.4 CONCRETE CURING MATERIALS

- A. Concrete curing materials, conform to one of the following:
 - 1. Burlap: Minimum 233 g/sq. m (7 ounces/sq. yd.) dry.
 - 2. Sheet Materials for Curing Concrete: ASTM C171.
 - Curing Compound: ASTM C309; Type 2; liquid membrane forming type, without paraffin or petroleum.

2.5 CONCRETE MIXES

- A. Design concrete mixes according to ASTM C94/C94M, Option C.
- B. Concrete Type: Air-entrained. See Table I.

TABLE I - CONCRETE TYPES						
Concrete	Minimum 28 Day Non-Air-Entrained		d	Air-Entrained		
Туре	Compressive	Min. Cement	Max.	Min. Cement	Max.	
	Strength f'c	kg/cu. m	Water	kg/cu. m	Water	
	MPa (psi)	(lbs./cu. yd.)	Cement	(lbs./cu. yd.)	Cement	
			Ratio		Ratio	
A	35 (5000)1,3	375 (630)	0.45	385 (650)	0.40	
В	30 (4000)1,3	325 (550)	0.55	340 (570)	0.50	
С	25 (3000)1,3	280 (470)	0.65	290 (490)	0.55	
D	25 (3000)1,2	300 (500)	*	310 (520)	*	
Footnotes:						
1. If trial mixes are used, achieve compressive strength 8.3 MPa (1,200 psi)						
in excess of f'c. For concrete strengths greater than 35 MPa (5,000 psi),						
achieve compressive strength 9.7 MPa (1,400 psi) in excess of f'c.						
2. For Concrete Exposed to High Sulfate Content Soils: Maximum water cement						
ratio is 0.44.						
3. Laboratory Determined according to ACI 211.1 for normal weight concrete.						

C. Maximum Slump: ASTM C143/C143M. See Table II.

TABLE II - MAXIMUM SLUMP					
APPLICATION	MAXIMUM SLUMP				
Curb & Gutter	75 mm (3 inches)				
Pedestrian Pavement	75 mm (3 inches)				
Vehicular Pavement	50 mm (2 inches) Machine Finished				
	100 mm (4 inches) Hand Finished				
Equipment Pad	75 to 100 mm (3 to 4 inches)				

2.6 ACCESSORIES

- A. Equipment and Tools: Obtain Contracting Officer's Representative's, approval of equipment and tools needed for handling materials and performing work before work begins.
- B. Maintain equipment and tools in satisfactory working condition.
- C. Sealants:
 - Concrete Paving Expansion Joints: ASTM D5893/D5893M, Type SL, single component, self-leveling, silicone joint sealant.
 - 2. Concrete Paving Joints: ASTM D6690, Type IV, hot-applied, single component joint sealant.
- D. Concrete Protective Coating: AASHTO M233 linseed oil mixture.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Prepare, construct, and finish subgrade. See Section 31 20 00, EARTHWORK.
- D. Maintain subgrade in smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SELECT SUBBASE

- A. Placing:
 - Place subbase material on prepared subgrade in uniform layer to required contour and grades, and to maximum 200 mm (8 inches) loose depth.

- When required compacted thickness exceeds 150 mm (6 inches), place subbase material in equal thickness layers.
- 3. When subbase elevation is 13 mm (1/2 inch) or more below required grade, excavate subbase minimum 75 mm (3 inches) deep. Place and compact subbase to required grade.
- B. Compaction:
 - Perform compaction with approved hand or mechanical equipment well suited to the material being compacted.
 - 2. Maintain subbase at optimum moisture content for compaction..
 - Compact each subbase layer to minimum 95 percent or 100 percent of maximum density as specified in Section 31 20 00, EARTHWORK.
- C. Subbase Tolerances:
 - 1. Variation from Indicated Grade: Maximum 9 mm (3/8 inch).
 - 2. Variation from Indicated Thickness: Maximum 13 mm (1/2 inch).
- D. Protection:
 - 1. Protect subbase from damage until concrete is placed.
 - 2. Reconstruct damaged subbase before placing concrete.

3.3 SETTING FORMS

- A. Form Substrate:
 - Compact form substrate to uniformly support forms along entire length.
 - Correct substrate imperfections and variations by cutting, filling, and compacting.
- B. Form Setting:
 - Set forms to indicated line and grade with tight joints. Rigidly brace forms preventing movement.
 - 2. Remove forms when removal will not damage concrete and when required for finishing.
 - 3. Clean and oil forms before each use.
 - 4. Correct forms, when required, immediately before placing concrete.
- C. Land Surveyor: Establish control, alignment, and grade for forms.
 - Notify Contracting Officer's Representative immediately when discrepancies exist between field conditions and drawings.
 - Correct discrepancies greater than 25 mm (1 inch) before placing concrete.
- D. Form Tolerances:

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 1. Variation from Indicated Line: Maximum 6 mm (1/4 inch).
- Variation from Indicated Grade: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).

3.4 PLACING REINFORCEMENT

- A. Keep reinforcement clean from contamination preventing concrete bond.
- B. Install reinforcement shown on drawings.
- C. Support and securely tie reinforcing steel to prevent displacement during concrete placement.
- D. Obtain Contracting Officer's Representative's reinforcement placement approval before placing concrete.

3.5 JOINTS - GENERAL

- A. Place joints, where shown on approved submittal Drawings.
 - 1. Conform to details shown.
 - 2. Install joints perpendicular to finished concrete surface.
- B. Make joints straight and continuous from edge to edge of pavement.

3.6 CONSTRUCTION JOINTS

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as indicated on approved submittal Drawings.
- B. Place transverse construction joints of type shown, where indicated, and whenever concrete placement is suspended for more than 30 minutes.
- C. Provide butt-type joint with dowels in curb and gutter at planned joint locations.
- D. Provide keyed joints with tie bars when joint occurs in middle third of planned curb and gutter joint interval.

3.7 CONTRACTION JOINTS

- A. Tool joints to width, depth, and radius edge shown on drawings using grooving tool or jointer.
- B. Construct joints in curbs and gutters by inserting 3 mm (1/8 inch) steel plates conforming to curb and gutter cross sections.
 - 1. Keep plates in place until concrete can hold its shape.
- C. Finish joint edges with edging tool.
- D. Score pedestrian pavement with grooving tool or jointer.
- E. With prior approval from the COR contraction joints may be sawcut. Saw cutting of new concrete shall be coordinated and performed with equipment that will result in a straight joint; free of blemishes or

32 05 23 - 10 CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS chipping. Sawcut joints shall be made in a single pass. Resulting joint shall be free of markings resulting from overlapping passes. Sawcut joints shall pass fully across pavement unless resulting cut would damage existing site improvements; in such locations, concrete joints shall be tooled.

 Sawcutting of joints shall be performed only by an installer with demonstrated experience in producing joints free of chipping and blemishes.

3.8 EXPANSION JOINTS

- A. Form expansion joints with expansion joint filler of thickness shown on drawings.
 - Locate joints around perimeter of structures and features abutting site work concrete.
 - Create complete, uniform separation between structure and site work concrete.
- B. Extend expansion joint material full depth of concrete with top edge of joint filler below finished concrete surface where sealant is indicated on Drawings.
- C. Cut and shape material matching cross section.
- D. Anchor with approved devices to prevent displacing during placing and finishing operations.
- E. Round joint edges with edging tool.

3.9 PLACING CONCRETE - GENERAL

- A. Preparation before Placing Concrete:
 - 1. Obtain Contracting Officer's Representative approval.
 - Ensure sufficient concrete materials are available and ordered to complete each day's pour, and without suspension of concrete placement for more than 30 minutes.
 - 3. Concrete materials shall be sourced from a single manufacturer unless otherwise approved by the COR. Such approval shall be sought no less than fourteen (14) calendar days in advance of placement.
 - 4. Remove debris and other foreign material.
 - 5. Uniformly moisten substrate, without standing water.
- B. Convey concrete from mixer to final location without segregation or loss of ingredients. Deposit concrete to minimize handling.

- C. During placement, consolidate concrete by spading or vibrating to minimize voids, honeycomb, and rock pockets.
 - 1. Vibrate concrete against forms and along joints.
 - 2. Avoid excess vibration and handling causing segregation.
- D. Place concrete continuously between joints without bulkheads.
- E. Install construction joint in concrete placement suspended for more than 30 minutes.
- F. Replace concrete with cracks, chips, bird baths, and other defects to nearest joints, approved by Contracting Officer's Representative.

3.10 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

- A. Place concrete in one layer conforming to cross section shown on Drawings after consolidating and finishing.
- B. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.
- C. Strike concrete surface to proper section ready for consolidation.
- D. Consolidate concrete by tamping and spading or with approved mechanical finishing equipment.
- E. Finish concrete surface with wood or metal float.
- F. Construct concrete pads and pavements with sufficient slope to drain, preventing standing water.

3.11 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete as close as possible to its final position.
- B. Place concrete continuously between construction joints without cold joints.
- C. Strike and consolidate concrete with finishing machine, vibrating screed, or by hand-finishing.
- D. Finish concrete surface to elevation and crown shown on drawings.
- E. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.
- F. Obtain Contracting Officer's Representative's approval before placing adjacent lanes.
- G. Curb-Forming Machines: Curb-forming machines for constructing curbs and gutter may be approved based on trial use on the project. When equipment produces unsatisfactory results, discontinue use of the equipment at any time during construction and accomplish work by hand

32 05 23 - 12

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

method construction. Remove unsatisfactory work and reconstruct full length between regularly scheduled joints. Dispose of removed portions off the project site.

3.12 FORM REMOVAL

- A. Keep forms in place minimum 12 hours after concrete placement. Remove forms without damaging concrete.
- B. Do not use bars or heavy tools against concrete to remove forms. Repair damage concrete found after form removal.

3.13 CONCRETE FINISHING - GENERAL

- A. Follow operation sequence below, unless otherwise indicated on Drawings:
 - Consolidating, floating, striking, troweling, texturing, and joint edging.
- B. Use edging tool with 6 mm (1/4 inch) radius, unless otherwise shown on Drawings.
- C. Keep finishing equipment and tools clean and suitable for use.

