Naval Facilities Engineering Command – Northwest
Public Works Department – Everett

Naval Radio Station Jim Creek, WA
Area 45 Substation Replacement and Switchyard Upgrades

PART 3

(Final – 28 Dec 2016)
Minor revisions 27 Jan 2017

1.0 PROJECT SUMMARY:

1.1 Provide coordination, design and construction services necessary to replace existing transformers. This project also includes but is not limited to AutoCad consolidation of both existing and new drawings into a single unified As-Built set. Work includes commissioning of the system. Project shall deliver finished facilities and infrastructure which shall be ready for tenant use upon final inspection and acceptance.

2.0 GENERAL PROGRAM REQUIREMENTS:

2.1 The requirements indicated herein set minimum program, technical performance, and prescriptive elements.

2.2 Unless otherwise indicated, provide all labor, equipment, and materials necessary to complete the work required.

2.3 Site visit shall be required prior to bidding in order to gain a full understanding of existing site conditions and the application of the projects program requirements.

3.0 PROJECT CHALLENGES:

3.1 Various elements of the project are noted, in the opinion of the Contracting Agency, to be potential program/project challenges. This is not an inclusive list and may not represent the opinions and actual challenges encountered by the design and\or construction team. These items are noted as follows:

3.1.1 Harmonics Design: The new system shall be designed for and shall not exceed the applicable limits as set forth in IEEE Standard 519-2014.

3.1.2 Station/Project Coordination: Documentation, scheduling and specific adherence to contract and station security requirements during the project shall require management attention.

3.1.3 Transmitter Coordination: Work occurs on an operational unit. Power, including emergency generator power shall be maintained at all times unless otherwise arranged. See Part 2A, Section 01140.

3.1.4 Construction Phasing: In order to facilitate uninterrupted power, the project shall be phased as outlined/inferred by the contract SOW and drawings. See Part 2A, Section 01140.

3.1.5 Site Constraints: Access to and around the Substation 45 area, both horizontally and vertically, shall be considered. Care shall be taken to fully evaluate and plan for any relevant physical interferences in addition to elevation changes, slopes, vegetation, soil conditions, etc.

3.1.6 As-Built Facility Documentation:

3.1.6.a As-built documents that clearly and fully depict the existing site conditions and utilities present may not exist at the time of award. Records that do exist do not represent the actual construction, and may not reflect subsequent modifications to include the installation of temporary emergency generator units in and adjacent to the Substation 45 area.

3.1.7 Drawing Coordination and Final As-Builts: AEDOR is to prepare a drawing coordination matrix for use in insuring that the design, construction, and closeout drawing effort is effective and efficiently coordinated together as a complete facility set of drawings for future use. Other requirements are as follows:

3.1.7.a Existing site and utility drawings shall be re-utilized to show all new site utility lines and improvements. Final set shall be in CAD format for final as-builts.

3.1.7.b Refer to the attached sample drawing matrix in for format of matrix to be used. Design team is to utilize this document to coordinate drawings.

3.1.7.c The project will deliver a complete set of coordinated and consolidated as-built drawings for future use. All drawings will be on NAVFAC title page and provided in CAD and PDF formats. Refer to attached consolidation document and paragraph 4.4.2.b below for further guidance.

3.1.8 Pre-Construction Data Collection Phasing: All required pre-construction data collection and analysis shall be submitted and approved prior to issuance of NTP for disturbance, demolition, and/or construction activities that permanently change the existing conditions.

3.1.9 Pre-Construction As-Built Consolidation Phasing: All As-Built consolidation into the master set shall be completed, submitted and approved prior to issuance of NTP for disturbance, demolition, and/or construction activities. This includes retiring of existing drawings incorporated into the master set. The approved master set shall then be used for construction and As-Built during construction.

3.1.10 Completeness of Renovation: This Statement of Work was developed to capture the most significant requirements; work shall include minor ancillary items necessary to provide completeness of work elements.

3.1.11 Codes, Requirements and Referenced Criteria: Efficient and effective application of reference criteria, codes, requirements, regulations, etc., as applicable to the scale of the subject project is noted as a design challenge. These documents are lengthy and contain content that must be determined to be applicable and applied where required. Refer to references throughout the SOW and attachments.

