

SECTION 01 00 00
GENERAL REQUIREMENTS

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VA Puget Sound Healthcare System
Building 100

PROJECT NO.: 663-15-102
Electrical Distribution
Upgrade from 5kV to 15Kv

1.27 STORAGE SPACE FOR DEPARTMENT OF VETERANS AFFAIRS EQUIPMENT (NOT USED)

1.28 CONSTRUCTION SIGN

1.29 SAFETY SIGN

1.30 PHOTOGRAPHIC DOCUMENTATION (NOT USED)

1.31 FINAL ELEVATION Digital Images (NOT USED)

1.32 HISTORIC PRESERVATION (NOT USED)

1.33 EQUIPMENT

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1.35 WARRANTY CALLS

1.36 INTERIM LIFE SAFETY MEASURE

1.37 VA TRIRIGA CPMS

SECTION 01 00 00
GENERAL REQUIREMENTS

1.1 SAFETY REQUIREMENTS

- A. Refer to section 01 35 26, SAFETY REQUIREMENTS for safety and infection control requirements.

1.2 GENERAL INTENTION

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish all necessary tools, equipment, labor, materials, temporary equipment and items, tools, specialty services, supervision, and perform all the work of replacing the 5kV Class switchgear with 15kV Class including secondary unit substations, diesel-engine generators, automatic transfer switches, motor controller units, and installation of 15kV cabling and equipment to interconnect the east campus and west campus distribution switchgear as required by drawings and specifications.
- B. It is strongly recommended that visits to the site be made prior to bid to verify existing conditions. All bids will take into consideration existing site conditions; it is the responsibility of the contractor to review the entire job site and existing site conditions prior to bid submission. All proposals shall include a detailed cost breakdown (materials, labor, and equipment) by trade, specification division and section; lump sum costs are not acceptable.
- C. Visits to the site by Bidders: refer to FAR 52.236-27 Site Visit - Construction. Only organized site visits are authorized. There may be more than one as needed; needs shall be as determined by the Contracting Officer.
- D. Offices of Sazän Group Inc., as Architect-Engineers will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not

be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.

- E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by Photo ID for project and employer, and restricted from unauthorized access.
- F. Normal Operation / Construction Hours: Construction operations at the VA Puget Sound Health Care System are 7:30 AM to 4:30 PM, Monday through Friday, with the exception of Federal Holidays. Requests to work beyond normal work hours shall be submitted in writing to the Project Engineer for approval and will include a description of work to be performed. Approval is subject to availability of the Project Engineer, type of work to be performed, and the specific hours requested. Contractors are reminded that patients are generally asleep after 10:00 PM. Approval to work beyond this time will also include an evaluation of the anticipated noise level generated by the contractor. Under no circumstances will the contractor proceed without express written approval of the Project Engineer.
- G. Before placement and installation of work subject to tests by testing laboratory or other parties retained by Department of Veterans Affairs or the Contractor, the Contractor shall notify the Project Engineer in sufficient time to enable testing laboratory and VA personnel to be present at the site to observe proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the Project Engineer.
- H. VA Green Environmental Management System (GEMS) Training: Prior to commencing work, the Contractor Superintendent shall complete the following GEMS Awareness Training and submit the completed forms to the COR:

Project #/Name: _____
COTR Name: _____

VA Puget Sound Health Care System Green Environmental Management System Awareness Training

VA Puget Sound GEMS Coordinator is: Chelsea Branchcomb (253) 583-3511

Purpose of the GEMS Program: Combine all aspects of environmental management into a centralized program to promote: Pollution Prevention, Regulatory Compliance, Continuous Environmental Improvement and integrate healthy environmental practices into VA Puget Sound Healthcare System.

- Executive Order (EO) 13148, entitled 'Greening the Government through Leadership in Environmental Management' – Use reduction, Release reduction, Pollution Prevention, compliance, environmental Management, etc.
- VA Directive 0057 & VA Directive 2005-011

The primary functions of the GEMS program are to...

- 1) Maintain regulatory compliance
- 2) Manage pollution prevention
- 3) Strive for continual environmental improvement
- 4) Provide Environmental Guidance to all VA Puget Sound Services

Potential harmful effects of our everyday activities may include:

- ✓ Unplanned spills of hazardous materials
- ✓ Financial penalty for non-compliance
- ✓ Contamination of surface/runoff water
- ✓ Toxic effects of chemicals to the environment.
- ✓ Excessive use of water resources
- ✓ Negative effects of poor chemical management
- ✓ Creation of additional waste to landfills

Waste Reduction

Contractors must complete and fill out the attached Record of Materials Recycled and Reused and turn into the COTR or project engineer at the completion of the contract or when requested. Recyclable materials:

- | | | |
|----------------------------|-------------------------|-------------------------------------|
| • Confidential White Paper | • Cement fiber products | • Fluorescent Lamps |
| • Cardboard | • Carpet and pad | • Pallets/Wood |
| • Ink & Toner | • Insulation | • Grease |
| • Scrap Metal | • Wallboard | • Reusable fixtures and accessories |
| • Oil | • Wood | |
| • Batteries | • Asphalt | |
| • Glass | • Concrete | |

Project #/Name: _____
COTR Name: _____

Mercury, Batteries and Lamps – Universal Waste

Recycle all batteries and lamps including: alkaline, lead acid, Ni-Cad, lithium, etc.
Provide all bill of lading or manifests to the COTR or project engineer if Universal Waste is disposed of as part of this contract. **Mercury Reduction.** It is the policy of the VA to use alternate non-mercury products and be “virtually mercury free.”

Hazardous Waste

Any items that are hazardous waste must be handled and disposed of properly in accordance with federal and state regulations. *If any hazardous waste is generated, ensure COTR or project engineer is aware and contacted the GEMS Coordinator to discuss accumulation limits, storage areas, etc.* All hazardous waste manifests must be signed by the GEMS Coordinator (except asbestos disposal manifests).

- Most items with an SDS meet WA State toxicity levels
- Used oil, hydraulic fuel, diesel fuel, jet fuel
- Contaminated soil
- Epoxies, adhesives, etc
- Waste paints, varnishes, solvents, sealers
- Spill or clean-up material used on above items
- Concentrated lead based paint
- Asbestos (Toxic Substance) ← GEMS Coordinator does not need to sign

Spill Prevention Control and Countermeasure Plan. Contractors may choose to use the facility’s SPCC Plan, but must also provide a basic amendment specific to the project. Storage of hazardous materials and fuels must be in weather protected areas, preferably in a berm or spill protected areas, and be accessible only to authorized personnel.

Air Emissions. No visible air emissions allowed in accordance with Puget Sound Clean Air Agency regulations; provide basic dust control plan to project engineer. Any work on refrigerators, air conditioners, chillers or other sources of ozone depleting substances must be reviewed by the GEMS Coordinator. Asbestos notifications with PSCAA are required when applicable.

Storm Water. Contractors must abide by all Clean Water Act and storm water requirements. Follow Western Washington Storm water Manual or stricter best management plans. Provide BMPs to COTR to project engineer. If construction permit is required, provide all documentation and Storm Water Pollution Prevention Plan to project engineer.

Project #/Name: _____
COTR Name: _____

Federal Green Purchasing Program. It is VA policy that at least 95% (or the maximum extent practical) of new contract actions for products and services (including construction) are energy efficient, water efficient, bio-based, and/or environmentally preferable. Products acquired will be non-ozone depleting, contain recycled content, or are non-toxic or less-toxic, where such products and services meet agency performance requirements. Green products compilation: <http://www.gsa.gov/portal/content/198257>.

- *Recycled Content Products*
The EPA recommends recycled content levels that you should use when purchasing CPG items. www.epa.gov/cpg
- *Environmentally Preferred products (EPP)*
These products are alternatives to products that contain hazardous materials such as green cleaning products or mercury-free thermometers. www.epa.gov/epp
- *Non Ozone Depleting Substances (ODSs)*
EPA identifies alternatives to ODSs through its Significant New Alternatives Policy (SNAP) program and provides recommendations for specific products, such as refrigerants and fire extinguishers. www.epa.gov/ozone/snap/lists/index.html
- *Alternative Fuel vehicles*
The Energy Policy Act (EPACT) of 2005 & EO 13423 mandated that 75% of Light Duty Vehicles in U.S. Metropolitan areas be alternative fuel vehicles (AFVs). Agencies then receive a credit for AFVs. As part of EO 13423 agencies are required to reduce petroleum usage by 2% annually.
- *BioBased Products*
The Farm Security and Rural Investment Act of 2002 requires the purchase of biobased products designated by the USDA. www.biopreferred.gov
- *Energy Star ® & energy Efficient products*
The Energy Policy Act of 2005 requires agencies purchasing Energy Star products or energy-efficient products designated by the Department of Energy's Federal Energy Management Program (FEMP). www.energystar.gov

I have read and acknowledged VA Puget Sound Health Care System GEMS Awareness Training.

Project Manager/Superintendent Name: _____

Project Manager/Superintendent Signature: _____

Company: _____ Date: _____

1.3 STATEMENT OF BID ITEM(S)

- A. GENERAL: The following Bid Items includes general construction, alterations, grading, necessary removal of existing structures, temporary services and construction, and certain other items of work required by the drawings and specifications. Temporary generators shall be obtained and connected to support the medical center's electrical demands during electrical equipment replacements. All service interruptions shall be scheduled in advance with the COR; the number and duration of service interruptions shall be kept to a minimum. All work of the contract is to be completed within 1,090 calendar days:
- B. ITEM I, NORMAL POWER UPGRADE FROM 5kV to 15kV -BASE ITEM:
1. Coordinate with Seattle City Light (SCL) to de-energize and remove the south 5MVA, 4.16kV transformer currently supplying the main switchgear. The north 5MVA unit shall remain in service to support existing and interim 5kV equipment while switchgear is replaced and substations are cutover to the new 15kV system. An existing 2500kVA padmount step-up transformer shall be relocated to temporarily supply 13.8kV for new equipment from the existing 5kV main switchgear.
 2. Construct a new utility service yard in phases to accommodate two new SCL 7.5MVA, 13.8kV transformers and padmount switchgear. At completion of the first phase, coordinate with SCL for installation and energization of the south 7.5MVA, 13.8kV transformer.
 3. Replace Unit Substations A, B, and C in turn with new 13.8kV-480V double-ended units; new equipment shall be installed in place of existing. Prepare for substation removal by disconnecting 480V feeders from each substation and connecting to a temporary power source. Temporary

power for Sub A loads shall also supply Sub D; the 5kV front end of Sub D shall be removed.

4. Provide temporary power to new Unit Substations B and C for testing while main switchgear is replaced. After testing, extend feeder conductors to transfer existing loads from temporary power to new 480V switchgear.
5. After all site loads have been removed from the 5kV main switchgear, coordinate with SCL to de-energize and remove the remaining 5MVA, 4.16kV transformer, and complete the construction of the new utility service yard. Coordinate with SCL for installation and energization of the north 7.5MVA, 13.8kV transformer.
6. Replace 5kV main switchgear with new 15kV main switchgear. Replace Unit Substation A with a new unit substation. Install a 15kV feeder to connect one end of new main switchgear to the new north 7.5MVA SCL transformer. Install a 15kV feeder from the main switchgear to Sub A. After testing, extend feeder circuits to transfer existing loads from the temporary power source to the new Sub A 480V switchgear. Refeed Substation D from Substation A with a 1600A 480V feeder.
7. When switchgear installations are complete and double-ended substations are supplied at each end by a 15kV feeder, open the tie breakers at the main switchgear and each unit substation, which will be their normal operating positions.

C. ITEM II, ESSENTIAL ELECTRICAL SYSTEM UPGRADE - OPTION ITEM:

1. Provide new 13.8kV-480V single-ended unit substations in Electrical Rooms A, B, and C to serve as the essential power source in each of these locations.

2. Provide temporary power sources to support existing loads fed from 480V Essential Switchgear A, B, and C until new switchgear installations are complete.
3. Remove existing 480V paralleling switchgear and install new 15kV paralleling switchgear in its place at the energy plant.
4. Replace five 520kW, 480V diesel-engine generators with two 2500kW, 13.8kV units including provisions for installation of a matching third generator unit.
5. Provide 15kV feeders from each generator set to the paralleling switchgear.
6. Provide a 15kV feeder from the paralleling switchgear to each single-ended unit substation.
7. After each new essential substation is satisfactorily tested, existing feeders shall be cutover from the temporary power to the new 480V switchgear.

D. ITEM III, CAMPUS FEED INTERCONNECTION -OPTION ITEM:

1. Feeders shall be installed for both normal and essential power switchgear for interconnection flexibility between the east and west campus distribution centers. Configure for manual operation with the capability to add control devices for future automated paralleling of the east and west generators and switchgear.
2. Provide a new switchgear section added to the west campus switchgear containing two 15kV vacuum breakers.
3. Provide two 15kV feeders to interconnect the east campus switchgear to the west campus switchgear; one feeder installed via existing underground ductbank, the second feeder routed through a combination of new duct bank and new conduit inside tunnels and workrooms.

E. ITEM IV, BUILDING 100 MOTOR CONTROLLER REPLACEMENT -OPTION ITEM:

1. Motor controller buckets in existing motor control centers shall be replaced in kind with after-market units.

F. ITEM V, AUTOMATIC TRANSFER SWITCH REPLACEMENT -OPTION ITEM:

1. Automatic transfer switches in Building 100 serving Life Safety and Critical branches of the ESS shall be replaced with new bypass isolation switches.
2. Automatic transfer switches serving Equipment branches of the ESS shall be retrofitted with new interior assemblies.
3. Provide control wiring from each ATS back to the new generator paralleling switchgear controller.
4. Temporary power sources and connections shall be provided to support normal building operations during the construction period.

1.4 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. Drawings, specifications, and contract documents shall be obtained from the website where the solicitation is posted. The Department of Veterans Affairs will not provide additional copies to Contractors.
- B. Contractors experiencing difficulties in downloading files shall contact the Contracting Officer for assistance.

1.5 CONSTRUCTION SECURITY REQUIREMENTS

- A. Security Plan:
 1. Physical security of the construction site and installations shall meet requirements from the VA document 'Physical Security Design Manual for VA Life-Safety Protected Facilities.'

2. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
3. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.
4. The General Contractor shall furnish to the Project Engineer lists of employees that will be or may be on the construction site(s). The List shall be on Company letter head that provides all of the company contact information; shall provide the project number and title, locations of work, names of the employees, their titles, their job types, and personal contact numbers (i.e. cell phone). All sub-contractors, vendors and suppliers for the project shall furnish the same listing on their individual company letter heads to the GC whom will provide the lists to the Project Engineer. These lists shall be updated as necessary during the entire duration of the project. These lists may be used to provide a check list record of personnel on-site each day to be provided with the contractors Daily Log reports. These lists may be used to provide a check list record of personnel on-site each day to be provided to the VA Police Department and their Dispatch Office where normal sign in and sign out occurs.

B. Security Procedures:

1. Contractor shall be required to obtain identification badges for employees working on the job site. IDs will be obtained by filling out VA Form 711, OF 306, and OF 612 and returning them to the Contracting Officer for completion. These forms will then be forwarded for abbreviated background investigations, and then an appointment will be scheduled for each employee for fingerprinting and photos

for the temporary ID badge. Contractor must account for return of all issued badges at the end of construction.

2. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
3. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days' notice to the Contracting Officer Project Engineer so that security and or escort arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown or access closure described later in this section.
4. No photography of VA premises is allowed without written permission of the Contracting Officer. Photography may never include VA patients or personnel.
5. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

C. Guards:

1. The General Contractor shall provide unarmed guards at the project site after construction hours.
2. The Contractor shall provide the guards and VA police with communication devices as directed.
3. The general Contractor shall install equipment for recording guard rounds to ensure systematic checking of the premises.

D. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the Contracting officers representative (COR) for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
2. The General Contractor shall turn over lock cylinders with associated parts and instructions to the VA Project Engineer and locksmith for permanent installation. See Section 08 71 00, DOOR HARDWARE and coordinate.
3. Contractor may be issued keys and/or keycard for construction through the Project Engineer.
4. All keys and/or keycard must be turned in at the end of Contract.
5. Any key assigned to the contractor, which is lost or stolen will result in a replacement cost of \$100.00 per key and/or keycard either lost or stolen. Any key either lost or stolen shall be reported to the Project Engineer; it is the contractor's responsibility to inform VA Police and give a detailed report about the key loss. The contractor shall take a copy of the official police report and make payment to the Agent Cashier before any additional replacement keys are made. Final payment may be withheld and/or reduced until all keys are returned or accounted for. A copy of the Police Report and receipt of payment shall be provided to the VA Project Engineer.

E. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".

2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
 - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
 - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

F. Motor Vehicle Restrictions

1. Loading Dock access shall be restricted to picking up and dropping off materials and supplies.
2. Contractors are prohibited from parking in patient/visitor and employee parking areas. Parking in the Loading Dock is never permitted unless contractor has received prior written approval from Project Engineer. Parking, if available, shall be in designated locations only. Violators will be ticketed.
3. A limited number of (2 to 5) permits shall be issued for General Contractor and its employees for parking in designated areas only.

G. Temporary Construction Partitions:

1. Install and maintain temporary construction partitions to provide smoke-tight separations between, construction areas, the areas that are described in phasing requirements, and adjoining areas. Construct partitions of gypsum board (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
2. When Construction circumstances permit contractors may use poly barriers; double 6-mil poly extending through suspended ceiling to Floor Slab deck of roof, in lieu of hard barriers. Use of Poly Barriers must be approved by Project Engineer prior to installation.
3. Install one-hour and/or two-hour fire-rated temporary construction partitions as shown on drawings and/or as indicated in the specification sections to maintain integrity of existing exit stair enclosures, exit

passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.

4. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration fire stop materials in accordance with Section 07 84 00, FIRESTOPPING.
- H. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- I. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Project Engineer.
- J. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to the Project Engineer.
- K. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- L. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- M. Smoke Detectors: Prevent accidental operation. Replace all smoke detection devices in the construction area with heat detection devices for the duration of the project. Coordinate with Project Engineer and CO to insure compliance with VA SOP & HPM's. Prior to final project inspection, smoke detectors shall be reinstalled. In lieu of replacement of smoke detectors, contractor may provide covers for smoke detectors to be installed for duration of workday and removed at the end of work operations each day. Use of temporary covers for smoke detectors

must be approved by Project Engineer prior to installation and use.

1.6 OPERATIONS AND STORAGE AREAS

- A. Refer to FAR 52.236-10 for applicable requirements.
- B. Working space and space available for storing materials shall be as determined by the COR. The Contractor shall keep ALL work areas, storage areas, staging areas, and access areas and routes clean and neat. The Contractor shall provide sufficient trash containers so there is no debris lying around. The containers shall be emptied at least daily and trash disposed of by the contractor.
- C. Workmen are subject to rules of the Medical Center applicable to their conduct.
- D. Execute work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times.
- E. Execute work so as to interfere as little as possible with normal functioning of the Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COR where required by limited working space.
 - 1. Do not store materials and equipment in other than assigned areas.
 - 2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for

not more than two (2) work days. Provide unobstructed access to the Medical Center areas required to remain in operation.

3. Contractor shall permit access to Department of Veterans Affairs personnel and patients through construction areas which serve as routes of access to such affected areas and equipment. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period. Immediate areas of alterations will be temporarily vacated while alterations are performed.
4. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

F. Utilities Services:

1. Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by the COR. All such actions shall be coordinated with the COR or Utility Company involved:
2. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, or gas, payment of such fee shall be the responsibility of the Government and not the Contractor.

G. Phasing:

1. The Medical Center must maintain its operation 24 hours a day 7 days a week. Therefore, any interruption in service

must be scheduled and coordinated with the COR to ensure that no lapses in operation occur. It is the CONTRACTOR'S responsibility to develop a work plan and schedule detailing, at a minimum, the procedures to be employed, the equipment and materials to be used, the interim life safety measure to be used during the work, and a schedule defining the duration of the work with milestone subtasks. The work to be outlined shall include, but not be limited to:

- a. Normal Power Upgrade from 5kV to 15kV
 - b. Essential Electrical System Upgrade
 - c. Campus Feed Interconnection between East and West 15kV SWGR
 - d. MCC After-market Motor Controller Replacements
 - e. Automatic Transfer Switch Replacement
2. To ensure such executions, Contractor shall furnish the COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof.
 3. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to insure accomplishment of this work in successive phases mutually agreeable to the Medical Center Director, COR and Contractor.
 4. The contractor shall submit his phasing schedule in writing to the Contracting Officer for review and approval in accordance with Section 01 32 16.13. This includes utility outages and access closures.
 5. All work, such as corridor work, which is outside the main construction area, shall be done on evenings or weekends, so as not to disrupt the normal operations.

6. All renovation activities will take place at a busy Medical Center. The contractor shall not interfere with existing, on-going functions, or normal activity of the hospital. The contractor will provide walk-off mats for dust control, appropriate construction barriers, and keep noise & vibration to a minimum during normal business hours. Certain portions of the work will be confined to evenings, and/or weekends, as directed.
 7. No work shall start until the preconstruction survey and inspection is completed.
 8. The Contractor shall provide a detailed asbestos abatement schedule, if required by the project scope.
 9. Any utility service, parking lot, roadway, loading dock, and/or Grounds interruption requests shall be submitted in writing two weeks in advance of the planned utility interruption/access closure.
 10. Set up phasing by buildings, wings, floors, or areas in accordance with information received from the Medical Center through the COR and the Contracting Officer.
- H. Occupied Buildings: Building(s) will be occupied during performance of work, but immediate areas of the electrical upgrades will be vacated.
1. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Medical Centers operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. These routes whether access or egress shall be isolated

from the construction area by temporary partitions and have walking surfaces, lighting etc. to facilitate patient and staff access. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period.

- I. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1 m (seven feet) minimum height, around the construction and/or contractors' area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 15 inches. Bottom of fences shall extend to one inch above grade. Remove the fence when directed by the COR. Fence shall be kept closed unless personnel are entering or exiting to prevent patients or staff from wandering into the area.
- J. Buildings and Systems: When a building and/or construction site is turned over to Contractor, the Contractor shall accept entire responsibility including upkeep and maintenance, therefore:
1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.
 2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.

- K. Utilities Services: Maintain existing utility services for the Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at a main branch or suitable places where shown; or, in absence of such indication, where directed by the COR.
1. No utility service such as water, gas, steam, sewers, electricity, or fire protection systems and communications systems may be interrupted without prior written approval of the COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without a detailed work plan, the Medical Center Director's prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS for additional requirements.
 2. Contractor shall submit a request to interrupt any such services to the COR, in writing, two weeks in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the Medical Center. Interruption time approved by

Medical Center may occur at other than Contractor's normal working hours.

4. Major interruptions of any system must be requested, in writing, at least two weeks prior to the desired time and shall be performed as directed by the COR.
 5. In case of a contract construction emergency, service will be interrupted on approval of the COR. Such approval will be confirmed in writing as soon as practical. On the next business day, the contractor's Daily Log report shall explain the circumstances causing the emergency and the corrective actions taken.
 6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
- L. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged at the main, branch or panel they originate from. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.
- M. Roads, Parking Lots, Docks and Grounds: To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and

vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.

2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.
 3. Interruptions of these areas must be requested, in writing, at least two weeks prior to the desired time and shall be performed as directed by the COR.
 4. Interruptions will follow the same procedures as outlined in Article 1.6.K., Utility Services.
- N. Coordination of Work: Coordinate the work for this contract with other construction operations as directed by the COR. This includes the scheduling of traffic and the use of roadways, as specified in USE OF ROADWAYS, PARKING LOTS, AND GROUNDS' article in this specification section.
- O. Coordination of Construction with Medical Center: The activities at the Medical Center shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Medical Center, through the COR, in arranging the construction schedule to cause the least possible interference with facility activities on the campus. All communication between the contractor and the medical center personnel must be done through the COR and/or CO. Contractors are not to disturb Medical Center Personnel during hours of operation. Construction noise during the events or services shall not disturb the events or service. Trucks and workmen shall not pass through the event or service area during this period:
1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal

holidays, to permit him to clean up all areas of operation adjacent to existing event or service areas before these dates.

2. The Medical Center observes the following Federal Holidays: New Years Day, Labor Day, Martin Luther King Jr. Day, Columbus Day, Presidents Day, Veterans Day, Memorial Day, Thanksgiving, Independence Day, and Christmas Day.
3. Clean-up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

P. Reports:

1. Daily Logs: The Contractor shall furnish a daily report for each day from the date of Notice to Proceed until Final Acceptance, including those days that no work is performed. The report shall have attached there to a copy of inspections conducted by the VA, a list of all employees on site that day. This report will include or be in addition to daily inspections.
2. Payment Requests: Monthly payment requests from the contractor will not be processed unless all paperwork is current, including daily reports, asbestos reports, updated process schedules and certified payrolls for the prime and all subs.
3. Requests for Information: All RFI's shall be submitted to the Project Engineer to ensure timely response. The Government will answer RFI's within twenty-one (21) calendar days from acceptance from the contractor.
4. Submittals:
 - a. Submittal Log: The contractor shall utilize the specifications and drawings to prepare and provide a

submittal log. The Submittal Log shall list all submittals by specification section, paragraph and drawing numbers from the beginning to the end of the documents. The Submittal Log shall be provided to the Project Engineer within ten (10) calendar days after receipt of Notice To Proceed. The Government may require additional submittals at its discretion at no additional cost.

- b. The contractor shall have all submittals completed and turned in to the Government for review by the A/E firm no later than thirty (30) calendar days from the date of the signed Notice to Proceed. The government will return submittals within twenty-one (21) calendar days from acceptance from the contractor. NO WORK SHALL BE STARTED UNTIL ALL RELATED SUBMITTALS ARE APPROVED. All materials shall be approved by the Government prior to delivery to the job site and start of work.

Q. Material Safety Data Sheets (MSDS's): Contractor shall provide one loose-leaf binder, permanently labeled "MSDS for Project _____" with copies of each Material Safety Data Sheet for each product, chemical, and other required materials to be used on this project.

1. All instructions for use shall be compiled with.
2. Products will not be used until MSDS's are submitted to the Project Engineer. These shall be provided for any material no later than the day before those materials arrive on VA property.
3. The contractor shall maintain a current binder on the job site at all times, readily available for viewing by the Project Engineer, Contracting Officer, or Safety Officer.

4. At no time shall the Contractor have, or permit the sub-contractors to have, materials on VA property/station without MSDS.

R. Fire Retardant Materials: All materials used on this project, including temporary barriers, plywood, poly, and other required materials shall be fire retardant. All poly shall be 6 mil. minimum. The semi-permanent construction barriers shall be smoke tight.

1.7 ALTERATIONS

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of in which alterations occur and areas which are anticipated routes of access. The contractor shall furnish a report, signed by all three, which lists any deficiencies noted at that time. This report shall be approved by the VA prior to the start of any work. The inspection shall include a list by rooms and spaces:

1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of building(s) and grounds.
2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, blinds, shades, etc., required by drawings to be either reused or relocated, or both.
3. Shall note any discrepancies between drawings and existing conditions at site(s).
4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.

- B. Relocated Items: Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of the COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty (30) calendar_days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:
1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
 2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.

3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.
4. Once the contractor is notified by the VA of problems or damage to VA property, the contractor shall take immediate corrective action to protect and restore said property. During normal duty hours, corrective action shall be initiated within two (2) hours. After normal duty hours, corrective action shall be initiated within four (4) hours. The Daily Log for that day shall explain the problem(s) and corrective action(s) taken.
5. Dampen debris to keep down dust and provide temporary construction, dust-proof, asbestos containment, smoke rated, and/or fire rated barriers where specified, where indicated on the drawings, and as directed by the Project Engineer. Access doors in barriers shall be hinged and secured with VA provided locks if available ; if VA locks are not available contractor is to provide locks as well as three (3)extra keys to the VA. Walk-off mats shall be provided at all access doors.
6. Block off all ducts and diffusers to prevent circulation of dust into occupied areas during construction. Provide Negative Air Machines as specified, to maintain negative pressure within the construction area(s).
7. The contractor shall not allow trash and debris to accumulate on the job site. As a minimum, trash and debris shall be removed once daily, with no flammable materials or trash left on the construction site overnight. All debris

shall be removed from the job site in a closed container and disposed of in a proper manner.

E. Final Cleanup:

1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
2. Perform final cleaning in accordance with Infection Control requirements detailed in specification section 01 35 00 SAFETY REQUIREMENTS.

1.8 DISPOSAL AND RETENTION

A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows and/or in accordance with Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT:

1. Reserved items which are to remain property of the Government are identified by attached tags or noted on drawings and/or in specifications as items to be stored. The Project Engineer may also designate items to remain the property of the Government. Items shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by the COR.
2. Items not reserved shall become property of the Contractor and be removed by Contractor from the Medical Center, or taken to the Engineering Shop area by the contractor on a case-by-case basis as directed by the COR.
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans

Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.

4. During above-ceiling work, the contractor will have to clear rooms, protect VA property and finishes, and move furnishings as necessary to protect the area and items from dust and debris, in the performance of the work above the ceiling.
5. PCB Transformers and Capacitors and Other Hazardous Waste: Washington State Department of Ecology 173-303 regulates PCB containing dielectric fluids at 2 ppm or greater. The Contractor shall be responsible for disposal of the Polychlorinated Biphenyl (PCB) transformers and capacitors and other Hazardous Waste. The transformers and capacitors and other Hazardous Waste shall be taken out of service and handled in accordance with the procedures of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) as outlined in Code of Federal Regulation (CFR), Titled 40 and 49 respectively. The EPA's Toxic Substance Control Act (TSCA) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 also apply. Upon removal of PCB transformers and capacitors and other Hazardous Waste for disposal, the "originator" copy of the Uniform Hazardous Waste Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the Contracting Officer who will annotate the contract file and transmit the Manifest to the Medical Center's Project Engineer.
 - a. Copies of the following listed CFR titles may be obtained from the Government Printing Office:

- 40 CFR 261.....Identification and Listing of Hazardous Waste
- 40 CFR 262.....Standards Applicable to Generators of Hazardous Waste
- 40 CFR 263.....Standards Applicable to Transporters of Hazardous Waste
- 40 CFR 761.....PCB Manufacturing, Processing, Distribution in Commerce, and use Prohibitions
- 49 CFR 172.....Hazardous Material tables and Hazardous Material Communications Regulations
- 49 CFR 173.....Shippers - General Requirements for Shipments and Packaging
- 49 CFR 173.....Subpart A General
- 49 CFR 173.....Subpart B Preparation of Hazardous Material for Transportation
- 49 CFR 173.....Subpart J Other Regulated Material; Definitions and Preparation
- TSCA.....Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7

- 6. Trash cans with outside hinges are not allowed.
- 7. Removal of materials or waste is only permitted before or after hospital work hours.

1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

- A. Refer to FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements for applicable requirements.

- B. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

1.10 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by

adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.11 PHYSICAL DATA (NOT USED)

1.12 PROFESSIONAL SURVEYING SERVICES

- A. A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

1.13 LAYOUT OF WORK (NOT USED)

1.14 AS-BUILT DRAWINGS

- A. The contractor shall maintain two (2) full size sets of as-built (working) drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. Additional sketches will be required where original detail is changed, site conditions differ, and where required to clarify mark-ups. To ensure compliance, as-built drawings shall be made available for the COR's review, as often as requested.
- C. Contractor shall deliver two (2) approved completed sets of as-built drawings to the COR within fifteen (15) calendar days after each completed phase of the project.
- D. Upon completion of the project and before final settlement, Contractor shall deliver two (2) approved completed detailed sets of as-built drawings to the COR within fifteen (15) calendar days after project acceptance. These drawings shall

show sizes, materials, connections to existing structures, utilities, building service equipment, circuits, electrical conduit and junction box locations and routes, and other required information.

- E. Paragraphs A, B, C, & D shall also apply to all shop drawings and Installation drawings provided by equipment suppliers and vendors.

1.15 USE OF ROADWAYS, PARKING LOTS, AND GROUNDS

- A. For hauling, use only established public roads, parking lots, and grounds on Medical Center property and, when authorized by the COR, such temporary roads as necessary in the performance of contract work. Temporary roads shall be constructed and restoration performed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, Contractor may construct them immediately for use to facilitate building operations. These roads may be used by all who have business thereon within zone of building operations.
- C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at time set for completion of such buildings or parts thereof.
- D. To minimize interference of construction activities with the flow of Medical Center Traffic and Parking, comply with the following:
 - 1. Keep roads, walks and entrances to grounds, parking, and occupied areas of buildings, clear of all construction materials, debris, vehicles, and standing equipment.

2. Methods and scheduling for the cutting, altering, removal and/or blockage of existing roads, walks, entrances, parking lots and grounds must be approved by the COR prior to any work.
3. The Contractor shall submit a request to interrupt any roadway, parking lot, or loading dock to the Contracting Officer, in writing, two weeks in advance of any proposed interruption. The request shall state the reason, areas to be affected, date, exact time of, and approximate duration of such interruption.

1.16 RESIDENT ENGINEER'S FIELD OFFICE (NOT USED)

1.17 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to written approval and compliance with the following provisions:

1. Permission to use each unit or system must be given by the COR in writing. If the equipment is not installed and maintained in accordance with the written agreement and following provisions, the COR will withdraw permission for use of the equipment. Metering may be required based on project use.
2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Installation of temporary electrical equipment or devices shall be in accordance with NFPA 70, National Electrical Code, (2014 Edition), Article 590, *Temporary Installations*. Voltage supplied to each item of equipment

shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.

3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
 4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage. ALL controls for the equipment shall be functioning properly to prevent damage to the equipment.
 5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced periodically during construction and at completion of construction and prior to testing and balancing of system.
 6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used, which show wear and tear beyond normal, shall be replaced with identical replacements at no additional cost to the Government.
- C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.
- D. Any damage to the equipment or excessive wear due to prolonged use will be repaired or replaced by the contractor at the contractor's expense.

1.18 TEMPORARY USE OF EXISTING ELEVATORS

A. Use of existing elevators for handling building materials and Contractor's personnel will be permitted subject to following provisions:

1. Contractor makes all arrangements with the COR for use of elevators. The COR will ascertain that elevators are in proper condition. Contractor may use elevators in Building No. 100 for daily use between the hours of 8:00 AM and 6:00 PM, and for special nonrecurring time intervals when permission is granted. Personnel for operating elevators will not be provided by the Department of Veterans Affairs.
2. Contractor covers and provides maximum protection of following elevator components:
 - a. Entrance jambs, heads soffits and threshold plates.
 - b. Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
 - c. Finish flooring.
3. Place elevator in condition equal, less normal wear, to that existing at time it was placed in service of Contractor as approved by Contracting Officer.