3.14 CONCRETE FINISHING - PEDESTRIAN PAVEMENT

- A. Walks, Grade Slabs, and Wheelchair Curb Ramps:
 - Finish concrete surfaces with metal float, troweled smooth, and finished with a broom moistened with clear water.
 - 2. Finish slab edges and formed transverse joints with edger.
 - 3. Broom surfaces transverse to traffic direction.
 - a. Use brooming to eliminate flat surface produced by edger.
 - b. Produce uniform corrugations, maximum 1.5 mm (1/16 inch) deep profile.
 - Provide surface uniform in color and free of surface blemishes, form marks, and tool marks.
 - 5. Paving Tolerances:
 - a. Variation from Indicated Plane: Maximum 5 mm in 3000 mm (3/16 inch in 10 feet).
 - b. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
 - Replace paving within joint boundary when paving exceeds specified tolerances.

3.15 CONCRETE FINISHING - VEHICULAR PAVEMENT

A. Align finish surfaces where new and existing pavements abut.

- B. Longitudinally float pavement surface to profile and grade indicated on drawings.
- C. Straighten surface removing irregularities and maintaining specified tolerances while concrete is plastic.
- D. Finish pavement edges and joints with edging tool.
- E. Broom finish concrete surface after bleed water dissipates and before concrete hardens.
 - 1. Broom surface transverse to traffic direction.
 - a. Use brooming to eliminate flat surface produced by edger.
 - b. Produce uniform corrugations, maximum 3 mm (1/8 inch) deep profile.
- F. Pavement Tolerances:
 - Variation from Indicated Plane: Maximum 6 mm in 3000 mm (1/4 inch in 10 feet) tested parallel and perpendicular to traffic direction at maximum 1500 mm (5 feet) intervals.
 - 2. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
- G. Replace paving within joint boundary when paving exceeds specified tolerances.

3.16 CONCRETE FINISHING - CURBS AND GUTTERS

- A. Round edges of gutter and top of curb with edging tool.
- B. Gutter and Curb Top:
 - Float surfaces and finish with smooth wood or metal float until true to grade and section and uniform color.
 - 2. Finish surfaces, while still plastic, longitudinally with bristle brush.
- C. Curb Face:
 - Remove curb form and immediately rub curb face with wood or concrete rubbing block removing blemishes, form marks, and tool marks and providing uniform color.
 - 2. Brush curb face, while still plastic, matching gutter and curb top.
- D. Curb and Gutter Tolerances: Except at grade changes or curves.
 - 1. Variation from Indicated Plane and Grade:
 - a. Gutter: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).
 - b. Curb Top and Face: Maximum 6 mm in 3000 mm (1/4 inch in 10 feet).

- E. Replace curbs and gutters within joint boundary when curbs and gutters exceed specified tolerances.
- F. Correct depressions causing standing water.

3.17 CONCRETE FINISHING - EQUIPMENT PADS

- A. Strike pad surface to elevation shown on Drawings.
- B. Provide smooth, dense float finish, free from depressions or irregularities.
- C. Finish pad edges with edger.
- D. After removing forms, rub pad edge faces with wood or concrete rubbing block, removing blemishes, form marks, and tool marks and providing uniform color.
- E. Pad Tolerances:
 - Variation from Indicated Plane: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).
 - 2. Variation from Indicated Elevation: Maximum 6 mm (1/4 inch).
 - 3. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
- F. Replace pads when pads exceed specified tolerances.

3.18 CONCRETE CURING

- A. Concrete Protection:
 - 1. Protect unhardened concrete from rain and flowing water.
 - Provide sufficient curing and protection materials available and ready for use before concrete placement begins.
 - Protect concrete to prevent pavement cracking from ambient temperature changes during curing period.
 - Replace pavement damaged by curing method allowing concrete cracking.
 - Employ another curing method as directed by Contracting Officer's Representative.
- B. Cure concrete for minimum 7 days by one of the following methods appropriate to weather conditions preventing moisture loss and rapid temperature change:
 - Burlap Mat: Provide minimum two layers kept saturated with water during curing period. Overlap Mats at least 150 mm (6 inches).
 - 2. Sheet Materials:
 - Wet exposed concrete surface with fine water spray and cover with sheet materials.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- b. Overlap sheets minimum 300 mm (12 inches).
- c. Securely anchor sheet materials preventing displacement.
- 3. Curing Compound:
 - a. Protect joints indicated to receive sealants preventing contamination from curing compound.
 - Insert moistened paper or fiber rope into joint or cover joint with waterproof paper.
 - c. Apply curing compound before concrete dries.
 - d. Apply curing compound in two coats at right angles to each other.
 - e. Application Rate: Maximum 5 sq. m/L (200 sq. ft./gallon), both coats.
 - Immediately reapply curing compound to surfaces damaged during curing period.

3.19 CONCRETE PROTECTIVE COATING

- A. Apply protective coating of linseed oil mixture to exposed-to-view concrete surfaces, drainage structures, and features that project through, into, or against concrete exterior improvements to protect the concrete against deicing materials.
- B. Complete backfilling and curing operation before applying protective coating.
- C. Dry and thoroughly clean concrete before each application.
- D. Apply two coats, with maximum coverage of 11 sq. m/L (50 sq. yds./gal.); first coat, and maximum 16 sq. m/L (70 sq. yds./gal.); second coat, except apply commercially prepared mixture according to manufacturer's instructions.
- E. Protect coated surfaces from vehicular and pedestrian traffic until dry.
- F. Do not heat protective coating, and do not expose protective coating to open flame, sparks, or fire adjacent to open containers or applicators. Do not apply material at temperatures lower than 10 degrees C (50 degrees F).

3.20 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
 - 1. Compaction.

- a. Pavement subgrade.
- b. Curb, gutter, and sidewalk.
- 2. Concrete:
 - a. Delivery samples.
 - b. Field samples.
- 3. Slip Resistance: Steps and pedestrian paving.

3.21 CLEANING

- A. After completing curing:
 - 1. Remove burlap and sheet curing materials.
 - 2. Sweep concrete clean, removing foreign matter from the joints.
 - 3. Seal joints as specified.

3.22 PROTECTION

- A. Protect exterior improvements from traffic and construction operations.
 - Prohibit traffic on paving for minimum seven days after placement, or longer as directed by Contracting Officer's Representative.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.
 - Replace concrete containing excessive cracking, fractures, spalling, and other defects within joint boundary, when directed by Contracting Officer's Representative, and at no additional cost to the Government.

- - - E N D - - -

SECTION 32 12 16 ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.
- C. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

1.3 INSPECTION OF PLANT AND EQUIPMENT

The Resident Engineer shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
 - Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
 - Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 3. Job-mix formula.
- C. Certifications:
 - Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
 - Asphalt cement certificate of conformance to State Highway Department requirements.
 - 3. Job-mix certification Submit plant mix certification that mix equals or exceeds the State Highway Specification.
- D. One copy of State Highway Department Specifications.
- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

A. Aggregate base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA Resident Engineer or VA Contracting Officer.

2.2 AGGREGATES

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").
- C. Base aggregate maximum size:
 - 1. Base course over 152mm(6") thick: 38mm(1-1/2");
 - 2. Other base courses: 19mm(3/4").
- D. Asphaltic base course:
 - 1. Maximum particle size not to exceed 25.4 mm(1'').
 - Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.
- E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

Sieve Sizes	Percentage Passing
19mm(3/4")	100
9.5mm(3/8")	67 to 85
6.4mm(1/4")	50 to 65
2.4mm(No. 8 mesh)	37 to 50
600µm(No. 30 mesh)	15 to 25
75µm(No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

2.3 ASPHALTS

- A. Comply with provisions of Asphalt Institute Specification SS2:
 - 1. Asphalt cement: Penetration grade 50/60
 - 2. Prime coat: Cut-back type, grade MC-250
 - 3. Tack coat: Uniformly emulsified, grade SS-1H

2.4 SEALER

- A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.
- B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
 - Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.

 Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.3 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

- A. Subbase (when required)
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
 - Prior to placement of asphaltic concrete materials, apply tack coat along face of curb to be in contact with asphaltic concrete upon placement.
 - Where final wear course is phased, apply tack coat along prior phase's wear course, and install asphalt joint as shown in the drawings.
- C. Receipt of asphaltic concrete materials:
 - Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).
 - Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.
- D. Spreading:
 - 1. Spread material in a manner that requires the least handling.
 - Where thickness of finished paving will be 76mm (3") or less, spread in one layer.
- E. Rolling:
 - After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown own the drawings.
 - 2. Roll in at least two directions until no roller marks are visible.
 - 3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.
- C. When sealing new asphalt paving wait an entire year to allow for the expansion and contraction of a year's cycle of both warm and cool temperatures. This allows for the asphalt's oils to properly cure and begin oxidation before applying a seal coat.
- D. When seal coating in less than a year apply two coats, spray applied. This application method is preferred for less than a year application when there is still plenty of asphalt cement present for the seal coat to bond to.

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

- - - E N D - - -

SECTION 32 17 23 PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - Paint and reflective glass beads on pavement surfaces, in form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings.

1.2 RELATED REQUIREMENTS

A. Paint VOC Limits: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. Federal Specifications (Fed. Spec.):
 - 1. TT-B-1325D Beads (Glass Spheres) Retro-Reflective.
 - 2. TT-P-1952F Paint, Traffic and Airfield Marking, Waterborne.
- C. Master Painters Institute (MPI):
 - 1. No. 97 Traffic Marking Paint, Latex.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show pavement marking configuration and dimensions.
 - Show international symbol of accessibility at designated parking spaces.
- C. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Application instructions.
- D. Samples:
 - 1. Paint: 200 mm (8 inches) square, each type and color.
- E. Certificates: Certify products comply with specifications.
- F. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer with project experience list.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 1. Regularly installs specified products.
- Installed specified products with satisfactory service on five similar installations for minimum five years.
 - Project Experience List: Provide contact names and addresses for completed projects.

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight conditioned facility.
- B. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

- A. Environment:
 - Product Temperature: Minimum 13 degrees C (55 degrees F) for minimum 48 hours before installation.
 - a. Surface to be painted and ambient temperature: Minimum
 10 degrees C (50 degrees F) and maximum 35 degrees C
 (95 degrees F).
- B. Field Measurements: Verify field conditions affecting traffic marking installation. Show field measurements on Submittal Drawings.

1.9 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design paint complying with specified performance:
 - 1. Application: Fed. Spec. TT-P-1952.

2.2 PRODUCTS - GENERAL

- A. Basis of Design: See drawings.
- B. Provide each product from one manufacturer and from one production run.

- Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
 - a. Paints and coatings.

