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GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 VETERANS EMPLOYMENT EMPHASIS FOR U.S. ARMY CORPS OF ENGINEERS CONTRACTS

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01 00 00.00 28

GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 VETERANS EMPLOYMENT EMPHASIS FOR U.S. ARMY CORPS OF ENGINEERS CONTRACTS

In addition to complying with the requirements outlined in FAR Part 22.13, FAR Provision 52.222-38, FAR Clause 52.222-35, FAR Clause 52.222-37, DFARS 222.13 and Department of Labor regulations, U.S. Army Corps of Engineers (USACE) contractors and subcontractors at all tiers are encouraged to promote the training and employment of U.S. veterans while performing under a USACE contract. While no set-aside, evaluation preference, or incentive applies to the solicitation or performance under the resultant contract, USACE contractors are encouraged to seek out highly qualified veterans to perform services under this contract. The following resources are available to assist USACE contractors in their outreach efforts:

Federal Veteran Employment Information
https://www.opm.gov/fedshirevets/

Department of Labor Veterans Employment Assistance
https://www.dol.gov/agencies/vets

Department of Veterans Affairs-VOW to Hire Heroes Act
https://benefits.va.gov/vow/

Army Recovery Care Program -
https://myarmybenefits.us.army.mil/Benefit-Library/Federal-Benefits/Army-Recovery-

U.S. Chamber of Commerce Foundation-Hiring Our Heroes
https://www.hiringourheroes.org/

Guide to Hiring Veterans - Reference Material
https://www.dol.gov/sites/dolgov/files/VETS/files/Employer-Guide-to-Hiring-Veteran

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SUPPLEMENTARY REQUIREMENTS

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1.3 DEFINITIONS
1.4 FIELD VERIFICATION OF SITE CONDITIONS
1.5 DOCUMENT SUBMITTALS
1.6 SUPPLEMENTAL DRAWINGS
1.7 EQUIPMENT LIST
1.8 TESTING OF EQUIPMENT
1.9 PROJECT SCHEDULE
1.10 PROTECTION AND RESTORATION OF EXISTING FACILITIES
1.11 CONTRACTOR RESPONSIBILITY FOR CONTRACT WORK
1.12 DISCONNECTED OIL LINES
1.13 FINAL INSPECTION AND GOVERNMENT ACCEPTANCE
1.14 POST AWARD MEETINGS
1.14.1 Pre-Work/Pre-Fabrication
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1.15 WEEKLY PRODUCTION MEETINGS
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1.15.3 Minutes
1.16 ADDITIONAL MEETINGS
1.17 GOVERNMENT QUALITY ASSURANCE SURVEILLANCE PLAN (QASP)

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

ATTACHMENTS:

Weekly Meeting Agenda

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SECTION 01 11 01.00 28

SUPPLEMENTARY REQUIREMENTS

PART 1 GENERAL

The work covered by this section of the specifications consists of work common to more than one section of these TECHNICAL SPECIFICATIONS.

1.1 REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 Safety and Occupational Health Requirements

Comply with the current edition and all changes posted on the web as of the effective date of this solicitation.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. Designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment List; I, C

Project Schedule; G, C

1.3 DEFINITIONS

a. Qualified Person.

As defined in EM 385-1-1; "DEFINITIONS", unless otherwise specified.

1.4 FIELD VERIFICATION OF SITE CONDITIONS

Field verify all elevations, dimensions, and coordinates of existing features indicated on the contract drawings that affect new fabrication. Any variations must be updated as per SECTION 01 78 00.00 28, CLOSEOUT SUBMITTALS, paragraphs WORKING AS-BUILT DRAWINGS.

1.5 DOCUMENT SUBMITTALS

In addition to other specified submittal requirements, a copy of all documents submitted as part of work on this contract, must be e-mailed to the Contracting Officer Representative (COR) and submitted in Resident Management System Contractor Mode (RMS CM). Include project contract

number, title, and e-mail topic in all e-mail subject lines.

1.6 SUPPLEMENTAL DRAWINGS

a) A “Supplemental Drawings” packet is provided as part of this contract for information only and is not part of Contract work. These drawings are not available in CAD. These drawings depict the best estimate of existing components and equipment. The Government does not guarantee the accuracy of Supplemental Drawings.

b) Contractor shall verify accuracy of these drawings prior to use. Any errors or deficiencies arising from use of these drawings shall be the responsibility of the Contractor and corrected at no additional cost to the Government.

1.7 EQUIPMENT LIST

Furnish a complete list of all equipment to be used on the Project 30 days prior to commencement of on-site work. Submit a revised list in the event of change of equipment. Lists includes rented equipment as well as lease-purchase or sale-leaseback equipment. The initial list and the revised lists shall indicate dates equipment is assigned to or removed from the Project and adequate identification or description of each item of equipment including manufacturer's name (abbreviated), model number, manufacturer's serial number, year of manufacture, and Contractor's assigned serial or record number.

1.8 TESTING OF EQUIPMENT

Before any machinery or mechanized equipment is put to use on the job, it must be inspected and tested by a qualified person and determined to be in safe operating condition. Cranes or derricks must be tested by the Contractor or a qualified testing agency in accordance with EM 385-1-1. Equipment must be large enough to safely handle proposed picks or tasks without exceeding the crane rating established by these tests.

1.9 PROJECT SCHEDULE

a. Furnish a cost loaded schedule for the complete project within 30 days after receipt of Notice of Award.

b. Email a digital copy of the schedule, in the original format the schedule was developed in (e.g. .xer, .xls., .mpp, etc.), to the Contracting Officer's Representative (COR). See SECTION 01 33 00 SUBMITTAL PROCEDURES paragraph "Digital Copies" for email address.

1.10 PROTECTION AND RESTORATION OF EXISTING FACILITIES

Reference FAR 52.236-9 Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements (Apr 1984).

1.11 CONTRACTOR RESPONSIBILITY FOR CONTRACT WORK

The Contractor is responsible for correcting all damage and defects to work covered by this contract, until final acceptance by the Government.

1.12 DISCONNECTED OIL LINES

Anytime an oil line is disconnected by the Contractor due to work

performed under this contract it is the Contractors responsibility to cap the line. Oil line cap must be rated at 125 percent of the pressure in the line. Notify the Contracting Officer when an oil line has been disconnected. Document with the Contracting Officer when the disconnected oil line has been sealed to ensure no transfer of oil or water, from or into the sealed line.

1.13 FINAL INSPECTION AND GOVERNMENT ACCEPTANCE

a. Final acceptance of the spare transformers will occur at Little Goose Lock and Dam storage yard upon delivery. After off-loading spare transformers, crating material may be removed, at the COR's discretion, to inspect all deliverables.

b. All spare transformer related items, that arrive at the Project in damaged packaging will be further inspected at the Project Site. The Contractor is responsible for correcting all damage that occurred during shipping, prior to Government acceptance, at no additional cost to the Government.

c. A complete final spare transformer inspection will be conducted during the offloading process as indicated in above paragraph "SPARE TRANSFORMER DELIVERY REQUIREMENTS".

d. Final payment for each spare transformers will not made until the "Transformer Field Test Report" submittal according to SECTION 48 20 00.04 26, TRANSFORMER SHIPMENT, HAULING AND SITE ASSEMBLY has been completed and approved by the Government.

1.14 POST AWARD MEETINGS

1.14.1 Pre-Work/Pre-Fabrication

Within 15 calendar days after receipt of Notice of Award, attend a Pre-Work/Pre-Fabrication Meeting. Pre-work/Pre-Fabrication meeting may be in person or via conference call. Senior Level members of the Contractor's staff involved with this contract shall participate in this meeting to discuss the overall contract requirements. The Government will lead the Pre-Work portion of the meeting, and take the meeting minutes.

1.14.2 Pre-Fabrication

For the Pre-Fabrication part of the meeting, the Project Superintendent shall lead the meeting and discuss the Contractor's plan on executing the work at the work site, schedule, and plan for implementing quality control.

1.14.2.1 Minutes

The Contractor is responsible for taking the meeting minutes and must send them electronically within 48 hours of the meeting to the Government's Project Engineer, Quality Assurance Representative, and Resident Engineer. Include project name and meeting topic in e-mail subject line.

1.14.3 RMS Orientation Meeting

a. Upon the Contractor's request, an RMS (Resident Management System) Orientation Meeting will be held after receipt of Notice of Award. See SECTION 01 45 01.00 28 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM) for additional information. The Orientation Meeting will be held

at NWW District Headquarters, and may occur in conjunction with, but not at the same time as, the Pre-Work Meeting. The Orientation Meeting can also occur via video conference. Coordinate meeting date and time with the Contracting Officer a minimum of 7 calendar days prior to the meeting.

b. At a minimum, the Contractor's RMS-CM Administrator and QC system manager must attend the RMS Orientation meeting. A Government Representative will lead the orientation. Anticipate the following at the meeting:

1. Allow for a maximum 4 hour duration.

2. Cover the following topics, at a minimum, in RMS Contractor Mode (CM):

i. Contractor use of RMS (CM) system.

ii. Contractor Data.

iii. Quality Control Reports.

iv. Submittals.

v. RFIs.

vi. Payment.

3. Receive a follow-up handout/guide for reference on the above items.

c. Contractor employees shall bring a computer with Wi-Fi capability (to gain access to the Internet), with RMS pre-loaded.

d. The RMS Orientation Meeting is required for Contractors with no prior RMS experience. The RMS Orientation Meeting, is optional, but may be requested, for all other Contractors.

e. The purpose of the RMS Orientation Meeting is to facilitate Contractor's use of RMS (CM). It does not relieve the Contractor of the requirement to use RMS (CM) in accordance with the Contract. See SECTION 01 45 01.00 28 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM), paragraph RMS SOFTWARE for information related to required download and installation deadlines.

1.15 WEEKLY PRODUCTION MEETINGS

1.15.1 Production Briefings

During all fabrication, hold a weekly production meeting to brief the Government on the status of the project.

a. Use the attached "Weekly Meeting Agenda" and discuss all elements of this agenda.

b. Provide a two (2) week 'look ahead'.

1. Describe all planned fabrication activities over the next two (2) weeks.

2. ENSURE these activities align to the overall fabrication SCHEDULE submitted under PROJECT SCHEDULE.

3. RECORD any changes to the Project Schedule AND INCLUDE IN the next scheduled update.

c. Key members of the Contractor's staff including the Quality Control System Manager must attend.

d. The Quality Control System Manager shall discuss all QC aspects outlined in SECTION 01 45 00.01 28 CONTRACTOR QUALITY CONTROL.

e. The Government reserves the right to require any person from the Contractor's staff such as the Project Manager, Engineer, Scheduler or Key Subcontractor Personnel to attend the meeting.

1.15.2 Fabrication Progress Photos

a. During fabrication activities, record fabrication progress by submitting weekly progress photographs. Provide photos of fabrication activities and progress to the Government for unrestricted use by the Government.

1. Submit photos at the end of each work week.

2. Furnish digital photographs, Utilize JPEG file format for all photograph and image files.

3. Provide full-color photos with photo resolution of not less than 4 megapixels and not more than 12 megapixels showing the sequence and progress of work.

4. Take a minimum of 20 digital photographs each week throughout the entire project.

5. Submit weekly digital photographs at weekly production meetings.

b. Ensure that the photographs are digitally dated. A log must be furnished for each photograph that records the following information:

1. Photograph number (the specific format should be tied to the filename of the digital photograph).

2. Date the photograph was taken.

3. A brief description of the location, what the photograph depicts, and the orientation of the view.

1.15.3 Minutes

The Contractor is responsible for taking the meeting minutes and shall send them electronically within 24 hours of the meeting to the Government's Project Engineer, Quality Assurance Representative, and Resident Engineer. Include project name and meeting topic in e-mail subject line.

1.16 ADDITIONAL MEETINGS

Record the minutes of all meetings, including all conference calls, that occur between the Contractor and Government. Send minutes electronically within 24 hours of the meeting to the Contracting Officer for concurrence. E-mail subject line shall include project name and meeting topic.

1.17 GOVERNMENT QUALITY ASSURANCE SURVEILLANCE PLAN (QASP)

1. The Government will monitor the Contractor's performance under this contract using quality assurance procedures developed by the Government. Typical procedures might include random sampling, checklists, customer complaints, and observations.

2. The Government reserves the right to inspect and test all services called for by the contract, to the extent practicable at all times and places during the term of the contract. The Government will perform inspections and tests in a manner that will not unduly delay the work.

3. If any of the services do not conform to contract requirements, the Government will request the Contractor to perform the services again, where appropriate, in conformity with contract requirements, at no increase in contract amount. When the defects in services cannot be corrected by re-performance, the Government may (1) require the Contractor to take necessary action to ensure future performance conforms to contract requirements and (2) reduce the contract price to reflect the reduced value of the services performed.

4. If the Contractor fails to promptly re-perform the services or to take the necessary action to ensure future performance in conformity with contract requirements, the Government may by contract, or otherwise (1) perform the services and charge to the Contractor any cost incurred by the Government that is directly related to the performance of such service or (2) terminate the contract in whole or in part.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

Weekly Meeting agenda template

Schedule -

Work scheduled over the next week
Three week look ahead
Overall Schedule Review

Submittals Review-

Submittal Register
Submittals approved by QC
Outstanding Submittals
RFI's
Letters

Coordination -

Clearances required over the next week, include the following:

- A description of the work to be performed under the Clearance.
- Determine the correct energy isolation points needed to perform the work safely.
- Physical barriers, protective grounds, piping blanks, or bulkheads that shall be used, including locations.
- Determine the procedure and method of testing for stored energy if applicable.
- The date and time the Clearance shall be required.
- The estimated length of time the system or equipment shall be out of service and the time to return the system or equipment to service in an emergency.

Coordination issues

Safety-

Review of AHA's for ongoing work
Pending AHA's
- Required for new work
- Status of Gov't approval

Safety issues

QC -

Preparatory meetings
- Held over last week- status of meeting minutes
- Required over the next week

Initial meetings over the next week
Follow up over the next week
Rework list
Review Deficiency tracking log

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 14 00.10 28

PROJECT SITE RESTRICTIONS

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 SITE CONDITIONS AND OPERATIONAL RESTRICTIONS
1.4 PROJECT SECURITY
1.4.1 Contractor Vehicle Access
1.4.2 Identification of Employees
1.4.2.1 Non-US Citizens
1.5 DELIVERY OF EQUIPMENT
1.6 LIFTING DEVICES
1.7 FACILITY OCCUPANCY CLOSURE
1.8 WORK SCHEDULES
1.8.1 Contractor's Work Schedule
1.8.2 Government's Work Schedule
1.9 USE OF WALLA WALLA DISTRICT PARKS

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01 14 00.10 28

PROJECT SITE RESTRICTIONS

PART 1 GENERAL

1.1 REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 Safety and Occupational Health Requirements

Comply with the current edition and all changes posted on the web as of the effective date of this solicitation.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. A designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Foreign Visit Request (FVR) Form; G, SLE

1.3 SITE CONDITIONS AND OPERATIONAL RESTRICTIONS

1. Government cranes are NOT available for Contractor use.

1.4 PROJECT SECURITY

The Project site is a secured area and access onto the Project is restricted. The security measures affect all of the Contractor's vehicles and personnel. There will be delays when entering Projects due to locked gates, vehicle inspections, and personnel checks. Inspections and checks may include inspection of tool boxes, brief cases, lunch boxes, and other containers.

1.4.1 Contractor Vehicle Access

Project access roads on both sides of the dams are secured with locked gates. All vehicles that pass through the locked gates will be subject to being searched. No privately owned vehicles (POV's) will be allowed through locked gates. Only Contractor's work vehicles and equipment that are essential to the conduct of the work will be allowed in the work areas. All Contractor vehicles shall display suitable permanent or temporary identification.

1.4.2 Identification of Employees

Every Contractor employee (prime or subcontractor) shall have a hard hat meeting the requirements of EM 385-1-1. Hardhats shall display the Prime Contractor name, subcontractor name, and the employee's name. Contractor employee hardhats shall **not** be white with red markings. It shall be the responsibility of the Project Superintendent to enforce this requirement.

1.4.2.1 Non-US Citizens

a. Non-US citizen access to Little Goose Lock & Dam Project site, requires submittal and approval of a Foreign Visit Request (FVR) form, available from the KO. FVR forms will be reviewed by the USACE Walla Walla District Security Office, and must be submitted according to the following requirements:

1. Chinese Nationals, a minimum of 95 calendar days prior to anticipated access date.

2. All other nationalities, a minimum of 35 calendar days prior to anticipated access date.

3. Include a copy of the employee's passport with the FVR form submittal.

4. Submit each FVR Form separately. Do NOT submit multiple forms in the same submittal.

b. Individuals with a Permanent Resident Card do NOT need to submit a FVR Form. Submit a current copy of the Permanent Resident Card.

c. Individuals in the United States on a work VISA must submit a FVR Form along with a current copy of the work VISA.

d. Access in less than the required number of days requires an approved waiver and is not guaranteed. Contact the KO for additional information.

1.5 DELIVERY OF EQUIPMENT

Contractor shall be responsible for delivery and receipt of all materials and equipment. Government personnel will not be available to assist the Contractor in these activities. To the maximum extent possible, deliveries shall arrive on the same side of the river as the Contractor's work area. Delivery vehicles will be allowed to cross the river over the dam only with Government approval. Delivery vehicles arriving on the opposite side of the river as the work area shall be unloaded outside the locked gate, equipment shall be loaded onto Contractor's vehicles, and Contractor's vehicles will then be allowed to cross the dam to the work area.