1.19 TEMPORARY USE OF NEW ELEVATORS (NOT USED)

1.20 TEMPORARY TOILETS

A. Provide where directed, (for use of all Contractor's workmen) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by the COR, provide suitable dry closets where directed. Keep such places clean and free from flies and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

- B. * Contractor may have for use of Contractor's workmen, such toilet accommodations as may be assigned to Contractor by the Medical Center's Project Engineer. Contractor shall keep such places clean and be responsible for any damage done thereto by Contractor's workmen. Failure to maintain satisfactory condition in toilets will deprive Contractor of the privilege to use such toilets.

1.21 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable utility services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. Temporary Utilities: The Contractor, at Contractor's expense and in a workmanlike manner, in compliance with code and as satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work and unless otherwise directed by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia and repair /restore the infrastructure as required.
- C. Meters: Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity and other utilities at the request of the CO or Project Engineer as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or

may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

1. Obtain heat by connecting to the Medical Center heating distribution system.
 - a. Steam is available at no cost to Contractor. The Contractor may connect to existing systems at their own expense.
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.
- F. Water (for Construction and Testing): Furnish temporary water service.
1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection as per code. Water is available at no cost to the Contractor.
 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at the COR discretion) of use of water from the Medical Center's system.
- G. Steam: Furnish steam system for testing required in various sections of specifications.

1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.
2. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is wasted. Failure to stop leakage or other waste will be cause for revocation (at the Project Engineer discretion), of use of steam from the Medical Center's system.

1.22 NEW TELEPHONE EQUIPMENT (NOT USED)

1.23 TESTS

- A. As per specification section 23 08 00 the contractor shall provide a written testing and commissioning plan complete with component level, equipment level, sub-system level and system level breakdowns. The plan will provide a schedule and a written sequence of what will be tested, how and what the expected outcome will be. This document will be submitted for approval prior to commencing work. The contractor shall document the results of the approved plan and submit for approval with the as built documentation.
- B. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- C. Conduct final tests required in various sections of specifications in presence of the COR and/or an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- D. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex system which must be coordinated to work together during normal

operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a complex system which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feedwater, condensate and other related components. Related components include but are not limited to: electrical room ventilation, switchgear and generator set control power sources (batteries); generator room supply air, exhaust air, damper controls, fuel system piping; electrical connections, automatic transfer switches, motor controllers, etc.

- E. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- F. Individual test results of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.24 INSTRUCTIONS

- A. Contractor shall furnish Maintenance and Operating manuals (hard copies and electronic) and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (two hard copies and one electronic copy on compact disc) for each separate piece of equipment and system shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals

shall be complete, detailed guides for the maintenance and operation of equipment and system. They shall include complete information necessary for starting, adjusting, programming, maintaining in continuous operation for long periods of time, and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Manuals shall include all wiring diagrams, pipe and tubing diagrams, programming instructions, and other required information to completely maintain and operate each piece of equipment and system. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

- C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment and system. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper

instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR, the Contracting Officer, and the M&O Supervisor, and shall be considered concluded only when the COR, the Contracting Officer, and the M&O Supervisor, are satisfied in regard to complete and thorough coverage. The contractor shall submit a course outline with associated material to the COR for review and approval prior to scheduling training to ensure the subject matter covers the expectations of the VA and the contractual requirements. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above. Training sessions may be recorded by the VA.

1.25 GOVERNMENT--FURNISHED PROPERTY (NOT USED)

1.26 RELOCATED // EQUIPMENT // ITEMS // (NOT USED)

1.27 STORAGE SPACE FOR DEPARTMENT OF VETERANS AFFAIRS EQUIPMENT (NOT USED)

1.28 CONSTRUCTION SIGN

- A. Maintain signs and remove when directed by the COR.
- B. Provide two (2) construction signs with point of contact information at each entrance to the construction areas. Signs shall be constructed of a durable material, twelve (12) inches high and thirty (30) inches wide with yellow background and blue Helvetica lettering two (2) inches high. Letter as shown in the following:

DANGER - KEEP OUT
CONSTRUCTION AREA
AUTHORIZED PERSONNEL ONLY
EXCUSE THE INCONVENIENCE
WE ARE WORKING TO IMPROVE YOUR FACILITY

1.29 SAFETY SIGN

- A. Provide a Safety Sign where directed by the COR. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 102 mm x 102 mm (four x four inch) posts extending full height of sign and 914 mm (three feet) into ground. Set bottom of sign level at 1219 mm (four feet) above ground.
- B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.
- C. Maintain signs and remove when directed by COR.
- D. Provide a Detail Drawing of construction sign showing required legend and other characteristics of sign to the COR for approval. Upon written approval, the contractor will construct and install the safety sign.
- E. Post the number of accident free days on a daily basis.
- F. Provide all OSHA required Safety Signs where required by OSHA and where directed by Project Engineer. These shall be commercially produced.

1.30 PHOTOGRAPHIC DOCUMENTATION (NOT USED)

1.31 FINAL ELEVATION DIGITAL IMAGES (NOT USED)

1.32 HISTORIC PRESERVATION (NOT USED)

1.33 EQUIPMENT

- A. The contractor shall coordinate the installation of equipment with work performed by others. This work shall be completed before the building is turned over to VA.
- B. All required programming devices, two (2) each of specialty tools, two (2) sets of start-up supplies, one (1) additional set of belts - fuses - etc. per each piece of equipment and other items required by the specification sections and drawings shall be furnished.

1.34 FINAL PAYMENT

- A. Final payment under this contract shall be withheld pending receipt of ALL tests, close out documents, all equipment manuals, staff training, specialty tools, start-up supplies, as built drawings and certifications. These tests and certifications shall include: sprinkler certification, fire alarm certification, plumbing system leak tests - to include hot - cold - waste - vents, medical gas certifications, fire/smoke wall certification, vibration analysis of motor driven equipment, motor - shaft - base - pulley alignment certifications, HVAC TAB, Air Handler control demonstration/training of VA personnel, and other required information, completed punch list items and the return of all keys.

1.35 WARRANTY CALLS

- A. The Government may contact the Contractor for warranty services by telephone, fax, e-mail, letter, or in person. The Contractor shall respond with actual physical repair activity (labor, equipment, materials, etc.) in accordance with contract documents. Please note that emergency calls may occur during other than normal work hours. A representative from the Facilities Management Service will identify the emergency calls.

1.36 INTERIM LIFE SAFETY MEASURE

- A. An interim life safety measure (ILSM) to be completed as a mandatory portion of construction design development, prior to award of construction.

1.37 VA TRIRIGA CPMS

- A. VA contractors, selected by award to perform work, are required to get access to the VA TRIRIGA CPMS. The TRIRIGA CPMS is the management and collaborative environment that the VA uses for all Major, Minor and Non-Recurring Maintenance (NRM) projects within the Office of Construction & Facilities Management (CFM),

Veterans Health Administration (VHA), National Cemetery Administration (NCA), and the Veterans Benefits Administration (VBA).

- B. The contractor is solely responsible for acquiring access to the VA TRIRIGA CPMS.
- C. To gain access to the VA TRIRIGA CPMS the contractor is encouraged to follow the licensing process outline as specified below:
- D. Requirement: TRIRIGA is the management and collaborative environment that VA uses for all construction projects. VA requires its contractors to procure TRIRIGA access as part of the cost of performance for a VA construction related contract.
- E. Access Request and Payment can be made through the following URL

<https://valicensing.oncfi.com/>

Inquiries or to request additional services, contact the following:

Craig Alsheimer, Federal Account Manager

Computerized Facility Integrations, LLC

18000 West Nine Mile Road

Suite 700

Southfield, MI 48075

Email: calsheimer@gocfi.com

Phone: 248-557-4234 Extension 6010; 410-292-7006

- F. Process:
 - 1. Once the contractor has been notified by VA of the award and a unique contract number, the contractor can enter a

request for access to TRIRIGA at URL
<https://valicensing.oncfi.com/>

2. CFI will process the request for access and payment. CFI will create the USER ID and a password. Security provisions required to align the contractor to the Contract Number will be entered and an email will be generated and submitted to the requestor.
3. CFI will also provide standard terms and conditions related to the transaction and use agreement.

- - - E N D - - -

SECTION 25 10 10
ADVANCED UTILITY METERING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes the following for the advanced metering of the electrical systems of the facility. The metering systems in each facility are part of a Corporate-Wide utility metering system, rendering the VA accurate and automated metering of its facilities' energy. Metering systems are comprised of:
1. PC-based workstation(s) or server(s) and software.
 2. Communication network and interface modules for RS-232, RS-485, Modbus TCP/IP, IEEE 802.3 data transmission protocols.
 3. Electric meters.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items 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): Low voltage cable.
- 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.
- E. Section 26 11 16, SECONDARY UNIT SUBSTATIONS.
- F. Section 26 13 13, MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR.
- G. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Secondary distribution switchgear.
- H. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: Secondary distribution switchboards.
- I. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY: Communications cables and conductors.
- J. Section 28 25 00, STATUS MONITORING VIA CAMPUS AUTOMATION NETWORK: Remote monitoring of equipment and alert status.

1.3 DEFINITIONS

- A. AMR: Automatic meter reading is the technology of automatically collecting consumption, diagnostic, and status data energy metering devices and transferring that data to a central database for billing, troubleshooting, and analyzing.
- B. AUMS: Advanced Utility Metering System: the system described by this Section.
- C. BACnet: BACnet is a Data Communications Protocol for Building Automation and Control Networks. It is defined by ASHRAE/ANSI Standard 135 (ISO 16484-5) standard protocol.
- D. Data Over Cable Service Interface Specification (DOCSIS): an international standard defining communications and operation support interface requirements for a data over cable system, by the Cable Television Laboratories, Inc. consortium
- E. Data Head (on meters): converts analog and pulse signals to digital signals for transmission to the Site Data Aggregation Device. Also provides for limited storage of the digital signals.
- F. Device Accuracy: accuracy in this section is based on actual flow, not full scale or full range. Device accuracy measures the conversion of flow information to analog or pulse signals.
- G. Ethernet: Local area network, based on IEEE 802.3 standards.
- H. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.
- I. Gateway: Bi-directional protocol translator connecting control systems that use different communication protocols.
- J. GB: gigabyte. When used to describe data storage, "GB" represents 1024 megabytes.
- K. HTML: Hypertext markup language.
- L. I/O: Input/output.
- M. KB: Short for kilobyte. When used to describe data storage, "KB" represents 1024 bytes.

- N. KY Pulse: A term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay changing status in response to the rotation of the disk in the meter.
- O. LAN: Local area network. Sometimes plural as "LANs."
- P. LCD: Liquid crystal display.
- Q. LonMark: An association comprising of suppliers and installers of LonTalk products. The Association provides guidelines for the implementation of the LonTalk protocol to ensure interoperability through Standard implementation.
- R. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication.
- S. LonWorks: Network technology developed by the Echelon Corporation.
- T. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.
- U. MB: megabyte. When used to describe data storage, "MB" represents 1024 kilobytes.
- V. Mbps: Megabytes per second, equal to 8 megabits per second
- W. Modbus TCP/IP: An open protocol for exchange of process data.
- X. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- Y. OTDR: Optical Time Domain Reflectometer. A test instrument that analyzes the light loss in an optical fiber. Used to find faults, splices and bends in the line, it works by sending out a light pulse and measuring its reflection. Such devices can measure fiber lines that are longer than 150 miles
- Z. PC: Personal computer
- AA. PICS, Protocol Implementation Conformance Statement: A written document that identifies the particular options specified by BACnet that are implemented in a device.
- BB. REO: Resident Engineer Office: the VA office administering the construction contract.

- CC. Reporting Accuracy: this is the root-mean-square sum of all of the metering devices' inaccuracies: measurement inaccuracy, mechanical inaccuracy, analog-to-digital or pulse integration inaccuracy, etc., up to the meter's data head.
- DD. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.
- EE. Router: A device that connects two or more networks at the network layer.
- FF. RS-232: A Telecommunications Industry Association standard for asynchronous serial data communications between terminal devices.
- GG. RS-485: A Telecommunications Industry Association standard for multipoint communications using two twisted-pairs.
- HH. TB: terabyte. When used to describe data storage, "TB" represents 1024 gigabytes.
- II. TCP/IP: Transport control protocol/internet protocol.
- JJ. Turn-down: the maximum flow divided by the minimum flow through a meter; used along with accuracy requirements. For example, a meter shall be accurate to within 2% of actual flow with throughout a 20:1 turndown
- KK. THD: Total harmonic distortion.
- LL. UPS: Uninterruptible power supply; used both in singular and plural context.
- MM. UTP: Unshielded twisted pair cabling, used to limit crosstalk and electromagnetic interference from the environment
- NN. WAN: Wide area network.

1.4 **QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced at least three years in manufacturing and installing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency, and marked for intended use.
- D. System Modifications: Make recommendations for system modification in writing to the VA. No system modifications shall be made without prior written approval of the VA. Any modifications made to the system shall be incorporated into the Operations and Maintenance Instructions, and other documentation affected. Provide to the VA software updates for all software furnished under this specification during this contract's construction and verification periods and for the first two years after government acceptance. All updated software shall be verified as part of this contract.

1.5 PERFORMANCE

- A. The advanced utility metering system shall conform to the following:
 1. Site Data Aggregation Device Graphic Display: The system shall display up to 4 graphics on a single screen with a minimum of (20) dynamic points per graphic. All current data shall be displayed within (10) seconds of the request.
 2. Site Data Aggregation Device Graphic Refresh: The system shall update all dynamic points with current data within ten seconds. Data refresh shall be automatic, without operator intervention.
 3. Meter Scan: All changes of metered values shall be transmitted over the high-speed network such that any data used or displayed at a controller or Site Data Aggregation Device will be current, within the prior ten seconds.
 4. Alarm Response Time: The maximum time from when meter goes into alarm to when it is annunciated at the workstation shall not exceed ten seconds.
 5. Reporting Accuracy: Listed below are minimum acceptable reporting accuracies for all values within the below minimum turn-down envelope reported by the meters:

Measured Variable	Units Measured	Minimum Turn-Down of Meter	Reporting Accuracy (Note 1)
Electricity	V, A, W, etc.	n/a	±0.5% of measured value

Table 1.5: Meter Performance Criteria

Table Notes:

1. This table shows reporting accuracy, not merely the meter's accuracy. Reporting accuracy includes meter accuracy and data conversion accuracy. See Article 1.3 in this Section for definition. Accuracy is shown against the measured value, not against the full range of the meter.
2. kW: kilowatt; kVA: kilovolt-ampere; pf: power factor

1.6 WARRANTY

- A. Labor and materials for advanced utility metering systems shall be warranted for a period as specified under Warranty in FAR clause 52.246-21.
- B. Advance utility metering system failures during the warranty period shall be adjusted, repaired, or replaced at no cost or reduction in service to the owner. The system includes all computer equipment, transmission equipment, and all sensors and metering devices.

1.7 SUBMITTALS

- A. Product Data: for each type of product indicated, Attach copies of approved Product Data submittals for products (such as meters, sensors transmitters, switchboards and switchgear) that describe advance utility metering features to illustrate coordination among related equipment and utility metering and control.
- B. Shop Drawings: include plans, elevations, sections, details, and attachments to other work.
 1. Outline Drawings: Indicate arrangement of meters, components and clearance and access requirements. Clearly identify system components, internal connections, and all field connections.
 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 4. Wiring Diagrams: Power, signal, and communications wiring. Coordinate nomenclature and presentation with a block diagram. Show all communications network components and include a communications single-line diagram indicating device

interconnection and addressing information for all system devices. Identify terminal blocks used for interconnections and wire type to be used.

5. UPS sizing calculations for workstation.

C. Software and Firmware Operational Documentation:

1. Self-study guide describing the process for setting equipment's network address; setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.

2. Software operating and upgrade manuals.

3. Software Backup: On a compact disc, complete with Owner-selected options.

4. Device address list and the set point of each device and operator option, as set in applications software.

5. Graphic file and printout of graphic screens and related icons, with legend.

6. "Quick-Start" guide to describe a simple, three-step commissioning process for setting the equipment's Ethernet address, and ensuring trouble-free data access from any PC on the network, using a standard web browser.

D. Software Upgrade Kit: For Owner to use in modifying software to suit future utility metering system revisions.

E. Firmware Upgrade Kit: For Owner to use in modifying firmware to suit future power system revisions or advanced utility metering system revisions. Firmware updates, and necessary software tools for firmware updates, shall be downloadable from the internet. VA shall be able to update firmware, in equipment, without removing device from the equipment. VA shall be capable of updating firmware over the utility metering communication network or through local communication ports on the device.

F. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

G. Qualification Data: For installer and manufacturer

H. Other Informational Submittals:

1. System installation and setup guides, with data forms to plan and record options and setup decisions.
- I. Revise and update the Contract Drawings to include details of the system design. Drawings shall be on 17 by 11 inches sheets. Details to be shown on the Design Drawing include:
 1. Details on logical structure of the network. This includes logical location of all network hardware.
 2. Manufacturer and model number for each piece of computer and network hardware.
 3. Physical location for each piece of network or computer hardware.
 4. Physical routing of LAN cabling.
 5. Physical and qualitative descriptions of connectivities.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For advanced utility metering system components and meters, to include in emergency operation and maintenance manuals. Include the following:
 1. Operating and applications software documentation.
 2. Software licenses.
 3. Software service agreement.
 4. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot compact disks, and drivers for all installed hardware. Provide separately for each PC.
 5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
 6. In addition to the copies required by 01 00 00, provide 5 bound paper copies of the Operation and Maintenance Data and two compact disks (CD), with all Instructions as Acrobat PDF files. The pdf files shall be identical to the paper copies and shall include Acrobat navigation tools including Bookmarks for each Chapter.
 7. The advanced utility metering system Operation and Maintenance Instructions shall include:

- a. Procedures for the AUMS system start-up, operation and shut-down.
 - b. Final As-Built drawings, including actual LAN cabling routing shown on architectural backgrounds.
 - 1) IP address(es) as applicable for each piece of network hardware.
 - 2) IP address for each computer server, workstation and networked printer.
 - 3) Network identifier (name) for each printer, computer server and computer workstation.
 - 4) CEA-709.1B address (domain, subnet, node address) for each CEA-709.1B TP/FT-10 to IP Router.
 - c. Routine maintenance checklist, rendered in a Microsoft Excel format. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all installed devices, the second column shall list each device's node identifier/address, the third column shall describe each device's physical location, the fourth column shall state the maintenance activity or state no maintenance required, the fifth column shall state the frequency of the maintenance activity, frequency of calibration and the sixth column for additional comments or reference.
 - d. Qualified service organization list.
 - e. In addition to the requirements in Section 01 33 23, the submittal shall include manufacturer Installation Requirements.
 - f. Include complete instructions for calibration of each meter type and model.
 - g. Start-Up and Start-Up Testing Report.
 - h. Performance verification test procedures and reports.
 - i. Preventive Maintenance Work Plan.
 - j. In addition to factory-trained manufacturers' representatives requirements in Section 01 00 00, provide signed letter by factory-trained manufacturers' representatives stating that the system and components are installed in strict accordance with the manufacturers' recommendations.
- B. Field quality-control test reports.

1.9 LICENSING AGREEMENT

- A. Licenses procured as part of this work become the property of the government upon acceptance of the work. Licenses shall have no expiration.
- B. Technical Support: Beginning with Government Acceptance, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Government Acceptance. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.10 MAINTENANCE AND SERVICE

- A. Preventive Maintenance Requirements: provide a preventative maintenance plan with attached procedures indicated by meter and component manufacturers. Perform maintenance procedures for a period of 1 year after government acceptance, at frequencies and using procedures required by the meter and component manufacturers. At a minimum and if the manufacturer is silent on its preventative maintenance requirements, frequencies, deliverables and activities shall comply with the following:
 - 1. Preventive Maintenance Work Plan: prepare a Preventive Maintenance Work Plan to schedule all required preventative maintenance. VA approval of the Work Plan shall be obtained. Adhere to the approved work plan to facilitate VA verification of work. If the Contractor finds it necessary to reschedule maintenance, a written request shall be made to the VA detailing the reasons for the proposed change at least five days prior to the originally scheduled date. Scheduled dates shall be changed only with the prior written approval of the REO.
 - 2. Semiannual Maintenance: perform the following Semiannual Maintenance as specified:
 - a. Perform data backups on all Server Hardware.
 - b. Run system diagnostics and correct diagnosed problems.
 - c. Perform fan checks and filter changes for AUMS hardware.

- d. Perform all necessary adjustments on printers.
 - e. Resolve all outstanding problems.
 - f. Install new ribbons, ink cartridges and toner cartridges into printers, and ensure that there is at least one spare ribbon or cartridge located at each printer.
3. Maintenance Procedures
- a. Maintenance Coordination: Any scheduled maintenance event by Contractor that will result in component downtime shall be coordinated with the VA as follows. Time periods shall be measured as actual elapsed time from beginning of equipment off-line period, including working and non-working hours.
 - 1) For non-redundant computer server hardware, provide 14 days notice, components shall be off-line for no more than 8 hours.
 - 2) For redundant computer server hardware, provide 7 days notice, components shall be off-line for no more than 36 hours.
 - 3) For active (powered) network hardware, provide 14 days notice, components shall be off-line for no more than 6 hours.
 - 4) For cabling and other passive network hardware, provide 21 days notice, components shall be off-line for no more than 12 hours.
 - b. Software/Firmware: Software/firmware maintenance shall include operating systems, application programs, and files required for the proper operation of the advanced utility metering system regardless of storage medium. User- (project site-) developed software is not covered by this contract, except that the advanced utility metering system software/firmware shall be maintained to allow user creation, modification, deletion, and proper execution of such user-developed software as specified. Perform diagnostics and corrective reprogramming as required to maintain total advanced utility metering system operations as specified. Back up software before performing any computer hardware and software maintenance. Do not modify any parameters without approval from the VA. Any approved changes and additions

shall be properly documented, and the appropriate manuals shall be updated.

- c. Network: Network maintenance shall include testing transmission media and equipment to verify signal levels, system data rates, errors and overall system performance.

B. Service Call Reception

1. A VA representative will advise the Contractor by phone or in person of all maintenance and service requests, as well as the classification of each based on the definitions specified. A description of the problem or requested work, date and time notified, location, classification, and other appropriate information will be placed on a Service Call Work Authorization Form by the VA.
2. The Contractor shall have procedures for receiving and responding to service calls during regular working hours. A single telephone number shall be provided for receipt of service calls during regular working hours. Service calls shall be considered received by the Contractor at the time and date the telephone call is placed by the VA.
3. Separately record each service call request, as received on the Service Call Work Authorization form. Complete the Service Call Work Authorization form for each service call. The completed form shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion.
4. Respond to each service call request within two working hours. The status of any item of work must be provided within four hours of the inquiry during regular working hours, and within sixteen hours after regular working hours or as needed to repair equipment.

1.11 SPARE PARTS

- A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Addressable Relays: One for every ten installed. Furnish at least one of each type.
 2. Data Line Surge Suppressors: One for every ten of each type installed. Furnish at least one of each type.
- B. Furnished spare parts shall not be used for any warranty-required remediation.

1.12 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced, unless otherwise noted. Publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
B31.1-2007.....Power Piping
- C. Consumer Electronics Association (CEA)
709.1B-2002.....Control Network Protocol Specification
709.3-1999.....Free-Topology Twisted-Pair Channel
Specification
852-A-2004.....Tunneling Component Network Protocols Over
Internet Protocol Channels
- D. Federal Communications Commission (FCC)
EMC-2002.....FCC Electromagnetic Compliance Requirements
- E. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
81-1983.....IEEE Guide for Measuring Earth Resistivity,
Ground Impedance, and Earth Surface Potentials
of a Ground System
100-2000.....The Authoritative Dictionary of IEEE Standards
Terms
802.1D-2004.....Media Access Control Bridges
802.2-2003.....Standards for Local Area Networks: Logical Link
Control
802.3-2005.....Information Technology - Telecommunications and
Information Exchange between Systems. Local and
Metropolitan Area Networks - Specific
Requirements - Part 3: Carrier Sense Multiple
Access with Collision Detection (CSMA/CD)

- Access Method and Physical Layer Specifications
(ANSI)
- 1100-2005.....Recommended Practice for Powering and Grounding
Electronic Equipment (ANSI)
- C37.90.1-2002.....Surge Withstand Capability (SWC) Tests for
Relays and Relay Systems Associated with
Electric Power Apparatus
- C57.13-2008.....Standard Requirements for Instrument
Transformers
- C62.41.1-2002.....Guide on the Surges Environment in Low-
Voltage(1000 V and Less) AC Power Circuits
- C62.41.2-2002.....Recommended Practice on Characterization of
Surges in Low-Voltage (1000 V and Less) AC
Power Circuits
- F. International Electrotechnical Commission (IEC)
- IEC 61000-2005.....Electromagnetic Compatibility (EMC)- Part 4-5:
Testing and Measurement Techniques; Surge
Immunity Test
- G. National Electrical Contractors Association
- NECA 1-2006.....Good Workmanship in Electrical Construction
- H. National Electrical Manufacturers Association (NEMA)
- 250-2008.....Enclosures for Electrical Equipment (1000 Volts
Maximum)
- C12.1-2008.....Electric Meters; Code for Electricity Metering
- C12.20-2002.....Electricity Meter - 0.2 and 0.5 Accuracy
Classes
- C62.61-1993.....Gas Tube Surge Arresters on Wire Line Telephone
Circuits
- ICS 1-2008.....Standard for Industrial Control and Systems
General Requirements
- I. National Institute of Standards and Technology (NIST)
- 800, Part 39-2008.....[DRAFT] Managing Risk from Information Systems:
An Organizational Perspective
- 800, Part 46-2009.....Guide to Enterprise Telework and Remote Access
Security
- 800, Part 52-2009.....Recommended Security Controls for Federal
Information Systems and Organizations

- (FIPS) 200-2006.....Minimum Security Requirements for Federal Information and Information Systems
- J. National Fire Protection Association (NFPA)
 - 70-2008.....National Electrical Code (NEC)
 - 101-06.....Life Safety Code
 - 262-2007.....Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
- K. Telecommunications Industry Association, (TIA/EIA)
 - H-088C3.....Pathway Design Handbook
 - 232-F-2002.....Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
 - 485-A-2003.....Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint System
 - 568-C.1-2009.....Commercial Building Telecommunications Cabling Standard
 - 606-A-2002.....Administration Standard for the Telecommunications Infrastructure
 - 607-A-2002.....Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- L. Underwriters Laboratories, Inc. (UL):
 - 916-2007.....Energy Management Equipment
 - 5085-3-2007.....UL Standard for Safety Standard Low Voltage
 - 1244-2000.....Electrical and Electronic Measuring and Testing Equipment
 - 1581-2006.....Electrical Wires, Cables, and Flexible Cords

PART 2 - PRODUCTS

2.1 ADVANCED UTILITY METERING SYSTEM

- A. Functional Description
 - 1. Meter and record load profiles. Chart energy consumption patterns.
 - a. Calculate and record the following:
 - 1) Load factor.
 - 2) Peak demand periods.
 - 3) Consumption correlated with facility activities.

- b. Measure and record metering data for Electricity.
- c. Software: calculate allocation of utility costs.
 - 1) Verify utility bills and analyze alternate energy rates.
- d. Electric Power Quality Monitoring: Identify power system anomalies and measure, display, capture waveforms, and record trends and alarms of the following power quality parameters:
 - 1) Voltage regulation and unbalance.
 - 2) Continuous three-phase rms voltage.
 - 3) Periodic max./min./avg. samples.
 - 4) Harmonics.
 - 5) Voltage excursions.
- e. System: Report equipment status and power system control.

B. Communications Components and Networks

- 1. Site Data Aggregation Device and its networked meters shall communicate using BACnet protocol. Backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135-2008, BACnet Annex J.
 - a. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2008, BACnet.
 - b. Each controller shall have a communication port for connection to an operator interface.
- 2. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard LAN and WAN and Internetworked LAN.
- 3. Communication protocol; LANs complying with RS-485 or RS-485 accessed through Ethernet, 100 Base-TX Ethernet, and TCP/IP.
- 4. Network Hardware
 - a. Building Point of Connection Hardware
 - 1) Active equipment and communication interfaces.
 - 2) Switches, hubs, bridges, routers and servers.
 - b. IP Network Hardware
 - 1) Wire and Cables, copper connectivity devices.
 - 2) Fiber Optic Patch Panel.
 - 3) Fiber Optic Media Converter

- 4) Ethernet Switch
- 5) IP Router

5. Communication Security

- a. Remote teleworking and remote access of the network shall be through a firewall, at the Site Data Aggregation Device, complying with the requirements associated with Level 1 security in the Federal Information Processing Standard 140-2 (2002), Security Requirements for Cryptographic Modules.
- b. Direct access to network shall be restricted as described in

2.2 SITE DATA AGGREGATION DEVICE - PERSONAL COMPUTER WORKSTATION

A. Hardware(Existing System)

1. Workstation Hardware

- a. Environmental Conditions: System components shall be capable of withstanding Indoor installation in spaces that have environmental controls to maintain ambient conditions of 36 to 140 deg F dry bulb temperature and 20 to 95% relative humidity, noncondensing environmental conditions without mechanical or electrical damage or degradation of operating capability.
- b. Computer: Commercial standard with supporting 32- or 64-bit hardware (as limited by the advanced utility metering system software) and software enterprise server. Internet Explorer v6.0 SP1 or higher, Windows Script Hosting version 5.6 or higher, Windows Message Queuing, Windows Internet Information Services (IIS) v5.0 or higher, minimum 2.8 GHz processor, minimum 4GB DDR3 SDRAM (minimum 1333 Mhz) memory, minimum 1 TB 7200 rpm SATA hard drive with 16 MB cache, 512 MB video card, and 16 speed high density DVD-RW+/- optical drive.
- c. Real-Time Clock:
 - 1) Accuracy: Plus or minus 1 minute per month.
 - 2) Time Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; automatic reset by software.
 - 3) Clock shall function for one year without power.
 - 4) Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.

- d. Serial Ports: Four USB ports and two RS-232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
 - e. Parallel Port: Enhanced.
 - f. Sound Card: For playback and recording of digital WAV sound files associated with audible warning and alarm functions.
 - g. Color Monitor: PC compatible, not less than 22 inches, LCD type, with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28 mm.
 - h. Keyboard: Minimum of 64 characters, standard ASCII character set based on ANSI INCITS 154.
 - i. Mouse: Standard, compatible with installed software.
 - j. Removable Disk Storage: Include the following, each with appropriate controller:
 - 1) Minimum 1 TB removable hard disk, maximum average access time of 10 ms.
 - k. Network Interface Card (NIC): integrated 10-100-1000 Base-TX Ethernet NIC with an RJ45 connector or a 100Base-FX Ethernet NIC with an SC/ST connector.
 - l. Cable Modem: 42.88 Mbps, DOCSIS 3.0 Certified, also backwards compatible with DCOSIS 2.0 and DOCSIS 1.1/1.0 standards. Provide Ethernet or USB connectivity.
 - m. Optical Modem: full duplex link, for use on 10 GBase-R single-mode and multi-mode fiber with a XENPAK module.
 - n. Modem: 56,600 bits per second, full duplex for asynchronous communications. With error detection, auto answer/autodial, and call-in-progress detection. Modem shall comply with requirements in ITU-T v.34, ITU-T v.42, ITU-T v.42 Appendix VI for error correction, and ITU-T v.42 BIS for data compression standards; and shall be suitable for operating on unconditioned voice-grade telephone lines complying with 47 CFR 68.
 - o. Audible Alarm: Manufacturer's standard.
2. Printers: provide a dedicated, minimum resolution 600 dpi, color laser printer, connected to the Site Data Aggregation Device through a USB interface.

- a. If a network printer is used instead of this dedicated printer, it shall have a 100Base-T interface with an RJ45 connection and shall have a firmware print spooler compatible with the Operating System print spooler.
 - b. RAM: 512 MB, minimum.
 - c. Printing Speed: Minimum twenty six pages per minute (color); minimum 30 pages per minute (black/white).
 - d. Paper Handling: Automatic sheet feeder with 250-sheet x 8.5 inch x 11 inch paper cassette and with automatic feed.
3. RS-232 ASCII Interface
- a. ASCII interface shall allow RS-232 connections to be made between a meter or circuit monitor operating as the host PC and any equipment that will accept RS-232 ASCII command strings, such as local display panels, dial-up modems, and alarm transmitters.
 - b. Pager System Interface: Alarms shall be able to activate a pager system with customized message for each input alarm.
 - c. RS-232 output shall be capable of connection to a pager interface that can be used to call a paging system or service and send a signal to a portable pager. System shall allow an individual alphanumeric message per alarm input to be sent to paging system. This interface shall support both numeric and alphanumeric pagers.
 - d. Alarm System Interface: RS-232 output shall be capable of transmitting alarms from other monitoring and alarm systems to workstation software.
 - e. Cables: provide Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - 1) NFPA 70, Type CMP.
 - 2) Flame Resistance: NFPA 262, Flame Test.
- B. Software (Existing Schneider Electric ION EEM)
1. Operating System (OS)

- a. For a Site Data Aggregation Device connected to multiple utility meters, software shall reside on the Workstation or Server PC connected to a network able to poll and support over 1000 utility metering devices; software shall be web-enabled with the option to add custom graphics displays and additional web-enabled clients. BACNet, Ethernet, Modbus TCP/IP, RS-232, and RS-485 digital communications.
- b. Operating System Software: Based on 32- or 64-bit, Microsoft Windows operating system, as required by the metering and database software. Software shall have the following features:
 - 1) Multiuser and multitasking to allow independent activities and monitoring to occur simultaneously at different workstations.
 - 2) Graphical user interface to show pull-down menus and a menu tree format.
 - 3) Capability for future additions within the indicated system size limits.
2. Office Automation Software shall consist of the e-mail, spreadsheet and word processing portions of the project site's standard office automation software.
3. Virus Protection Software shall consist of the project site's standard virus protection software complete with a virus definition update subscription.
4. Configuration server shall meet the requirements of CEA-852-A.
5. Network configuration tool shall meet the following minimum requirements:
 - a. It shall allow configuration of the network while off-line such that an operator may set up changes to the network while disconnected from the network, and then execute all of them once connected.
 - b. It shall have a graphics-based user interface, and be able to display and print a graphical representation of the control network.
 - c. It shall be capable of generating and printing a table containing domain/subnet/node address and node identifier for

the entire network or any subset thereof, selected by the User.

- d. It shall be capable of merging two existing standard databases into a single standard database.