2.3 SANDBLASTING EQUIPMENT

A. Air compressor, hoses, and nozzles of proper size and capacity as required for cleaning painted surfaces. Compressor to provide minimum 0.08 cu. m/s (150 cfm) of air at pressure of minimum 625 kPa (90 psi) at each nozzle used.

2.4 PAINT APPLICATOR

A. Apply marking paint with approved mechanical equipment. Provide equipment with constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in case of skip lines. Equipment to have manual control to apply continuous lines of varying length and marking widths as indicated on Drawings. Provide pneumatic spray guns for hand application of paint in areas where mobile paint applicator cannot be used. Use separate piece of equipment when equipment does not have glass bead dispenser. Adjust and synchronize equipment with paint applicator to distribute reflective beads on paint lines uniformly within ten seconds without any waste.

2.5 PAINT

A. Paint: MPI No. 97, yellow. For obliterating existing markings comply with Fed. Spec. TT-P-1952. Provide minimum 18 L (5 gallons) containers.

2.6 REFLECTIVE GLASS BEADS

A. Beads: Comply with Fed. Spec. TT-B-1325, Type I, Gradation A. In regions of high humidity, coat beads with silicone or other suitable waterproofing material to ensure free flow. Provide glass beads in containers suitable for handling and strong enough to prevent loss during shipment.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Allow new pavement surfaces to cure for period of minimum 14 days before application of marking materials.
- B. Protect existing construction and completed work from damage.
- C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.
 - Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or combination of these methods.
 - Completely remove rubber deposits, existing paint markings, and other coatings adhering to pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by Contracting Officer's Representative.
 - 3. As an option, comply with Fed. Spec. TT-P-1952 for removal of existing paint markings on asphalt pavement. Apply black paint in as many coats as necessary to completely obliterate existing markings.
 - 4. Scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application, Where oil or grease are present on old pavements to be marked, .
 - a. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through new paint.
 - Clean and dry surface before pavement marking.Do not begin any marking until Contracting Officer's Representative inspected surface and gives permission to proceed.

3.2 TEMPORARY PAVEMENT MARKING

- A. Apply Temporary Pavement Markings of colors, widths and lengths shown on drawings or directed by Contracting Officer's Representative. After temporary marking has served its purpose and when so ordered by Contracting Officer's Representative, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method to prevent damage on applied surface.
- B. As an option, provide approved preformed pressure sensitive, reflective, adhesive tape type of temporary pavement marking of required colors, widths and lengths in lieu of temporary painted and reflective marking. Continuous durability and effectiveness of such marking is required during period for which its use is required. Remove
any unsatisfactory tape type marking and replace with painted and reflective markings.

3.3 INSTALLATION - GENERAL

- A. Install products according to manufacturer's instructions and approved submittal drawings.
 - When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

3.4 PAINT APPLICATION

- A. Apply uniformly painted and reflective pavement marking of required colors, length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces.
- B. Comply with details as indicated on drawings and established control points.
- C. Apply paint at wet film thickness of 0.4 mm (0.015 inch). Disperse reflective glass beads evenly on wet paint at rate of 720 g/L (6 pounds per gal.) of paint. Apply paint in one coat. When directed by Contracting Officer's Representative, apply additional coats at markings showing light spots. Comply with paint manufacturer's maximum drying time requirements to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic.
- D. When deficiency in marking drying occurs, discontinue paint operations until cause of slow drying is determined and corrected.
- E. Remove and replace marking applied less than minimum material rates, deviates from true alignment, exceeds stipulated length and width tolerances, or shows light spots, faulty distribution of beads, smears, or other deficiencies or irregularities.
- F. Remove marking by carefully controlled sandblasting, approved grinding equipment, or other approve method to prevent damage on applied surface.

3.5 DETAIL PAVEMENT MARKING APPLICATION

- A. Apply Detail Pavement Markings, exclusive of actual traffic lane marking as follows:
 - 1. At exit and entrance islands and turnouts.
 - 2. On curbs.
 - 3. At crosswalks.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 4. At parking bays.
- 5. Other locations as indicated on drawings.
- B. Apply International Handicapped Symbol at indicated parking spaces. Yellow. Apply paint for symbol using suitable template that will provide pavement marking with true, sharp edges and ends.
- C. Install detail pavement markings of colors, widths and lengths, and design pattern at locations indicated on drawings.

3.6 TOLERANCES

- A. Length and Width of Lines: Plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in case of skip markings.
- B. Length of intervals exceeding line length tolerance are not acceptable.

3.7 CLEANING

A. Remove excess paint before paint sets.

3.8 PROTECTION

- A. Protect pavement markings from traffic and construction operations.
 - 1. Protect newly painted markings from vehicular traffic until paint is dry and track free.
 - Place warning signs at beginning of wet line, and at points well in advance of marking equipment for alerting approaching traffic from both directions.
 - Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
- B. Repair damage.

- - - E N D - - -

SECTION 32 90 00 PLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plants, soils, turf, and landscape materials and accessories.

1.2 RELATED REQUIREMENTS

- A. Topsoil Materials, Stripping and Stockpiling: Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Topsoil Placement and Compaction Test: Section 31 20 11, EARTH MOVING (SHORT FORM).
- C. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- D. Erosion control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Protection of Trees and Plantings: Section 02 41 10, DEMOLITION.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute (ANSI) Publications:
 - 1. ANSI Z60.1-2014 Nursery Stock.
 - ANSI Z133.1-2012 Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush- Safety Requirements.
- C. ASTM International (ASTM):
 - 1. C33/C33M-16-Concrete Aggregates.
 - 2. C136/C136M-14 Sieve Analysis of Fine and Coarse Aggregates.
 - D698-12 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
- D. Hortus Third, most current edition: A Concise Dictionary of Plants Cultivated in the United States and Canada.
- E. National Cemetery Administration (NCA):
 - 1. Handbook 3410 Integrate Pest Management.
 - 2. Handbook 3420-11 Turfgrass Maintenance.
- F. Turfgrass Producers International (TPI):
 - 1. 2006 Guideline Specifications to Turfgrass Sodding.
- G. United States Department of Agriculture (USDA):
 - Federal Seed Act-2011 Rules and Regulations of the Secretary of Agriculture.

H. United States Environmental Protection Agency (EPA):

1. 40 CFR Part 503-1993 - Biosolids Rule.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - a. Sod.
 - b. Seed.
 - c. Hydromulch.
 - d. Soil amendments.
 - e. Antidesiccant.
 - f. Erosion control materials.
 - g. Non-Asphaltic Trackifier.
 - h. Herbicide.
 - i. Weed Control.
 - 2. Plant list: List of local/regional suppliers for each species to be installed. Include quantities, plant dimension (height x spread) and container/root ball size. Certify in writing, confirmed orders for plants by submitting a Bill of Sale for each plant to be installed. Each plant of the same species shall be supplied by one grower only unless otherwise approved by COR.
 - a. Requests for substitutions of plants not available in size, quantity or type specified must be made within 30 days after Contract award. Submit written evidence that a specified plant cannot be obtained and has been unobtainable since Contract award.
 - b. Substitutions will only be authorized when a plant (or its alternates as specified) is not obtainable and COR, in consultation with District Agronomist, authorizes a change order for use of nearest equivalent obtainable size or variety of plant having same essential characteristics with an equitable adjustment of contract price.
 - 3. Warranty.
 - 4. Photographs: Color photographs of each plant species showing actual size and condition of plants to be provided with measuring device

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

included for scale. Where more than 20 plants are required of any species, submit minimum three photographs of average, best, and worst quality plant to be provided. Include on each photograph, plant full scientific name, size, and source nursery.

- C. Test reports: Certify products comply with specifications.
 - Imported Topsoil: Provide 5 lbs. representative sample from each proposed source for testing, analysis, and approval. Deliver samples to acceptable testing laboratory and have testing report sent directly to COR. Testing reports to include following tests and recommendations according to Association of Official Agricultural Chemists standards:
 - a. Soil Composition: USDA particle size analysis indicating percentages of sand, silt and clay, and percent organic matter. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) performed by public extension service agency, State Land Grant College, or certified private testing laboratory. Percentages of clay and silt to be determined by hydrometer.
 - b. Percent of organics to be determined by loss on ignition of oven-dried samples. Test samples to be oven-dried to constant weight at 110 degrees C (230 degrees F), plus or minus 5 degrees C (41 degrees F).
 - c. Macro and micro nutrient fertility tests as determined by Chemical analysis to include Macro and micro nutrient fertility tests as determined by pH, Salinity (EC), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Soluble Copper, Zinc, Manganese, Iron, Saturation Extract Boron, Aluminum, Soluble Salts, Exchangeable Sodium Percentage (ESP), Sodium Adsorption Ratio (SAR), and Cation Exchange Capacity (CEC).
 - d. Tests, as specified, for gradation, organics, soil chemistry and pH to be performed by testing laboratory retained by National Cemetery Administration as described in Section 01 45 29, TESTING LABORATORY SERVICES.
 - e. Include recommendations for soil additives to correct soils deficiencies, as necessary, and for fertilizing and to adjust soil pH to optimum range for cool season turfgrass liming applications to support successful turfgrass growth.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 2. Organic Soil Amendment:
 - a. Testing: Provide testing by an independent laboratory, with the experience and capability to conduct the testing indicated following U.S. Composting Council Seal of Testing Assurance (STA) procedures, or equivalent.
 - b. Soil Amendment Analysis: Provide documentation from supplier that compost has reached a monitored temperature of 140 degrees Fahrenheit for at least one week. Engage an independent soil testing laboratory to test representative samples of compost and provide compost analysis report for the following parameters:
 - Percent organic matter, percent moisture, percent inerts (foreign matter), pH, soluble salts, and particle size.
 - Nutrient content, including: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg) and Sulfur s.
 - 3) Trace Metals, including: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn).
 - Maturity Indicator. Provide bioassay results. Provide Carbon-Nitrogen ratio.
 - 5) Stability Indicator: Provide respiration test results.
- 3. Amended Soil (in place): Following incorporation of amendments and additives, provide minimum six (6)samples per 40,000 sq. ft., 6 inch depth by 3 inch diameter core samples of amended soil taken from project site for testing, analysis, and approval. Locate each samples as directed by COR from areas designated to be planted in turfgrass. Deliver samples to testing laboratories and have testing report sent directly to COR. Obtain amended soil sample acceptance before sodding.
- D. Certificates: Certify products comply with specifications.
- E. Before delivery, submit notarized certificates for approval to COR attesting that following materials meet specified requirements:
 - Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
 - 2. Fertilizers: Four certificates of analysis for each type of fertilizer.
 - 3. Lime.