1.6 LIFTING DEVICES

The Contractor is responsible for furnishing all rigging, lifting devices, and containers for use with the cranes. Any special lifting devices required for handling new equipment furnished by the Contractor must be turned over to the Government upon completion of the contract. Standard slings and shackles are not considered "special" lifting devices.

1.7 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government cannot be closed or obstructed without written permission from the Contracting Officer.

1.8 WORK SCHEDULES

1.8.1 Contractor's Work Schedule

At the Pre-Work Meeting, furnish a schedule of number of working days per week, shifts per day, and hours per shift for contract work. Furnish notification of any change of schedule of regular work hours, overtime work hours, and shifts of work crews and personnel at the site. This notification shall be provided a minimum of 48 hours prior to any schedule change to allow suitable scheduling of Government personnel and inspection. Exception to this requirement may be allowed in case of schedule change due to emergency conditions.

1.8.2 Government's Work Schedule

a. Maintenance crews at Little Goose Lock & Dam work from 6:30 a.m. to 5:00 p.m., Monday through Thursday. Crews and staff do not work on weekends and Federal holidays. If a Federal holiday falls on a Friday, the crews and staff do not work on the preceding Thursday. A powerhouse operator is at the site 24 hours a day, 7 days a week, including Federal holidays but is not available to assist the Contractor.

b. The Contractor must coordinate with the Government to support, or assist with all deliveries. Deliveries are made between the hours of 10:00 a.m. to 2:00 p.m. (Monday - Thursday) only.

c. If the Contractor requires Government support or assistance outside of normal work hours, the Contractor must make a formal written request to the COR at least one week prior to the date that support/assistance is needed. The Government will review this request, but there is no guarantee that Government support or assistance can be provided.

1.9 USE OF WALLA WALLA DISTRICT PARKS

Special consideration for the use of the Walla Walla District Camping Grounds **will not** be given to the Contractor if camping at these sites. The Contractor's crew may not use Government parking lots near the Little Goose Lock and Dam for RV parking.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 14 00.90 28

INTEGRATING ANTITERRORISM (AT) AND OPERATIONS SECURITY (OPSEC)

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 RESOURCES
1.4 GENERAL SECURITY REQUIREMENTS AND GUIDANCE
1.5 PHYSICAL SECURITY AND ACCESS CONTROL REQUIREMENTS
1.6 ESCORTING IN CLASSIFIED AND/OR SENSITIVE AREAS
1.7 PRE-SCREEN CANDIDATES USING E-VERIFY PROGRAM

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01 14 00.90 28

INTEGRATING ANTITERRORISM (AT) AND OPERATIONS SECURITY (OPSEC)

PART 1 GENERAL

The work covered by this section of the specifications consists of work common to more than one section of these TECHNICAL SPECIFICATIONS. This contract does not require access to or handling of classified material. This contract does not require access to secured and restricted areas, sensitive information, or equipment. Secured area is considered any location where on-site work is performed by contractor personnel. The restricted areas, sensitive information, or equipment consists of everything inside the security fence at the project.

1.1 REFERENCES

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

FEDERAL ACQUISITION REGULATIONS (FAR)

FAR 52.222-54	Employment Eligibility Verification
FAR 22.18	Employment Eligibility Verification
FAR 22.102-1	Federal and State labor requirements

Website for Federal Acquisition Regulation Supplement:
https://www.acquisition.gov/browse/index/far

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. The designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pre-Screen Candidates Using E-Verify Program; G, C

1.3 RESOURCES

The following resources are accessible from the Walla Walla District (NWW) Public Website:

https://www.nww.usace.army.mil/Business-With-Us/Contracting/AT-OPSEC-for-Contractors/

a. E-Verify Program.

1.4 GENERAL SECURITY REQUIREMENTS AND GUIDANCE

a. The security requirements described in this SECTION apply to **all**

contractor personnel supporting the performance requirements of this contract. Contractor personnel includes employees of the prime Contractor ("Contractor") and all subcontractor employees. The Contractor is responsible for compliance with these security requirements. Questions regarding security matters must be addressed to the Contracting Officer (KO).

b. The Department of Defense (DoD) and Army security training requirements specified in this SECTION, are performance requirements. All contractor personnel shall complete initial training within 30 calendar days of contract Notice of Award, or the date new contractor personnel begin performance on the contract. Within five business days from the completion of training, the Contractor shall submit written documentation of completed training to the KO. **The documentation shall include the names of contractor personnel trained, and which training they completed.** The Contractor shall maintain training records as part of their contract files and be prepared to provide copies of training certificates to the KO.

c. Contractor personnel and vehicles are subject to search when entering federal installations. Additionally, all contractor personnel shall comply with Force Protection Condition (FPCON) measures, Random Antiterrorism Measures (commonly referred to as "RAMs"), and Health Protection Condition (HPCON) measures.

d. The Contractor is responsible for meeting performance requirements during elevated FPCON and/or HPCON levels in accordance with applicable Walla Walla District (NWW) plans and procedures. This includes identifying mission essential and non-mission essential personnel.

e. In addition to the changes otherwise authorized by the changes clause of this contract, should the FPCON or HPCON levels at any individual facility or installation change, the Government may implement security changes that affect contractor personnel. The Contractor shall ensure all contractor personnel are aware of their security responsibilities, including any site-specific requirements identified in local policies or procedures.

1.5 PHYSICAL SECURITY AND ACCESS CONTROL REQUIREMENTS

a. All contractor personnel requiring physical access to a federal installation or facility must comply with the access control procedures of that location.

b. Contractor personnel requiring unescorted access to meet contract performance requirements on a DoD installation in the US shall be vetted by the installation/facility Provost Marshal/Directorate of Emergency Services/ Security Office using the National Crime Information Center-Interstate Identification Index (commonly referred to as "NCIC-III") and Terrorist Screening Database (commonly referred to as "TSDB"). Contractor personnel shall comply with all personal identity verification requirements specified in installation/facility policies and procedures.

c. **Contractor personnel who do not meet requirements for unescorted access to USACE facilities shall coordinate escorted access with the KO, as needed.** Coordinate escorted access with the KO a minimum of 14 calendar days prior to date of needed escort. Government escorts are

dependent upon availability of personnel. The Government is not responsible for impacts to Contractor work due to unavailability of Government escorts.

d. Contractor personnel who receive keys, access cards, or lock combinations that provide access to government-owned property shall comply with key and lock control procedures of NWW.

1.6 ESCORTING IN CLASSIFIED AND/OR SENSITIVE AREAS

In accordance with applicable regulations, all contractor personnel who do not possess the appropriate security clearance or access privileges will be escorted in areas where they may be exposed to classified information or operations, sensitive information or activities, or restricted areas.

1.7 PRE-SCREEN CANDIDATES USING E-VERIFY PROGRAM

a. Contractors must comply with the requirements set forth in FAR 52.222-54 Employment Eligibility Verification and FAR 22.18 in using the E-Verify Program to meet the contract employment eligibility requirements. Contractors are encouraged to cooperate with Federal and State agencies responsible for enforcing labor requirements to include eligibility for employment under United States immigration laws in accordance with FAR 22.102-1. See paragraph RESOURCES for link to the E-Verify website.

b. An initial list of verified/eligible candidates shall be provided to the KO no later than three business days after receipt of Notice of Award. Submit pre-screening results to the KO via email as a password protected pdf file.

c. Submit updates to list of verified/eligible candidates within three business days of new verifications. The Contractor shall maintain a current list of verified/eligible employees as part of their contract files and provide copies to the KO upon request.

d. When contracts are with individuals, the individuals will be required to complete a Form I-9, Employment Eligibility Verification, and submit it to the Contracting Officer to become part of the official contract file.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01 32 16.00 28

SMALL PROJECT FABRICATION AND ASSEMBLY PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. Designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Fabrication And Assembly Schedule; G, C

SD-07 Certificates

Monthly Updates; G, C

1.2 ACCEPTANCE

Prior to the start of work, prepare and submit to the Contracting Officer Representative (COR) for acceptance a fabrication and assembly schedule in the form of a Network Analysis Schedule (NAS), except as modified in this contract.

The acceptance of a Baseline Fabrication And Assembly Schedule is a condition precedent to:

a. The Contractor starting work on the fabrication stage(s) of the contract.

b. Processing Contractor's invoice(s) for fabrication and assembly activities/items of work.

c. Review of any schedule updates.

Submittal of the Baseline Schedule, and subsequent schedule updates, is understood to be the Contractor's certification that the submitted schedule meets all of the requirements of the Contract Documents, represents the Contractor's plan on how the work will be accomplished, and accurately reflects the work that has been accomplished and how it was sequenced (as-built logic).

1.3 SCHEDULE FORMAT

1.3.1 Network Analysis Schedule (NAS)

Use the critical path method (CPM) to schedule and control project activities. Prepare and maintain project schedules using Primavera P6 or Microsoft Project 2016. Importing data into the scheduling program using data conversion techniques or third party software is cause for rejection of the submitted schedule. Build the schedule as follows:

a. The Project Schedule must show pre-fabrication submittals, Government review periods, material/equipment delivery, utility outages, all on-site assembly, inspection, testing, and closeout activities. Government and Contractor on-site work activities must be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days.

b. With the exception of the Contract Award and End Contract milestone activities, no activities are to be open-ended; each activity must have predecessor and successor ties. No activity must have open start or open finish (dangling) logic. Minimize redundant logic ties. Once an activity exists on the schedule it must not be deleted or renamed to change the scope of the activity and must not be removed from the schedule logic without approval from the COR. While an activity cannot be deleted, where said activity is no longer applicable to the schedule but must remain within the logic stream for historical record, it can be changed to a milestone. Document any such change in the milestone's "Notebook", including a date and explanation for the change. The ID number for a deleted activity must not be re-used for another activity.

c. Each activity must be assigned its appropriate Responsibility Code indicating responsibility to accomplish the work indicated by the activity, Phase Code and Work Location Code.

d. Date/time constraint(s) and/or lags, other than those required by the contract, are not allowed unless accepted by the COR. Include as the last activity in the contract schedule, a milestone activity named "Contract Completion Date".

1.3.1.1 Primavera P6 Settings and Parameters

Use the following Primavera P6 settings and parameters in preparing the Baseline Schedule. Deviation from these settings and parameters, without prior consent of the COR, is cause for rejection of schedule submission.

a. General: Define or establish Calendars and Activity Codes at the "Project" level, not the "Global" level.

b. Admin Drop-Down Menu, Admin Preferences, Time Periods Tab:

(1) Set time periods for P6 to 8.0 Hours/Day, 40.0 Hours/Week, 172.0 Hours/Month and 2000.0 Hours/Year.

(2) Use assigned calendar to specify the number of work hours for each time period: Must be checked.

c. Project Level, Dates Tab:

(1) Set "Must Finish By" date to "Contract Completion Date".

d. Project Level, Defaults Tab:

(1) Duration Type: Set to "Fixed Duration & Units".

(2) Percent Complete Type: Set to "Physical".

(3) Activity Type: Set to "Task Dependent".

(4) Calendar: Set to "Standard 5 Day Workweek". Calendar must reflect Saturday, Sunday and all Federal holidays as non-work days. Alternative calendars may be used with COR approval.

e. Project Level, Calculations Tab:

(1) Activity percent complete based on activity steps: Must be Checked.

(2) Reset Remaining Duration and Units to Original: Must be Checked.

(3) Subtract Actual from At Completion: Must be Checked.

(4) Recalculate Actual units and Cost when duration percent(%) complete changes: Must be Checked.

(5) Link Actual to Date and Actual This Period Units and Cost: Must be Checked.

f. Project Level, Settings Tab:

(1) Define Critical Activities: Check "Total Float is less than or equal to" and add "0d".

g. No on-site assembly activity may have durations in excess of 10 working days.

1.3.1.2 Microsoft Project 2016 Settings and Parameters

The Network must have a minimum of 30 fabrication and assembly activities. No on-site assembly activity may have durations in excess of 10 working days.

1.3.2 Schedule Submittals and Procedures

Submit Network Analysis Schedules (NAS) and updates in hard copy and on electronic media that is acceptable to the COR. Submit an electronic back-up of the project schedule in an import format compatible with the Government's scheduling program.

1.4 SCHEDULE MONTHLY UPDATES

Update the Fabrication and Assembly Schedule at monthly intervals or when the schedule has been revised. The updated schedule must be kept current, reflecting actual activity progress and plan for completing the remaining work. Submit copies of purchase orders and confirmation of delivery dates as directed by the COR.

a. Narrative Report: Provide with schedule updates. Identify and justify;

(1) Progress made in each area of the project

(2) Critical Path

(3) Date/time constraint(s), other than those required by the contract

(4) Changes in the following; added or deleted activities, original and remaining durations for activities that have not started, logic, milestones, planned sequence of operations, and critical

path

(5) Status of Contract Completion Date and interim milestones;

(6) Current and anticipated delays (describe cause of delay and corrective actions(s) and mitigation measures to minimize);

(7) Description of current and future schedule problem areas.

Each entry in the narrative report must cite the respective Activity ID and Activity Description, the date and reason for the change, and description of the change.

1.5 CONTRACT MODIFICATION

Submit a Time Impact Analysis (TIA) with each cost and time proposal for a proposed change. TIA must illustrate the influence of each change or delay on the Contract Completion Date or milestones. No time extensions will be granted nor delay damages paid unless a delay occurs which consumes all available Project Float, and extends the Projected Finish beyond the Contract Completion Date.

a. Each TIA must be in both narrative and schedule form. The narrative must define the scope and conditions of the change; provide start and finish dates of impact, successor and predecessor activity to impact period, responsible party, describe how it originated, and how it impacts the schedule. The schedule submission must consist of three native files:

(1) Fragnet used to define the scope of the changed condition

(2) Most recent accepted schedule update as of the time of the proposal or claim submission that has been updated to show all activity progress as of the time of the impact start date.

(3) The impacted schedule that has the fragnet inserted in the updated schedule and the schedule "run" so that the new completion date is determined.

b. For claimed as-built project delay, the inserted fragnet TIA method must be modified to account for as-built events known to occur after the data date of schedule update used.

c. All TIA's must include any mitigation, and must determine the apportionment of the overall delay assignable to each individual delay. The associated narrative must clearly describe the findings in a chronological listing beginning with the earliest delay event.

(1) Identify types of delays as follows:

(a) Excusable Delay: Force-Majeure (e.g. weather) - Contractor may receive time extension, but time will not be compensable.

(b) Inexcusable Delay: Contractor Responsibility - Contractor will not receive time extension.

(c) Compensable Delay: Government Responsibility - Contractor may receive compensable time extension.

(2) If a combination of any of the delay types outlined above occurs, it is considered a Concurrent Delay, which will require an analysis of the facts to determine compensability and entitlement to any time extension under the applicable contract clauses.

d. Submit Data disks containing the narrative and native schedule files.

e. Unless the COR requests otherwise, only add conformed contract modifications into the Project NAS.

1.6 CORRESPONDENCE AND TEST REPORTS:

All correspondence (e.g., letters, Requests for Information (RFIs), e-mails, meeting minute items, Production and QC Daily Reports, material delivery tickets, photographs) must reference Schedule Activities that are being addressed. All test reports (e.g., concrete, soil compaction, weld, pressure) must reference Schedule Activities that are being addressed.

1.7 ADDITIONAL SCHEDULING REQUIREMENTS

Any references to additional scheduling requirements, including systems to be inspected, tested and commissioned, that are located throughout the remainder of the Contract Documents, are subject to all requirements of this section.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

ATTACHMENTS:

ENG Form 4025

Submittal Register

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Make certain that each submittal is complete and in sufficient detail to easily determine contract compliance.

a. Use the same units of weights and measures as the contract drawings.

b. Contractor's Quality Control (CQC) System Manager must check and approve all items prior to submittal and stamp, sign, and date indicating action taken.

c. Clearly identify any proposed variations from the contract requirements.

d. Include drawings; literature (catalog cuts, diagrams, operating charts or curves); test reports; samples; O&M manuals (including parts list); certifications; warranties; and other necessary information.

e. Obtain submittal approval prior to acquiring the covered material or equipment.

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ERDC/ITL SR-23-1	(Aug 2023) A/E/C Graphics Standard, Release 2.2
ERDC/ITL SR-24-3	(Jul 2024) A/E/C Computer-Aided Design (CAD) Standard - Release 6.2

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. Designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Bentley DGN Sample Sheets; G, GS

1.3 DEFINITIONS

1.3.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required to be approved prior to commencing on-site work and fabrication work. Submittals required prior to the start of the next major phase of the fabrication on a multi-phase contract. Schedules or tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Unless otherwise specified testing must have been completed within three (3) years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after

installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a fabrication contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of fabrication on a multi-phase contract.

1.3.2 Reviewing Authority

Office or designated person to review submittal.

1.3.2.1 Action Elements for Submittal Review

AE Architect/Engineer
C Engineering & Construction Division, Construction Branch
CS Cybersecurity, Electrical Design Lead
DDC Walla Walla District Dive Coordinator, Safety Office
DDE Construction Branch, Designated Data Entry Point of Contact
A Engineering & Construction Division, Structural Design "Architectural"
ECC Operation's Division, Environmental Compliance Coordinator
ECCS Operation's Division, Environmental Compliance Coordinator and Safety Officer
OPC Operation's Division, Pesticide Coordinator
EL Engineering & Construction Division, Electrical Design
GT Engineering & Construction Division, Geotechnical Design
H Engineering & Construction Division, Hydraulic Design
ME Engineering & Construction Division, Mechanical Design
ST Engineering & Construction Division, Structural Design
TL Engineering & Construction Division, Technical Lead
HDC Hydroelectric Design Center
GE Engineering & Construction Division, General Engineering
GS Engineering & Construction Division, Geospatial
PMP Project Management Division, Planning
PEC Project Management Division, Planning, Environmental Compliance
SO Safety Office
SLE Security Law Enforcement Officer
EOC Engineering Design, Project Operations and Construction
CERL Construction Engineering Research Laboratory
EC Engineering and Construction

1.3.3 Work

As used in this SECTION, on- and off-site fabrication required by contract documents, including labor necessary to produce submittals, fabrication, materials, products, equipment, and systems incorporated or to be incorporated in such fabrication.