6. Metering Software

a. Basic Requirements:

- 1) Fully compatible with and based on the approved operating system.
- 2) Password-protected operator login and access; three levels, minimum.
- 3) Password-protected setup functions.
- 4) Context sensitive on-line help.
- 5) Capability of creating, deleting, and copying files; and automatically maintaining a directory of all files, including size and location of each sequential and random-ordered record.
- 6) Capability for importing custom icons into graphic views to represent alarms and I/O devices.
- 7) Automatic and encrypted backups for database and history; automatically stored at the Site Data Aggregation Device and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
- 8) Operator audit trail for recording and reporting all changes made to user-defined system options.

b. Workstation and Server Functions:

- 1) Support other client PCs on the LAN and WAN.
- 2) Maintain recorded data in databases accessible from other PCs on the LAN and WAN.

c. Data Formats:

- 1) User-programmable export and import of data to and from commonly used Microsoft Windows spreadsheet, database, billing, and other applications; using dynamic data exchange technology.
- 2) Option to convert reports and graphics to HTML format.
- 3) Interactive graphics.

- 4) Option to send preprogrammed or operator designed e-mail reports.
 - 5) Option to serve information to third-party applications via Object Linking and Embedding for Process Control using open standards.
- d. Metered data: Display metered values in real time with a rigid time-stamp. Couple all metered data with measured outside air conditions at the relevant facility.
- e. Metered Data alarms: Provide generic alarm modules to notify Users and highlight metered data gaps, data spikes outside of range, and data timestamp errors.
- 1) Customize the generic alarm modules to the application.
 - 2) Modules shall allow for user adjustment of alarm criteria.
 - 3) Alarm notices shall be shown via hyperlinks on the graphical User interface, and shall also be shown by flags within the data set.
- f. Automatic Data Scrubbing: Provide tools for User-programming of rules to scrub the data of the followings errors: data gaps, data spikes outside of range, and data timestamp errors. Use these rules to scrub the raw metered data. Flag all data which has been so scrubbed.
- g. Remote control:
- 1) (for electrical load control) Display circuit-breaker status and allow breaker control.
 - 2) User defined with load-shedding automatically initiated and executed schemes responding to programmed time schedules, set points of metered demands, utility contracted load shedding, or combinations of these.
- h. Equipment Documentation: Database for recording of equipment ratings and characteristics; with capability for graphic display on monitors.
- i. User-Defined Events: Display and record with date and time stamps accurate to 0.1 second, and including the following:
- 1) Operator log on/off.
 - 2) Attempted operator log on/off.
 - 3) All alarms.

- 4) Equipment operation counters.
 - 5) Out-of-limit, pickup, trip, and no-response events.
- j. (for electrical power monitoring) Waveform Data: Display and record waveforms on demand or automatically on an alarm or programmed event; include the graphic displays of the following, based on user-specified criteria:
- 1) Phase voltages, phase currents, and residual current.
 - 2) Overlay of three-phase currents, and overlay each phase voltage and current.
 - 3) Waveforms ranging in length from 2 cycles to 5 minutes.
 - 4) Disturbance and steady-state waveforms up to 512 points per cycle.
 - 5) Transient waveforms up to 83,333 points per cycle on 60-Hz base.
 - 6) Calculated waveform on a minimum of four cycles of data of the following:
 - a) THD.
 - b) rms magnitudes.
 - c) Peak values.
 - d) Crest factors.
 - e) Magnitude of individual harmonics.
- k. Data Sharing: Allow export of recorded displays and tabular data to third-party applications software on the local server.
- l. Activity Tracking Software:
- 1) Automatically compute and prepare activity demand and energy-use statements based on metering of energy use and peak demand integrated over user-defined interval.
 - 2) Intervals shall be same as used by electric utilities, including current vendor.
 - 3) Import metered data from saved records that were generated by metering and monitoring software.
 - 4) Maintain separate directory for each activity's historical billing information.
 - 5) Prepare summary reports in user-defined formats and time intervals.
- m. Passwords

- n. Protocol Drivers
- o. System Graphic Displays: provide interactive color-graphics platform with pull-down menus and mouse-driven generation of power system graphics, in formats widely used for such drafting; to include the following:
 - 1) Site plan.
 - 2) Floor plans.
 - 3) Equipment elevations.
 - 4) Single-line diagrams.
 - 5) Custom graphic screens configured, not programmed, using drag-and-drop tools available within the software.
- p. Alarms: display and record alarm messages from discrete input and controls outputs, according to user programmable protocol.
 - 1) Functions requiring user acknowledgment shall run in background during computer use for other applications and override other presentations when they occur.
- q. Trending: display and record data acquired in real-time from different meters or devices, in historical format over user-defined time; unlimited as to interval, duration, or quantity of trends.
 - 1) Spreadsheet functions of sum, delta, percent, average, mean, standard deviation, and related functions applied to recorded data.
 - 2) Charting, statistical, and display functions of standard Windows-based spreadsheet.
- r. Report Generation: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.
 - 1) Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.
 - a) Sort and report by device name and by function.
 - b) Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
 - c) Differentiate alarm signals from other indications.

- d) When system is reset, report reset event with same information concerning device, location, date, and time.
7. BACnet: Site Data Aggregation Device shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L
 8. Site Data Aggregation Device shall periodically upload metered data to the VA Corporate-wide server:
 - a. The metering software shall provide periodic upload (adjustable interval, initially set on 15-minute intervals) of the scrubbed and collected data.
 - b. The VA's Corporate wide server accepts the following data structures:
 - 1) Information structured using the 2005 and 2008 SQL server database engine.
 - 2) The following data stores are acceptable:
 - a) Databases: SQL Server, DB2, Oracle, Access, Sybase, MySQL.
 - b) Flat files: .CSV, .XLS, .TXT, .XML, .PQDIF
 - c. The minimum data to be uploaded (per meter) includes:
 - 1) A time stamp
 - 2) A device identifier
 - 3) A power flow value
 - 4) A flow order of magnitude
 - 5) Description of the flow's units
 - 6) The outside air drybulb temperature at the time stamp
 - 7) The outside air wetbulb temperature at the time stamp
 - 8) A "scrubbed data" flag
 - 9) An irregular data alarm stamp
- C. Self-contained uninterruptible power supply (UPS):
1. Size: Provide a minimum of six hours of operation of workstation station equipment, including two hours of alarm printer operation.
 2. Batteries: Sealed, valve regulated, recombinant, lead calcium.

3. Accessories:
 - a. Transient voltage suppression.
 - b. Input-harmonics reduction.
 - c. Rectifier/charger.
 - d. Battery disconnect device.
 - e. Static bypass transfer switch.
 - f. First six subparagraphs below are optional accessories.
 - g. Internal maintenance bypass/isolation switch.
 - h. External maintenance bypass/isolation switch.
 - i. Output isolation transformer.
 - j. Remote UPS monitoring.
 - k. Battery monitoring.
 - l. Remote battery monitoring.

2.3 CABLE SYSTEMS - TWISTED PAIR AND FIBER OPTIC

A. General:

1. All metallic cable sheaths, etc. (i.e.: risers, underground, station wiring, etc. shall be grounded.
2. Install temporary cable and wire pairs so as to not present a pedestrian safety hazard. Provide for all associated work for any temporary installation and for removal when no longer necessary. Temporary cable installations are not required to meet Industry Standards; but, must be reviewed and approved by the VA prior to installation.
3. Cable conductors to provide protection against induction in circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
4. Minimize the radiation of RF noise generated by the System equipment so as not to interfere with audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.
5. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs.
6. Label system's cables on each end. Test and certify cables in writing to the VA before conducting proof-of-performance testing. Minimum cable test requirements are for impedance compliance,

inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges specified. The cable tests shall demonstrate the operation of this cable at not less than 10 mega (m) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of 10^{-6} at the maximum rate of speed. Make available all cable installation and test records at acceptance testing by the VA and shall thereafter be maintained in the Facility's Telephone Switch Room. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.

7. Provide all cable pairs/circuits from the Server Room and establish circuits throughout the Facility for all cabling as described herein.
8. Provide proper test equipment to demonstrate that cable pairs meet each OEM's standard transmission requirements, and guarantee the cable will carry data transmissions at the required speeds, frequencies, and fully loaded bandwidth.

B. LAN COPPER CABLES

1. Comply with 28 05 13 "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
2. RS-485 Cable:
 - a. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
3. Unshielded Twisted Pair Cables: Category 5e or 6 as specified for horizontal cable for data service in Section 28 05 13 "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
4. Cabling products shall be tested and certified for use at data speeds up to at least 100 Mbps. Other types of media commonly used within IEEE Std 802.3 LANs (e.g., 10Base-T and 10Base-2) shall be used only in cases to interconnect with existing media. Short lengths of media and transceivers may be used in these applications. Provide separately orderable media, taps and connectors.

5. Ethernet Switch shall be IEEE Std 802.3 bridges which shall function as the center of a distributed-star architecture and shall be "learning" bridges with spanning tree algorithms in accordance with IEEE Std 802.1D. The switch shall support the connected media types and shall have a minimum of 150% the required ports and no fewer than 4 ports. One port shall be switch selectable as an uplink port.
6. Provide IP router network equipment. The routers shall be fully configurable for protocol types, security, and routing selection of sub-networks. The router shall meet all requirements of RFC 1812.

C. LAN FIBER OPTICAL CABLES

1. Interior Fiber Optic Cable: Interior Fiber Optic Cable shall be Multimode or Singlemode fiber, 62.5/125 micron for multimode or 10/125 micron for singlemode with SC or ST connectors as specified in TIA-568-C.1. Terminations, patch panels, and other hardware shall be compatible with the specified fiber. The data communications equipment shall use the 850-nm range of multimode or 1310-nm range of singlemode fiber-optic cable. Fiber-optic cable shall be suitable for use with the 100Base-FX standard as defined in IEEE Std 802.3.
2. Exterior Fiber Optic Cable: Exterior Fiber Optic Cable shall be Multimode or Singlemode Fiber, 62.5/125 micron for multimode or 10/125 micron for singlemode with SC or ST connectors as specified in TIA-568-C.1. Terminations, patch panels, and other hardware shall be compatible with the specified fiber. The data communications equipment shall use the 850-nm range of multimode or 1310-nm range of singlemode fiber-optic cable. Fiber-optic cable shall be suitable for use with the 100Base-FX standard as defined in IEEE Std 802.3.
3. Fiber Optic Patch Panels shall be wall or rack mountable and designed to provide termination facilities for up to 24 fibers. Unit shall also have capability to be equipped with spliced trays, six packs (for adapters), and blank panels for easy termination of the fiber bundles and tube cables. Fiber-optic terminating equipment shall provide for mounting of ST or SC connectors on an optical patch panel. Provide fiber-cable

management and cable-routing hardware to assure conformance to minimum fiber and cable bend radii. Connectors on the patch panel shall be ST or SC feed through. Provide access to both sides of the panel. The patch panel for the connectors shall be mounted to facilitate rearrangement and identification. Each apparatus shall have cabling and connection instructions associated with it.

4. Fiber Optic media converter shall provide media conversion between layer 1 copper and fiber media to support data rates equal to the greater of the physical layer or 100 Mbps as specified in IEEE Std 802.3.

D. LOW-VOLTAGE WIRING

1. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
 - a. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
 - b. Ordinary Switching Circuits: Three conductors, unless otherwise indicated.
 - c. Switching Circuits with Pilot Lights or Locator Feature: Five conductors, unless otherwise indicated.

E. WIRELESS MODEMS

1. Provide wireless modems for high speed, point-to-point Ethernet communications between sites. Transceivers shall be single integral units and may be mounted within the building in a NEMA 1 enclosure or weatherproof with integral antenna and pole mounted. System shall have the following features as a minimum:
 2. Frequency bands to match those currently in use at the site.
 3. Obtain FCC license on behalf of the VA for each licensed frequency as required.
 4. Security protocol shall utilize a minimum of 128-bit data encryption. Provide Simple Network Management Protocol (SNMP) for network diagnostics and management. Transceiver shall have status indicators for power, Ethernet link status and RF link status.
 5. Operating Conditions: 0 degrees C to 55 degrees C, 85% relative humidity (32 degrees F to 131 degrees F, 85% relative humidity).

6. Transmitter/Receiver/Antenna combination shall provide less than 0.005% frame error rate at 10Mbps data rate between sites.
7. Antennas may be omni-directional or directional as required for system gain. Antennas and supports shall withstand a combined load of ½" ice and 125mph wind loading.
8. Provide heavy-duty antenna masks and wall or roof mask mount to support antennas. All hardware shall be stainless steel. Ground antenna mast per NFPA 780.
9. Coaxial cable shall be 0.200 diameter minimum for lengths below 50' and 0.400 diameter or greater for length greater than 50'.
10. Surge suppressors for coaxial cables shall be rated for the frequency of operation, utilize gas tube technology and have a maximum let thru of 1mJ. Provide UL1449 listed, Type 1, 50kA, 120V, surge protective device for each power circuit.

2.4 GROUNDING

- A. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Comply with VA 27 05 26 Grounding and Bonding for Communications Systems and with VA 26 05 26 Grounding and Bonding for Electrical Systems.

2.5 METER COMMUNICATION

- A. Provide a BACnet network allowing communication from the meters' data heads to the Site Data Aggregation Device.
- B. Provide data heads at each meter, converting analog and pulsed information to digital information. Data heads shall allow for up to 24 hours of data storage (including time stamp, measured value, and scaling factor).
 1. Each data head shall reside on a BACnet network using the MS/TP Data Link/Physical layer protocol. Each data head shall have a communication port for connection to an operator interface.
 2. Environment: Data Head hardware shall be suitable for the conditions ranging from -29°C to 60°C (-20°F to 140°F). Data Heads used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at conditions ranging from -29°C to 60°C (-20°F to 140°F).

3. Provide a local keypad and display for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display.
4. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
5. Memory. The building controller shall maintain all BIOS and data in the event of a power loss for at least 72 hours.
6. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.6 ELECTRICAL POWER METERS AND SUB-METERS

A. ELECTRICAL METER APPLICATIONS

1. Energy meters in the advanced utility metering system shall have models available for amperage ranges of 100-3200 amperes.
 - a. The RS-485 communications shall provide communications links up to 10,000 feet long.
2. Power meters shall be installed as part of the advanced utility metering system.
 - a. All setup parameters required by the power meter shall be stored in nonvolatile memory and retained in the event of a control power interruption.
 - b. The power meter may be applied in three-phase, three- or four- wire systems.
 - c. The power meter shall be capable of being applied without modification at nominal frequencies of 50, 60, or 400 Hz.
 - d. The power meter shall provide for onboard data logging, able to log data, alarms, waveforms and events.

B. Physical and Common Requirements

1. Electrical power meters shall be separately mounted, and enclosed in a NEMA 250, Type 1 enclosure. Environmental Conditions: System components shall be capable of withstanding the following

environmental conditions without mechanical or electrical damage or degradation of operating capability:

- a. Ambient conditions of 0 to 140 deg F dry bulb and 20 to 95 percent relative humidity, noncondensing.

C. Current and voltage ratings:

1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
2. Withstand ratings shall be not less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
3. Voltage inputs from standard instrument potential transformers with 120 volt secondary output. The power meter shall support PT primaries through 3.2 MV.
4. The power meter shall operate properly over a wide range of control power including 90-457 VAC or 100-300 VDC.

D. Electrical measurements and calculated values

1. Power meters shall include the following rms Real-Time Measurements:
 - a. Current: Each phase, neutral, average of three phases, percent unbalance.
 - b. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
 - c. Power: Per phase and three-phase total.
 - d. Reactive Power: Per phase and three-phase total.
 - e. Apparent Power: Per phase and three-phase total.
 - f. True Power Factor: Per phase and three-phase total.
 - g. Displacement Power Factor: Per phase and three-phase total.
 - h. Frequency.
 - i. THD: Current and voltage.
 - j. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
 - k. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

1. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
2. Power meters shall perform the following demand current calculations, per phase, three-phase average and neutral:
 - a. Present.
 - b. Running average.
 - c. Last completed interval.
 - d. Peak.
3. Power meters shall perform the following demand real power calculations, three-phase total:
 - a. Present.
 - b. Running average.
 - c. Last completed interval.
 - d. Predicted.
 - e. Peak.
 - f. Coincident with peak kVA demand.
 - g. Coincident with kVAR demand.
4. Power meters shall perform the following demand reactive power calculations, three-phase total:
 - a. Present.
 - b. Running average.
 - c. Last completed interval.
 - d. Predicted.
 - e. Peak.
 - f. Coincident with peak kVA demand.
 - g. Coincident with kVAR demand.
5. Power meters shall perform the following demand apparent power calculations, three-phase total:
 - a. Present.
 - b. Running average.
 - c. Last completed interval.
 - d. Predicted.
 - e. Peak.
 - f. Coincident with peak kVA demand.
 - g. Coincident with kVAR demand.
6. Power meters shall perform the following average true power factor calculations, demand coincident, three-phase total:

- a. Last completed interval.
 - b. Coincident with kW peak.
 - c. Coincident with kVAR peak.
 - d. Coincident with kVA peak.
7. Power Analysis Values:
- a. THD, Voltage and Current: Per phase, three phase, and neutral.
 - b. Displacement Power Factor: Per phase, three phase.
 - c. Fundamental Voltage, Magnitude and Angle: Per phase.
 - d. Fundamental Currents, Magnitude and Angle: Per phase.
 - e. Fundamental Real Power: Per phase, three phase.
 - f. Fundamental Reactive Power: Per phase.
 - g. Harmonic Power: Per phase, three phase.
 - h. Phase rotation.
 - i. Unbalance: Current and voltage.
 - j. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 31st harmonic.
8. Power meters shall perform one of the following demand calculations, selectable by the User; meters shall be capable of performance of all of the following demand calculations.
- a. Block interval with optional subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
 - 1) Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
 - 2) Fixed block that calculates demand at end of the interval.
 - 3) Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
 - b. Demand calculations initiated by a Utility-furnished synchronization signal:
 - 1) Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.

2) Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.

3) Demand can be synchronized with clock in the power meter.

c. Minimum and maximum values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:

- 1) Line-to-line voltage.
- 2) Line-to-neutral voltage.
- 3) Current per phase.
- 4) Line-to-line voltage unbalance.
- 5) Line-to-neutral voltage unbalance.
- 6) Power factor.
- 7) Displacement power factor.
- 8) Total power.
- 9) Total reactive power.
- 10) Total apparent power.
- 11) THD voltage L-L.
- 12) THD voltage L-N.
- 13) THD current.
- 14) Frequency.

d. Harmonic calculation: display and record the following:

- 1) Harmonic magnitudes and angles for each phase voltage and current through 31st harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
- 2) Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by the VA.

E. Waveform Capture:

1. Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 cycles, 128 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.

2. Capture and store disturbance waveform captures of voltage and current channels, initiated automatically based on an alarm event. Each capture shall be fully configurable for duration with resolution of at least 128 data points per cycle, for all channels simultaneously. Waveform shall be configurable to capture pre-event cycles for analysis.
 3. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.
- F. Meter accuracy:
1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters.
 2. Accuracy from Light to Full Rating:
 - a. Power: Accurate to 0.5 percent of reading.
 - b. Voltage and Current: Accurate to 0.5 percent of reading.
 - c. Power Factor: Plus or minus 0.005, from 0.5 leading to 0.5 lagging.
 - d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.
- G. Meter input, sampling, display, output, recording and reading Capabilities
1. Input: One digital input signal.
 - a. Normal mode for on/off signal.
 - b. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
 - c. Conditional energy signal to control conditional energy accumulation.
 - d. GPS time synchronization.
 2. Sampling:
 - a. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.
 - b. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.
 3. Display Monitor:
 - a. Backlighted LCD to display metered data with touch-screen or touch-pad selecting device.

- b. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
 - c. Display four values on one screen at same time.
 - 1) Coordinate list below with meter capabilities specified in subparagraphs above.
 - 2) Current, per phase rms, three-phase average.
 - 3) Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
 - 4) Real power, per phase and three-phase total.
 - 5) Reactive power, per phase and three-phase total.
 - 6) Apparent power, per phase and three-phase total.
 - 7) Power factor, per phase and three-phase total.
 - 8) Frequency.
 - 9) Demand current, per phase and three-phase average.
 - 10) Demand real power, three-phase total.
 - 11) Demand apparent power, three-phase total.
 - 12) Accumulated energy (MWh and MVARh).
 - 13) THD, current and voltage, per phase.
 - d. Reset: Allow reset of the following parameters at the display:
 - 1) Peak demand current.
 - 2) Peak demand power (kW) and peak demand apparent power (kVA).
 - 3) Energy (MWh) and reactive energy (MVARh).
4. Outputs:
- a. Operated either by user command sent via communication link, or set to operate in response to user-defined alarm or event.
 - b. Closed in either a momentary or latched mode as defined by user.
 - c. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
 - d. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.

- e. One relay output module, providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
 - f. Output Relay Control:
 - 1) Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
 - 2) Normally open and normally closed contacts, field configured to operate as follows:
 - a) Normal contact closure where contacts change state for as long as signal exists.
 - b) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
 - c) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
 - d) End of power demand interval when relay operates as synchronization pulse for other devices.
 - e) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
 - f) Output controlled by multiple alarms using Boolean-type logic.
5. Onboard Data Logging:
- a. Store logged data, alarms, events, and waveforms in 2 MB of onboard nonvolatile memory.
 - b. Stored Data:
 - 1) Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 to 52 days of 15-minute interval data, depending on number of quantities selected.
 - 2) Custom Data Logs: three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:

- a) Schedule interval.
 - b) Event definition.
 - c) Configured as "fill-and-hold" or "circular, first-in first-out."
- 3) Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
 - 4) Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."
- c. Default values for all logs shall be initially set at factory, with logging to begin on device power up.
6. Alarms.
- a. User Options:
 - 1) Define pickup, dropout, and delay.
 - 2) Assign one of four severity levels to make it easier for user to respond to the most important events first.
 - 3) Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.
 - b. Alarm Events:
 - 1) Over/undercurrent.
 - 2) Over/undervoltage.
 - 3) Current imbalance.
 - 4) Phase loss, current.
 - 5) Phase loss, voltage.
 - 6) Voltage imbalance.
 - 7) Over kW demand.
 - 8) Phase reversal.
 - 9) Digital input off/on.
 - 10) End of incremental energy interval.
 - 11) End of demand interval.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Cabling

1. Install Category 5e UTP, Category 6 UTP, and optical fiber cabling system as detailed in TIA-568-C.1, TIA/EIA-568-B.2, or TIA-568-C.3.

2. Screw terminals shall not be used except where specifically indicated on plans.
3. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations.
4. Do not untwist Category 5e, Category 6 UTP cables more than 12 mm (1/2 inch) from the point of termination to maintain cable geometry.
5. Provide service loop on each end of the cable, 3 m (10 feet) at the server rack and 304 mm (12 inches) at the meter.
6. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables.
7. Provide a device to monitor cable pull tensions. Do not exceed 110 N (25 pounds) pull tension for four pair copper cables.
8. Do not chafe or damage outer jacket materials.
9. Use only lubricants approved by cable manufacturer.
10. Do not over cinch cables, or crush cables with staples.
11. For UTP cable, bend radii shall not be less than four times the cable diameter.
12. Cables shall be terminated; no cable shall contain unterminated elements.
13. Cables shall not be spliced.
14. Label cabling in accordance with paragraph Labeling in this section.

B. Labeling

1. Labels: Provide labeling in accordance with TIA/EIA-606-A. Handwritten labeling is unacceptable. Stenciled lettering for all circuits shall be provided using laser printer.
2. Cables: Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA/EIA-606-A.

- C. Grounding: ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and grounding conductor of nonmetallic sheathed cables, as well as equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

Comply with VA 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS and with VA 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

D. Surge Protection

1. Provide surge protective devices on all metallic cables entering and leaving an interior environment to an exterior environment or vice versa, i.e. surge protective device at each interior location of a penetration to the exterior environment.

E. Network Hardware

1. System components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable wired or wireless data transmission system shall be provided and shall be fully integrated with the configured network chosen for the project.

F. Computer Hardware

1. Provide the server(s) or personal computer workstation(s) where shown on the plans or indicated diagrammatically.

G. Computer Software

1. User friendly software shall be suitable for operation on computer workstations which serve as site data aggregation devices by monitoring the meters in the system, recording events, indicating alarm conditions, and logging and displaying system reports.
2. The software shall be developed by the manufacturer of the monitoring devices, and shall be designed specifically for energy, power monitoring and control. Additional utilities, i.e. water, air gas, and steam shall also be easily integrated.
3. The software shall be configured, not programmed. All software shall be configured by the vendor and delivered ready to use. This configuration shall include preparation of all graphics, displays, and interactive one-line diagrams required as a part of this project.
 - a. Configuration shall be to the point that when monitoring devices are required to be added, the user shall only convey

to the software the communications address and type of device.

4. The software shall be a standard product offering with no customization required and clients shall interface with the server or computer workstation via Internet Explorer browser.
 - a. The web-enabled interactive graphics client shall only reside on the server PC, client PC not required to host any application software other than Internet Explorer 6.0 SP1 or higher browser to become a fully functional system.

H. Electrical Meters

1. Power monitoring and control components shall all be factory installed, wired and tested prior to shipment to the job site.
2. All control power, CT, PT and data communications wire shall be factory wired and harnessed within the equipment enclosure.
3. Where external circuit connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.
4. All wiring required to externally connect separate equipment lineups shall be furnished and installed at the site as part of the contractor's responsibility.
5. Contractor interconnection wiring requirements shall be clearly identified on the power monitoring and control system shop drawings.

3.2 ADJUSTING AND 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.

3.3 FIELD QUALITY CONTROL

- A. The power monitoring and control system vendor must be able to provide development, integration and installation services required to complete and turn over a fully functional system including:
 1. Project management to coordinate personnel, information and on-site supervision for the various levels and functions of suppliers required for completion of the project.

2. All technical coordination, installation, integration, and testing of all components.
 3. Detailed system design and system drawings.
- B. Cabling, equipment and hardware manufacturers shall have a minimum of 5 years experience in the manufacturing, assembly, and factory testing of components which comply with EIA TIA/EIA-568-B.1, EIA TIA/EIA-568-B.2 and EIA TIA/EIA-568-B.3.
- C. The network cabling contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified network cabling systems and equipment. The contractor shall demonstrate experience in providing successful systems within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful network cabling system installations.
1. Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

3.4 ACCEPTANCE TESTING

- A. Develop testing procedures to address all specified functions and components of the Advanced Utility Metering System (AUMS). Testing shall demonstrate proper and anticipated responses to normal and abnormal operating conditions.
1. Provide skilled technicians to start and operate equipment.
 2. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
 3. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for issues identified in testing.
 4. Provide all tools to start, check-out and functionally test equipment and systems.
 5. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for issues identified in any testing
 6. Review test procedures, testing and results with Government.

- B. Testing checklists: Develop project-specific checklists to document the systems and all components are installed in accordance with the manufacturers recommendation and the Contract Documents.
- C. Before testing, the following prerequisite items must be completed.
 - 1. All related equipment has been started and start-up reports and checklists submitted and approved as ready for testing:
 - 2. All associated system functions for all interlocking systems are programmed and operable per contract documents.
 - 3. All punchlist items for the AUMS and equipment are corrected.
 - 4. The test procedures reviewed and approved.
 - 5. Safeties and operating ranges reviewed.
- D. The following testing shall be included:
 - 1. Demonstrate reporting of data and alarm conditions for each point and ensure that alarms are received at the assigned location, including Site Data Collection Device.
 - 2. Demonstrate ability of software program to function for the intended application.
 - 3. Demonstrate via graphed trends to show the reports are executed in correct manner.
 - 4. Demonstrate that the meter readings are accurate using portable NIST traceable portable devices and calibrated valves in the piping system
 - 5. Demonstrate that the systems perform during power loss and resumption of power.
- E. Copper cables: Contractor shall provide all necessary testing equipment to test all copper network circuit cables. Tests shall conform to EIA/TIA 568B Permanent Link testing criteria. All testers are to be EIA/TIA 568B, Level IIe compliant. The primary field test parameters are:
 - 1. Wire map: The wire map test is intended to verify pair to pin termination at each end and check for installation connectivity errors. For each of the conductors in the cable, the wire map indicates:
 - a. Continuity to the remote end
 - b. Shorts between any two or more conductors

- c. Crossed pairs
 - d. Reversed pairs
 - e. Split pairs
 - f. Any other mis-wiring
2. Length requirements: The maximum physical length of the basic link shall be 94 meters (including test equipment cords).
 3. Insertion Loss: Worst case insertion loss relative to the maximum insertion loss allowed shall be reported.
 4. Near-end crosstalk (NEXT) loss: Field tests of NEXT shall be performed at both ends of the test configuration.
 5. Power sum near-end crosstalk (PSNEXT) loss
 6. Equal-level far-end crosstalk (ELFEXT): Field tests of ELFEXT shall be performed at both ends of the test configuration
 7. Power sum equal-level far-end crosstalk (PSELFEXT): Must be determined from both ends of the cable. Power sum Near End Crosstalk is not a category 3 parameter. For all frequencies from 1 to 100 MHz, the category 5e PSELFEXT of the cabling shall be measured in accordance with annex E of ANSI/TIA/EIA-568-B.2 and shall meet the values determined using equations (12) and (13) for the permanent link. PSELFEXT is not a required category 3 measurement parameter.
 8. Return loss: Includes all the components of the link. The limits are based on the category of components and cable lengths. Return loss must be tested at both ends of the cable. Cabling return loss is not a required measurement for category 3 cabling.
 9. Propagation delay and delay skew: Propagation delay is the time it takes for a signal to propagate from one end to the other. Propagation delay shall be measured in accordance with annex D of ANSI/TIA/EIA-568 B.2. The maximum propagation delay for all category permanent link configurations shall not exceed 498 ns measured at 10 MHz. Delay skew is a measurement of the signaling delay difference from the fastest pair to the slowest. Delay skew shall be measured in accordance with annex D of ANSI/TIA/EIA-568-B.2. The maximum delay skew for all category permanent link configurations shall not exceed 44 ns.

10. Administration: In addition to Pass/Fail indications, measured values of test parameters should be recorded in the administration system. Any reconfiguration of link components after testing may change the performance of the link and thus invalidates previous test results. Such links shall require retesting to regain conformance.
 11. Test equipment connectors and cords: Adapter cords that are qualified and determined by the test equipment manufacturer to be suitable for permanent link measurements shall be used to attach the field tester to the permanent link under consideration.
 12. Test setup: The permanent link test configuration is to be used by installers and users of data telecommunications systems to verify the performance of permanently installed cabling. A schematic representation of the permanent link is illustrated in figure 1. The permanent link consists of up to 90 m (295 ft) of horizontal cabling and one connection at each end and may also include an optional transition/consolidation point connection. The permanent link excludes both the cable portion of the field test instrument cord and the connection to the field test instrument.
 13. Replace or repair and cables, connectors, and/or terminations found to be defective.
 14. Repair, replace, and/or re-work any or all defective components to achieve cabling tests which meet or exceed 568B permanent link requirements prior to acceptance of the installation or payment for services.
- F. Optical Fiber cables: Contractor shall provide all necessary testing equipment to test all optical fiber cables.
1. Attenuation Testing:
 - a. Singlemode testing shall conform to TIA/EIA 526-7 Method A.1 single jumper reference and TIA/EIA 568-B-1 requirements for link segment testing.
 - b. Multimode testing shall conform to TIA/EIA 526-14-A Method B single jumper reference and TIA/EIA 568-B-1 requirements for link segment testing.

- c. Attenuation testing shall be performed in one direction at each operating wavelength.
 - d. Testing of backbone fiber optic cabling shall be performed from main telecommunications room to each telecommunications room.
 - e. Testing of horizontal fiber optic cabling shall be performed from telecommunications room to station outlet location.
 - f. Tester shall be capable of recording and reporting test reading in an electronic format.
2. OTDR Testing:
- a. OTDR testing is required on all backbone fiber optic cables
 - b. The test shall be performed as per the EIA/TIA 455-61.
 - c. Multimode testing shall be performed with a minimum 80 meter launch cable.
 - d. Singlemode testing shall be performed with a minimum of 500 meter launch cable.
 - e. Tests shall be performed on each fiber in each direction at both operating wavelengths.
3. Test report data shall reference cables by cable labeling standards. Tests shall be submitted on a 1.5mb, 3.5" DOS formatted floppy disk. Contractor shall provide tests in the native file format of the tester. Contractor shall provide all software needed to view, print, and edit tests.
4. Replace or repair and defective cables, connectors, terminations, etc.
5. Mated connector pairs shall have no more than 0.5dB loss. Fusion splices shall have no more than .15dB loss per splice. Cable attenuation shall be no more than 2% more than the attenuation of the cable on the reel as certified at the factory. Repair, replace, and/or rework any or all defective components to achieve specified test results prior to acceptance of the installation or payment for services.
- G. Wireless Modems: Test system by sending 100,000 commands. Frame error rate shall not be greater than 5 out 100,000 commands.

3.5 DEMONSTRATION AND INSTRUCTION

- A. Furnish the services of a factory-trained engineer or technician for a total of two four-hour classes to instruct designated Facility

Information Technologies personnel. Instruction shall include cross connection, corrective, and preventive maintenance of the wired network system and connectivity equipment.

- B. Before the System can be accepted by the VA, this training must be provided and executed. Training will be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.
- C. On-site start-up and training of the advanced utility metering system shall include a complete working demonstration of the system with simulation of possible operating conditions that may be encountered.
 - 1. Include any documentation and hands-on exercises necessary to enable electrical and mechanical operations personnel to assume full operating responsibility for the advanced utility monitoring system after completion of the training period.
- D. Include 6 days on-site start-up assistance and 3 days on-site training in two sessions separated by minimum 1 month.
- E. Regularly schedule and make available factory training for VA staff training on all aspects of advanced utility metering system including:
 - 1. Comprehensive software and hardware setup, configuration, and operation.
 - 2. Advanced monitoring and data reporting.
 - 3. Advanced power quality and disturbance monitoring.
- F. Before the system is accepted by the VA, the contractor shall walk-through the installation with the VA's representative and the design engineer to verify proper installation. The contractor may be requested to open enclosures and terminal compartments to verify cable labeling and/or installation compliance.
- G. As-built drawings shall be provided noting the exact cable path and cable labeling information. Drawings in .DWG format will be available to the contractor. As-builts shall be submitted to the VA on disk saved as .DXF or .DWG files. Redline hardcopies shall be provided as well. CAD generated as-built information shall be shown on a new layer named AS_BUILT.