- 4. Gypsum.
- 5. Soil Sulfur.
- 6. Humates.
- 7. Mycorrhizae.
- 8. Peat.
- 9. Sod.
- 10. Seed.
- 11. Hydromulch.
- 12. Membranes.
- F. Maintenance Data:
 - 1. Care instructions for each plant material.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Regularly installs specified materials and products.
 - Installed specified products with satisfactory service on five similar installations for minimum five years.
 - Project Experience List: Provide contact names and addresses for completed projects.
 - b. A member with good standing of either the Professional Landcare Network (PLANET) the AmericanHort.
 - c. Maintain an experienced full-time supervisor on Project site when work is in progress.
 - d. Installer's shall have certification in one of the following categories from the Professional Landcare Network and submit one copy of certificate to the COR:
 - e. Certified Landscape Technician (CLT) Exterior, with installation specialty areas, designated CLT-Exterior.
 - f. Certified Ornamental Landscape Professional designated COLP.
- B. Licenses: Submit licenses to COR:
 - 1. Arborist: One copy.
 - 2. Pesticide Applicator: License in state of project, commercial.

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.
- D. Bulk Products:
 - Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants. Protect products from weather.
 - 2. Install erosion control materials to prevent erosion or displacement of bulk products.
- E. Notify COR of delivery schedule five days in advance, minimum. COR will inspect materials upon arrival. Remove unacceptable plant materials from project site immediately.
- F. Protect plants during delivery to prevent damage to root balls or desiccation of leaves.
- G. Protect trees during transport by covering root balls and tying branches.
- H. Machine dug plants are permitted provided root balls are sized according to ANSI Z60.1 and tops are protected from damage.
- I. Protect sod from drying out.

1.7 STORAGE AND HANDLING

- A. Store soil amendments, fertilizers, and packaged materials in dry locations away from contaminants.
- B. Keep sod moist and protect from exposure to wind and direct sunlight.
- C. Store plants not installed on day of arrival at project site as follows:
 - 1. Shade and protect plants from wind when stored outside.
 - 2. Heel in bare root plants.
 - 3. Protect plants by covering roots with moist wood chips, shredded bark, peat moss, or similar mulching material.
 - 4. Keep plants moist including those in containers, by watering with fine mist spray until planted.

1.8 FIELD CONDITIONS

- A. Seasons and Conditions:
 - Perform landscape planting operations within following dates: From April 15 to June 15 for spring and from September 15 to November 1 for fall, but not before irrigation system installed, tested, and approved.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Perform turfgrass installation operations within following dates, but not before irrigation system installed, tested, and approved.
 - 1. Spring Planting: April 15 to June 15.
 - 2. Fall Planting: September 15 to November 15.
- C. Restrictions: Do not plant when ground is frozen or in otherwise unsuitable condition for planting. Special conditions may exist that warrant variance in specified planting dates or conditions. Submit written request for approval to COR stating special conditions and proposal variance.

1.9 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant plantings against material defects with the following supplements:
 - One Year Plant and Turfgrass Warranty: Warranty begins when Government accepts plants and turfgrass but not before end of Landscape Plant and Turfgrass Establishment Period.
 - Replace any dead plant material and any areas void of turfgrass immediately during warranty period and during an active growing season. One year warranty for replaced plants and turfgrass begins on day replacement work is completed and accepted.
 - Replacement of relocated plants, not furnished, is not required unless they die from improper handling and care. Loss due to improper handling, care, or negligence requires replacement in kind and size.
 - 4. Government will inspect replacement plants and turfgrass at end of Warranty period. Replace any dead, missing, or defective plant material and turfgrass immediately and during growing season. Warranty ends on date of this inspection provided work specified in this section is complied.
 - 5. Remove stakes, guys wires/straps at end of one year warranty.

PART 2 - PRODUCTS

2.1 PRODUCTS - GENERAL

- A. Provide each product from one source or manufacturer.
- B. Plant and Turf Grasses: Comply with the varieties specified or shown in plant list.
- C. Warrant plants are true to botanical name as listed in Hortus Third.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

D. Maintain equipment, tools and machinery on project site in sufficient quantities and capacity for proper execution of Work.

2.2 ORGANIC SOIL AMENDMENT

- A. Organic Soil Amendment: Dark brown or black and capable of enhancing plant growth. Ninety-eight percent of material passes 25 mm (1 inch) screen. No admixture of refuse (i.e. noticeable inert contamination) or materials toxic to plant growth are permitted, free of all woody fibers, seeds, leaf structures, plastic, petroleum products, and toxic and non-organic matter.
 - Acceptable Organic Soil Amendments: Peat moss, humus or peat, and commercially available combinations thereof.
 - Acceptable Compost: Natural organic sources such as food or animal residuals, or yard trimmings.
 - Unacceptable Sole Sources of Organic Matter: Untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.

Test Parameter	Acceptable Ranges
Organic Matter	27 to 80 percent
рH	5.5 to 8.5
Ash	20 to 65 percent
Nitrogen	0.4 to 3.5 percent
Phosphorus	0.2 to 1.5 percent
Potassium	0.4 to 1.5 percent
C: N Ratio	25 to 30: 1
CEC	50 to 150 meq/100 g
Heavy Metals	Less than max. limits established by
	EPA 40 CFR Part 503
Inert Contents	Less than 1 percent by weight
Water-Holding Capacity	150 to 200 percent
Pathogen/Weed Seed	Proof of EPA minimum heating requirements
Destruction	

B. Minimum Material Requirements:

C. Topsoil stripped and stockpiled on project site is acceptable provided, after testing and addition of necessary additives, meets above

specification. Provide additional Organic Soil Amendment as required to complete work.

- D. Provide organic soil amendment in areas with organic matter content below 4 percent that will be seeded, sodded or sprigged after grading activities are completed to create satisfactory topsoil horizon.
- E. Spread and incorporate organic soil amendment into finished subgrade at depths indicated on drawings to raise soil organic content to minimum four percent and maximum six percent. Allow for additional depth of organic soil amendment to bring all grades to required finished grades as shown on grading plans.

2.3 PLANTS

- A. Plants: ANSI Z60.1, except as otherwise stated in this section or shown on drawings. Where drawings or specifications are in conflict with ANSI Z60.1, drawings and specification will prevail.
 - Provide well-branched and formed planting stock, sound, vigorous, and free of disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems.
 - Provide single stemmed trees, with a single leader, unless otherwise indicated.
 - Provide trees and shrubs of uniform, symmetrical growth, with straight boles or stems, free from objectionable disfigurements, and with branch spread of branches typical of variety.
 - 4. Provide ground cover and vine plants with number and length of runners for size, and proper age for grade of plants specified. Provide well established plants in removable containers, integral containers, or formed homogeneous soil sections.
 - 5. Provide plants grown under climatic conditions similar to those in project locality.
- B. Minimum acceptable sizes of all plants, measured with branches in normal position, to conform to plant list and ANSI Z60.1. Larger plants with COR's approval, at no additional cost to the Government. Increase ball of earth or spread of roots according to ANSI Z60.1 when larger plants are provided.
- C. Do not handle plants by trunk or stem. Trees must be moved by lifting root ball, box or container.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- D. Bare-root (BR) plants to have root system substantially intact, but with earth carefully removed. Cover roots with thick coating of mud by "puddling" after the plants are dug.
- E. Container grown plants to have sufficient root growth to hold earth intact when removed from containers, but not be root bound.
- F. When existing plants are to be relocated, ball sizes to conform to ANSI Z60.1 requirements for collected plants, with plants dug, handled, and replanted according to applicable requirements of this section.

2.4 LABELS

A. Legibly tag each plant, or group and bundles or containers of the species, variety, and size of plant with durable, waterproof and weather-resistant label indicating correct plant name and size specified in plant list. Labels to be securely attached and not removed until acceptance by the Government.

2.5 TOPSOIL

- A. Topsoil: Provide well-graded soil of good uniform quality, natural, friable soil representative of productive soils in project vicinity. Topsoil to be free of subsoil, foreign matter, objects larger than 1 inch in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and have pH value of minimum 6.0 and maximum 7.0, and be best suited to region, climate and plant material specific to project.
- B. Obtain material from stockpiles established under Section 31 20 11, EARTH MOVING (SHORT FORM), subparagraph, Stripping Topsoil that meet general requirements stated above. Amend topsoil not meeting pH range specified by the addition of pH adjusters.
- C. When sufficient topsoil is not available on project site to specified depth, provide additional topsoil. Minimum 10 days before topsoil delivery, notify COR of sources from which topsoil will be furnished. Obtain topsoil meeting general requirements stated above and comply with requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting pH range specified by adding pH adjusters.

2.6 INORGANIC SOIL AMENDMENTS

A. Lime: Agricultural limestone, minimum 90 percent calcium and magnesium carbonates. Grind lime fineness, minimum 90 percent passes No. 8 mesh and minimum 25 percent passes No. 100 mesh. Maximum moisture, 10 percent.

- Dolomitic Lime: Natural, agricultural limestone (calcium and magnesium carbonate), minimum of 20 percent calcium and 11 percent magnesium and as follows:
 - a. Screen Analysis: 100 percent passing through No.30 sieve; 70 percent passing through No. 100 sieve; minimum 30 percent passing through No.325 sieve. Provide lime in form of granulated, prilled, dolomitic limestone.
- Calcitic Lime: Natural, agricultural limestone (calcium carbonate), minimum of 36 percent calcium and as follows:
 - a. Screen Analysis: minimum of 100 percent passing through No. 10 sieve; minimum of 80 percent passing through No. 100 sieve.
 Provide lime in form of granulated, prilled, limestone.
- Agricultural Gypsum: Finely ground, minimum of 90 percent calcium sulfate, or 85 percent calcium sulfate dihydrate.
- Sulfur: Granular, biodegradable, minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- 5. Iron Sulfate: Granulated ferrous sulfate minimum of 20 percent iron and 10 percent sulfur.
- 6. Aluminum Sulfate: Commercial grade, unadulterated.
- Sand: Clean washed river sand, free of calcium, chlorides and other deleterious substances.
- Humates: Derived from mined Gypsum and with guaranteed minimum analysis; Calcium Sulfate dihydrate (CaSO4 • 2H20) 35.00%; Calcium (Ca) 7.00%; Sulfur s 5.00%, plus Humic Acids 1.5% derived from Leonardite. Pelletized product used for ease of application.
- 9. Mycorrhizae: Endomycorrhizal powder inoculum consisting of the following 4 species blend of propagules of arbuscular mycorrhizal fungi: Glomus intraradices, Glomus mosseae, Glomus aggregatum, and Glomus etunicatum. Minimum 100,000 spores/propagules per pound. The powder particle size shall be less than 300 microns (100 percent passing the #50 screen).