1.4 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

G - This code is for submittals requiring government approval that were listed in the original government-generated specs.

I - This code is used for both Government-generated submittals and Contractor-generated submittals. This code is reserved for submittals that don't require approval, e.g. test reports.

NOTE: See "Contractor Action Codes" Paragraph in this SECTION for further information.

1.4.1 Government Approved (G)

Government approval is required for extensions of design, critical materials, variations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Government approval is required for any variations from the Solicitation or Accepted Proposal and other items as designated by the Contracting Officer. Within the terms of the Contract Clause submittals are considered to be "shop drawings."

1.4.2 Information Only (I)

Submittals not requiring Government approval will be for information only (FIO).

1.5 CAD FILE REQUIREMENTS

The following applies to all CAD File submittals for this Contract, unless otherwise noted:

a. Furnish CAD files in the latest version of Bentley DGN format, for all CAD Files submitted by the Contractor in performance of this contract.

b. Unless otherwise noted, all CAD Files shall meet A/E/C CAD and Graphic Standards, as follows:

1. Compliant with the A/E/C CAD Standard ERDC/ITL SR-24-3, A/E/C Graphics Standard ERDC/ITL SR-23-1.

c. CAD Files shall have presentation graphics which can be edited by Bentley software (with the exception of photographs). Presentation graphics typically consist of drawing elements such as lines, arcs, shapes, text, and their attributes (e.g., color, width, line style).

d. If CAD files are developed in a format other than the specified Bentley software, furnish the following:

1. The converted CAD files in Bentley DGN format, in compliance with all specified CAD file requirements.

2. The original CAD files in their native file format.

e. In addition to CAD files, submit a PDF of each CAD File. The PDFs and the CAD files shall be identical.

f. Submit files using the DoD SAFE (Secure Access File Exchange) website as directed by the Contracting Officer.

g. Request Government CAD/BIM files through the Contracting Officer, who will then request the files from the USACE CAD/BIM Managers.

1.5.1 CAD File Requirements for Design Drawings Created After Award

In addition to the requirements listed above, when the Contractor prepares

design drawings for requirements stated in the contract, for a modification, or as part of a Value Engineer Change Proposal, the following requirements apply:

a. Digital files shall be .dgn format, unless otherwise noted, with element types that can be edited (i.e. no attached raster files, .dxf, or .dwg file formats will be accepted). Use the provided Walla Walla District Templates/seed files and the A/E/C workspace to match the A/E/C CAD and Graphics standards for all drawings. Include the appropriate firm name within the title block.

b. Each drawing file shall be completely independent of any data in any other file, including fonts and shapes not included with the basic CAD software program utilized. Drawing files with external references or special fonts are not acceptable. All displayed graphic elements on all levels of the drawing file shall be part of the project drawing image. The drawing file shall not contain any graphic element that is not part of the drawing image.

c. Provide an index of drawings sheet in CAD as part of the drawing set, and a list in Microsoft Excel of all drawings. Include the filename, the sheet reference number, the sheet number, and the sheet title, containing the data for each drawing.

d. Design drawings may be prepared more like shop drawings to minimize fabrication submittals after final designs are approved. Therefore, the Contractor is encouraged to prepare and submit with the design drawings, appropriate connection, fabrication, layout, and product specific drawings.

e. The Contractor-originated drawings will be used as the basis for the record drawings. Shop drawings included as design documents shall comply with the same drawing requirements such as drawing form, sheet size, layering, lettering, and title block used in design drawings.

f. All final Contractor-originated design drawings shall be signed, dated, and bear the seal of the registered architect or the registered engineer of the respective discipline. This seal shall be the seal of the Designer of Record for that drawing, and who is professionally registered for work in that discipline. Application of the digital seal and signature accepts responsibility for the work shown thereon.

1.5.1.1 Bentley DGN File Submittal Requirements

a. If CAD files are developed in a format other than the specified Bentley software, furnish full Sheet Bentley DGN sample sheets along with submitted Design Drawings. At a minimum, sample sheet submittal must include the following Sheet types:

1. One Plan Sheet.

2. One Elevation or Section Sheet.

3. One Detail Sheet.

b. All Final Shop Drawings, and Record Drawings must be submitted in Bentley DGN format, and meet all requirements of paragraphs CAD FILE REQUIREMENTS, and "Format for SD-02 Shop Drawings", in this SECTION.

1.5.2 USACE CAD/BIM Technology Center

The USACE CAD/BIM Technology Center hosts all standard content for USACE. This content can be accessed through the CAD/BIM Technology Center website, https://cadbimcenter.erdc.dren.mil.

1.6 PREPARATION

1.6.1 Transmittal Form

The attached sample transmittal form (ENG Form 4025) is in RMS and shall be completed in RMS 3.0 Contractor Mode. Use ENG Form 4025 for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form.

Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.6.2 Identifying Submittals

When submittals are provided by either the Prime Contractor or subcontractor, the Prime Contractor is responsible to prepare, review and stamp with Contractor's approval all specified submittals prior to submitting for Government approval.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title, location, and date.

b. Contract number.

c. Date of the drawings and revisions.

d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second tier Contractor associated with submittal.

e. Section number of the specification section by which submittal is required.

f. Submittal description (SD) number of each component of submittal.

g. When a resubmission, add a number suffix on submittal description, for example, submittal 18 would become 18.1, to indicate the resubmission.

h. Product identification and location in project.

The sequence of submission of drawings shall be such that all information is available for checking each drawing when it is received. Contract number and project shall be shown directly above the revision space on all drawings submitted. Drawing details and notes shall be of such quality and clarity and of sufficient definition and line weight as to permit sharp and totally legible scanning. All items shall be adequately

identified to show where they will be used, and shall be referenced to applicable contract drawings and specification section.

All shop drawings submitted on a single transmittal (ENG form 4025) shall pertain to only one (1) specification section. Computed weights of all items shall be indicated on the shop drawings. Where drawings are submitted for either one (1) assembly consisting of more than one (1) piece of equipment, or two (2) systems consisting of numerous components dependent one on the other for matching or compatible characteristics, complete information shall be submitted on all such related components at the same time.

1.6.3 Format For Digital Submittals

The PDF filename of all submittals shall include the contract and transmittal number.

a. example: 24C0001 01 35 29.10 28-1 Item 1, 5

b. re-submittal example: 24C0001 01 35 29.10 28-1.1 Item 1, 5

All digital submittals shall be in color and digitally searchable. All pages in the file shall be oriented so that no rotation or manipulation to view is needed.

1.6.4 Format for SD-02 Shop Drawings

All shop drawings prepared by the Contractor for this contract shall be formatted to American National Standards Institute (ANSI D).

a. All shop drawings must have a title block prepared by the Contractor independent of any Contract Drawing. Include a revision block.

b. Title block shall include the following:

1. Project title.

2. Sheet description.

3. Sheet number.

4. Contract number.

5. Issue date.

c. Revision block shall contain revision mark, revision description, date of revision.

d. Each Sheet shall have a unique number.

e. Each sheet shall have the Contractor Firm name on it.

f. CAD requirements for Shop Drawings include the following:

1. CAD file(s) meeting requirements of paragraph "CAD File Requirements" in this SECTION.

2. A PDF copy of the corresponding CAD file(s). The PDFs and CAD

files shall be identical.

3. Shop drawing format does not need to comply with A/E/C CAD and Graphic Standards.

1.6.4.1 Shop Drawing Submittals

Shop Drawing Submittals are required as follows:

a. As shown and specified in the plans and specifications during design and fabrication. **Submit in PDF file format only**.

b. As specified in SECTION 01 78 00.00 28 CLOSEOUT SUBMITTALS, paragraph FINAL SHOP DRAWINGS, including all CAD Files as specified in paragraph CAD FILE REQUIREMENTS, in this SECTION. **Submit in both PDF file format and Bentley DGN format**.

1.6.5 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

a. Present product data submittals for each section as required. Include table of contents, listing page and catalog item numbers for product data.

b. Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains. Mark out all product data not pertaining to the product being submitted.

c. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of SD-07 Certificates.

d. Provide all software code, user interfaces, logic and graphic information, manuals, documentation, etc. in English, only.

e. Provide product data in English dimensions. Where product data are included in preprinted catalogs with Metric units only, submit English dimensions on separate sheet.

f. Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

g. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

h. Collect required data submittals for each specific material, product, unit of work, or system into a single submittal. Mark the

submittal to clearly indicate what choices, options, and portions of the product offering will be incorporated into the work. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of fabrication effort.

i. Submit manufacturer's instructions prior to installation.

1.6.6 Format of SD-04 Samples

a. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:

(1) Sample of Equipment or Device: Full size.

(2) Sample of Materials Less Than 2 by 3 inches built up to 8-1/2 by 11 inches.

(3) Sample of Materials Exceeding 8-1/2 by 11 inches: Cut down to 8-1/2 by 11 inches and adequate to indicate color, texture, and material variations.

(4) Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

(5) Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

(6) Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

(7) Sample Panel: 4 by 4 feet.

(8) Sample Installation: 100 square feet.

b. Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three (3) units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

c. Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at time of use.

d. Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean-up of project.

e. When color, texture or pattern is specified by naming a particular manufacturer and style, include one (1) sample of that manufacturer and style, for comparison.

1.6.7 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates formatted for 8-1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

1.6.8 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

a. Provide reports formatted for 8-1/2 by 11 inches paper in one complete file.

b. Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.6.9 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

When the submittal includes a document which is to be used in the project or become part of the project record, other than as a submittal, do not apply Contractor's approval stamp to the document, but to a separate sheet accompanying the document.

1.7 QUANTITY OF SUBMITTALS

The quantities listed below are for all submittals except for the closeout quantities of submittals required in SECTION 01 78 00.00 28 CLOSEOUT SUBMITTALS.

1.7.1 Digital Copies

Each submittal shall be submitted in PDF format, unless otherwise noted, through RMS CM and via e-mail to the COR and the transmittal mailbox for the Upper Snake River Resident Office:

UpperSnakeConResidentOffc@usace.army.mil

The e-mail subject line shall be formatted as follows:

Contract #, Project Name - Trans #, Name(s)
Example: "24C0001 LGA PH HVAC - Trans 41 01 20.72 26-1 HVAC Test Reports"

Submittal files too large to send via e-mail shall be submitted using the DoD SAFE (Secure Access File Exchange) website as directed by the Contracting Officer.

1.7.2 **Hard Copies (HC)**

In addition to the digital submission required for all submittals, hard copies shall also be submitted for submittals designated with a (HC) in the submittal title or as specifically designated by type of submittal or as stated in the technical specification for that given submittal.

submittal title example: Final O&M Manuals and Parts Catalogs (HC)

1.7.2.1 Hard Copy Submittals

SUBMITTALS WITH AN HC DESIGNATED REQUIRE A HARD COPY SUBMISSION IN THE QUANTITIES DISCUSSED BELOW:

Submit two (2) paper copies of all (HC) designated submittals to the address below, **unless otherwise noted**. Each copy must be sent with the ENG Form 4025.

District Commander
ATTN: CENWW-EC-C
Walla Walla District Corps of Engineers
201 North Third Avenue
Walla Walla, WA 99362-1876

1.7.3 Official Receipt of Transmittals

Official receipt of a transmittal that is sent electronically begins the business day after the Government receives that transmission by e-mail or through the Safe Access File Exchange website as directed by the Contracting Officer.

Official receipt of the transmittal that also requires a hard copy submission only begins when the Government receives the hard copy and not the electronic submission.

1.7.4 Number of Samples SD-04 Samples

ALL SD-04 SUBMITTALS REQUIRE A HARD COPY SUBMISSION IN THE QUANTITIES DISCUSSED BELOW:

a. Submit two (2) samples, or two (2) sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.

b. Submit one (1) sample panel. Include components listed in technical section or as directed.

c. Submit one (1) sample installation.

d. Submit one (1) sample of non-solid materials, for example paint.

e. Submit to address shown in paragraph "Hard Copy Submittals" above.

1.7.5 Number of Copies of SD-10 Operation and Maintenance Data

SD-10 SUBMITTALS WITH AN HC DESIGNATED REQUIRE A HARD COPY SUBMISSION IN THE QUANTITIES DISCUSSED BELOW:

Submit in compliance with SECTION 01 78 00.00 28 CLOSEOUT SUBMITTALS and SECTION 01 78 23.00 28 OPERATION AND MAINTENANCE DATA.

Submit to the District office address. See paragraph "Hard Copy Submittals".

1.8 INFORMATION ONLY SUBMITTALS

Approval of the Contracting Officer is not required on information only submittals. The following list applies to all for information only submittals:

a. The Contractor is not relieved from the obligation to furnish material conforming to the plans and specifications.

b. The Contracting Officer reserves the right to require the Contractor to resubmit any item found not to comply with the contract, and is not prevented from requiring removal and replacement of nonconforming material incorporated in the work.

c. Does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.9 VARIATIONS REQUESTS

Variations from contract requirements require Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.9.1 Considering Variations

Discussion with Contracting Officer prior to submission will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP). Specifically point out variations from contract requirements in transmittal letters. Failure to point out variations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

1.9.2 Proposing Variations

When proposing a variation / variations, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to the Government. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

Check the column "variation" of ENG Form 4025 for submittals which include proposed variations requested by the Contractor. Set forth in writing the reason for any variations and annotate such variations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted variations.

1.9.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.9.4 Review Schedule Is Modified

In addition to the normal submittal review period, a period of ten (10) working days will be allowed for consideration by the Government of submittals with variations.

1.10 SUBMITTAL REGISTER

The Submittal Register will be loaded into RMS by the Government. A copy

of the Submittal Register is attached to the end of this SECTION with the following fields filled in:

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

Column (f): Indicate approving authority for each submittal. The Contractor is responsible for maintaining the submittal register in accordance with SECTION 01 45 01.00 28 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM)

1.10.1 Use Of Submittal Register

Verify that all submittals required for the project are listed and add missing submittals. The submittal register may be required to be imported into the Primavera P6 project schedule, or some other means for tracking submittal progress, as acceptable to the Government. See SECTION 01 32 16.00 28 SMALL PROJECT FABRICATION AND ASSEMBLY PROGRESS SCHEDULES for additional information. Coordinate and complete the following fields on the register:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.10.2 Contractor Use of Submittal Register

Update the following fields with each submittal throughout contract:

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.10.3 Approving Authority Use of Submittal Register

Update the following fields in the Government-furnished submittal register program:

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.10.4 Contractor Action Codes

DESIGN BID BUILD SUBMITTALS			
Submittal Classifications shown in UFGS Sections	Submittal Classification	Corresponding SpecsIntact Submittal Register Code which is populated in the SI Submittal Register. Software Limitations: (The software shows one character delineation in the SpecsIntact Submittal Register)	RMS – The following Submittal Classifications are populated in RMS when the SpecsIntact Submittal Data File is pulled into RMS)
G	Submittal requires Government Approval	G	GA
I	Submittal is For Information Only (FIO)	I	FIO

1.10.5 Contractor Action Code and Action Code

Entries for columns (j) and (o), are to be used as follows (others may be prescribed by Transmittal Form):

NR - Not Received

AN - Approved as noted

A - Approved

RR - Disapproved, Revise, and Resubmit

1.10.6 Copies Delivered to the Government

Deliver a PDF copy of the submittal register, updated by Contractor, to Government with each invoice request.

1.11 SCHEDULING

Schedule, and submit concurrently, submittals covering component items forming a system or items that are interrelated. Submit all related certifications along with the pertinent drawings. No delay, damages, or time extensions will be allowed for time lost due to late submittals.

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.

b. Submittals called for by the contract documents will be listed in the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."

c. Re-submit register, and update monthly, with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.

d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

e. Allow the Government **thirty (30)** calendar days to review submittals and for each resubmittal. The 30-day period shall commence at date of receipt of transmittals from the Contractor by the Government and the period shall end at date of signature of Approving Authority on the ENG Form 4025.

Within **fifteen (15)** calendar days of receipt of Notice of Award provide, for approval by the Contracting Officer, the following schedule of submittals in the Project Schedule submittal:

a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).

See SECTION 01 32 16.00 28 SMALL PROJECT FABRICATION AND ASSEMBLY PROGRESS SCHEDULES for additional information.

1.12 GOVERNMENT APPROVING AUTHORITY

When the approving authority is the Government, the Contracting Officer will:

a. Note date on which submittal was received from QC system Manager.

b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph "Review Notations" along with markings appropriate for action indicated.

The Government will provide the appropriate review notation for submittals, upon completion of review. The official response will only be through RMS.

1.12.1 Review Notations

Contracting Officer review will be completed within **thirty (30)** calendar days after date of receipt of submittal. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked with an action code of "A" are "approved" or "accepted" and authorize the Contractor to proceed with the work covered.

b. Submittals marked with an action code of "B" are "accepted as noted on drawing", "accepted except as noted on drawing", and authorize the Contractor to proceed with the work covered once they make the changes to the submittal provided they take no exception to the corrections.

c. Submittals marked with an action code of "C" are "accepted as noted, resubmission required", and authorize the Contractor to proceed with the work covered provided they take no exception to the corrections. The Contractor shall resubmit with appropriate changes to address the Government notations.

d. Submittals marked with an action code of "E" are "disapproved", "not accepted", and indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved or accepted.

e. Submittals marked with an action code of "F" are Submittals marked "receipt acknowledge" and will indicate submittal has been received but not necessarily reviewed by the Government. Comments to these submittals may or may not be provided; however the Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract.

f. FIO submittals marked with an action code of "X" are Submittals marked as "does not comply as noted with contract requirements" and indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes for Government approval or acceptance. No work shall proceed for this item until resubmittal is received.