----- END -----

SECTION 26 13 13
MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of medium-voltage circuit breaker switchgear, indicated as switchgear in this section.

1.2 RELATED WORK

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint for nonstructural components.
- C. Section 25 10 10, ADVANCED UTILITY METERING: Electric meters installed in switchgear.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- E. Section 26 05 13, MEDIUM-VOLTAGE CABLES: Medium-voltage cables and terminations.
- F. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- G. 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.
- H. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- I. Section 26 23 13, GENERATOR PARALLELING CONTROLS: For switchgear used as part of a generator paralleling system.
- J. Section 26 24 16, PANELBOARDS: For panelboards integral to the switchgear.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. Switchgear shall be thoroughly tested at the factory, with the circuit breakers in the connected position in their cubicles. Tests shall be in accordance with ANSI C37.54 and C37.55, and IEEE C37.09. Factory tests shall be certified, and shall include the following tests:
1. Design tests.
 2. Production tests.
 3. Conformance tests.
- B. The following additional tests shall be performed:
1. Verify that circuit breaker sizes and types correspond to drawings, and the Overcurrent Protective Device Coordination Study.
 2. Verify that current and voltage transformer ratios correspond to drawings.
 3. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 4. Confirm correct operation and sequencing of key-type mechanical interlock systems for multiple circuit breakers by attempting closure on locked-open devices, and attempting to open locked-closed devices, and making key exchange with devices operated in off-normal positions.
 5. Verify correct barrier and shutter installation and operation.
 6. Exercise all active components.
 7. Inspect indicating devices for correct operation.
 8. Perform an insulation-resistance test, phase to ground, on each bus section, with phases not under test grounded, in accordance with manufacturer's published data.
 9. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 V DC for 300-volt rated cable and 1000 V DC for 600-volt rated cable, or as required if solid-state components or control devices cannot tolerate the applied voltage.
 10. If applicable, verify correct function of control transfer relays located in the switchgear with multiple control power sources.

11. Perform phasing checks on double-ended or dual-source switchgear to insure correct bus phasing from each source.

- C. Furnish four (4) copies of certified manufacturer's factory test reports to the COR prior to shipment of the switchgear to ensure that the switchgear has been successfully tested as specified.
- D. The Government shall have an option to witness the factory tests. All expenses of the Government Representative's trips to witness the testing will be paid by the Government. Notify the COR not less than 30 days prior to making tests at the factory.

1.5 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:

- a. Switchgear shop drawings shall be submitted simultaneously with or after the Overcurrent Protective Device Coordination Study.
- b. Submit sufficient information to demonstrate compliance with drawings and specifications.
- c. Prior to fabrication of switchgear, submit the following data for approval:
 - 1) Complete electrical ratings.
 - 2) Circuit breaker sizes.
 - 3) Interrupting ratings.
 - 4) Safety features.
 - 5) Accessories and nameplate data.
 - 6) Switchgear one line diagram, showing ampere rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.
 - 7) Elementary and interconnection wiring diagrams.
 - 8) Technical data for each component.
 - 9) Dimensioned exterior views of the switchgear.
 - 10) Dimensioned section views of the switchgear.
 - 11) Floor plan of the switchgear.
 - 12) Foundation plan for the switchgear.
 - 13) Provisions and required locations for external conduit and wiring entrances.

- 14) Approximate design weights.
 - d. Certification from the manufacturer that representative switchgear has been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.
 - e. Obtain and submit written approval from the electric utility company, that the equipment and material interface with the customer meets with their requirements and approval.
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) Three-line diagrams showing device terminal numbers.
 - 2) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the switchgear.
 - 3) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
 - 4) 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.
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.
4. Certifications: Two weeks prior to final inspection, submit four copies of the following.

- a. Certification by the manufacturer that switchgear conforms to the requirements of the drawings and specifications.
- b. Certification by the Contractor that switchgear 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 the basic designation only.
- B. American National Standards Institute (ANSI):
 - C37.54-10.....Indoor Alternating Current High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear - Conformance Test Procedures
 - C37.55-10.....Medium-Voltage Metal-Clad Assemblies - Conformance Test Procedures
- C. Institute of Electrical and Electronics Engineers (IEEE):
 - C37.04-09.....Standard for Rating Structure for AC High-Voltage Circuit Breakers
 - C37.09-11.....Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - C37.20.2-99.....Standard for Metal-Clad Switchgear
 - C37.90-06.....Standard for Relays and Relay Systems Associated with Electric Power Apparatus
 - C57.13-93.....Standard Requirements for Instrument Transformers
- D. International Code Council (ICC):
 - IBC-12.....International Building Code
- E. National Electrical Manufacturers Association (NEMA):
 - C37.06.1-00.....Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - C37.57-10.....Switchgear-Metal-Enclosed Interrupter Switchgear Assemblies - Conformance Testing
 - LA 1-09.....Surge Arrestors
 - SG 4-09.....Alternating-Current High-Voltage Circuit Breakers

- F. National Fire Protection Association (NFPA):
70-11.....National Electrical Code (NEC)

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Switchgear shall be in accordance with ANSI, IEEE, NEMA, NFPA, as shown on the drawings, and have the following features:
1. Switchgear shall be a complete, grounded, continuous-duty, integral assembly, metal clad, dead-front, dead-rear, self-supporting, indoor type switchgear assembly. Incorporate devices shown on the drawings and all related components required to fulfill operational and functional requirements.
 2. Ratings shall not be less than shown on the drawings. Short circuit ratings shall not be less than 18kA, with 23kA at 2 seconds and 37kA rms close and latch rating.
 3. Switchgear shall conform to the arrangements and details shown on the drawings.
 4. Coordinate all requirements with the electric utility company supplying electrical service to the switchgear. The incoming electric utility feeder and revenue metering installation shall conform to the requirements of the electric utility company.
 5. Key-type mechanical interlocks for multiple circuit breakers shall be provided as shown on the drawings.
 6. Switchgear shall be assembled, connected, and wired at the factory so that only external circuit connections are required at the construction site. Split the structure only as required for shipping and installation. Circuit breakers and accessories shall be packaged and shipped separately. Packaging shall provide adequate protection against rough handling during shipment.
 7. All non-current-carrying parts shall be grounded per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS for additional requirements.

2.2 HOUSING

- A. Shall have the following features:
1. Frames and enclosures:
 - a. The assembly shall be braced with reinforcing gussets using bolted connections to assure rectangular rigidity.

- b. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.
 - c. Die-pierce the holes for connecting adjacent structures to insure proper alignment, and to allow for future additions.
 - d. All bolts, nuts, and washers shall be minimum Grade 3 cadmium-plated or zinc plated steel.
2. Cubicles:
- a. An individual cubicle shall be supplied for each circuit breaker and each future circuit breaker as shown on the drawings. Cubicles shall be provided with isolated wireways for control wiring between devices.
 - 1) Compartment each cubicle so that the circuit breaker, buses, and cable terminations are in separate compartments with steel partitions or barriers of approved and properly installed insulation.
 - 2) Each cubicle furnished with a circuit breaker (active or spare) shall be fully equipped as noted on drawings and specified below.
 - 3) Each cubicle noted as space for future circuit breaker shall be fully equipped for positioning and connecting the breakers. Provide all equipment required to implement the future breaker installation, except the relays and meters on the cubicle doors and the associated current transformers.
 - b. Conveniently locate test blocks within each cubicle for circuit breaker wiring connections.
3. Auxiliary compartments:
- a. Cubicles shall be provided for auxiliaries, metering, and transition or termination sections as required by the manufacturer, and as shown on drawings. Cubicles shall be provided with isolated wireways for control wiring between devices.
4. Cubicle doors:
- a. The doors shall permit convenient removal and interchanging of the circuit breakers between cubicles. The doors shall be capable of a swing approaching 180 degrees and shall be provided with intermediate doorstops.

- b. Each door shall include suitable handles and padlocking provisions. Concealed or semi-concealed hinges shall be provided to attach the doors. Weld the hinges to the equipment structure and to the cubicle doors.
- c. The following equipment shall be mounted on the door of circuit breaker cubicles:
 - 1) A breaker control switch.
 - 2) Breaker-position-indicator lamps.
 - 3) Protective relays and/or metering as indicated on the drawings or other sections of the specifications.
 - 4) Any additional components indicated on the drawings.

B. Finish:

- 1. All metal surfaces shall be thoroughly cleaned, phosphatized and factory primed prior to applying baked enamel or lacquer finish.
- 2. Provide a light gray finish for indoor switchgear.

2.3 BUS

A. Bus Bars and Interconnections:

- 1. Provide copper buses, fully rated for the amperage shown on the drawings for entire length of the switchgear. Bus shall be silver plated at all joints, and ends where future extensions are allowed.
- 2. Fully insulate and totally enclose the buses within the bus compartment of switchgear cubicles.
- 3. Mount the buses on appropriately spaced insulators and brace to withstand the available short circuit currents.
- 4. The bus and bus compartment shall be designed so that the acceptable NEMA standard temperature rises are not exceeded.
- 5. Install a copper ground bus the full length of the switchgear assembly.
- 6. All bolts, nuts, and washers shall be minimum Grade 5 cadmium-plated or stainless steel. Bolts shall be torqued to the values recommended by the manufacturer. Bus-to-bus connections shall be made with Belleville washers and associated flat washers, under the nut and under the bolt head.
- 7. Make provisions for future bus extensions by means of bolt holes or other approved method.

- B. Insulation: The insulation shall be a high flame-retardant, self-extinguishing, high track-resistant material that complies with the ANSI/IEEE C37.23-87 65 degree C (149 F) temperature rise.
- C. Control Bus: Extend the control buses to all of the circuit breaker cubicles including spare and spaces for future circuit breakers.

2.4 CIRCUIT BREAKERS

- A. Breakers that have the same ratings shall be interchangeable with other breakers in that line-up.
- B. Circuit breakers shall have the following features:
 - 1. Drawout, vacuum interrupter type.
 - a. Vacuum:
 - 1) Three independent sealed high-vacuum interrupters.
 - 2) Protect the interrupter contacts from moisture and contaminated atmospheres.
 - 3) Readily accessible contact wear indicator for each interrupter.
 - 4) Breaker total interrupting time of 3 cycles.
 - 5) Maintenance free interrupter.
 - 6) Contact surfaces to be of special alloys (such as copper chrome) to reduce effect of chopping.
 - 2. Operating mechanism:
 - a. The mechanism shall operate in a quick-make, quick-break manner and shall be charged by a small universal motor to provide stored-energy for breaker operation. Breaker tripping, closing, and indicating lamps shall be DC operated.
 - b. The speed of the contacts during the operation shall be independent of the control voltage and the operator's movements.
 - c. Equip the mechanism for manual opening and closing of the contacts during loss of normal control power.
 - 3. Relays: Comply with IEEE C37.90, integrated digital type with test blocks and plugs. Provide ANSI functions as shown on the drawings.
 - 4. Drawout rails:

- a. Design the rails to guide the breakers to their disconnected, test, and connected positions. Provide a positive stop at each of the positions by a levering mechanism.
 - b. The breaker shall maintain contact with ground in all positions through flexible connections and ground shoes.
 - c. Make provisions for padlocking the breaker in the test and disconnected position.
5. Power line and load disconnecting contact fingers and springs:
 - a. The contact fingers shall be silver-plated, full-floating, self-aligning, self-coupling, and designed for cleaning action during engaging and disengaging movements.
 - b. Provide adequate flexibility between stationary and movable components to assure proper meeting of the contact fingers, while also providing adequate pressure on the contact surfaces.
 6. The stationary contacts for the line and load breaker contact fingers shall be isolated from the breaker compartment by shutters when the breaker is removed from the connected position.
 7. The control and auxiliary contacts of the breaker shall be silver plated, multi-contact, self-coupling, plug and socket type. The contacts shall connect the circuits through terminal blocks that shall be conveniently mounted on the breaker for visual inspection. Provide sufficient 52a and 52b auxiliary contacts on each breaker required for monitoring and control described within the Specifications, plus at least two 52a and two 52b contacts available for Owner use and wired to a terminal block outside of the breaker compartment.
 8. Mechanical interlocks:
 - a. Shall prevent the breaker from movement, except when the breaker contacts are in the open position.
 - b. Shall prevent the breaker from closing the contacts while in the connected position, except when the power line and load disconnecting contacts are completely connected.
- C. The interrupting ratings of the breakers shall be not less than 18kA, with 23kA at 2 seconds and 37kA rms close and latch rating.

- D. Breaker Status Indicators: Provide individual illumination of breaker status at each breaker position as follows:
1. Green - breaker open (fully racked in and test positions)
 2. Red - breaker closed (fully racked in and test positions)
 3. Blue - breaker-specific arc flash reduction mechanism enabled (fully racked in and test positions)
 4. Yellow - breaker not ready summary alarm (racked to test position or fully racked out, loss of charging/closing control, loss of relay power where applicable, auxiliary device summary alarm where applicable).

2.5 CURRENT TRANSFORMERS

- A. Provide encapsulated type current transformers or approved equal. The transformers shall have a mechanical and one-second thermal rating in RMS amperes of not less than the momentary and interrupting rating of the breaker at rated voltage.
- B. Provide transformer ratios as shown on the drawings. Accuracies shall be coordinated with the associated relays by the switchgear manufacturer to assure proper operation at the selected pick-up and operating current ratings.

2.6 POTENTIAL TRANSFORMERS

- A. The potential transformers shall be encapsulated, drawout, disconnecting type, and shall be properly protected by primary current-limiting fuses.
- B. When the transformers are withdrawn from the compartment the primary terminals shall be grounded.
- C. The transformer ratios and accuracies shall be coordinated, with the associated relays by the switchgear manufacturer.

2.7 CONTROL POWER TRANSFORMERS

- A. The control power transformers shall be encapsulated, drawout, disconnecting type and shall be properly protected by primary current-limiting fuses.
- B. The ratings of the transformer shall be as indicated on the drawings.
- C. Refer to the drawings for rating and capacity of the circuit breaker equipped panelboard served by the control power transformer.
- D. Equip the control power transformer compartment door with indicating lights and nameplates to indicate when the control power is energized.

E. Dual Control Power Supplies:

1. For each of the incoming feeders, provide a separate control power transformer.
2. An automatic transfer switch shall transfer the secondary connected load as follows:
 - a. While the preferred incoming feeder is energized, the load shall be connected to the transformer energized by the feeder.
 - b. While the preferred incoming feeder is de-energized and the other incoming feeder is energized, the load shall be transferred to the energized incoming feeder.

2.8 ELECTRIC UTILITY COMPANY EQUIPMENT

- A. Provide separate cubicles for electric utility company metering equipment.
- B. Provide suitable arrangements within the electric utility company primary metering cubicles for mounting metering equipment. Obtain the electric utility company's approval of the cubicle arrangements prior to fabrication of the switchgear.
- C. Allow access to electric utility company personnel as required for installation of utility metering equipment.

2.9 BATTERY SYSTEM

- A. Batteries:
 1. Provide high discharge rate type maintenance-free nickel-cadmium batteries. Battery voltage shall be 125 volts nominal. Calculate the battery capacity based on the lowest ambient temperature in the room where it is to be installed. Include a safety margin of 50 percent for reserve capacity.
 - a. Provide sufficient battery capacity to carry all continuous loads (lamps, relays, etc.) for 8 hours and then perform the greater of the following duties, with the charger de-energized.
 - 1) Trip all circuit breakers simultaneously or,
 - 2) Close the largest breaker in a line-up of four or less breakers, or close the two largest breakers simultaneously in a line-up of more than four breakers. Breaker closing current shall include both the spring

release coil current and the starting current of the spring charging motor.

2. Provide battery connector covers for protection against external short circuits.
3. Provide corrosion-resistant steel battery racks.
4. In seismic areas, batteries shall be secured to the battery rack to prevent overturning during a seismic event. Battery rack shall also be secured to the floor.

B. Battery Charger:

1. Provide a charger of the full-wave rectifier type utilizing silicon controlled rectifiers as the power-control elements. Construction shall be modular with plug-in control units for easy replacement.
2. The charger shall maintain 1/2 of one percent voltage regulation from no load to full load for line voltage variation of 10 percent, and frequency variation of 3 Hz from 60 Hz.
3. The charger shall maintain a nominal float voltage of 1.4 vpc, and a nominal equalizing voltage of 1.5 vpc.
4. The charger shall be capable of continuous operation in an ambient temperature of 40 degrees C (104 degrees F) without derating. The charger shall be installed in a convection cooled NEMA Type 1 ventilated enclosure. The housing is to have a hinged front door with all equipment accessible from the front.
5. Provide both AC and DC transient protection. Charger shall be able to recharge a fully discharged battery without tripping AC protective devices. AC circuit breaker shall not trip under any DC load condition, including short circuit on output terminals.
6. The charger shall be capable of supplying the following demand simultaneously:
 - a. Recharging a fully discharged battery in 12 hours.
 - b. Supervisory panel and control panel.
 - c. Steady loads (indicating lamps, relays, etc.).
7. The charger shall have fused AC input and DC output protection.
8. The charger shall not discharge the batteries when AC power fails.

9. The charger shall have the following accessories:
 - a. On-off control switch with pilot light.
 - b. AC power failure alarm light.
 - c. High DC voltage alarm light.
 - d. Low DC voltage alarm light.
 - e. Ground detection switch and alarm light.
 - f. DC ammeter - 2 percent accuracy.
 - g. DC voltmeter - 2 percent accuracy: Float/equalize voltage marked in red on voltmeter.
 - h. Provisions for activation of remote annunciation of trouble for the above conditions.