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

2.7 ORGANIC SOIL AMENDMENTS

- A. Peat: Natural product of sphagnum moss peat derived from fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Shred and granulate peat to pass 1/2 inch mesh screen and condition in storage piles for minimum six months after excavation.
- B. Perlite: Horticulture grade.
- C. Vermiculite: Horticultural grade, free of any toxic materials.
- D. Organic Matter: Commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.8 PLANTING SOIL MIXTURE

- A. Ornamental Plantings: Planting soil mixture composed of 3 parts topsoil and 1 part peat moss.
- B. Native Plantings: 100 percent native on-site soil free of clds and subsoil .

2.9 PLANT FERTILIZERS

- A. Provide commercial grade plant fertilizer of uniform composition and complying with applicable state and federal regulations.
- B. For new plant material, provide uniform free-flowing granular complete analysis fertilizer based on recommendations of soils reports, containing minimum 10 percent nitrogen, phosphoric acid and potash by weight with minimum 50 percent of nitrogen from controlled release source such as sulfur coated urea (SCU), polymer coated urea (PCU), and sulfur-coated/polymer coated urea (PCSCU).
- C. For existing trees, provide a uniform free-flowing granular fertilizer bearing manufacturer's warranted statement of analysis. Granular fertilizer to contain minimum 10 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 10 percent available phosphoric acid, and 10 percent potash.

2.10 TURFGRASS FERTILIZER

A. Provide commercial grade granular fertilizer, free flowing, uniform in composition, and complying with applicable state and federal regulations. Submit fertilizer manufacturer's warranted statement of analysis. Fertilizer contain minimum 20 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 5 percent available phosphoric acid, and 15 percent potash. Liquid starter

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

fertilizer for hydro mulch slurry, commercial type with 50 percent of nitrogen from controlled release source.

2.11 WATER

A. Water: Contains no elements toxic to plant life, obtained from as specified in Section 01 00 01, GENERAL REQUIREMENTS, Paragraph, Temporary Services.

2.12 ANTIDESICCANT

A. Antidesiccant: Emulsion manufactured for agricultural use to provide protective film over plant surfaces permeable enough to permit transpiration.

$\frac{2}{2}$

2.13 SOD

A. Sod: Nursery grown, certified and classified in TPI's "Guideline Specifications to Turfgrass Sodding" as GSS. Machine cut sod at uniform thickness of 19 mm (3/4 inch) within tolerance of 6 mm (1/4 inch), excluding top growth and thatch. Each individual sod piece to be strong enough to support its own weight when lifted by ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will not be permitted.

2.14 SEED

- A. Grass Seed: Landscaper's Mix as supplied by Central Landscaper Supply or approved equal; delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable. Field mixes will be acceptable when field mix is performed on site in presence of Contracting Officer's Representative.
- B. Seed Mixtures: Per the manufacturer's Recommendation

2.15 HERBICIDES AND OTHER PESTICIDES

A. Properly label and register pesticides with U.S. Environmental Protection Agency. Keep all pesticides in original labeled containers indicating analysis and method of use.

2.16 MULCH

A. Organic Mulch:

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- Shredded hardwood project site when available. Biobased content minimum 100 percent. Wood cellulose fiber processed to contain no growth or germination-inhibiting factors, dyed with non-toxic, biodegradable dye to an appropriate color to facilitate visual metering of application.
 - a. Straw for Lawn Seed Bed Mulch: Stalks from oats, wheat, rye, barley, or rice free of noxious weeds, mold or other objectionable material. Air dried and suitable for placing with blower equipment.
 - b. Wood cellulose fiber for hydraulic application of grass seed and fertilizer: Specially prepared wood cellulose fiber, processed to contain no growth or germination inhibiting factors, and dyed an appropriate color to facilitate visual metering of application of materials. Maximum 12 percent moisture dry weight, plus or minus 3 percent at time of manufacture. pH range from 3.5 to 5.0. Manufacturer wood cellulose fiber for application as follows:
 - After addition and agitation in slurry tanks with fertilizers, grass seeds, water, and other approved additives, fibers will become uniformly suspended to form a homogeneous slurry.
 - When hydraulically sprayed, material will form blotter-like cover impregnated uniformly with grass seed.
 - Cover will allow absorption of moisture and allow rainfall or applied water to percolate to underlying soil.
- 2. Color: Natural.
- B. Compost Mulch: Decomposed organic matter with low carbon to nitrogen ratio.

2.17 TACKIFIERS AND ADHESIVES

- A. Nonasphalt Tackifier: Colloidal liquid fixative recommended by fiber mulch manufacturer for hydroseeding.
- B. Asphalt emulsion: ASTM D977, Grade SS-1.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- B. Protect existing construction and completed work from damage.
- C. Examine areas to receive planting for compliance with requirements and other conditions affecting performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Identify and review all underground utility locations before commencing work and exercise caution when working close to utilities. Notify COR of apparent conflicts with construction and utilities to plan adjustment before installation.

3.2 FINE GRADING AND ORGANIC AND INORGANIC SOIL AMENDMENT INCORPORATION

- A. Obtain COR's written approval of previously completed rough grading work before incorporating organic soil amendments.
- B. Immediately before dumping and spreading approved organic soil amendment, clean subgrade of stones larger than 2 inches and debris or rubbish and remove from project site. Before spreading organic soil amendment, rip subgrades too compact to drain water or based upon compaction tests with claw 12 inches deep, pulled by bulldozer 24 inches on center, both directions, then regrade surface.
- C. Place and uniformly spread soil amendment materials humates and mycorrhizae over approved sub-grades. Apply inorganic soil amendments as recommended by soils report. Apply organic amendments to depth sufficiently greater than specified depth so after natural settlement and light rolling, specified minimum settled depth conform to lines, grades and elevations indicated on drawings. Incorporate soil amendment by disc harrowing, rototilling or other means in uniform manner. Incorporate upon organic matter deep enough to produce finished soil with organic matter content of between 4 and 6 percent. Provide additional organic soil amendment material, after in-place testing and approval, as required for organic matter content and finished grades at no additional cost to Government.
- D. Spread organic soil amendment material minimum 100 mm (4 inches) deep to finished grade at disturbed areas outside project limits.
- E. Do not handle subsoil or organic soil amendment material when wet or frozen.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- F. Set sufficient number of grade stakes to check finished grades. Set stakes in bottom of swales and at top of slopes. Connect contours and spot elevations with even slope.
- G. After incorporating soil amendments material into subsoil, prepare by scarifying or harrowing and hand raking. Remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove stones over 1-1/2 inch diameter from amended soil bed. Amended soil also to be free of smaller stones in excessive quantities as determined by COR.

3.3 EXCAVATION FOR PLANTING

- A. Compact whole surface with roller or by other suitable means to achieve 88 to 85 percent maximum dry density according to ASTM D698. During compaction process, fill all depressions caused by settling or rolling with additional organic soil amendment. Regrade and roll surface until presenting smooth and even finish corresponding to required grades. Acceptable finished soil grade condition for all new turfgrass areas is "fine textured and firm." Satisfactory firmness test requires surface soil not be fluffy or powdery and able to support weight of average adult person without creating visible depression.
- B. Verify location of underground utilities before plant pit or bed excavation. Repair damaged utility lines. Where lawns have been established before planting, cover and protect before beginning excavations. Protect existing trees, shrubbery, and beds with barricades during project construction.
- C. Remove rocks and other underground obstructions to depth necessary to permit proper planting according to Drawings. Where underground utilities, construction, or solid rock ledges are encountered, COR may select other locations for plant material.
- D. Dig plant pits by approved method to provide vertical sides and flat bottoms. When sides of pit become glazed, scarify glazed surface.
- E. Where ground cover and planting beds occur in existing turfgrass areas, remove turfgrass to depth that will ensure removal of entire root system. Prepare bed as follows:
 - Where existing soil is to be used in place, till beds 12 inches deep. Spread soil amendment uniformly over bed 2 inches deep and thoroughly incorporate into existing soil 12 inches deep using a roto-tiller or

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

similar equipment to obtain uniform and well pulverized soil mix. Where existing soil is compacted (former roadways, parking lots, etc.) till soil to necessary depth to support growth of new planting. Remove all sticks, stones, roots, and other objectionable materials. Bring plant beds to smooth and even surface to comply with established grades.

- F. In newly grading areas where existing soil will be removed and replaced to prepare new planting beds, remove 12 inches of existing soil and replace with topsoil. Bring plant beds to smooth and even surface to comply with established grades. Till 2 inches of soil amendment into topsoil as specified.
- G. Form earth saucers around plants with topsoil. Provide 2 inch high basins for shrubs and 4 inch high basins for trees.
- H. Treat plant saucers, shrub, and ground cover bed areas, before mulching, with approved preemergence granular ornamental herbicide. Apply herbicide at 200 lbs./acre before both early spring and early fall weed seed germination. Plant ground cover in areas to receive erosion control material through that material after material is in place.

3.4 SETTING PLANTS

- A. Move balled and container-grown plants only by supporting container. Remove container, taking care to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around roots or ball. Set plants with root crown 1 inch above surrounding grade. Plant ground cover plants after mulch is in place. Avoid contaminating mulch with planting soil.
- B. Backfill container-grown plants with native soil removed from planting hole to approximately half ball depth, then tamp and water. Use native soil to backfill hole. Completely remove all wire caging or similar material. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill, then form earth saucers or water basins around isolated plants with topsoil.

3.5 PRUNING

A. Do not prune new plants unless otherwise directed by arborist and approved by the COR. Prune indicated existing plant material as follows:1. Remove dead, broken and crossing branches.