1.13 DISAPPROVED OR REJECTED SUBMITTALS

Make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications, give notice to the Contracting Officer as required under the FAR clause titled CHANGES. The Contractor is responsible for the dimensions and design of connection details and the fabrication of work. Failure to point out variations may cause the Government to require rejection and removal of

such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and resubmit in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.14 APPROVED/ACCEPTED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of fabrication, materials, detailing and other information are satisfactory.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist. The Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, ensuring information contained within each submittal accurately conforms with the requirements of the contract documents, and the satisfactory fabrication of all work.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.15 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not to be construed to change or modify any contract requirements. Before submitting samples, assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved. Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at their expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at their expense, if so requested. Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service. Samples of various materials or equipment delivered on-site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Replace such materials or equipment to meet contract requirements. Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of their responsibilities under the contract.

1.16 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.17 STAMPS

Stamps used by the CQC system manager on the submittal data to certify that the submittal meets contract requirements is to be similar to the

following:

CONTRACT NUMBER
CONTRACTOR
(Firm Name)
_____ Approved
_____ Approved with corrections as noted on submittal data and/or attach sheets(s)
SIGNATURE: _____
TITLE: CQC SYSTEM MANAGER
DATE: _____

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

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U.S. Army Corps of Engineers (USACE)

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE

For use of this form, see ER 415-1-10; the proponent agency is CECW-CE.

DATE	TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (*This section will be initiated by the contractor*)

TO:	FROM:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL _____

SPECIFICATION SEC. NO. (*Cover only one section with each transmittal*)	PROJECT TITLE AND LOCATION	THIS TRANSMITTAL IS FOR: (*Check one*) ☐ FIO ☐ GA ☐ DA ☐ CR ☐ DA/CR ☐ DA/GA

ITEM NO. (*See Note 3*) a.	DESCRIPTION OF SUBMITTAL ITEM (*Type size, model number/etc.*) b.	SUBMITTAL TYPE CODE (*See Note 8*) c.	NO. OF COPIES d.	CONTRACT DOCUMENT REFERENCE		CONTRACTOR REVIEW CODE g.	VARIATION Enter "Y" if requesting a variation (*See Note 6*) h.	USACE ACTION CODE (*Note 9*) i.
				SPEC. PARA. NO. e.	DRAWING SHEET NO. f.			

REMARKS

I certify that the above submitted items had been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

NAME OF CONTRACTOR	SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED (*List by item No.*)	NAME AND TITLE OF APPROVING AUTHORITY	SIGNATURE OF APPROVING AUTHORITY	DATE

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.

2. Each Transmittal shall be numbered consecutively. The Transmittal Number typically includes two parts separated by a dash (-). The first part is the specification section number. The second part is a sequential number for the submittals under that spec section. If the Transmittal is a resubmittal, then add a decimal point to the end of the original Transmittal Number and begin numbering the resubmittal packages sequentially after the decimal.

3. The "Item No." for each entry on this form will be the same "Item No." as indicated on ENG FORM 4288-R.

4. Submittals requiring expeditious handling will be submitted on a separate ENG Form 4025-R.

5. Items transmitted on each transmittal form will be from the same specification section. Do not combine submittal information from different specification sections in a single transmittal.

6. If the data submitted are intentionally in variance with the contract requirements, indicate a variation in column h, and enter a statement in the Remarks block describing he detailed reason for the variation.

7. ENG Form 4025-R is self-transmitting - a letter of transmittal is not required.

8. When submittal items are transmitted, indicate the "Submittal Type" (*SD-01 through SD-11*) in column c of Section I.
   Submittal types are the following:
   SD-01 - Preconstruction SD-02 - Shop Drawings SD-03 - Product Data SD-04 - Samples SD-05 - Design Data SD-06 - Test Reports
   SD-07 - Certificates SD-08 - Manufacturer's Instructions SD-09 - Manufacturer's Field Reports SD-10 - O&M Data SD-11 - Closeout

9. For each submittal item, the Contractor will assign Submittal Action Codes in column g of Section I. The U.S. Army Corps of Engineers approving authority will assign Submittal Action Codes in column i of Section I. The Submittal Action Codes are:

   A -- Approved as submitted.
   B -- Approved, except as noted on drawings. Resubmission not required.
   C -- Approved, except as noted on drawings. Refer to attached comments. Resubmission required.
   D -- Will be returned by separate correspondence.
   E -- Disapproved. Refer to attached comments.
   F -- Receipt acknowledged.
   X -- Receipt acknowledged, does not comply with contract requirements, as noted.
   G -- Other action required *(Specify)*
   K -- Government concurs with intermediate design. (*For D-B contracts*)
   R -- Design submittal is acceptable for release for construction. (*For D-B contracts*)

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract.

SUBMITTAL REGISTER

CONTRACT NO.
W912EF26RA003

TITLE AND LOCATION
LGA Lower Snake River Spare Transformers

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 11 01.00 28	SD-01 Preconstruction Submittals															
			Equipment List	1.7	I	C												
			Project Schedule	1.9	G	C												
		01 14 00.10 28	SD-01 Preconstruction Submittals															
			Foreign Visit Request (FVR)	1.4.2.1	G	SLE												
			Form															
		01 14 00.90 28	SD-01 Preconstruction Submittals															
			Pre-Screen Candidates Using	1.7	G	C												
			E-Verify Program															
		01 32 16.00 28	SD-01 Preconstruction Submittals															
			Fabrication And Assembly	1.2	G	C												
			Schedule															
			SD-07 Certificates															
			Monthly Updates	1.4	G	C												
		01 33 00	SD-01 Preconstruction Submittals															
			Bentley DGN Sample Sheets	1.5.1.1	G	GS												
		01 35 29.10 28	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.8	G	C												
			Activity Hazard Analysis (AHA)	1.9	G	C												
			Safe Clearance	1.10	I	C												
			Authorized Individuals	1.10	I	C												
			Standard Lift Plan	1.8.1.1	G	C												
			Critical Lift Plan	1.8.1.2	G	C												
			Crane Wheel And Outrigger	1.14.5	G	ST												
			Loading Diagram And Deck															
			Protection For Outriggers															

SUBMITTAL REGISTER

CONTRACT NO.
W912EF26RA003

TITLE AND LOCATION
LGA Lower Snake River Spare Transformers

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 35 29.10 28	Competent Person Qualifications	1.7.1.2	G	C												
			Confined Space Entry Permit	1.11.1	G	C												
			Site Safety And Health Officer	1.7.1.1	G	C												
			(SSHO) Designation Letter															
			Eng Form 6277 Energized	3.5.1	G	C												
			Electrical Work Permit															
			Master or Journeyman Electrician	3.5.2	I	C												
			SD-06 Test Reports															
			Accident Reports	1.14.2	I	C												
			LHE Inspection Reports	1.14.3	I	C												
			Accident, Mishap, and Near Miss	1.14.1	I	C												
			Investigation and Reporting															
			SD-07 Certificates															
			Crane Operators/Riggers	1.7.1.4	I	C												
			Hot Work Permit	1.11.1	I	C												
			Certificate of Compliance	1.14.4	I	C												
			Competent Person Trainer	1.7.1.3	G	C												
		01 45 00.01 28	SD-01 Preconstruction Submittals															
			Contractor Quality Control Plan	3.1	G	C												
		01 55 10.00 28	SD-01 Preconstruction Submittals															
			Transport Loading Diagrams	1.4	G	ST												
		01 57 20.00 28	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.6	G	ECC												
		01 78 00.00 28	SD-11 Closeout Submittals															
			Spare Parts	2.1	G	C												
			Final Shop Drawings	3.1	G	GS												

SUBMITTAL REGISTER

CONTRACT NO.
W912EF26RA003

TITLE AND LOCATION
LGA Lower Snake River Spare Transformers

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 78 00.00 28	Working As-Built Drawings	3.2.1	I	C												
			Final As-Built Drawings	3.3	G	C												
			Record Drawings	3.4	G	GS												
			Government Issued Items	3.5	G	C												
		01 78 23.00 28	SD-10 Operation and Maintenance															
			Data															
			Preliminary O&M Manuals and	1.2.2	G	C	H											
			Parts Catalogs															
			Draft O&M Manuals and Parts	1.2.2	G	C	H											
			Catalogs															
			O&M Database	1.3	G	C	H											
			SD-11 Closeout Submittals															
			Final O&M Manuals and Parts	1.2.2	G	C	H											
			Catalogs (HC)															
		26 05 19.00 26	SD-03 Product Data															
			Insulated Wire and Cable	2.1	G	HDC												
			Signal and Communications	2.3.3	G	HDC												
			Cable															
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			Ground Conductors	2.3.4	G	HDC												
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			Terminations	3.1.8	G	HDC												
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			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.
W912EF26RA003

TITLE AND LOCATION
LGA Lower Snake River Spare Transformers

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
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			Shield Resistance Test	3.2.1	G HDC													
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			Cabinet Heater Sizing	2.15.9	G HDC													
			Calculations															
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			Transformer Factory Acceptance	3.5.2	G HDC													
			Test Report															
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		48 19 23.04 26	Bushing Routine Tests	3.6.4	G HDC													
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			Tests															
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		48 19 23.08 26	Transformer Design Data Review Report	3.1.2	G	HDC												
			Descriptive Data	2.1.5	G	HDC												
			Spare Parts List	2.18	G	HDC												
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			Cabinet Heater Sizing Calculations	2.15.9	G	HDC												
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		48 20 00.04 26	SD-08 Manufacturer's Instructions															
			Training Outline	3.15.2	G	AO												
			Site Delivery Inspection	3.5.1	G	HDC												
			Procedure And Schedule															
			SD-09 Manufacturer's Field															
			Reports															
			Impact Recorder Summary	3.5.2	G	AO												
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GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ANSI/ASSP)

ANSI/ASSP A10.8	(2019) Scaffolding Safety Requirements
ANSI/ASSP A10.34	(2021) Protection of the Public on or Adjacent to Construction Sites
ANSI/ASSP Z244.1	(2016) The Control of Hazardous Energy Lockout, Tagout and Alternative Methods
ANSI/ASSP Z359.0	(2018) Definitions and Nomenclature Used for Fall Protection and Fall Arrest
ANSI/ASSP Z359.1	(2020) The Fall Protection Code
ANSI/ASSP Z359.2	(2017) Minimum Requirements for a Comprehensive Managed Fall Protection Program
ANSI/ASSP Z359.3	(2019) Safety Requirements for Lanyards and Positioning Lanyards
ANSI/ASSP Z359.4	(2013) Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components
ANSI/ASSP Z359.6	(2016) Specifications and Design Requirements for Active Fall Protection Systems
ANSI/ASSP Z359.7	(2019) Qualification and Verification Testing of Fall Protection Products
ANSI/ASSP Z359.11	(2021) Safety Requirements for Full Body Harnesses
ANSI/ASSP Z359.12	(2019) Connecting Components for Personal Fall Arrest Systems
ANSI/ASSP Z359.13	(2013) Personal Energy Absorbers and Energy Absorbing Lanyards
ANSI/ASSP Z359.14	(2021) Safety Requirements for Self-Retracting Devices for Personal Fall

	Arrest and Rescue Systems
ANSI/ASSP Z359.15	(2014) Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B30.20	(2018) Below-the-Hook Lifting Devices
ASME B30.22	(2023) Articulating Boom Cranes
ASME B30.26	(2015; R 2020) Rigging Hardware
ASME B30.5	(2021) Mobile and Locomotive Cranes
ASME B30.8	(2020) Floating Cranes and Floating Derricks
ASME B30.9	(2018) Slings

ASTM INTERNATIONAL (ASTM)

ASTM F855	(2020) Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1048	(2016) Guide for Protective Grounding of Power Lines
IEEE C2	(2023) National Electrical Safety Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z89.1	(2014; R 2019) American National Standard for Industrial Head Protection

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2022; ERTA 1 2021) Standard for Portable Fire Extinguishers
NFPA 241	(2022) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 51B	(2024) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

NWWP 385-1-20	Safe Clearance Program for the Control of Hazardous Energy
EM 385-1-1	Safety and Occupational Health Requirements

Comply with the current edition and all changes posted on the web as of the effective date of this solicitation.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1400	Cranes and Derricks in Construction

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. A designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G, C

Activity Hazard Analysis (AHA); G, C

Safe Clearance; I, C

Authorized Individuals; I, C

Standard Lift Plan; G, C

Critical Lift Plan; G, C

Crane Wheel And Outrigger Loading Diagram And Deck Protection For Outriggers; G, ST

Competent Person Qualifications; G, C

Confined Space Entry Permit; G, C

Site Safety And Health Officer (SSHO) Designation Letter; G, C

Eng Form 6277 Energized Electrical Work Permit; G, C

Master or Journeyman Electrician; I, C

SD-06 Test Reports

Accident Reports; I, C

LHE Inspection Reports; I, C

Accident, Mishap, and Near Miss Investigation and Reporting; I, C

SD-07 Certificates

Crane Operators/Riggers; I, C

Hot Work Permit; I, C

Certificate of Compliance; I, C

Competent Person Trainer; G, C

1.3 ENGINEER FORMS

All Engineer Forms (ENG FORM) referenced in this SECTION are available online at the following location:

https://www.publications.usace.army.mil/USACE-Publications/Engineer-Forms/

NOTE: If Forms produce a "Please Wait" screen, click on the "Download" tab and download the file to your computer. Open the file in Adobe and click the "Enable All Features" tab.

1.4 DEFINITIONS

1.4.1 Accident

Any unplanned event or series of events that results in death, injury, or illness to personnel, or damage to or loss of equipment or property. Within the context of EM 385-1-1, accident is synonymous with mishap.

1.4.2 Competent Person (CP)

a. CP is a person meeting the requirements as defined in EM 385-1-1, in addition to the following requirements:

1. Be designated in writing to be responsible for the immediate supervision, implementation and monitoring of the program.

2. Through training, knowledge and experience be able to correctly identify, evaluate and address existing and potential hazards.

3. Has the authority to take prompt corrective measures with regard to specified hazards.

b. CP's are required for the following:

1. Confined Space 29 CFR 1926.1200, EM 385-1-1 Chapter 34 Confined Spaces in Ships and Vessels (CPCSSV).

2. Cranes and Rigging ASME B30, EM 385-1-1 Chapter 16.

3. Fall Protection EM 385-1-1 Chapter 21.

4. Scaffolding 29 CFR 1926 Subpart L, EM 385-1-1 Chapter 22.

See Competent Person Roles and Responsibilities in EM 385-1-1 for additional information.

1.4.3 Load Handling Equipment (LHE)

Load Handling Equipment(LHE) is a term used to describe cranes, hoists and all other hoisting equipment (hoisting equipment means equipment, including excavators or forklifts, used with rigging to hoist and move a load).

1.4.4 Medical Treatment

Medical Treatment is treatment administered by a physician, or registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

1.4.5 Mishap

Within the context of EM 385-1-1, mishap is synonymous with accident. See above paragraph "accident" in this SECTION for definition.

1.4.6 Near Miss

A potentially serious accident that could have resulted in personal injury, death, or property damage, damage to the environment, or illness; but did not occur due to one or more factors (e.g., a worker falls off a scaffold and is not injured; a crane swings around to move the load and narrowly misses a parked vehicle).

1.4.7 Operating Envelope

The area surrounding any crane. Inside this "envelope" is the crane, the 360-degree area up to the crane's maximum working radius, the operator, riggers and crane walkers, rigging gear between the hook and the load, the load, and the crane's supporting structure (for example, ground, rail).

1.4.8 Qualified Person (QP)

A QP is a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.

1.4.9 Recordable Accident

A reportable accident that meets the minimum criteria stated in EM 385-1-1.

1.4.10 Recordable Injuries or Illnesses

Recordable Injuries or Illnesses are any work-related injury or illness that results in:

a. Death, regardless of the time between the injury and death, or the length of the illness.

b. Days away from work (any time lost after day of injury/illness onset);

c. Restricted work;

d. Transfer to another job;

e. Medical treatment beyond first aid;

f. Loss of consciousness; or

g. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (a) through (f) above.

1.4.11 Reportable Accident

All occurrences that cause injury, occupational illness, or property damage of any kind.

1.4.12 Site Safety and Health Officer (SSHO)

A Contractor Employee that is responsible for overseeing and ensuring implementation of the prime Contractor's Safety and Occupational Health (SOH) program according to the Contract, EM 385-1-1, applicable federal, state, and local requirements.

1.4.12.1 Level 1 SSHO

A designated employee with Level 1 full-time SOH responsibility that meets and follows the requirements of EM 385-1-1.

1.4.12.2 Level 2 SSHO

A designated employee with Level 2 SSHO responsibility that meets and follows the requirements of EM 385-1-1. Level 2 SSHOs cannot be assigned to projects that have a residual Risk Assessment Code (RAC) of high or extremely high.

1.4.12.3 Level 3 SSHO

A designated Qualified Person or Competent Person with SOH responsibility that meets and follows the requirements of EM 385-1-1. Level 3 SSHOs cannot be assigned to projects that have a residual RAC of high or extremely high.

1.4.12.4 Alternate SSHO

An employee that meets the definition of the contract-required level SSHO, but is not the primary SSHO.

1.4.13 USACE Property and Equipment

Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

1.4.14 Load Handling Equipment (LHE) Accident or Load Handling Equipment Mishap

Accidents, mishaps, and near misses that involve Load Handling Equipment (LHE) as defined in EM 385-1-1 Chapter 16 that occur during operation, including operation during maintenance or testing, resulting in personal injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between

the load, crane, or other objects.