2.10 AUTOMATIC THROWOVER SYSTEM

- A. Where indicated on drawings, provide an automatic throwover system for double-ended switchgear. The system shall control the two main breakers and the bus tie breaker(s) in case of loss of voltage at either supply connection. When in the automatic mode the system shall prevent momentary or sustained paralleling of sources.
- B. The automatic throwover system shall not close a breaker into a faulted bus or a bus with voltage or frequency outside of acceptable limits.
- C. Provide adjustable delayed operation per drawings.
- D. Provide positive visual indication of the automatic throwover system status on the switchgear front.

2.11 ARC FLASH REDUCTION SYSTEM

- A. Provide an arc flash reduction system with manual selection, or manual selectable automatic system, to allow reduction of arc flash risk during construction or maintenance activity within the switchgear or equipment supplied from the switchgear.
- B. Provide positive visual indication of the arc flash reduction system status on the switchgear front. System status for arc flash reduction specific to a breaker shall be indicated at the breaker per Section 2.4.F herein
- C. Arc flash reduction systems are not required for primary selective breaker sections of unit substations.

2.12 METERING

- A. Refer to Section 25 10 10, ADVANCED UTILITY METERING. Refer to drawings for meter locations.
- B. As necessary, provide vertical structure with a front hinged door to provide safe isolated access to meters and all associated terminal and fuse blocks for maintenance, calibration or testing.
- C. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.
 - 1. Where relays and meters are served by common current transformers, install the relay connections closest to the current transformer output shorting strips. Provide additional isolating shorting strips between relay and meter terminations.
- D. Provide voltage transformers including primary fuses and secondary protective devices for metering as shown on the drawings.

2.13 OTHER EQUIPMENT

- A. Furnish tools and accessories required for circuit breaker and switchgear test, inspection, maintenance, and proper operation.
- B. Cable terminations:
 - 1. Cable terminations shall conform to the requirements in Section 26 05 13, MEDIUM-VOLTAGE CABLES.
 - 2. Coordinate cable terminations with the switchgear being furnished.
- C. Medium-voltage surge arresters:
 - 1. Distribution class, metal-oxide-varistor type. Comply with NEMA LA 1.
 - 2. Provide each ungrounded conductor of each incoming circuit with an appropriate arrester for the application voltage.
- D. All illuminated status indicators shall be LED type, with lamp test circuit and control.
- E. Circuit breaker removal equipment: Furnish a portable circuit breaker removal lift and carriage for installation and removal of circuit breakers.

2.14 CONTROL WIRING

- A. Switchgear control wiring shall not be less than No. 14 AWG copper 600 volt rated. Install wiring complete at the factory, adequately bundled

and protected. Provide separate control circuit fuses in each breaker compartment and locate for ease of access and maintenance.

- B. Where supported with tie wraps, the ties shall be bolted or screwed to their compartment wall; adhesive supports are not acceptable.

2.15 NAMEPLATES AND MIMIC BUS

- A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. Nameplates shall indicate equipment served, spares, or spares in accordance with one line diagram shown on drawings. Nameplates shall be mounted with plated screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.
- B. Mimic Bus: Provide an approved mimic bus on front of each switchgear assembly. Color shall be black for the Normal Power system and red for the Essential Electrical System, either factory-painted plastic or metal strips. Plastic tape shall not be used. Use symbols similar to one line diagram shown on drawings. Plastic or metal strips shall be mounted with plated screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install switchgear in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor switchgear 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. In seismic areas, switchgear shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- D. Interior Location. Mount switchgear 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 75mm (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 switchgear 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. Prior to the final inspection for acceptance, a technical representative from the electric utility company shall witness the testing of the equipment to assure the proper operation of the individual components, and to confirm proper operation/coordination with electric utility company's equipment.
- C. 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. Confirm correct application of manufacturer's recommended lubricants.
 - d. Verify appropriate anchorage, required area clearances, and correct alignment.
 - e. Verify that circuit breaker sizes and types correspond to approved shop drawings.
 - f. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
 - g. Verify appropriate equipment grounding.
 - h. Confirm correct operation and sequencing of key-type mechanical interlock systems.
 - i. Vacuum-clean enclosure interior. Clean enclosure exterior.

- j. Inspect insulators for evidence of physical damage or contaminated surfaces.
 - k. Verify correct shutter installation and operation.
 - l. Exercise all active components.
 - m. Verify the correct operation of all sensing devices, alarms, and indicating devices.
 - n. Verify that vents are clear.
 - o. Inspect control power transformers.
2. Electrical tests:
- a. Perform insulation-resistance tests on each bus section.
 - b. Perform overpotential tests.
 - c. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.
 - d. Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.
 - e. Circuit breakers shall be tripped by operation of each protective device.
- 3.3 FOLLOW-UP VERIFICATION**
- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the medium-voltage circuit breaker switchgear is in good operating condition and properly performing the intended function.
- 3.4 TEMPORARY HEATING**
- A. Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.
- 3.5 WARNING SIGN**
- A. Mount on each entrance door of the switchgear room, approximately 1.5 M (5 feet) above grade or floor, a clearly lettered warning sign for warning personnel. The sign shall be attached with rustproof metal screws.
- 3.6 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 in the switchgear room or in the outdoor switchgear enclosure.

- B. Furnish a written sequence of operation for the switchgear 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 in the switchgear room or in the outdoor switchgear enclosure.
- C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COR.

3.7 AS-LEFT RELAY SETTINGS, AND FUSE RATINGS FOR CONTROL EQUIPMENT

- A. The relay settings shall be set in the field by an authorized representative of the switchgear manufacturer per the approved Overcurrent Protective Device Coordination Study in accordance with Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY.
- B. The relay settings of the main breaker(s) shall be reviewed by the electric utility company to assure coordination with the electric utility company primary overcurrent protective device. Prior to switchgear activation, provide written verification of this review to the COR.
- C. Post a durable copy of the "as-left" relay settings, and fuse ratings for control equipment in a convenient location in the switchgear room. Deliver four additional copies of the settings and fuse ratings to the COR. Furnish this information prior to the activation of the switchgear.

3.8 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 switchgear, on the dates requested by the COR.

---END---

SECTION 33 10 00
WATER UTILITIES

PART 1 - 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.

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.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends and flange faces.
- B. 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.
- C. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- D. Store plastic piping protected from direct sunlight and support to prevent sagging and bending.
- E. Cleanliness of Piping and Equipment Systems:
 - 1. 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 connection to water main with Public Utility company.
- B. Coordinate water service lines with building contractor.

1.7 QUALITY ASSURANCE:

- A. Products Criteria:
 1. 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.
- 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. Regulatory requirements:
 1. Comply with the rules and regulations of the public utility company having jurisdiction over the connection to public water lines and the extension and/or modifications to public utility systems.
 2. Comply with rules and regulations of Local authorities having jurisdiction for fire-suppression water-service piping including materials, hose threads, installation and testing.
- C. 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.
- D. 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 "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.
 4. All welds shall be stamped according to the provisions of the American Welding Society.
- E. 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.
- F. Applicable codes:
1. Plumbing Systems: IPC, International Plumbing Code.
 2. 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.
 3. 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. MSS SP-60-2004 Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
- C. MSS SP-123-1998(R2006) Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube
- D. American Society of Mechanical Engineers (ASME):
- B16.22-2001.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - B31.....Code for Pressure Piping Standards
- E. American Society for Testing and Materials (ASTM):
- A536-84(2009).....Ductile Iron Castings
 - A674-10.....Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
 - B88/B88M-09.....Seamless Copper Water Tube
 - C651-05.....Disinfecting Water Mains

- F. 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.....Ductile Iron and Gray-Iron 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
 - C600-10.....Installation of Ductile Iron Mains and Their Appurtenances
 - C606-11.....Grooved and Shouldered Joints
 - C651-05.....Disinfecting Water Mains
 - C800-05.....Underground Service Line Valves and Fittings
- G. National Fire Protection Association (NFPA):
 - NFPA 24-2010 Ed.....Installation of Private Fire Service Mains and Their Appurtenances
- H. 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
- I. American Welding Society (AWS):
 - A5.8/A5.8M-2004Filler Metals for Brazing and Braze Welding
- J.

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 one year 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.

PART 2 - 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 gray-iron 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).
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, round-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances: ASTM A47, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions matching pipe, 350 psi (3400 kPa).
 2. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions, Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
 3. Gaskets: AWWA C111.
- D. Flanged Ductile Iron Pipe: AWWA C115/A21.11, with factory applied screwed long hub flanges.
1. Flanges: ASME B16.1 for 125 psi (850 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.
- E. Exterior Pipe Coating: The exterior of pipe shall have the standard asphaltic coating.
- 2.4 SOFT COPPER TUBING**
- A. ASTM B88, Type K
- 2.5 HARD COPPER TUBING**
- A. ASTM B88, Type K
- 2.6 FITTINGS**
- A. ASME B16.18, cast copper alloy
 - B. ASME B16.22, wrought copper alloy
 - C. Solder joint pressure fittings
- 2.7 COPPER UNIONS**
- A. ANSI MSS SP-123, cast copper alloy
 - B. Hexagonal-stock body with ball-and-socket
 - C. Metal-to-metal seating surfaces and solder-joint
 - D. Threaded ends
- 2.8 VALVE BOXES**
- A. AWWA M44 with top section, adjustable extension of length required for depth of burial of valve.

- B. Plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel.

2.9 VALVES SMALLER THAN 2 INCHES (25 MM)

- A. ASTM B61, resilient seat, bronze body and bonnet, pressure rating of 200 psi (1380 kPa).
- B. Ends to match main line piping.

2.10 SERVICE SADDLE:

- A. Copper alloy with seal and threaded outlet for corporation valve.

2.11 CORPORATION VALVE:

- A. Bronze body and ground-key plug, with threaded inlet and outlet matching service piping material.

2.12 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.

2.13 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".

PART 3 - Execution

3.1 PIPING APPLICATIONS

- A. Use pipe, fittings, and joining methods for piping systems according to the following applications.
 - 1. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- B. Underground water-service piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be the following:
 - 1. Soft copper tube with wrought-copper, solder-joint fittings
 - 2. Brazed copper, pressure-seal fittings
 - 3. Pressure-sealed joints.
- C. Underground water-service piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be the following:

1. Soft copper tube with wrought-copper, solder-joint fittings; and brazed joints.
 2. Ductile iron, push-on-joint pipe; ductile iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile iron, mechanical-joint fittings; and mechanical grooved-end pipe; ductile iron-pipe appurtenances; and grooved joints.
 3. Water-service piping materials listed in subparagraphs below are for potable-water service. They may not be suitable for fire-service mains.
 4. Hard copper tube with wrought-copper, solder-joint fittings
 5. Brazed copper, pressure-seal fittings
- D. Pressure-sealed joints.
- E. Underground Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be the following:
1. Ductile iron, push-on-joint pipe; ductile iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile iron, mechanical-joint fittings; and mechanical grooved-end pipe; ductile iron-pipe appurtenances; and grooved joints.

3.2 DUCTILE IRON PIPE

- A. Install Ductile Iron, water-service piping according to AWWA C600 and AWWA M41-3rd Edition.
 1. Install PE corrosion-protection encasement according to ASTM A674 or AWWA C105/A21.5.
- 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 COPPER PIPE

- A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations.
- B. Copper piping shall be bedded in 6 inches (150 mm) of sand.

3.4 ANCHORAGE INSTALLATION

- A. Install water-distribution piping with restrained joints as shown on the plans.

3.5 SERVICE CONNECTION

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Install water service lines to a point of connection within approximately 5 feet (1500 mm) outside of building(s) to which service is to be connected and make connections thereto. If building services have not been installed provide temporary caps and mark for future connection.

3.6 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.
 - 1. 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.

3.7 IDENTIFICATION

- A. Install continuous underground warning tape 12 inches (300 mm) directly over piping.

3.8 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.
 - 4. 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.

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Section 33 30 00
Sanitary Sewer utilities

PART 1 - General

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside, underground sanitary 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.

1.3 DEFINITIONS

- A. Sanitary Side Sewer System: Pipe line and appurtenances which are part of the sanitary side sewer system outside the building.

1.4 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store plastic piping protected from direct sunlight and support to prevent sagging and bending. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.

1.6 COORDINATION

- A. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall.

1.7 QUALITY ASSURANCE:

- A. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.8 SUBMITTALS:

- A. Manufacturers' Literature and Data shall be submitted for the following as one package:
 - 1. Pipe, Fittings, and, Appurtenances.
 - 2. Jointing Material.

1.9 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):
 - C1173-10Flexible Transition Couplings for Underground Piping Systems
 - D3034-08Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - F477-10Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 - F1417-11Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
 - F1668-08Construction Procedures for Buried Plastic Pipe
 - C. American Water Works Association (AWWA):
 - C900-07Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
- American Society of Mechanical Engineers:
A112.36.2M-1991Cleanouts

1.10 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 one year from final acceptance. Further, the Contractor will provide all manufacturers' and supplier's 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.
- B. 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 PVC, GRAVITY SEWER PIPE AND FITTINGS

- A. PVC Gravity Sewer Piping:
 - 1. Pipe and Fittings shall conform to SDR 35
 - 2. Gaskets: ASTM F477.

2.3 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve type, reducing or transition coupling, for joining underground nonpressure piping. Include ends to match same sizes of main line piping and install corrosion-resistant metal tension bands and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Plastic Pipes: ASTM F477, elastomeric seal.
 - 2. For Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
 - 1. Couplings shall be elastomeric sleeve with stainless steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, Flexible Couplings:
 - 1. Couplings shall meet ASTM C1460 with elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield with corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type, Flexible Couplings:
 - 1. Couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger mainline pipe and for spigot of smaller main line pipe to fit inside ring.
- F. Nonpressure-Type, Rigid Couplings:
 - 1. Coupling shall be ASTM C1461, sleeve-type, reducing or transition-type mechanical coupling, molded from ASTM C1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.4 CLEANOUTS

- A. PVC Cleanouts:

- B. PVC body with PVC threaded plug: Cleanout shall be as per ASTM D3034. PVC sewer pipe fitting and riser to cleanout.
- C. Cleanout Riser: Sewer pipe fitting on main line sewer and riser shall match main line piping.

2.5 WARNING TAPE

- A. Warning tape shall be standard, 4 mil (0.1 mm) polyethylene 3 inch (76 mm) wide tape, detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

PART 3 - Execution

3.1 PIPING INSTALLATION

- A. Drawing plans and details indicate the general location and arrangement of underground sanitary sewer piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at the low point, true to grades and alignment indicated on the drawings, 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 using lubricants, cements, and other installation requirements.
- C. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- D. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- E. 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.
- F. 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.
- G. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches over the crown of the pipe.
- H. Warning tape shall be continuously placed 12 inches above sewer pipe

- I. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- J. 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.
- K. Install gravity-flow, non-pressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
 - 2. Install piping with 18" minimum cover as shown on Drawings.
 - 3. Install PVC gravity sewer according to ASTM D2321 and ASTM F1668.
- L. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.2 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure, drainage piping according to the following:
 - 1. Join PVC piping according to ASTM D2321.
 - 2. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.
 - a. Flexible couplings for pipes of same or slightly different OD.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.3 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES WITHIN VAULTS

- A. Install concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.4 BUILDING SERVICE LINES

- A. Install sanitary sewer service lines to point of connection within approximately 5 feet outside of building(s) where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

3.5 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Cleanouts should be 6 inches in diameter and consist of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete, 18 by 18 by 12 inches and 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.
- D. The top of the cleanout assembly shall be 2 inches below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.6 CONNECTIONS

- A. Make connections to existing piping and underground manholes by coring and installing the pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.

- B. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
1. Make branch connections from the side into existing piping, NPS 4 to NPS 20, by removing a section of the existing pipe.
 2. Make branch connections from the side into existing piping, NPS 21 or larger, or to underground manholes by cutting an opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in concrete to provide additional support of collar from connection to undisturbed ground.
 3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 PIPE SEPARATION

- A. Horizontal Separation - Water Mains and Sewers:
1. Existing and proposed water mains shall be at least 10 feet horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
 2. Gravity flow mains and pressure (force) mains may be located closer than 10 feet but not closer than 6 feet to a water main when:
 - a. Local conditions prevent a lateral separation of 10 feet; and
 - b. The water main invert is at least 18 inches above the crown of the gravity sewer or 24 inches above the crown of the pressure (force) main; and the water main is in a separate trench separated by undisturbed earth.
 3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe.
- B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 24 inches above the crown of gravity flow sewer or 48 inches above the crown of pressure (force) mains. The vertical separation shall be maintained within 10 feet (3 m) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 24 inches of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches above or 12 inches (300 mm) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 24 inches below the water line provided both the water line and sewer line are constructed of ductile iron pipe.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 10 feet.

3.8 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edges of underground manholes.

3.9 FIELD QUALITY CONTROL

- A. All systems shall be inspected and obtain the Resident Engineer's approval. 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.
- B. To inspect, thoroughly flush out the lines and manholes before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lips at joints on the inside of gravity sewer lines are not acceptable.
 1. Submit separate report 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. Re-inspect and repeat procedure until results are satisfactory.
- C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
- 1. Test plastic gravity sewer piping according to ASTM F1417.
 - 2. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 4 psi and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi greater than the average back-pressure of any groundwater above the sewer.
- 3.10 CLEANING**
- A. Clean dirt and superfluous material from interior of piping.

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