- Make cuts with sharp instruments as close as possible to branch collar. Do not make flush cuts.
- Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove leader.
- 4. Remove trimmings from project site.
- 5. Do not apply tree wound dressing to cuts.
- B. Prune existing trees as indicated on Drawings. Perform tree pruning and cavity work by licensed arborist according to ANSI Z133.1. Remove 1/2 inch diameter or larger dead wood, branches interfering with or hindering healthy growth of trees, and diseased branches with clean cut made flush with branch collar. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Use of climbing spurs is not acceptable. Remove stubs or limbs improper cuts or breaks.

3.6 TILLAGE FOR LAWN AREAS

A. Thoroughly rip subgrades minimum 6 inches) deep by scarifying, disking, harrowing, or other approved methods. Remove debris and stones on surface larger than 1 inch on surface after tillage. Do not till areas of 3: 1 slope ratio or greater. Scarify these areas to 1 inch depth and remove debris and stones.

3.7 FINISH GRADING

A. After ripping subgrade for topsoil/subsoil bonding, spread topsoil evenly to minimum 6 inches deep. Incorporate topsoil at least 2 to 3 inches into subsoil to avoid soil layering. Spread additional topsoil as required to meet finish grades. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished lawn areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.8 APPLICATION OF FERTILIZER AND SOIL AMENDMENTS FOR TURFGRASS AREAS

- A. Apply turfgrass fertilizer and adjust soil acidity as recommended by soil test results. Add soil conditioners as specified for suitable topsoil in PART 2.
- B. Spread soil amendments as recommended by soil test results.
- C. Incorporate soil amendments into soil to minimum depth as recommended by soil test results in finish grading operation. Lightly mix starter

fertilizer with top 1/2 inch of soil. Immediately restore soil an even condition before seeding or sod placement.

3.9 SODDING

- A. Place sod according to TPI Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at bottom of slope.
- B. Finishing: After sodding, blend edges of sod smoothly into surrounding area. Roll with lightweight roller to eliminate air spaces between sod and firmed soil.

3.10 WATERING

- A. Watering: Start watering turfgrass areas immediately after installation at sufficient rate to ensure thorough wetting of soil to minimum 2 inches deep. Supervise watering operation to prevent run-off. Supply necessary pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations. Keep soil surface constantly moist, not wet, until turfgrass plants are well established.
- B. Deep water all trees twice each week during Plant Establishment Period, providing water penetration throughout root zone to full depth of planting pits, as verified by COR. Discontinue watering at first hard frost in fall and resume at ground thaw in spring.

3.11 SEEDING

- A. Broadcast and Drop Seeding: Uniformly broadcast seed at rate specified per MNDOT Seeding Manual per specified seed mix. Use broadcast or drop seeders. Sow one-half seed in one direction and sow remainder at right angles to first sowing. Cover seed uniformly to maximum 6 mm (1/4 inch) deep in clay soils and 13 mm (1/2 inch) deep in sandy soils by means of spike-tooth harrow, cultipacker, raking, or other approved device.
- B. Drill Seeding: Drill seed at rate specified per MNDOT Seeding Manual per specified seed mix. Use grass seed drills. Drill seed uniformly to 13 mm (1/2 inch) deep.
- C. Rolling: Immediately after seeding, firm entire area, except for slopes in excess of 3 to 1, with roller not exceeding 130 kg/m (90 lb./ft.) of roller width.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.12 HYDROSEEDING

- A. Mix water with wood cellulose fiber, paper fiber, or recycled paper at rate of 11.2 kg per 100 square meters (1,000 lb. per acre) dry weight. Add seed and fertilizer to fiber and water and mix to produce homogeneous slurry.
 - 1. Broadcast seed mixture at rate of specified per manufacturer.
 - Hydraulically spray slurry to form uniformly impregnated grass seed cover. Spread with one application with no second application of mulch.

3.13 LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD

- A. Landscape Plant and Turfgrass Establishment Period: Begins immediately after installation, with COR's approval, and continues through growing season sufficiently long for turfgrass and landscape plant materials to become establish and provide satisfactory to District Agronomist and NCA. Conditions and appearance are as follows:
 - Turfgrass has obtained minimum of 98 percent generally weed-free surface cover.
 - Landscape Plant Materials are fully rooted, actively growing and healthy and planting beds generally weed-free.
 - 3. Maintain plant and turfgrass during establishment period.
 - Plants and turfgrass will not be accepted until completion of acceptable establishment period.
 - 5. During Landscape Plant and Turfgrass Establishment Period complete the following:
 - a. Water plants and turfgrass to maintain moist soil surface until plants and turfgrass are well established. Quantity of applied water required to achieve and maintain these conditions determined on site by District Agronomist in consultation with COR.
 - b. Prune plants and replace mulch as required.
 - c. Replace and restore stakes, guy straps, and eroded plant saucers as required.
 - d. Remove grass, weeds, and other undesired vegetation, including root growth, before they reach 3 inches high in plant bed and saucers. After all unwanted vegetation has been removed, apply approved preemmergence herbicides and remulch.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- e. Spray with approved insecticides and fungicides to control pests and ensure plant survival in healthy growing condition, as directed by COR in coordination with District Agronomist.
- f. Provide the following during turfgrass establishment:
 - Eradicate weeds. Water, fertilize, overseed, and perform other operation necessary to promote growth of turfgrass.
 - 2) Mow turfgrasses as often as necessary to maintain NCA specified mowing height for each type of turfgrass before final acceptance. Begin mowing when cool season turfgrass is 4 inches high. For warm season turfgrasses, mow at appropriate heights for species and cultivar as directed by COR in consultation with District Agronomist.
- g. Replace dead, missing or defective plant material during establishment period and an active growing season. Immediately replace each plant with one of same size and species.
- Replant areas void of turfgrass during an active growing season only.
- i. Sod will be evaluated for species and health thirty (30) days after laying last piece and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from sod operation will be living sod, uniform in color and leaf texture. Bare spots to be maximum 2 sq. inches. Joints between sod pieces to be tight and free of weeds and other undesirable growth.
- j. Seeding will be evaluated for species and health thirty (30) days after final planting and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from seeding operation will be 98 percent coverage uniform in color and leaf texture. Bare spots to be maximum 2 sq. inches. Reseed unsatisfactory areas within seven days during an active growing season.
- k. Complete remedial measures as directed by COR in consultation with District Agronomist to ensure plant and turfgrass survival.
- Repair damage caused while making plant or turfgrass replacements.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.14 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE

- A. Landscape plant and turfgrass acceptance will occur after completion of LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. Contractor to have completed, located, and installed all plants and turfgrass according to drawings and specifications. All plants and turfgrass are expected to be living and in healthy condition at time of inspection and acceptance. Make written request two weeks before final inspection of landscape plants and turfgrass. Upon inspection, when work is found to not meet specifications, PLANT AND TURFGRASS ESTABLISHMENT PERIOD will be extended at no additional cost to Government until work has been satisfactorily completed, inspected and accepted.
- B. Criteria for Acceptance of Landscape Plants:
 - Planter beds and earth mound water basins are properly mulched and free of weeds.
 - 2. Tree support stakes, guys, and turnbuckles are in good condition.
 - 3. Total plants on site as required by specifications and required replacements have been installed.
 - 4. Remedial measures directed by COR have been completed.
- C. Criteria for Acceptance of Turfgrass:
 - Sod: Living sod grass plants uniform in color and leaf texture and well rooted into soil below so that gentle pulling of turfgrass leaves by hand does not dislodge sod. Bare spots to be maximum
 2 sq. inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 - 2. Seed: Living turfgrass plants with 98 percent coverage, uniform in color and leaf texture. Bare spots to be maximum 0.5 sq. ft.

3.15 CLEANING

- A. Remove and legally dispose of all debris, rubbish, and excess material from project site.
- B. Where existing or new turfgrass areas have been damaged or scarred, restore disturbed areas to original condition.
- C. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers.
- D. Maintain minimum one paved pedestrian access route and one paved vehicular access route to each building clean at all times.
- E. Clear other paved areas when work in adjacent areas are completed.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.16 PROTECTION

- A. Protect plants and turfgrass areas from traffic and construction operations. Erect barricades, as required, and place approved signs at appropriate intervals until final acceptance.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.

3.17 ENVIRONMENTAL PROTECTION

A. All work and operations to comply with requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

- - - E N D - - -

SECTION 33 10 00 WATER UTILITIES

GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of underground water distribution for domestic and/or fire supply systems outside the building that are complete and ready for operation. This includes piping, structures, appurtenances and all other incidentals.
- 1.2 RELATED WORK
- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete: Section 03 30 00, CAST IN-PLACE CONCRETE.
- C. Fire Protection System connection: Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.
- D. General plumbing: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- F. Metering: Section 25 10 10, ADVANCED UTILITY METERING SYSTEM.
- G. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 DEFINITIONS

- A. Water distribution system: Pipelines and appurtenances which are part of the distribution system outside the building for potable water and fire supply.
- B. Water service line: Pipeline from main line to 5 feet outside of building.

1.4 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic.
- B. DI: Ductile iron pipe.
- C.WOG: Water, Oil and Gas.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.

33 10 00-1 WATER UTILITIES

- C. Store plastic piping protected from direct sunlight and support to prevent sagging and bending.
- D. Cleanliness of Piping and Equipment Systems:
 - Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
 - 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

1.6 COORDINATION

- A. Coordinate water service lines with building contractor.
- B. Coordinate any potential campus service disruptions with the COR no less than 15 working days in advance of the potential disruption. Potentially disruptive work shall not occur without prior approval from the COR.

1.7 QUALITY ASSURANCE:

- A. Products Criteria:
 - When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
- B. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least three years. Digital electronic devices, software and systems such as controls, instruments or computer work stations shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
- C. Regulatory requirements:
 - Comply with the rules and regulations of the Federal, State, and Local Health Department having jurisdiction for potable waterservice.
 - 2. Comply with rules and regulations of Federal, State, and Local authorities having jurisdiction for fire-suppression water-service piping including materials, hose threads, installation and testing.
- D. Provide certification of factory hydrostatic testing of not less than 500 psi (3.5 MPa) in accordance with AWWA C151. Piping materials shall bear the label, stamp or other markings of the specified testing agency.
- E. Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

- Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
- 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
- 3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- All welds shall be stamped according to the provisions of the American Welding Society.
- F. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Resident Engineer prior to installation.
- G. Applicable codes:
 - 1. Plumbing Systems: IPC, International Plumbing Code.
 - Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
 - Fire-service main products shall be listed in the FM Global "Approval Guide" or Underwriters Laboratories (UL) "Fire Protection Equipment Directory".