A dropped load, derailment, two-blocking, overload, and collision are considered accidents, even if no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, or bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, or roll over).

Report load handling equipment accidents, mishaps, and near misses in accordance with EM 385-1-1 Table 2-1.

1.5 MONTHLY EXPOSURE REPORTS

When submitting each monthly billing request enter Contractor and sub-contractor hours of work in the Resident Management System (RMS).

This report is a compilation of employee-hours worked each month for all site workers.

Failure to submit the Exposure Hours report may result in retention of up to 10 percent of Contractor payment.

1.6 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1, and all federal, state, and local laws.

Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work.

Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.7 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.7.1 Personnel Qualifications

1.7.1.1 Site Safety and Health Officer (SSHO)

Employ a minimum of one Level 1 Site Safety and Health Officer (SSHO) at each project site, in accordance with EM 385-1-1 Chapter 2-8, to function as the primary SSHO. The primary SSHO is responsible for ensuring all site personnel are implementing SOH requirements according to this contract, the EM 385-1-1, applicable federal, state, and local requirements to include specific responsibilities outlined in EM 385-1-1 Chapter 2-4. The SSHO must be employed by the Prime Contractor. **The SSHO can be assigned as the Project Superintendent on this project**.

a. A Designation Letter is required for all levels of onsite SSHOs. Designate in writing all SSHOs on mandatory ENG Form 6282 (Site Safety and Health Officer Designation Letter). Both the Contractor Corporate Safety Official and the SSHO are to sign the form and submit it to the Contracting Officer for acceptance.

b. If a new or additional SSHO is assigned to perform SOH duties onsite, the Contractor must submit a new Designation Letter. Work is

prohibited from being conducted until the Contracting Officer accepts ENG Form 6282 (Site Safety and Health Officer (SSHO) Designation Letter). Maintain a copy of the accepted form at the site of work.

c. All onsite SSHOs are required to meet the qualification and training requirements commensurate with the SSHO level, as established in this contract, and in accordance with EM 385-1-1 Chapter 2-3, and ENG Form 6282.

d. A designated SSHO is required to be at the site of work whenever work is performed and located so that they have full mobility and reasonable access to all major work operations occurring during the shift.

e. If the SSHO has to temporarily (that is, up to 24 hours/one day) leave the site of work due to unforeseen or emergency situations, a Level 1, 2, or 3 SSHO may be used in the interim and is to be on the site of work at all times when work is being performed.

f. If the SSHO is off-site for a period longer than 24 hours/one day, an additional/alternate SSHO of equivalent training and experience is required at the site of work to fulfill the same roles and responsibilities when work is performed.

1.7.1.2 Competent Person Qualifications

Provide Competent Persons (CP) in accordance with EM 385-1-1. Roles and Responsibilities of the Competent Person are addressed in EM 385-1-1 Chapter 2-4(c) Competent Person (CP). Competent Persons are required for confined spaces, cranes and rigging, and fall protection. The CP for these activities must be designated in writing and meet the requirements for the specific activity (e.g. Competent Person, fall protection).

The CP identified in the Contractor's Safety and Health Program and accepted Accident Prevention Plan, must be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Submit documentation of training and experience to the Contracting Officer.

1.7.1.3 Qualified Trainer Requirements

Individuals who are qualified to instruct the 40 hour contract safety awareness course, or portions thereof, must meet the definition of a Competent Person Trainer, and, at a minimum, possess a working knowledge of the following subject areas: EM 385-1-1, Fall Protection, Confined Space Entry, and Scaffolds in accordance with 29 CFR 1926. Submit Certification of Competent Person training.

Instructors are required to:

a. Prepare class presentations that cover fabrication-related safety requirements.

B. Ensure that all attendees attend all sessions by using a class roster signed daily by each attendee. Maintain copies of the roster for at least five (5) years. This is a certification class and must be attended 100 percent. In cases of emergency where an attendee cannot make it to a session, the attendee can make it up in another class session for the same subject.

c. Update training course materials whenever an update of the EM 385-1-1 becomes available.

d. Provide a written exam of at least 50 questions. Students are required to answer 80 percent correctly to pass.

e. Request, review and incorporate student feedback into a continuous course improvement program.

1.7.1.4 Crane Operators/Riggers

Provide Qualified Crane Operators meeting the requirements in EM 385-1-1, Chapter 16-3. Provide Qualified Riggers meeting the requirements in EM 385-1-1 Chapter 15-3.

The following is required for the certification and qualification of all crane operators. Contractor must use mandatory ENG Form 6209 (Certificate of Compliance for Load Handling Equipment and Rigging) to designate each operator for the equipment to be used.

a. Crane operators must be trained, tested, and certified by a nationally accredited testing organization. The Contractor is still responsible for designating in writing that the operator is qualified to operate a particular type, capacity, and configuration of equipment.

1.7.2 Meetings

1.7.2.1 Preconstruction Meeting

Refer to SECTION 01 11 01.00 28 SUPPLEMENTARY REQUIREMENT for additional requirements on the Preconstruction Meeting.

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project must attend the preconstruction meeting. This includes the project superintendent, Site Safety and Occupational Health officer, quality control manager, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHA's) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHA's that must be developed and implemented during the performance of the contract. This list of proposed AHA's will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, and Government review of AHA's to preclude project delays.

c. Deficiencies in the submitted APP, identified during the Contracting Officer's review, must be corrected, and the APP re-submitted for review prior to the start of fabrication.

1.7.2.2 Safety Meetings

Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide

pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors on the project location. The SSHO, supervisors, foremen must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the Contracting Officer on request. Notify the Contracting Officer of all scheduled meetings a minimum of Seven (7) calendar days in advance of each meeting.

1.8 ACCIDENT PREVENTION PLAN (APP)

Prepare the APP in accordance with the format and requirements of EM 385-1-1 Chapter 2-7. A Competent Person is required to prepare the written, site-specific APP on ENG FORM 6293, Accident Prevention Plan (APP) Worksheet. The following conditions apply:

1. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors.

2. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.

3. If English is not the foreman's primary language, the Prime Contractor must provide an interpreter.

Submit the APP to the Contracting Officer **Fifteen (15) calendar days** prior to the date of the preconstruction meeting for acceptance. Contract work will not be allowed to proceed without a Contracting Officer accepted APP. Once reviewed and accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract.

1. Disregarding the provisions of this contract or the accepted APP is cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

2. The SSHO must conduct on-going evaluations and updates of the APP throughout the life of the project to ensure it is up to date and site specific. Changes, revisions, and updates to the APP are to be reviewed and approved by the Contractor and submitted to the Contracting Officer for acceptance.

3. Incorporate activities not identified in the original APP as they are identified. If exposure or potential exposure to a hazard is identified, cease work in the area, secure the area, and develop a plan to mitigate and control the hazard. Notify the Contracting Officer immediately, no later than 24 hours after identification. Eliminate and remove the hazard.

4. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ANSI/ASSP A10.34), and the environment.

1.8.1 Plans

Provide plans in the APP as well as required names and qualifications, in accordance with the requirements outlined in EM 385-1-1, including the following:

1.8.1.1 Standard Lift Plan (SLP)

Plan all lifts to avoid situations where the operator cannot maintain safe control of the lift. Prepare a written SLP for every lift or series of lifts (if duty cycle or routine lifts are being performed), using ENG Form 6203 (Crane Standard Lift Plan). The SLP must be developed by a Competent Person (CP) with assistance from a Qualified Person (QP) if necessary, and, reviewed, and accepted by all personnel involved in the lift. Keep a copy of the SLP on the LHE for the specific approved lift(s). Keep a copy of every SLP for a minimum of three months.

1.8.1.2 Critical Lift Plan- Crane or Load Handling Equipment

Provide a Critical Lift Plan as required by EM 385-1-1, Chapter 16-7 using Load Handling Equipment Crane Operation Critical Lift Plan ENG Form 6213. Critical lifts require detailed planning and additional safety precautions. Before any critical lift, a CP or QP is required to prepare a Critical Lift Plan and submit it for approval or acceptance by the Contracting Officer thirty (30) calendar days prior to critical lift. Comply with load testing requirements in accordance with EM 385-1-1 Chapter 16.

The critical lift plan must also include the following:

a. For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400 and EM 385-1-1 Chapter 16

b. When Powered Industrial Trucks (PITs)/Telehandlers and other mechanized equipment are used to hoist loads utilizing hooks, eyes, slings, chains, or other rigging, the following requirements apply:

   (a) Do not use this equipment to hoist loads unless authorized by the equipment manufacturer.

   (b) Follow the procedures included in equipment manufacturer's operating manual.

   (c) Equipment operators, riggers, and others involved in the hoisting operations must provide written proof of qualifications.

   (d) Operators must properly use and keep onsite a copy of each manufacturer's load rating capacities or charts for the approved attachments

c. Multi-purpose machines, material handling equipment, and fabrication equipment used to lift loads that are suspended by rigging gear, require proof of authorization from the machine OEM that the machine is capable of making lifts of loads suspended by rigging equipment. Demonstrate that the operator is properly trained and that the equipment is properly configured to make such lifts and is equipped with a load chart.

1.8.1.3 Fall Protection and Prevention (FP&P) Plan

The plan must comply with the requirements of EM 385-1-1, Chapter 21-7 and ANSI/ASSP Z359.2. Be site specific, and address all fall hazards in the workplace and during different phases of fabrication. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards 6 feet or more in height.

The FP&P plan must be developed by a CP or QP.

Include fall protection and prevention systems, equipment and methods employed for every phase of work, roles and responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods.

Review and revise, as necessary, the Fall Protection and Prevention Plan as conditions change, but at a minimum every year, reflecting any changes during the course of fabrication due to changes in personnel, equipment, systems or work habits.

Keep and maintain the accepted Fall Protection and Prevention Plan documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Plan documentation in the Accident Prevention Plan (APP).

1.8.1.4 Rescue and Evacuation Plan

Provide a Rescue and Evacuation Plan in accordance with EM 385-1-1 Chapter 21-7, ANSI/ASSP Z359.2 and include in the FP&P Plan and as part of the APP. Include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

1.8.1.5 Site-Specific Energy Control Plan (SSECP)

Develop a Site-Specific Energy Control Plan (SSECP) in accordance with EM 385-1-1 Chapter 12 and NWWP 385-1-20. This is a site-specific form of HECP required for work on or near any system that produces, uses, or stores hazardous energy. The SSECP is required to be site-specific and developed according to EM 385-1-1 figure 12-1 and ANSI/ASSP Z244.1. Include the required elements of NFPA 70E when electricity is a potential energy source. Submit this SSECP as part of the Accident Prevention Plan (APP).

When work involving hazardous energy is required to be performed at or on a USACE-operated facility, coordinate a meeting with the Contracting Officer and Project personnel, including the Project Safety Officer. The purpose of the meeting is to determine which of the scenarios in EM 385-1-1 Chapter 12-4(c) will be followed as it pertains to HEC. Document the meeting and provide copies of documentation to the Contracting Officer and Issuing Individual(s).

1.8.1.6 Emergency Action Plan (EAP)

The Contractor must ensure that all Contractor personnel at Government facilities are familiar with the Government's emergency evacuation plans and procedures specific to that facility. At the Pre-work Meeting, both the Contractor and the Government are to designate points of contact for

proper coordination of the EAP and to help ensure efficient and rapid evacuation of the facility.

Prior to submitting the APP, coordinate with the point of contact for that Government facility to discuss conditions where an evacuation may be necessary, specific evacuation plans to include routes and exits, any employees to remain after evacuation notification to shut-down critical operations and/or perform other duties before evacuating, employee accounting post-evacuation, and any special equipment for employees.

Develop an EAP based upon EM 385-1-1, 29 CFR 1910.38 Emergency Action Plans, and 29 CFR 1926.35, Employee Emergency Action Plans. Include the EAP in the APP. Ensure that all Contractor and Sub-contractor personnel are trained and familiar with the EAP.

1.9 ACTIVITY HAZARD ANALYSIS (AHA)

a. See EM 385-1-1 Chapter 2-6 for AHA requirements.

Before beginning each work activity, task or Definable Feature of Work (DFOW) the Contractor(s) performing that work activity are required to prepare an AHA to ensure minimum safety requirements are adequately addressed. Use ENG FORM 6206, Activity Hazard Analysis (AHA) to complete each AHA. The following applies to all AHA's:

1. AHA's must be developed by the Prime Contractor, subcontractor, or supplier performing the work, and provided for Prime Contractor review and approval before submitting to the Contracting Officer.

2. Develop AHA's using the Project Schedule as the basis for the activities performed. All activities listed on the Project Schedule requires an AHA to be completed.

3. AHA's must identify Competent Persons as required by EM 385-1-1.

4. AHA's must be provided to, reviewed by, and signed by all involved employees prior to starting the activity. Provide copies of signed AHAs to Contracting Officer upon request.

5. Submit each AHA to the Contracting Officer for review at least thirty (30) calendar days prior to the start of each activity.

b. The Government reserves the right to require the Contractor to revise and resubmit the AHA if it fails to effectively identify the work sequences, specific anticipated hazards, site conditions, equipment, materials, personnel and the control measures to be implemented.

1.10 LOCKOUT/TAGOUT (LOTO)-SAFE CLEARANCE OR HAZARDOUS ENERGY CONTROL PROGRAM (HECP) PROCEDURES

All Contractor work on site must meet the requirements of NWWP 385-1-20 and EM 385-1-1. Digital copies of NWWP 385-1-20 may be obtained from the Contracting Officer upon request. Safe Clearance procedures are used by Project and Contractor personnel to protect personnel, equipment and the environment as well as to ensure continuity of service. Any work performed by the Contractor that requires taking project operated equipment out of service is to be done only after a formal clearance is

obtained through the Government. Report violations to the Issuing Individual. Violators of safe clearance program may require retraining and retesting.

For jobs with multiple tasks that require AHA's, prepare and submit an Activity Hazard Analysis (AHA) on the first feature of work that requires a clearance request. Verify AHA requirements at the Pre-Fabrication Meeting.

The following applies to LOTO and HECP procedures:

a. The Government will provide Safe Clearance Tags to Contractor for clearances using the Government Safe Clearance Procedures. The Contractor must provide personal safety locks, meeting NWWP 385-1-20 Chapter 6, for use with the Government's safe clearance procedures. See NWWP 385-1-20, Chapter 6 - Locks and Tags, and Chapter 10 - Outside/Contractor Personnel for further guidance.

b. Use Government HECP procedures on equipment/systems owned by the Government. Use them on all points interfacing with Government owned equipment/systems. In instances where equipment is owned by the Contractor, not yet turned over to the Government, or equipment which is not tied into Government energy sources, the Contractor may use their own Lockout/Tagout Program. Contractor Programs must be pre-approved by the Project's Responsible Official.

c. Submit the names of Authorized Individuals to the Contracting Officer prior to the Pre-Fabrication Meeting. Project-specific training will be given by the Responsible Official or designee and will be approximately 30 minutes in length. Project-specific training will be provided for every contract and only to the Contractor's Authorized Individuals. The Authorized Individuals are required to brief their work crews and subcontractors of any project-specific clearance information. Training is only required once per year and is, with the exception of project-specific training, valid for every facility within the Walla Walla District.

d. If the Responsible Official or designee determines that the Authorized Individual's knowledge of the HECP procedures are inadequate, the Responsible Official may require retraining and retesting. See NWWP 385-1-20 Chapter 5 - Training for further guidance.

1.10.1 Safe Clearance Training

Contractor, subcontractor, vendors and visitors are required to take the appropriate level of HECP Procedure training commensurate with their job duties. Only HECP certificates generated by Vivid Learning Systems for the Walla Walla District are accepted.

Unless otherwise directed by the Contracting Officer, the Contractor shall have a sufficient number of Authorized Individuals trained to ensure adequate oversight and that there are no delays to the project.

All Contractor personnel working in areas under a Safe Clearance must be trained as Affected Persons. Any non-working personnel, vendors and visitors, entering an area under Safe Clearance must take Awareness Level training. Complete and submit training certificates to the Contracting Officer a minimum of seven (7) calendar days prior to the individual's

arrival onsite. Time estimates for training follow:

a. Awareness Level Training: Approximately 1 hour (non-working personnel, vendors and visitors).

b. Affected Persons: Approximately 2 hours in addition to Awareness Level training.

c. Authorized Individuals: Approximately 3 hours in addition to Awareness Level training and Affected Personnel Training.

All costs for this training are considered incidental to the work, and therefore, no additional payment will be made. Training is an annual requirement and expires one year from completion date. Training is provided by Vivid Learning Systems available online at:

https://hecp.vividlms.com/

NOTE: The Contractor may see a "Platform Upgrade Notice" when you click on the link. Ignore the upgrade notice and click on the "Sign Up Here" tab at the bottom of the page to continue.

Cost for the training is displayed on the home page. Maintain training documentation on site, including the individual's name and date of training completion, in accordance with NWWP 385-1-20.

1.11 DISPLAY OF SAFETY INFORMATION

1.11.1 Safety Bulletin Board

Within seven (7) calendar day(s) after mobilizing to the job site, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, may be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, Chapter 2-8 SOH Bulletin Board. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

1.11.2 Safety and Occupational Health (SOH) Deficiency Tracking System

Establish a SOH deficiency tracking system that lists and monitors the status of SOH deficiencies in chronological order. Use the tracking system to evaluate the effectiveness of the APP. A monthly evaluation of the data must be discussed in the QC or SOH meeting with everyone on the project. Post the list on the project bulletin board and update daily. Provide the following information:

a. Date deficiency identified;

b. Description of deficiency;

c. Name of person responsible for correcting deficiency;

d. Projected resolution date;

e. Date actually resolved.