3.1.12 Construction Phasing and Security Operations Shutdowns: The contractor shall assume that actual construction shall be phased as indicated in the SOW and that work during construction may be delayed a full day or more in order to accommodate an unanticipated short duration operational event. See Part 2A, Section 01140.

4.0 TECHNICAL PERFORMANCE AND PRESCRIPTIVE REQUIREMENTS

4.1 GENERAL TECHNICAL REQUIREMENTS

4.1.1 Technical requirements necessary for use in analysis and construction shall be further developed and identified during the design phase to provide complete and usable facilities.

4.1.1.a Refer to the below and to Part 2B for additional design requirements.

4.1.1.b **Design Engineer:** Independent Engineering services must be performed and/or validated by a Registered Professional Electrical Engineer with distribution system experience similar to that gained working as a Power Systems or Transformer Engineer. The independent third party shall have not previously performed engineering design, equipment selections, studies, modification or any other like type work on this system. The Registered Professional Electrical Engineer must have a minimum of fifteen (15) years of experience in performing High Voltage Distribution System Design Build Construction. The Registered Professional Electrical Engineer must also demonstrate experience with Power Systems and Transformer Engineering. Work includes, but is not limited to the following:

i. ELECTRICAL SYSTEM MODELING: Update existing SKM model to fully and accurately reflect the proposed conditions upon final installation, including but not limited to all new equipment and changes in configuration.

ii. Provide deliverables per Part 2B.

4.1.1.c **Design Transients:** Transformers shall be designed to withstand crowbar, direct current overload, and carrier cutoff transients. At a minimum this shall include the provision of bracing at a minimum of 1.25 times the nameplate capacity of each transformer. Provide minimum 550 kV BIL for line to ground. Provide additional strengthening for all provided components as recommended by the transformer manufacturer and/or design engineer. The design transients are:

i. Crowbars are the term for an event where the transmitter's DC power supply bus is shorted to ground. The transmitter's electronic circuit is designed to protect the vacuum tubes from an

overload or a fault condition by initiating a crowbar event. Crowbars are initiated either automatically at random intervals by the transmitter's electronic circuit control or manually by operators when performing system maintenance tests. The power supply system reacts to a crowbar as if it were a three-phase bolted fault at the transformer windings. Peak current of 55,000 Amps may occur.

ii. Direct current overloads are similar to crowbars and the system will react as if a bolted fault occurred. The primary difference is the impedance between the fault location and the generators will vary. The variation will cause the fault currents to vary.

iii. Carrier cutoff is a condition when the transmitter detects a transmission issue. To correct the situation, the transmitter will bring down the load over a period of 25 milliseconds. After 500 milliseconds, the transmitter will bring the load back up over a period of 25 milliseconds. If the issues continue, the carrier cutoff will repeat three times. After the third occurrence, the system will lock out and require a manual restart. To a power system, the carrier cutoff will appear as a sudden loss of all loads and then the assumption of a large block load.

4.1.1.d **Attached Design Specifications:**

i. Designer shall use the relevant design transformer parameters contained in Attachment E1 to update the latest version of UFGS. This updated UFGS specification section, modified as appropriate by paragraph 4.4.1.b above, shall then be used by the Contractor for design of the new transformers.

4.1.1.e **Transformer Design Efficiency**

i. Transformer design efficiency shall follow DOE, FEMP, and Energy Star Standards and minimize losses in the spirit of the 2016 DOE Standard – 10 CFR Part 431 Energy Conservation Standards for Distribution Transformers, Final Rule or equivalent shall apply.

ii. Transformer design shall minimize expected losses. Transformer efficiency at 100% excitation voltage shall not be less than 98.82% at 10% nameplate-rated load and not less than 99.47% at 30% nameplate-rated load as determined according to the DOE test method for measuring the energy consumption of distribution transformers under Appendix A to Subpart K of 10 CFR part 431.

4.2 CODES AND STANDARDS:

4.2.1 Comply with codes and standards specified herein in specific elements of work.

4.2.2 Refer to Parts 2A and 2B for specific listing of applicable Unified Facilities Criteria (UFC) Manuals and the specific codes reference within the UFC document.

4.2.3 Utilize the latest revision/edition of the referenced codes and standards listed herein at the time of award.

4.3 MATERIAL REQUIREMENTS:

4.3.1 The design team in coordination with the contractor shall select high-quality commercial grade materials for use that meet the prescriptive or performance requirements included herein including but not limited to requirements for harmonic control.