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):

MSS SP-60-2004Connecting Flange Joint Between Tapping Sleeves and Tapping Valves

MSS SP-108-2002.....Resilient-Seated Cast Iron, Eccentric Plug Valves

MSS SP-123-1998(R2006)..Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube

C. American Society of Mechanical Engineers (ASME):

33 10 00-3 WATER UTILITIES VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 A112.1.2-2004.....Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water-Connected Receptors)) A112.6.3-2001.....Floor Drains B16.1-2010.....Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 B16.18-2001.....Cast Copper Alloy Solder Joint Pressure Fittings B16.22-2001.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings B16.24-2006.....Cast Copper Alloy Pipe Flanges and Flanged Fittings; Classes 150, 300, 600, 900, 1500 and 2500 B31..... Piping Standards D. American Society for Testing and Materials (ASTM): A36/A36M-08.....Carbon Structural Steel A48/A48M-08(2008).....Gray Iron Castings A536-84(2009).....Ductile Iron Castings A674-10.....Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids B61-08.....Steam or Valve Bronze Castings B62-09..... Metal Castings B88/B88M-09.....Seamless Copper Water Tube C651-05.....Disinfecting Water Mains C858-10e1.....Underground Precast Utility Structures D1785-06.....Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 D2239-03.....Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter D2464-06.....Threaded Poly (Vinyl Chloride) PVC Pipe Fittings, Schedule 80

> 33 10 00-4 WATER UTILITIES

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 D2466-06.....Poly (Vinyl Chloride) (PVC) Pipe Fittings, Schedule 40 D2467-06.....Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 D2609-02(2008).....Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe D3350-10a.....Polyethylene Plastics Pipe and Fittings Materials F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter F1267-07.....Metal, Expanded, Steel E. American Water Works Association (AWWA): B300-10.....Hypochlorites B301-10.....Liquid Chlorine C104-08.....Cement-Mortar Lining for Ductile Iron Pipe and Fittings C105/A21.5-10.....Polyethylene Encasement for Ductile Iron Pipe Systems C110-08..... Fittings C111/A21.11-07.....Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings C115/A21.11-11.....Flanged Ductile Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges C151/A21.51-09.....Ductile Iron Pipe, Centrifugally Cast C153/A21.53-11.....Ductile Iron Compact Fittings for Water Service C502-05.....Dry-Barrel Fire Hydrants C503-05.....Wet-Barrel Fire Hydrants C504-10.....Rubber-Seated Butterfly Valves C508-09.....Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS

> 33 10 00-5 WATER UTILITIES

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C509-09.....Resilient-Seated Gate Valves for Water Supply Service C510-07..... Double Check Valve Backflow Prevention Assembly C511-07.....Reduced-Pressure Principle Backflow Prevention Assembly C512-07.....Air Release, Air/Vacuum and Combination Air Valves C550-05.....Protective Interior Coatings for Valves and Hydrants C600-10..... Installation of Ductile Iron Mains and Their Appurtenances C605-11......Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water C606-11.....Grooved and Shouldered Joints C651-05.....Disinfecting Water Mains C700-09.....Cold-Water Meters, "Displacement Type," Bronze Main Case C800-05.....Underground Service Line Valves and Fittings C900-09.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution C906-07..... Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 64 In. (1,600 mm), for Water Distribution and Transmission C907-04.....Injection-Molded PVC Pressure Fittings, 4 Inch through 12 Inch (100 mm through 300 mm), for Water Distribution M23-2nd Ed.....PVC Pipe, Design and Installation M44-2nd Ed.....Distribution Valves: Selection, Installation, Field Testing and Maintenance

> 33 10 00-6 WATER UTILITIES

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 F. National Fire Protection Association (NFPA): NFPA 24-2010 Ed.....Installation of Private Fire Service Mains and Their Appurtenances NFPA 1963-2009 Ed.....Fire Hose Connections G. NSF International (NSF): NSF/ANSI 14 (2013).....Plastics Piping System Components and Related Materials NSF/ANSI 61-2012.....Drinking Water System Components - Health Effects NSF/ANSI 372-2011.....Drinking Water System Components - Lead Content H. American Welding Society (AWS): A5.8/A5.8M-2004Filler Metals for Brazing and Braze Welding I. American Society of Safety Engineers (ASSE): 1003-2009Water Pressure Reducing Valves 1015-2009......Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies 1020-2004..... Pressure Vacuum Breaker Assembly 1047-2009..... Performance Requirements for Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies 1048-2009..... Performance Requirements for Double Check Detector Fire Protection Backflow Prevention Assemblies 1060-2006..... Performance Requirements for Outdoor Enclosures for Fluid Conveying Components J. Underwriters' Laboratories (UL): 262.....Gate Valves for Fire-Protection Service 312.....Check Valves for Fire-Protection Service

> 33 10 00-7 WATER UTILITIES

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

405.....Fire Department Connection Devices
753.....Alarm Accessories for Automatic Water-Supply
Control Valves for Fire Protection Service
789.....Indicator Posts for Fire-Protection Service
1091....Butterfly Valves for Fire-Protection Service
1285.....Pipe and Couplings, Polyvinyl Chloride (PVC),
and Oriented Polyvinyl Chloride (PVCO) for
Underground Fire Service

1.9 WARRANTY

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of two years from final acceptance. Further, the Contractor will furnish all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61 or NSF 372.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended.

2.2 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements. The contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.3 DUCTILE IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).

- 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or grayiron standard pattern or AWWA C153, ductile-iron compact pattern.
- 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).
 - Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or grayiron standard pattern or AWWA C153, ductile-iron compact pattern.
 Gaskets: AWWA C111, rubber, conductive.
- C. Flanged Ductile Iron Pipe: AWWA C115/A21.11, with factory applied screwed long hub flanges.
 - 1. Flanges: ASME B16.1 for 250 psi (1725 kPa) pressure ratings, as necessary.
 - 2. Wall Sleeve Castings, size and types shown on the drawings, shall be hot dipped galvanized per ASTM A123.
 - 3. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 09 91 00, PAINTING. Pipe shall be shop primed with one coat of rust inhibitive primer. Final paint color shall match the final wall color.

2.4 POLYVINYL CHLORIDE PIPE AND FITTINGS

- A. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.
 - 1. PVC Fabricated Fittings: AWWA C900, Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 2. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 3. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or grayiron standard pattern.

a.Gaskets: AWWA C111, rubber.

- 4. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or grayiron standard pattern or AWWA C153, ductile-iron compact pattern. a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. PVC, AWWA Pipe: AWWA C900, Class 200, with restrained integral bell or restrained coupling. Include elastomeric gasket in each bell or coupling

meeting ASTM F477. C900/RJ Certa-Lok, C900/RJIB Certa-Lok or approved equal.

2.5 DISINFECTION CHLORINE

- A. Liquid chlorine: AWWA B301.
- B. Sodium Hypochlorite: AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite: AWWA B300 supplied in granular form of 5 g. tablets, and shall contain 65 percent chlorine by weight.

2.6 WARNING TAPE

A. Warning tape shall be standard, 4 mil. Polyethylene, 3 inch (76 mm) wide tape, detectable type, blue with black letters and imprinted with "CAUTION BURIED WATER LINE BELOW".

EXECUTION

3.1 PIPING APPLICATIONS

- A. Use pipe, fittings, and joining methods for piping systems according to the following applications.
 - Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
 - 2. Do not use flanges or unions for underground piping.
- B. Underground water-service piping NPS 3/4 to NPS 3 (DN 20 to DN 80)
 - 1. PVC, Schedule 40 pipe, socket fittings; and solvent-cemented joints.
- C. Underground water-service piping NPS 4 to NPS 8 (DN 100 to DN 200)
 - Ductile iron, mechanical-joint pipe; ductile iron, mechanical-joint fittings; and mechanical joints.
 - 2. PVC, AWWA Class 200 pipe for NPS 8 (DN 200): PVC, AWWA Class 200 fabricated mechanical-joint, ductile iron fittings; and gasketed joints.
- D. Underground Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be any of the following:
 - Ductile iron, mechanical-joint pipe; ductile iron, mechanical-joint fittings; and mechanical joints.
 - 2. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.

33 10 00-10 WATER UTILITIES

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

3.2 DUCTILE IRON PIPE

- A. Install Ductile Iron, water-service piping according to AWWA C600 and AWWA M41-3rd Edition.
- B. Pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.
- D. Push on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead.

3.3 PVC PIPE

- A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA C605. Place selected material and thoroughly compacted to one foot above the top of the pipe.
- B. Install Copper Tracer Wire, No. 12 AWG copper clad steel, with 450 lb break load minimum, insulated, color: blue. Copperhead Industries or approved equal. Install in the trench with piping to allow location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be Snakebite locking connectors or approved equal. At least every 1000 feet (300 m) provide a 5-pound (2.3 kg) magnesium anode attached to the main tracer wire. An anode shall also be attached at the end of each line. Where piping is installed through directional drilling or jack and bore, tracer wire shall be No. 10 AWG copper clad steel, with 2,000 lb break load minimum, single conductor, insulated with 45 mil thick HDPE insulation, color: blue.

3.4 ANCHORAGE INSTALLATION

- A. Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include: Megalug joint restraints as manufactured by EBAA Iron or approved equal.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
- 1. Gasketed-Joint, Ductile Iron, Water-Service Piping: According to AWWA C600.
- 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
- 3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 FIELD QUALITY CONTROL

- A. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
- C. Perform hydrostatic tests at not less than one-and-one-half times working pressure for two hours.
 - Increase pressure in 50-psi (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psi (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare reports of testing activities.

3.6 IDENTIFICATION

A. Install continuous underground warning tape 12 inches (300 mm) directly over piping.

3.7 CLEANING

- A. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
- B. Use purging and disinfecting procedure prescribed by local utility provider or other authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - 1. Fill the water system with a water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

- 2. Drain the system of the previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow system to stand for 3 hours.
- 3. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
- Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- C. Prepare reports of purging and disinfecting activities.

--- E N D ---

SECTION 33 40 00

STORM SEWER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Materials and Testing Report Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- E. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 ABBREVIATIONS

- A. HDPE: High-density polyethylene
- B. PE: Polyethylene

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

1.5 COORDINATION

A. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.6 QUALITY ASSURANCE:

A. Products Criteria:

- When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
- 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast

integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.7 SUBMITTALS

A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, hydrants, valves and other miscellaneous items.