1.12 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

1.13 EMERGENCY MEDICAL TREATMENT

Contractors must arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.14 NOTIFICATIONS and REPORTS

1.14.1 Accident, Mishap, and Near Miss Investigation and Reporting

Report all accidents, mishaps, and near misses occurring incidentally to an operation, project, or facility as applicable according to EM 385-1-1 Chapter 2, Table 2-1. The Contractor is responsible for obtaining appropriate medical and emergency assistance and for notifying fire, law enforcement, and regulatory agencies.

Any fatality, in-patient hospitalization, amputation, eye loss, or property damage over $600,000 is required to be reported to the Contracting Officer immediately, but no more than eight (8) hours after the mishap occurs.

Immediate notifications includes Contractor name; contract title; type of contact; name of activity; installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known; and brief description of accident (for example, type of fabrication equipment used and PPE used).

Preserve the scene of the accident, mishap, or near miss and all related evidence until Government investigators are on-site and the Government investigation is concluded. Assist and cooperate fully with the Government's investigation(s) of any accident, mishap, or near miss.

1.14.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, property damage, and near misses as defined in EM 385-1-1 utilizing ENG Form 3394, to establish the root cause(s) of the accident.

b. Report all accidents to the Contracting Officer, using local mishap reporting procedures, in accordance with EM 385-1-1 Chapter 2, Table 2-1. The Contracting Officer will provide the Contractor the required forms.

c. Conduct an accident investigation for any load handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident in accordance with EM 385-1-1 Chapter 2, Table 2-1. Do not proceed with crane operations until cause is determined, and corrective actions have been implemented to the satisfaction of the Contracting Officer. The Contracting Officer will provide copies of any required forms.

1.14.3 LHE Inspection Reports

Submit LHE inspection reports required in accordance with EM 385-1-1 and as specified herein with Daily Reports of Inspections.

1.14.4 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging

Develop and submit a Standard Lift Plan (SLP) using ENG Form 6203 for each lift in accordance with EM 385-1-1 Chapter 16-7. The SLP is required to be developed, reviewed, and accepted by all personnel involved in the lift. Submit SLP to the Contracting Officer for approval a minimum of Fifteen (15) calendar days in advance of planned lift. Keep a copy of the SLP on the LHE for the specific approved lift(s).

Develop a Certificate of Compliance using ENG Form 6209 for each LHE prior to bringing on site in accordance with EM 385-1-1 Chapter 16-8. Submit the Certificate of Compliance to the Contracting Officer. Keep a copy of the Certificate of Compliance on the LHE.

1.14.5 Contractor's Cranes

a. Contractor's cranes and equipment furnished for this work are required to conform to the EM 385-1-1 and all applicable federal, state, local and OSHA requirements. Submit Crane Wheel and Outrigger Loading Diagram and Deck Protection for Outriggers plan at least Thirty (30) calendar days prior to using any crane rated 50 tons or more on any of the Project decks. Provide in the submittal the following information on a plan view sketch or drawing. A marked-up Government-provided contract Supplemental drawing can also be used, if available.

1. Crane outrigger locations with dimensions from the center of each outrigger to identifiable project feature(s).

2. Dimensions of each outrigger.

3. Maximum load on each outrigger.

4. Outrigger pad deck protection dimensions and location. Provide deck protection for all outrigger pads.

5. If cribbing material is used, show the cribbing material dimensions and location.

b. Include, in the submittal, the cribbing material properties, and calculations to verify the cribbing material's adequacy to carry the intended loads. To the greatest extent possible, place the outriggers over existing supports such as walls. Avoid placing the outriggers next to a wall or support. Under no circumstance can an outrigger or cribbing to be placed on metal grating or hatches. See SECTION 01 55 10.00 28 CONTRACTOR WORK, ACCESS AND STORAGE AREAS, paragraph GOVERNMENT ROADWAYS AND DECK ACCESS RESTRICTIONS for information on deck loading capacities.

1.15 HOT WORK

Activities which generate or have the potential to generate heat, sparks,

open flame, or explosion (for example, hot riveting, welding, burning, abrasive blasting, brazing, cutting, grinding, powder-actuated tools, or soldering) is considered Hot Work in accordance with EM 385-1-1 chapter 9-2.

Provide at least one, fully charged fire extinguisher, minimum 10 lbs. (4.5 kg), that must be readily available in the immediate area of the hot work. All extinguishers are required to be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. Train the Fire Watch in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the Hot Work Permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and the emergency phone number. Report any fire to the Government POC immediately.

Obtain permit approval from a NFPA Certified Marine Chemist, or Certified Industrial Hygienist for "HOT WORK" within or around flammable materials (such as fuel systems, welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, vaults, etc.) that have the potential for flammable or explosive atmospheres.

1.16 SEVERE STORM PLAN

In case of a severe storm warning, develop an emergency plan to ensure employee safety at the project. The plan must be prepared in writing and be reviewed with all affected employees. The Contractor must complete the following:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 FABRICATION AND OTHER WORK

Comply with EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

Provide and use PPE in accordance with EM 385-1-1 Chapter 5. The use of PPE is governed in all areas by the nature of the work the employee is performing.

Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Mandatory PPE includes the following, as a minimum, in accordance with EM 385-1-1, chapter 5-8:

a. Head Protection that meets ANSI/ISEA Z89.1.

b. Long Pants (excessively long or baggy pants are prohibited).

c. Leather or other protective footwear. Open-toed shoes are prohibited.

d. Appropriate Class Reflective Vests.

e. Eye and /or face protection is required when there is a potential for eye and/or face injury.

f. Short Sleeved Shirt.

3.1.1 Worksite Communication

Employees working alone in a remote location or away from other workers must be provided an effective means of emergency communications (e.g., cellular phone, two-way radios, land-line telephones or other acceptable means).

The selected communication must be readily available (easily within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment.

An employee check-in/check-out communication procedure must be developed to ensure employee safety.

3.1.2 Hazardous Material Exclusions

Radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint, and hexavalent chromium, are prohibited.

The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval.

Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on Project site.

3.1.3 Unforeseen Hazardous Material

If during the course of fabrication, the Contractor encounters unforeseen hazardous material(s) such as PCB, lead paint, friable and non-friable asbestos that may be hazardous to human health, stop that portion of work and notify the Contracting Officer immediately.

Within Fourteen (14) calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change.

If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to

FAR 52.243-4, "Changes" and FAR 52.236-2, "Differing Site Conditions."

3.2 FALL PROTECTION AND PREVENTION PLAN

Prepare, update, review, and approve a Fall Protection and Protection Plan, for the protection of all employees working at heights or exposed to fall hazards.

Specify in the Fall Protection and Prevention Plan, the fall protection systems, anchorage location, connecting means, body harness, and other equipment that Authorized Persons are required to use when exposed to a fall hazard in accordance with EM 385-1-1 Chapter 21-7.

3.2.1 Training

Institute a fall protection training program. As part of the Fall Protection and Prevention Plan, provide training for each employee who might be exposed to fall hazards. Provide training by a Competent Person for fall protection in accordance with EM 385-1-1 Chapter 21-3. Document the training and the practical application of the systems used in the AHA.

3.2.2 Fall Protection Equipment and Systems

Enforce use of personal fall protection equipment and systems designated (to include fall arrest, restraint, and positioning) for each specific work activity in the Site Specific Fall Protection and Prevention Plan and AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Chapter 21 "Fall Protection".

Provide personal fall protection equipment, systems, subsystems, and components that comply with EM 385-1-1 Chapter 21, 29 CFR 1926 Subpart M, ANSI/ASSP Z359.0, ANSI/ASSP Z359.1, ANSI/ASSP Z359.2, ANSI/ASSP Z359.3, ANSI/ASSP Z359.4, ANSI/ASSP Z359.6, ANSI/ASSP Z359.7, ANSI/ASSP Z359.11, ANSI/ASSP Z359.12, ANSI/ASSP Z359.13, ANSI/ASSP Z359.14, and ANSI/ASSP Z359.15.

3.2.2.1 Additional Personal Fall Protection

a. In addition to the required fall protection systems, other protection such as safety skiffs, personal floatation devices, and life rings, are required when working above or next to water in accordance with EM 385-1-1 Chapter 21-8.

b. Personal fall protection systems and equipment are required for the following:

1. When working from an articulating or extendible boom, a swing stage, or a suspended platform.

2. When operating other equipment such as scissor lifts.

c. Lanyards are required to be short enough to provide fall restraint and prohibit workers from climbing out of or being ejected from the platform or lift in accordance with EM 385-1-1 Chapter 21-8.

3.2.2.2 Personal Fall Protection Harnesses

Only a full-body harness with a shock-absorbing lanyard or self-retracting

lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable.

3.2.3 Flexible Horizontal Lifelines (HLL)

Provide a flexible HLL in accordance with EM 385-1-1, Chapter 21-8. Commercially manufactured horizontal lifelines (HLL) must be designed, installed, certified and used, under the supervision of a Qualified Person, for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 in accordance with 29 CFR 1926 Subpart M.

3.2.4 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1, Chapter 21-8 and 29 CFR 1926 Subpart M.

3.2.5 Rescue and Evacuation Plan and Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue or assisted-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP). The plan must comply with the requirements of EM 385-1-1, ANSI/ASSP Z359.2, and ANSI/ASSP Z359.4.

3.3 WORK PLATFORMS

3.3.1 Scaffolding

Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Comply with the following requirements:

a. Provide an access ladder or equivalent safe access. Where a built-in ladder is part of a scaffold system, it must meet the requirements for ladders according to EM 385-1-1 chapter 24.

b. An adequate gate is required.

c. Employees performing scaffold erection and dismantling must be qualified, and work under the supervision of the Competent Person (CP), Scaffolding.

d. Scaffolding and its components are required to meet the requirements contained in ANSI/ASSP A10.8 or other applicable ANSI/ASSP standards and be capable of supporting without failure at least 4 times the maximum anticipated load.

e. Where the scaffold height exceeds four times the minimum scaffold base dimension (including the width added by outriggers, if used), the scaffold is required to be secured to the wall or structure. Place tie-ins in accordance with EM 385-1-1 Chapter 22-8.

f. Do not use brackets on scaffolds unless the tipping effect is controlled.

g. Scaffolding other than suspended types must bear on base plates upon wood mud sills (2 in x 10 in x 8 in minimum) or other adequate firm foundation.

h. For workers erecting and dismantling scaffolds at or above 6 ft, a CP is required to conduct an evaluation to determine the feasibility and safety of providing fall protection. If fall protection is not feasible, submit an AHA detailing rationale for infeasibility of use of fall protection for approval by the Contracting Officer.

i. When working above six feet or above dangerous operations, delineate fall protection requirements in the Fall Protection and Prevention (FP&P) Plan, and Activity Hazard Analysis (AHA) for the phase of work.

j. A CP must inspect all scaffold and scaffold components for visible defects before each work shift and after any occurrence which could affect the scaffold's structural integrity. All scaffold inspections must be documented on the scaffold inspection tag prior to use.

3.3.2 Elevated Aerial Work Platforms (AWP's)

Workers must be anchored to the basket, bucket, or platform in accordance with manufacturer's specifications and instructions (anchoring to the boom may only be used when allowed by the manufacturer and permitted by the CP).

Lanyards are required to be sufficiently short to provide fall restraint and prohibit worker from climbing out of or being ejected from the basket or platform. Lanyards with built-in shock absorbers are acceptable. Self-retracting devices are not acceptable.

The climbing of rails is prohibited.

Tying off to an adjacent pole or structure is not permitted unless a safe device for 100 percent tie-off is used for the transfer.

AWP's are required to be operated, inspected, and maintained as specified in the operating manual for the equipment and delineated in the AHA. Operators of AWP's are required to have training in accordance with EM 385-1-1 Chapter 22-3. Maintain proof of qualifications on site. Provide qualifications to the Contracting Officer on request.

3.4 EQUIPMENT

3.4.1 Material Handling Equipment (MHE)

a. Do not use forklifts/PITs to support work platforms unless there is no other practical method. The manufacturer must specifically allow the specific machine to lift personnel. Maintain the operator’s manual at the work site on the forklift. If rough terrain (RT) forklift must be used, all the conditions in EM 385-1-1 Chapter 22-8 are required to be met. Do not move the forklift horizontally when a work platform is occupied. Driving a forklift equipped with a personnel work platform in a raised position or with personnel on the platform is forbidden.

b. When PITs, forklifts, or telehandlers are configured to hoist and lower (by means of a winch or hook and/or with rigging) and horizontally move a suspended load, refer to EM 385-1-1 Chapters 15 and 16.

c. Train operators of forklifts, PITs, or telehandlers according to 29 CFR 1910.178, including both classroom and practical operation. Train employees on the same type of truck they are expected to use on the job. The employer must certify that the operator has been trained and evaluated as required by the standard. Include in the certification the name of the operator, the dated of the training, the date of the evaluation, and the identity of the person(s) performing the training or evaluation in accordance with EM 385-1-1 Chapter 18-3.

3.4.2 Load Handling Equipment (LHE)

a. Equip cranes and derricks as specified in EM 385-1-1, Chapter 16.

b. Notify the Contracting Officer a minimum of twenty-one (21) calendar days in advance of any LHE entering the activity, in accordance with EM 385-1-1, Chapter 16, so that necessary quality assurance spot checks can be coordinated. Contractor's operator must remain with the crane during the spot check. Rigging gear must comply with OSHA, ASME B30.9 Standards.

c. Comply with the LHE manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.8 for floating cranes and floating derricks, ASME B30.9 for slings, ASME B30.20 for below the hook lifting devices and ASME B30.26 for rigging hardware.

e. A Contractor is not allowed to make a lift at, or above 90% of the crane's rated capacity in any configuration.

f. When operating in the vicinity of overhead transmission lines, operators and riggers must be alert to this hazard and follow the requirements of EM 385-1-1 Chapter 11, and ASME B30.5 or ASME B30.22 as applicable.

g. Do not use LHE to hoist personnel, except where the Contractor demonstrates that the assembly, use, and disassembly of conventional means of reaching the work area (such as personal hoist, ladder, stairway, aerial lift, elevating work platform, or scaffold) is more hazardous or is not possible because of the project's physical features or work site conditions. Document this determination in the Critical Lift Plan following the requirements of EM 385-1-1 Chapter 16-7. Perform all hoisting of personnel as required in 29 CFR 1926.1431 Do not lift personnel with a line hoist or friction crane.

h. Submit an AHA for hoisting personnel to the Contracting Officer, ensuring the activity and AHA are thoroughly reviewed by all involved personnel.

i. Inspect, maintain, and recharge portable fire extinguishers as specified in EM 385-1-1 Chapter 9, and NFPA 10, Standard for Portable Fire Extinguishers.

j. All employees must keep clear of loads about to be lifted, and of suspended loads.

k. Use cribbing when performing lifts on outriggers.

l. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

m. Barricade the accessible areas at the rear of the LHE's rotating superstructure and within the swing radius of permanently or temporarily mounted items to prevent an employee from being struck or crushed.

n. Maintain inspection records in accordance with EM 385-1-1 Chapter 16-5, including shift, monthly, and annual inspections, the signature of the person performing the inspection, and the serial number or other identifier of the LHE that was inspected. Records must be available for review by the Contracting Officer.

o. Maintain written reports of operational and load testing in accordance with EM 385-1-1, Chapter 16-8, listing the load test procedures used along with any repairs or alterations performed on the LHE. Reports must be available for review by the Contracting Officer.

p. Certify that all LHE operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

q. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. At wind speeds greater than 20 mph, the operator, rigger and lift director must cease all crane operations, evaluate conditions and determine if the lift may proceed. Base this determination on the manufacturer's instructions for calculating wind speed . Document the decision to proceed or not with the lift in the LHE/crane operator's logbook.

3.4.3 Machinery and Mechanized Equipment

a. The operators of vehicles, machinery, and mechanized equipment are required to present operator's license or permit to the Contracting Officer upon request. Failure to do so results in the immediate prohibition of the operator to operate the vehicle, machinery, or equipment. Maintain operator's licenses and permits at the Project site.

b. Manufacturer's operating manual(s)must be on-site and reviewed for safety precautions or requirements. Incorporate manufacturers requirements into AHA's.

3.4.4 Explosives

Explosives must not be used on, or brought to the Project site, unless approved in writing, by the Contracting Officer. Obtain written permission from the Contracting Officer before bringing explosive materials onto the jobsite. Periodic replenishment of previously approved supplies does not require re-approval.

3.5 ELECTRICAL

Perform electrical work in accordance with EM 385-1-1, Chapters 11 and 12.

3.5.1 Conduct of Electrical Work

a. As required in EM 385-1-1 Chapter 11-8, all equipment and circuits must be de-energized before work is started unless energized work can be justified.

b. In situations where equipment and circuits must be worked on in an energized condition, submit ENG Form 6277 Energized Electrical Work Permit (EEWP) to the Contracting Officer for acceptance fifteen (15) calendar days prior to the work to be performed.

c. Provide an AHA with the EEWP and include a summary of why the equipment/circuit needs to be worked on while energized. Treat underground electrical spaces as confined spaces in accordance with EM 385-1-1 Chapter 34.

d. Cables to be cut must be positively identified and de-energized prior to performing each cut. Attach temporary grounds in accordance with ASTM F855 and IEEE 1048. Perform all high voltage cable cutting remotely using hydraulic cutting tool.

e. When racking in or live switching of circuit breakers, no additional personnel other than the switch operator is allowed in the space during the operation. Plan so that work near energized parts are minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method.

f. When working in energized substations, only qualified electrical workers are permitted to enter.

g. When work is required near energized circuits as defined by NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves and electrical arc flash protection for personnel as required by NFPA 70E.

h. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

i. Ensure that each employee is familiar with and complies with NWWP 385-1-20, and 29 CFR 1910 procedures.