4.3.2 Refer also to Part 2A and 2B for material submittal, specifications and design requirements and additional requirements listed below.

4.4 DATA COLLECTION, CONSOLIDATION, AND ANALYSIS:

4.4.1 DATA COLLECTION & ANALYSIS – GENERAL REQUIREMENTS

4.4.1.a **Data Collection and Analysis:**

i. Electrical utility system data collection, analysis, and associated work as listed in each work element below.
   a. Electrical distribution system modeling: Update electrical utility system modeling to the proposed design using SKM's Power Tools software.
      i. Use Version 7.0.5.1 in order to remain compatible with Government software.
      ii. Use attached model as the baseline concept. A fully verified model will be provided at the time of design by the Government.
      iii. Input data and update one-line modeling using version 7.0.5.1 of SKM® software.

iv. Perform in accordance with UFC 3-501-01 section 3-2.5.4.

4.4.1.b **Systems Coordination and Verification:**

i. AMI System Update: The existing electrical feeders are equipped with Advanced Metering Initiative (AMI) System installed by Schneider Electric which provides a full range of electric system parameters.
   b. Obtain readings by competent individuals prior to de-energizing.
   c. Test pre and post construction AMI meter functionality in the presence of the COR and appropriate Government subject matter experts.
      i. All voltage phases are present.
      ii. Phase rotation is correct.
      iii. Phase angles are correct.
      iv. The meter accurately measures power magnitude and direction, and can communicate to the DAS.
   d. Field verify CT on each phase of the transformer and/or associated feeders.
   e. See attached existing AMI system information.

ii. SCADA Interface: The existing SCADA system has auto/manual control for the existing voltage regulators. Remove existing control wiring from the PLC digital output card in the Substation 45 walk-in switchgear control panel to each of the existing voltage regulators (voltage regulators to be demolished). Provide auto/manual control for provided automatic load tap changing equipment at each transformer. Extend existing raceway to new equipment and provide new wiring for auto/manual control. Perform testing and verification of auto/manual control to each automatic load tap changer. Conduct post-construction testing to demonstrate proper operation. Including verifying that remote monitoring/control from B01 has been maintained.

iii. System Commissioning: As per ANSI/NETA ATS-2013 and attached addendum to Section 33 73 00.00 40.

4.4.1.c **Facility As-built Drawing Consolidation and Organization**

i. **Background**
- Numerous sets of drawings have been created during the life-cycle of Area 45. These documents are currently not assembled or maintained in single sequential drawing set.
- This project begins the process of converting drawings into AutoCad format and assembling them into a uniform comprehensive "Area 45" set.
- The Area 45 Substation Replacement drawing set shall constitute the master set to which relevant As-built information shall be added to from all other existing drawings.

ii. A consolidated and complete set of facility as-built drawings shall be assembled by the AEDOR for the project. The set shall utilize existing project drawings and incorporate existing facility as-built drawing information from other drawings into the set.

iii. Renaming and re-numbering shall occur to deliver an organized final set for use. Drawing and document file naming conventions must be understood, mutually agreed to, and delivered as specified.

iv. **Consolidation Details**
- Existing drawings identified in the coordination matrix shall have relevant details transferred to the master set. Transferred information shall be clouded on the existing drawing and annotated as to what master set sheet(s) now contain
- Out-of-Date information on existing drawings shall be struck out.
- Existing drawing marked "Retired"
- Where new site features, design details and other CAD generated work is necessary but does not fit onto the master set, new drawings can be created, or existing drawings recreated and modified in CAD to allow for incorporation of the new work. Follow master set numbering.
- Refer to Part 2B for CAD criteria and professional registration and design signing and stamping requirements.

v. Utilize the attached Facility Drawing Coordination Matrix for use in planning and obtaining approval for creation of new drawings and reuse and\or modify existing facility drawings prior to proceeding.

vi. Drawing Coordinator and Progress Tracking: The AEDOR shall appoint a single individual who is responsible for creating a pre-

design drawing coordination matrix. This position shall track the status of all drawing requirements and shall provide an updated matrix tracking sheet every two weeks throughout the project, including the "as-built" close-out phase.

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