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):

A185/A185M-07.....Steel Welded Wire Reinforcement, Plain, for Concrete

A242/A242M-04(2009)	.High-Strength Low-Alloy Structural Steel
A536-84(2009)	.Ductile Iron Castings
A615/A615M-09b	.Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A760/A760M-10	.Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
A798/A798M-07	.Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
A849-10	.Post-Applied Coatings, Paving, and Linings for Corrugated Steel Sewer and Drainage Pipe
A929/A929M-01(2007)	.Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
B745/B745M-97(2005)	.Corrugated Aluminum Pipe for Sewers and Drains
B788/B788M-09	.Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe
C14-07	.Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe
СЗЗ/СЗЗМ-08	.Concrete Aggregates

33 40 00-2 STORM SEWER UTILITIES VAMC St. Cloud, MN VA Project 656-21-235 March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C76-11..... Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe C139-10.....Concrete Masonry Units for Construction of Catch Basins and Manholes C150/C150M-11.....Portland Cement C443-10.....Joints for Concrete Pipe and Manholes, Using Rubber Gaskets C478-09.....Precast Reinforced Concrete Manhole Sections C506-10b.....Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe C507-10b......Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe C655-09......Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe C857-07......Minimum Structural Design Loading for Underground Precast Concrete Utility Structures C891-09..... Installation of Underground Precast Concrete Utility Structures C913-08..... Precast Concrete Water and Wastewater Structures C923-08.....Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals C924-02(2009).....Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method C990-09.....Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants C1103-03(2009).....Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 C1173-08......Flexible Transition Couplings for Underground Piping Systems C1433-10.....Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers C1479-10.....Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations D448-08.....Sizes of Aggregate for Road and Bridge Construction D698-07e1.....Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3)) D1056-07.....Flexible Cellular Materials-Sponge or Expanded Rubber D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 D2321-11.....Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications D2751-05......Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings D2774-08......Underground Installation of Thermoplastic Pressure Piping D3034-08.....Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings D3350-10.....Polyethylene Plastics Pipe and Fittings Materials D3753-05e1.....Glass-Fiber-Reinforced Polyester Manholes and Wetwells D4101-11.....Polypropylene Injection and Extrusion Materials

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 D5926-09.....Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe F679-08.....Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter F794-03(2009).....Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter F891-10.....Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core F894-07.....Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe F949-10.....Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings F1417-11.....Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air F1668-08.....Construction Procedures for Buried Plastic Pipe C. American Association of State Highway and Transportation Officials (AASHTO): M190-04.....Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches M198-10.....Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants M252-09.....Corrugated Polyethylene Drainage Pipe M294-10.....Corrugated Polyethylene Pipe, 12 to 60 In. (300 to 1500 mm) Diameter

VA Project 656-21-235 VAMC St. Cloud, MN March 30, 2022 EHRM Infrastructure Upgrades 4801 Veterans Drive 100% CD Issued for Bidding St. Cloud, MN 56303 D. American Water Works Association (AWWA): C105/A21.5-10.....Polyethylene Encasement for Ductile iron Pipe Systems C110-08..... Ductile-Iron and Gray-Iron Fittings C219-11.....Bolted, Sleeve-Type Couplings for Plain-End Pipe C600-10..... Installation of Ductile iron Mains and Their Appurtenances C900-07.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution M23-2nd ed.....PVC Pipe "Design And Installation" E. American Society of Mechanical Engineers (ASME): A112.6.3-2001.....Floor and Trench Drains A112.14.1-2003.....Backwater Valves A112.36.2M-1991....Cleanouts F. American Concrete Institute (ACI): 318-05..... And Commentary and Commentary 350/350M-06.....Environmental Engineering Concrete Structures and Commentary G. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for Erosion and Sediment Control 1.9 WARRANTY The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom

workmanship and pay for any damage to other work resulting therefrom within a period of two years from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements. The Contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 ABS PIPE AND FITTINGS

- A. ABS Sewer Pipe and Fittings: Pipe and fittings shall conform to ASTM D2751, with bell-and-spigot ends for gasketed joints.1. NPS 3 to NPS 6 (DN 80 to DN 150): SDR 35.
 - 2.NPS 8 to NPS 12 (DN 200 to DN 300): SDR 42.
- B. Gaskets: ASTM F477, elastomeric seals.

2.3 PE PIPE AND FITTINGS

- A. Corrugated PE drainage pipe and fittings, NPS 3 to NPS 10 (DN 80 to DN 250); ASTM F714, SDR 21 with smooth waterway for coupling joints.
 - Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
- B. Corrugated PE pipe and fittings, NPS 12 to NPS 60 (DN 300 to DN 1500); ASTM F714, SDR 21 for pipes 3 to 24 inches (300 to 600 mm) with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.
 - Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
- C. Profile Wall PE Pipe: Pipe shall comply with ASTM F894, Class 160.
 - Profile Wall PE Plastic Pipe Joints: Joints shall be as per ASTM F894, gasket or thermal weld type with integral bell.
- D. PVC Pipe And Fittings
 - PVC Cellular-Core Pipe And Fittings: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
 - 2. Fittings: ASTM D3034, SDR 26, PVC socket-type fittings.
- E. PVC Corrugated Sewer Piping

- 1. Pipe: ASTM F949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
- 2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
- 3. Gaskets: ASTM F477, elastomeric seals.
- F. PVC Profile Sewer Piping
 - 1. Pipe: ASTM F794, PVC profile, gravity sewer pipe with bell-and-spigot ends.
 - 2. Fittings: ASTM D3034, PVC with bell ends.
 - 3. Gaskets: ASTM F477, elastomeric seals.
- G. PVC Type PSM Sewer Piping
 - 1. Pipe: ASTM D3034, SDR 26, PVC Type PSM sewer pipe with bell-andspigot ends.
 - 2. Fittings: ASTM D3034, PVC with bell ends.
 - 3. Gaskets: ASTM F477, elastomeric seals.
- H. PVC Gravity Sewer Piping
 - 1. Pipe and fittings shall be ASTM F679, 115 psi, PVC gravity sewer pipe with bell-and-spigot ends.
 - 2. Gaskets: ASTM F477, elastomeric seals for gasketed joints.

2.4 CONCRETE PIPE AND FITTINGS

- A.Reinforced-Concrete sewer pipe and fittings shall be ASTM C76 or ASTM C655.
 - 1. Bell-and-spigot, gasketed joints with ASTM C443, rubber gaskets.
 - 2. Class IV: Wall C.

2.5 WARNING TAPE

A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape detectable type, green with black letters, and imprinted with "CAUTION BURIED STORM DRAIN LINE BELOW".

2.6 HDPE PIPE AND FITTINGS

- Corrugated HDPE pipe and fittings, NPS 4 to NPS 60 (DN 100 to DN 1500); ASTM F2648 for pipes 4 to 60 inches (100 to 1500 mm) with smooth interior and annual exterior corrugations.
 - Material for pipe production shall be an engineered compound of virgin and recycled high-density polyethylene conforming with the minimum requirements of cell classification 424420C (ESCR Test Condition B) for 4 through 10 inch (100 to 250 mm) diameters, and 435420C (ESCR Test Condition B) for 12 through 60-inch (300 to 1500

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%.

- 2. Pipe shall be joined using a bell & spigot joint meeting ASTM F2648. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.
- 3. Pipe fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the watertight joint performance requirements of ASTM F2306.

PART 3 - EXECUTION

3.1 PIPE BEDDING

A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.2 PIPING INSTALLATION

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping with cover matching the existing condition, or minimum cover as shown on the Drawings.

- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
 - Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
 - 3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
 - 4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
 - 5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
 - 6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.
 - 7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fittings; or cast in-place concrete supports or anchors.
 - 3. Install ductile iron piping and special fittings according to AWWA C600.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 4. Install corrugated steel piping according to ASTM A798.
- 5. Install corrugated aluminum piping according to ASTM B788.
- 6. Install ABS sewer piping according to ASTM D2321 and ASTM F1668.
- 7. Install PE corrugated sewer piping according to ASTM D2321 with gasketed joints or gaskets with fused joints.
- 8. Install HDPE Dual Wall sewer piping according to ASTM D2321 and manufacturer's recommended installation guidelines.
- 9. Install PVC cellular-core piping, PVC sewer piping, and PVC profile gravity sewer piping, according to ASTM D2321 and ASTM F1668.
- 10. Install reinforced concrete sewer piping according to ASTM C1479.

3.3 REGRADING

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

3.4 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.5 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
1. Close open ends of piping with at least 8 inch (203 mm) thick, brick masonry bulkheads.

- Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Backfill to grade according to Division 31 Section EARTH MOVING.

3.6 IDENTIFICATION

A. Install green warning tape directly over piping and at outside edge of underground structures.

3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined. 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.

3.8 TESTING OF STORM SEWERS:

A. Submit separate report for each test.

- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - Test completed piping systems according to requirements of authorities having jurisdiction.
 - Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
 - 4. Submit separate report for each test.

VA Project 656-21-235 March 30, 2022 100% CD Issued for Bidding

- 5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
- C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

--- E N D ----

Bookmark Summary

00 00 00 Spec Cover Page VOL2	Page 1
Certifications	Page 3
211313	Page 6
220511	Page 15
220523	Page 41
220711	Page 47
221100	Page 62
221300	Page 72
221400	Page 83
230511	Page 94
230593	Page 126
230711	Page 135
232113	Page 156
232213	Page 172
232300	Page 186
233100	Page 196
238123	Page 208
260511	Page 215
260519	Page 226
260526	Page 233
260533	Page 240
260573	Page 252
260800	Page 257
260923	Page 261
261219	Page 265
262416	Page 275
262600	Page 281
262726	Page 285
262911	Page 291
262921	Page 297
263353.01	Page 301
263353	Page 313
263623	Page 320
264313	Page 332
265100	Page 336
270511	Page 345
270526	Page 389

270533	Page 397
270800	Page 410
271000	Page 413
271100	Page 423
271500	Page 434
280500	Page 451
280513	Page 523
280526	Page 540
280528.33	Page 547
281600	Page 562
283100	Page 583
312000 - Earthwork Short Form	Page 597
312319 - Dewatering	Page 617
320523 - Cement and Concrete for Exterior Improvements	Page 622
321216 - Asphalt Paving	Page 639
321723 - Pavement Markings	Page 645
329000 - Planting	Page 651
331000 - Water Utilities	Page 674
334000 - Storm Sewer Utilities	Page 687