3.5.2 Qualifications

a. Electrical work must be performed by Qualified Persons with verifiable credentials who are familiar with applicable code and electrical safety requirements including NFPA 70E. This includes work pertaining to, but not limited to the following: installation and/or removal of electric conductors, equipment, raceways, and manipulation of cables.

b. Verifiable credentials consist of State, National, and Local

Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and must be identified in the appropriate AHA.

c. Train such Qualified Persons to the level of duties as assigned. All training programs are required to be approved by the Authority Having Jurisdiction (AHJ), and be properly documented.

d. Journeyman/Apprentice ratio must be in accordance with State, Local requirements applicable to where work is being performed.

e. Submit all credentials to the Contracting Officer for acceptance.

3.5.3 Grounding

Ground electrical circuits, equipment and enclosures in accordance with NFPA 70 and IEEE C2 to provide a permanent, continuous and effective path to ground unless otherwise noted by EM 385-1-1 Chapter 11.

Check grounding circuits to ensure that the circuit between the ground and a grounded power conductor has a resistance low enough to permit sufficient current flow to allow the fuse or circuit breaker to interrupt the current.

3.5.4 Testing

Test temporary electrical distribution systems in accordance with EM 385-1-1. Including testing for polarity, ground continuity, and ground resistance before initial use and before use after modification. Test associated GFCI's monthly.

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SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g. ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aashto.org
Internet: http://www.aashto.org

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
P.O. Box 28518
1711 Arlingate Lane
Columbus, OH 43228-0518
Ph: 800-222-2768; 614-274-6003
Fax: 614-274-6899
E-mail: tjones@asnt.org
Internet: http://www.asnt.org

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191
Ph: 703-295-6300; 800-548-2723
E-mail: member@asce.org
Internet: http://www.asce.org

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ANSI/ASSP)
1800 East Oakton Street
Des Plaines, IL 60018
Ph: 847-699-2929
Internet: http://www.asse.org

AMERICAN WELDING SOCIETY (AWS)
13301 NW 47 Ave
Miami, FL 33054
Ph: 888-WELDING, 305-824-1177, 305-826-6192
Fax: 305-826-6195
E-mail: customer.service@awspubs.com
Internet: http://www.aws.org

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Two Park Avenue, M/S 10E
New York, NY 10016-5990
Ph: 800-843-2763
Fax: 973-882-1717
E-mail: customercare@asme.org
Internet:https://www.asme.org/

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 877-909-2786
Internet: http://www.astm.org

FEDERAL ACQUISITION REGULATIONS (FAR)
Internet:https://www.acquisition.gov/browse/index/far

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 and 501 Hoes Lane
Piscataway, NJ 08854-4141
Ph: 732-981-0060 or 800-701-4333
Fax: 732-562-9667
E-mail: onlinesupport@ieee.org
Internet: http://www.ieee.org

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
3050 Old Centre Ave. Suite 102
Portage, MI 49024
Ph: 269-488-6382
Internet: http://www.netaworld.org

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)
1901 North Moore Street
Arlington, VA 22209-1762
Ph: 703-525-1695
Fax: 703-528-2148
Internet: http://www.safetyequipment.org/

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
127 Park Street, NE
Vienna, VA 22180-4602
Ph: 703-281-6613
E-mail: info@mss-hq.com
Internet: http://mss-hq.org/Store/index.cfm

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 900
Arlington, VA 22209
Ph: 703-841-3200
Internet: http://www.nema.org/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000
Fax: 617-770-0700
Internet: http://www.nfpa.org

U.S. ARMY CORPS OF ENGINEERS (USACE)
CRD-C DOCUMENTS available on Internet:
http://www.wbdg.org/ccb/browse_cat.php?c=68
Order Other Documents from:
USACE Publications Depot
Attn: CEHEC-IM-PD
2803 52nd Avenue
Hyattsville, MD 20781-1102
Ph: 301-394-0081
Fax: 301-394-0084
E-mail: pubs-army@usace.army.mil
Internet: http://www.publications.usace.army.mil/
or
http://www.hnc.usace.army.mil/Missions/Engineering/TECHINFO.aspx

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Fax: 301-837-0483
Internet: http://www.archives.gov
Order documents from:
Superintendent of Documents
U.S.Government Printing Office (GPO)
710 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: http://www.gpoaccess.gov

UL SOLUTIONS (UL)
333 Pfingsten Road
Northbrook, IL 60062
Ph: 877-854-3577 or 360-817-5500
E-mail: CustomerExperienceCenter@ul.com
Internet: https://www.ul.com/

UL Directories available through IHS at https://accuristech.com/

WASHINGTON STATE ADMINISTRATIVE CODE (WAC)
Legislative Information Center
Gerry Sheehan, Coordinator
106 Legislative Building
Olympia, WA 98504-0600
Ph: 360-786-7573
Fax: 360-786-1529
E-mail: support@leg.wa.gov
Internet: http://app.leg.wa.gov/wac/Default.aspx

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Sample of Quality Control Report, WWD-QCR (Rev Sep 85)

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SECTION 01 45 00.01 28

CONTRACTOR QUALITY CONTROL (SHORT FORM)

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. A designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Quality Control Plan; G, C

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CONTRACTOR QUALITY CONTROL (CQC) PLAN

Furnish for review by the Government, not later than 5 calendar days after receipt of Notice of Award, the Contractor Quality Control Plan proposed to implement the requirements of the clause entitled INSPECTION OF SUPPLIES--FIXED PRICE of the CONTRACT CLAUSES. The plan needs to identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 15 calendar days of operation. Fabrication will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan is not permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.1.1 Additional Requirement

Identify as CQC System Manager an individual within the onsite work organization who is responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager must be a fabrication person with a minimum of five (5) years in related work. This CQC System Manager must be on the site at all times during fabrication and be employed by the prime Contractor. The CQC System Manager can be assigned as the Project Superintendent. Identify in the plan an alternate to serve in the event of the CQC System Manager's absence. The requirements for the alternate are the same as the CQC System Manager. The CQC System Manager shall have completed the course entitled "Quality Management for Contractors" within the last five (5) years. This course will periodically be offered at various locations throughout the Pacific Northwest. For information concerning this course call your local Associated General Contractor's Plan Room.

3.2 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the fabrication, to include that of subcontractors and suppliers, complies with the requirements of the contract. The controls shall be adequate to cover all fabrication operations, including both on-site and off-site fabrication, and shall be keyed to the proposed fabrication sequence. The controls shall include at least three (3) phases of control to be conducted by the CQC system manager for all definable features of work, as follows:

3.2.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work and shall include:

a. A review of each paragraph of applicable specifications.

b. A review of the contract plans.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. A check to assure that provisions have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawing or submitted data, and are properly stored.

g. A review of the appropriate Activity Hazard Analysis to assure safety requirements are met.

h. Discussion of procedures for constructing the work including repetitive deficiencies. Document fabrication tolerances and workmanship standards for that phase of work.

i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. The Government shall be notified at least 24 hours in advance of beginning any of the required action of the preparatory phase. This phase shall include a meeting conducted by the CQC system manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily QC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.2.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of preliminary work to ensure that it is in compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verification of full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC system manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase shall be repeated for each new crew to work on-site, or any time acceptable specified quality standards are not being met.

3.2.3 Follow-up Phase

Daily inspections shall be performed to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. The inspections shall be made a matter of record in the CQC documentation. Final follow-up inspections shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. Do not build upon or conceal non-conforming work.

3.2.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases must be conducted on the same definable features of work as determined by the Government if the quality of on-going work is unacceptable; or if there are changes in the applicable QC staff or in the on-site production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.3 ORGANIZATION

Identify an individual within the organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor, including stoppage of work and removal of noncompliant work. The CQC System Manager shall be on the site at all times during fabrication, including during the work of subcontractors.

3.4 SUBMITTALS

The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements by signing the ENG FORM 4025.

3.5 AS-BUILT DRAWINGS

Maintain working "as-built" contract drawings as required in SECTION 01 78 00.00 28 CLOSEOUT SUBMITTALS.

3.6 DOCUMENTATION

Maintain current records of quality control operations, activities, and tests performed, including the work of subcontractors and suppliers. These records shall be on an acceptable form, see attached Sample of Quality Control Report, WWD-QCR (Rev Sep 85), and shall include factual evidence that required quality control activities and/or tests have been performed, including but not limited to the following:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Test and/or control activities performed with results and references to specifications/plan requirements. List deficiencies noted along with corrective action.

d. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

e. List instructions given/received and conflicts in plans and/or specifications.

f. Contractor's verification statement on form WWD-QCR.

g. Work performed today, giving location, description, and by whom.

h. Material received with statement as to its acceptability and storage.

i. Identify submittals reviewed, with contract reference, by whom, and action taken.

j. These records must indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records cover both conforming and deficient features and includes a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one (1) copy of these records in report form must be furnished to the Government daily within 24 hours after the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one (1) report must be prepared and submitted for every seven (7) calendar days of no work and on the last day of a no work period. All calendar days must be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC

system manager. The report includes copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.7 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. After receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor at the site of the work, is deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order suspending or stopping all or part of the work until satisfactory corrective action has been taken.

-- End of Section --

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CONTRACTOR'S NAME
(Address)

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Contract No.: _____ Date: _____ Report No.: _____

Description and Location of Work: _____

WEATHER: (Clear) (P. Cloudy) (Cloudy) Temperature: _____Min. _____Max.
Rainfall: _____inches

Contractor/Subcontractors and Area of Responsibility with Labor Count for Each:

a._____

b._____

c._____

d._____

Equipment Data: (Indicate items of construction equipment, other than hand tools, at the jobsite, and whether or not used.)

1. Work Performed Today: (Indicate location and description of work performed. Refer to work performed by prime and/or subcontractors by letter in table above.)*

---

2. Results of Surveillance: (Include satisfactory work completed, or deficiencies, with action to be taken.)*

a. Preparatory Inspection:

b. Initial Inspection:

c. Follow-up Inspections:

3. Tests Required by Plans and/or Specifications Performed and Results of Tests:

4. Verbal Instructions Received: (List any instructions given by Government personnel on construction deficiencies, retesting required, etc., with action to be taken.)*

5. Remarks: (Cover any conflicts in plans, specifications, or instructions, or any delay to the job attributable to weather conditions. Include environment protection activities, construction deficiencies and corrective action, etc.)*

6. Results of Safety Inspection: (Include safety violations and corrective actions taken.)*

_____
(Contractor's Inspector)

CONTRACTOR'S VERIFICATION: The above report is complete and correct and all material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.*

_____
CQC System Manager

*Attach additional sheet as necessary.

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 45 01.00 28

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)

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SECTION 01 45 01.00 28

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 Safety and Occupational Health Requirements

Comply with the current edition and all changes posted on the web as of the effective date of this solicitation.

1.2 CONTRACT ADMINISTRATION

The Government will use the Resident Management System (RMS) to assist in its monitoring and administration of this contract. The Government accesses the system using the Government Mode of RMS (RMS GM) and the Contractor accesses the system using the Contractor Mode (RMS CM). The term RMS will be used in the remainder of this section for both RMS GM and RMS CM. The joint Government-Contractor use of RMS facilitates electronic exchange of information and overall management of the contract. The Contractor accesses RMS to record, maintain, input, track, and electronically share information with the Government throughout the contract period in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Closeout
Import/Export of Data

The Contractor must be prepared to transition from the Resident Management System (RMS) to the new Construction Management Platform (CMP) at any time during the period of performance of this contract, once the USACE enterprise implements this change. The Contractor's obligation to transition from RMS to the CMP system is a requirement of this contract. Therefore, additional time or cost increase to complete this transition will not be considered. In the event of the transition, RMS project information will be migrated to CMP by the government and available in the CMP system. After the transition, the Contractor must utilize the CMP system to perform all contract administration functions previously required in RMS, including all areas listed above. After the transition, “RMS” and “CMP” will be synonymous for all “Resident Management System” and “RMS” references in this contract’s specification. To facilitate the transition from RMS to CMP, online training for the CMP system will be made available to the Contractor with enough time to train staff, prior to the transition occurring.

1.2.1 Correspondence and Electronic Communications

For ease and speed of communications, exchange correspondence and other documents in electronic format to the maximum extent feasible between the Government and Contractor.

1.2.2 Other Factors

Particular attention is directed to the schedules for Contracts, Contract Clause, "Payments", SECTION 01 33 00 SUBMITTAL PROCEDURES, and SECTION 01 45 00.01 28 CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through RMS. Also, there is no separate payment for establishing and maintaining the RMS database; costs associated will be included in the contract pricing for the work.

1.3 RMS SOFTWARE

RMS is a Windows-based program that can be run on a Windows-based PC meeting the requirements as specified in Paragraph: SYSTEM REQUIREMENTS. Download, install and be able to utilize the latest version of the RMS software within 7 calendar days of receipt of the Notice of Award. RMS software, user manuals, access and installation instructions, program updates and training information are available from the RMS website (https://rms.usace.army.mil/rms_manuals&help_files.html). The Government and the Contractor will have different access authorities to the same contract database through RMS. The common database will be updated automatically each time a user finalizes an entry or change.

1.4 SYSTEM REQUIREMENTS

The following is the recommended system configuration to run the Contractor Mode RMS for full utilization of all features for all types and sizes of contracts. Smaller, less complicated, projects may not require the configuration levels described below. Required configuration also noted below.

Recommended RMS System Requirements	
Hardware	
Windows-based PC	1.7 GHz i3; AMD A6 3650 GHz or higher processor (REQUIRED)
RAM	8 GB
Hard drive disk	100 GB space for sole use by RMS system
Monitor	Screen resolution 1366 x 768
Mouse or other pointing device	
Windows compatible printer	Laser printer must have 4 MB+ of RAM
Connection to the Internet	minimum 4 Mbs per user
Software	
MS Windows	Windows 7 x 64 bit (RMS requires 64 bit O/S) or newer (REQUIRED)

Recommended RMS System Requirements	
Word Processing software	Viewer for MS Word 2013, MS Excel 2013 or newer (REQUIRED)
E-mail	MAPI compatible (REQUIRED)
Virus protection software	Regularly upgraded with all issued Manufacturer's updates and is able to detect most zero day viruses (REQUIRED)

1.5 RELATED INFORMATION

1.5.1 RMS User Guide

After contract award, download instructions for the installation and use of RMS from the Government RMS Internet Website.

1.6 CONTRACT DATABASE - GOVERNMENT

The Government will enter the basic contract award data in RMS prior to granting the Contractor access. The Government entries into RMS will generally be related to submittal reviews, correspondence status, and Quality Assurance (QA) comments, as well as other miscellaneous administrative information.

1.7 CONTRACT DATABASE - CONTRACTOR

Contractor entries into RMS establish, maintain, and update data throughout the duration of the contract. Contractor entries generally include prime and subcontractor information, daily reports, submittals, RFI's, schedule updates and payment requests. RMS includes the ability to import attachments and export reports in many of the modules, including submittals. The Contractor responsibilities for entries in RMS typically include the following items:

1.7.1 Administration

1.7.1.1 Contractor Information

Contain within the database the Contractor's name, address, telephone numbers, management staff, and other required items. Within 7 calendar days of receipt of RMS software from the Government, deliver Contractor administrative data in electronic format in RMS.

1.7.1.1.1 New Contractors to RMS-CM

Appoint a RMS-CM administrator. This administrator will be given appropriate administrative rights required to enter data by the Government.

1.7.1.2 Subcontractor Information

Contain within the database the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor is listed separately for each trade to be performed. Assign each subcontractor/trade a unique Responsibility Code, provided in RMS. Within 7 calendar days of receipt of RMS software from the Government, deliver subcontractor administrative data in electronic format.

1.7.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters are numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

All correspondence with a serial number shall be sent by email to the Government's Project Engineer and Contracting Officer's Representative assigned to this project.

1.7.1.4 Equipment

Contain within the Contractor's RMS database, a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.7.1.5 Management Reporting

RMS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of RMS. Among these reports are: Progress Payment Request worksheet, Quality Assurance/Quality Control (QA/QC) comments, Submittal Register Status, Three-Phase Control checklists.

1.7.1.6 Request For Information (RFI)

Exchange all Requests For Information (RFI) using the Built-in RFI generator and tracker in RMS. Email the RFI to the COR and the submittal transmittal mailbox specified in SECTION 01 33 00 SUBMITTAL PROCEDURES paragraph "Electronic Copies" and in the format specified in paragraph Format For Electronic Submittals.

1.7.2 Finances

1.7.2.1 Pay Activity Data

Include within the RMS database a list of pay activities that the Contractor develops in conjunction with the fabrication schedule. The sum of pay activities equals the total contract amount, including modifications. Each pay activity must be assigned to a Contract Line Item Number (CLIN). The sum of the activities equals the amount of each CLIN. The sum of all CLINs equals the contract amount.

1.7.2.2 Payment Requests

Prepare all payment requests using RMS. Complete the payment request worksheet, prompt payment certification, and payment invoice in RMS. Update the work completed under the contract at least monthly. After the update, generate a payment request report using RMS, if applicable. Include emailing the notification to PayRequest@usace.army.mil of the payment request submitted in RMS.

1.7.3 Quality Control (QC)

RMS provides a means to track implementation of the 3-phase QC Control

System, prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements. Maintain this data on a daily basis. Entered data will automatically output to the RMS generated daily report. Provide the Government a Contractor Quality Control (CQC) Plan within the time required in SECTION 01 45 00.01 28 CONTRACTOR QUALITY CONTROL. Within 7 calendar days of Government acceptance, submit a RMS update reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.7.3.1 Daily Contractor Quality Control (CQC) Reports

RMS includes the means to produce the Daily CQC Report. The Contractor can use other formats to record basic Quality Control(QC) data. However, the Daily CQC Report generated by RMS must be the Contractor's official report. Summarize data from any supplemental reports by the Contractor and consolidate onto the RMS-generated Daily CQC Report. Submit daily CQC Reports as required by SECTION 01 45 01.00 28 CONTRACTOR QUALITY CONTROL. Electronically submit reports to the Government within 24 hours after the date covered by the report. Provide the Government a printed signed copy of the QC Daily Report.

Reports must include the following activities, at a minimum:

a. Weather conditions

b. References to Activity Hazard Analysis

c. Inspection activities

d. Detailed description of work performed

e. Photographs

f. Tests performed with results

g. Tools and parts control daily checklist

h. Problems noted

i. Ongoing punch list items

1.7.3.2 Deficiency Tracking

Use RMS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using its Quality Control (QC) punch list items. Maintain a current log of its QC punch list items in the RMS database. The Government will log the deficiencies it has identified using its Quality Assurance (QA) punch list items. The Government's QA punch list items will be included in its export file to the Contractor. Regularly update the correction status of both QC and QA punch list items.

1.7.3.3 QC Requirements

Develop and maintain a complete list of QC testing and required structural and life safety special inspections required by the International Code Council (ICC), transferred and installed property, and user training requirements in RMS. Update data on these QC requirements as work progresses, and promptly provide the information to the Government via RMS.

1.7.3.4 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in RMS.

1.7.3.5 Labor and Equipment Hours

Log labor and equipment exposure hours on a daily basis. Combine the labor and equipment exposure data into a monthly exposure report.

1.7.3.6 Accident/Safety Reporting

Both the Contractor and the Government enter safety related comments in RMS as a deficiency. Regularly update the correction status of the safety comments. In addition, utilize RMS to advise the Government of any accidents occurring on the jobsite. A brief supplemental entry of an accident is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 300.

1.7.3.7 Features of Work

Include a complete list of the features of work in the RMS database. A feature of work is associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.7.3.8 Hazard Analysis

Use RMS CM to develop a hazard analysis for each feature of work included in the CQC Plan. The Activity Hazard Analysis will include information required by EM 385-1-1, paragraph "Activity Hazard Analysis (AHA) Requirements", and related paragraphs.

1.7.4 Submittal Management

The Government will provide the initial Submittal Register in electronic format. Thereafter, maintain a complete list of submittals, including completion of data columns. Dates when submittals are received and returned by the Government will be included. Use RMS CM to track and transmit submittals. ENG Form 4025, Submittal Transmittal Form, and the Submittal Register update is produced using RMS. RMS will be used to update, store and exchange submittal registers and transmittals. In addition to requirements stated in SECTION 01 33 00 SUBMITTAL PROCEDURES, actual submittals are to be stored in RMS CM, with hard copies also provided. Exception will be where the Contracting Officer specifies only hard copies required, and where samples, spare parts, color boards, and full size drawings are to be provided.

1.7.5 Schedule

Develop a fabrication Schedule consisting of pay activities, in accordance with SECTION 01 11 01.00 28 SUPPLEMENTARY REQUIREMENTS paragraph PROJECT SCHEDULE, and SECTION 01 32 16.00 28 SMALL PROJECT FABRICATION AND ASSEMBLY PROGRESS SCHEDULES. Input and maintain in the RMS database the schedule either manually or by using the Standard Data Exchange Format (SDEF). Include with each pay request the updated schedule. Provide electronic copies of transmittals.

1.7.6 Import/Export of Data

RMS includes the ability to import schedule data using SDEF.

1.8 IMPLEMENTATION

Use of RMS CM as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain contract data within the RMS CM system. RMS CM is an integral part of the Contractor's management of quality control.

1.9 MONTHLY COORDINATION MEETING

Update the RMS CM database each workday. At least monthly, generate and submit a Schedule Update. At least one week prior to submittal, meet with the Government representative to review the planned progress payment data submission for errors and omissions.

Make required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will not be accepted. The Government will not process progress payments until all required corrections are processed.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this SPECIFICATION. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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CONTRACTOR WORK, ACCESS AND STORAGE AREAS

PART 1 GENERAL

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1.3 CONTRACTOR ACCESS TO STORAGE AREA
1.3.1 Storage Areas
1.4 GOVERNMENT ROADWAYS ACCESS RESTRICTIONS
1.5 PERMITS AND RESPONSIBILITIES
1.6 HAULING MATERIAL
1.7 FIRE CONTROL
1.7.1 Fire Procedures

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01 55 10.00 28

CONTRACTOR WORK, ACCESS AND STORAGE AREAS

PART 1 GENERAL

The work covered by this section of the specifications consists of work common to more than one section of these TECHNICAL SPECIFICATIONS.

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LRFD	(9th Edition 2020; R 2021) LRFD Bridge Design Specifications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. A designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Transport Loading Diagrams; G ST

1.3 CONTRACTOR ACCESS TO STORAGE AREA

1.3.1 Storage Areas

Transformer delivery and storage area is in the Project's "Storage Yard". The Contractor is to offload the transformer in the storage yard per contract requirements during normal business days and work hours only. All access to the storage yard is from the South side of the dam. The Contracting Officer Representative (COR) will designate where the transformer is to be stored.

1.4 GOVERNMENT ROADWAYS ACCESS RESTRICTIONS

Hauling of materials and equipment will be permitted on the project's roadways. Submit transport loading diagrams indicating wheel loads and axle configurations for transport vehicles to haul loads exceeding HS-20, in accordance with AASHTO LRFD Bridge Design Specifications. (AASHTO LRFD Bridge Design Specifications defines HS-20 vehicles as having a gross vehicle weight of 72,000 lbs. and a maximum axle load of 32,000 lbs).

1.5 PERMITS AND RESPONSIBILITIES

The Contractor is responsible for complying with all Federal, State, and

municipal laws, codes, and regulations applicable to work on this contract. This includes obtaining all necessary licenses and permits related to transportation of equipment and/or contract items, and other areas of work on this contract, as applicable. Licenses and permits shall be obtained without additional expense to the Government.

1.6 HAULING MATERIAL

No material shall be allowed to drop off vehicles while in transit. The Contractor shall take all necessary precautions to prevent any material from dropping off the vehicle onto local roads.

1.7 FIRE CONTROL

Each piece of internal combustion engine driven equipment used at the work site shall be equipped with a fire extinguisher in accordance with National Fire Protection Association (NFPA) recommendations as appropriate. The minimum approved rating of extinguishers shall not be less than 5-B:C.

1.7.1 Fire Procedures

In the case of a fire within the contract area, the Contractor shall first attempt to put out the fire. If this is not possible, notify the fire department. The appropriate COR must be notified as soon as possible of the fire and any damage estimates.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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DIVISION 01 - GENERAL REQUIREMENTS

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SECTION 01 57 20.00 28

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 GENERAL INFORMATION

This SECTION covers preventing environmental pollution and minimizing environmental degradation during and as a result of Contractor operations. Other requirements in the Technical Sections may also contain specific requirements for environmental protection. Those specific requirements are in addition to or modify the requirements in this SECTION. The control of environmental pollution requires consideration of sound levels, air, water, and land resources.

1.2 PUBLICATIONS

1.2.1 Applicable Regulations

Prevent, abate, and control all environmental pollution, and minimize environmental degradation by complying with all applicable Federal, State, and local laws and regulations, as well as specific requirements of this Contract. Where conflicting or duplicate regulations apply, the most stringent requirement governs. Comply with the most current version of the environmental regulations at time of contract Solicitation where applicable.

1.2.2 Referenced Publications and Regulations

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety and Occupational Health Requirements

Comply with the current edition and all changes posted on the web as of the effective date of this solicitation.

WETLANDS DELINEATION MANUAL	(1987) Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1

ASTM INTERNATIONAL (ASTM)

ASTM D5864	(2011) Standard Test Method for Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1001	OSHA General Industry - Asbestos
29 CFR 1910.1200	OSHA General Industry - Hazard Communication

29 CFR 1910.120	OSHA General Industry - Hazardous Waste Operations and Emergency Response (HAZWOPER)
29 CFR 1926.1101	OSHA Construction - Asbestos
29 CFR 1926.65	OSHA Construction - Hazardous Waste Operations and Emergency Response (HAZWOPER)
33 CFR 328	Definition of Waters of the United States
40 CFR 112	Oil Pollution Prevention
40 CFR 122	EPA Administered Permit Programs: The National Pollutant Discharge Elimination System
40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)
40 CFR 763	Toxic Substances Control Act (TSCA) - Asbestos
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 171-178	Transportation of Hazardous Materials Regulations
40 CFR 241	Guidelines for Disposal of Solid Waste
40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	RCRA Standards Applicable to Transporters of Hazardous Waste
40 CFR 273	Standards for the Management of Universal Waste - light bulbs, batteries, mercury switches
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Comprehensive Environmental Response Compensation and Liability Act (CERCLA) - Hazardous Substance Spill Reporting Requirements: Asbestos, PCBs, etc.

40 CFR 355	Emergency Planning and Notification
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 68	Chemical Accident Prevention Provisions
40 CFR 82	Protection of Stratospheric Ozone - Refrigerant and SF6 Gas
49 CFR 178	Specifications for Packagings

WASHINGTON STATE ADMINISTRATIVE CODE (WAC)

WAC 173-303	Dangerous Waste Regulation
WAC 173-400	General Standard for Maximum Emissions

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. The designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G, ECC

1.4 DEFINITIONS

1.4.1 Discarded Material

The term "discarded material", as used herein, is any material that is abandoned, recycled, or considered "inherently waste-like" as described in 40 CFR 260

1.4.2 Environmental Pollution and Damage

The term "environmental pollution and damage", as used herein, is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally, and/or historically.

1.4.3 Environmental Litigation

The term "environmental litigation", as used herein, means a lawsuit alleging that the work will have an adverse effect on the environment or that the Government has not duly considered, either substantively or procedurally, the effect work has on the environment.

1.4.4 Environmental Protection

The term "environmental protection", as used herein, is the prevention/control of pollution and habitat disruption that may occur to the environment during Contractor operations. The control of

environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.4.5 Solid Waste

The term "solid waste", as used herein, is any discarded material that is not excluded under 40 CFR 261.4(a) or that is not excluded by a variance granted under 260.30 and 260.31 or that is not excluded by a non-waste determination under 260.30 and 260.34.

1.4.6 Hazardous Waste

The term "hazardous waste", as used herein, is a Solid Waste that is not excluded from regulation under 40 CFR 262.11, but is either:

a. A listed waste under subpart D of 40 CFR 261 or;

b. A characteristic waste as described in subpart C of 40 CFR 261 or;

c. A Washington State Dangerous Waste as defined in WAC 173-303-100.

1.4.7 Universal Waste

The term "universal waste", as used herein, is any of the following Hazardous Wastes that are subject to the universal waste requirements of 40 CFR 273, or WAC 173-303-573:

a. Used batteries that designate as hazardous waste including; lead acid batteries, lithium ion batteries, nickel-cadmium batteries, alkaline batteries, etc.

b. Used light bulbs that designate as hazardous waste including; florescent bulbs, compact florescent bulbs, sodium vapor lamps, mercury vapor lamps, etc.

c. Used mercury containing material which is a device or part of a device that contains elemental mercury integral to its function including; thermostats, thermometers, electrical switches, etc.

1.4.8 Other Regulated Waste

The term "other regulated waste", as used herein, is a solid waste that is not a hazardous waste, but is still regulated by federal and state laws for transportation and/or disposal. The types of waste in this category include, but are not limited to: asbestos, PCB contaminated waste, used oil, oily water, anti-freeze, refrigerants and compressed gasses.

1.4.9 Surface Discharge

The term "surface discharge", as used herein, implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge the water from the governing agency under 40 CFR 122.26.

1.4.10 Waters of the United States

The term "waters of the United States (U.S.)", as used herein, include all waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.4.11 Fugitive Dust

The term "fugitive dust", as used herein, is particulate matter that is generated or emitted from open air operations (emissions that do not pass through a stack or vent). Particulate matter consists of solid particles and liquid droplets suspended in the air. These small airborne particles have the potential to adversely affect human health or the environment.

1.5 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of Contractor operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this Contract. Comply with all applicable Federal, State, and local environmental laws and regulations. Any delays resulting from failure to comply with environmental laws and regulations is the Contractor's responsibility.

1.6 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing Contractor activities or delivery of materials to the site, submit an Environmental Protection Plan (EPP) for review and approval by the Contracting Officer. Submit the Environmental Protection Plan no later than 30 calendar days prior to the start of on-site work. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which shall be addressed during Contractor activities. Define issues of concern within the Environmental Protection Plan as outlined in this SECTION. Address each topic at a level of detail commensurate with the environmental issue and required Contractor task(s). Identify and discuss topics or issues which are not identified in this SECTION, but which is considered necessary, after those items formally identified in this SECTION. The Environmental Protection Plan shall be current and maintained on site.

1.6.1 Compliance

No requirement in this SECTION relieves the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Contractor operations, identify, implement, and submit for approval any additional requirements to be included in the Environmental Protection Plan.

1.6.2 Contents

The Environmental Protection Plan (EPP) shall include, but not be limited to, the following:

a. Name(s) and phone numbers of individual(s) within the Contractor's organization responsible for ensuring adherence to the Environmental Protection Plan.

b. Description of the Contractor's environmental protection personnel

training program.

c. Contractor's process for immediately notifying the Contracting Officer, onsite Representative and the Facility's Environmental Compliance Coordinator (ECC) of any spills. The Contractor is responsible for all spill notifications to regulatory agencies (Federal, State, and local). This plan will include the contact information for Federal, State, and local agencies. In the event of a spill, provide a copy of the notification reports to the Contracting Officer and ECC.

d. Solid Wastes Management Plan

1. Solid waste is as defined in 40 CFR 261. The EPP shall describe how solid wastes will be picked up and placed in covered containers which are emptied regularly.

2. Housekeeping measures to prevent contamination of the site or other areas when handling and disposing of solid waste.

3. Management of spent hazardous material shall be described in the Hazardous Waste Handling Plan.

e. Hazardous Waste Handling Plan that complies with all Federal, State, and local laws or regulations that pertain to generation, storage, and transportation of hazardous materials: 40 CFR 260-40 CFR 263, WAC 173-303-100, 49 CFR 171-178, 29 CFR 1910.120/29 CFR 1926.65. This includes the handling of such hazardous materials as hazardous wastes (including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags) if applicable. The Contractor shall prepare and submit a compliance plan detailing how the Contractor handles hazardous materials, petroleum products, and hazardous waste personnel qualifications. The plan shall include all the elements specified in Part 3 EXECUTION as applicable.

f. Fugitive dust control plan.

g. Used Oil Management plan for any used oil to be transported off-project in accordance with 40 CFR 279, WAC 173-303-515.

h. Universal Waste Management and Disposal plan for light bulbs, batteries and mercury ampules in accordance with 40 CFR 273, WAC 173-303-573.

i. Wastewater management plan that identifies the methods and procedures for management and/or discharge of wastewaters which are directly derived from Contractor activities, such as concrete curing water, clean up water, dewatering of ground water, disinfections water, hydrostatic test water, and water used in flushing of lines. Waste water will not be disposed of on government property or into waters of the U.S.

1.7 ENVIRONMENTAL REVIEW OF CONTRACT VARIATIONS

Any proposed Contractor methods or requested variations from the specifications and drawings that may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods OR VARIATIONS, even if they are

more cost effective, if the Contracting Officer determines that the proposed alternate method OR VARIATION will have an unacceptable adverse environmental impact.

1.8 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State, or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection Plan. After receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the Contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 WASTE HANDLING AND DISPOSAL

Dispose of wastes as directed below, unless otherwise specified and/or shown on the Drawings:

3.1.1 Solid Wastes

Provide waste receptacles. Place solid wastes in Contractor-provided containers which are emptied or removed from the job site on a regular schedule. Conduct handling, storage, and disposal to prevent contamination. Employ segregation measures so that no hazardous waste will become co-mingled with solid waste. Transport solid waste off Government property and dispose of it in compliance with applicable Federal, State, and local requirements for solid waste disposal. A Subtitle D Resource Conservation and Recovery Act (RCRA) permitted landfill shall be the minimum acceptable off-site solid waste disposal option. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. Comply with applicable Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.1.2 Hazardous Waste Handling Plan

The Contractor is required to comply with all Federal, State, and local laws or regulations when handling hazardous materials. This includes the handling of such hazardous materials as hazardous wastes if applicable. The Contractor shall prepare and submit a compliance plan detailing how the Contractor handles hazardous materials, petroleum products, and hazardous waste. The plan includes, but is not limited to, the following elements as appropriate:

a. General storage site plan.

b. An inventory of all hazardous materials brought onto the project site accompanied by their respective Safety Data Sheets (SDS). The Contractor and the Government will jointly maintain the SDSs for all

hazardous materials in accordance with 29 CFR 1910.1200.

c. A list of all anticipated hazardous wastes to be generated.

d. Waste collection and containment procedures in accordance with applicable Federal, State, and local laws or regulations 40 CFR 262, WAC 173-303-200.

e. A hazardous material spill and cleanup plan, including tools and readily available materials on hand to facilitate containment and cleanup, 29 CFR 1910.120/29 CFR 1926.65.

f. Documentation to show that the person handling hazardous waste or sampling hazardous materials is trained and certified to do so.

g. A waste determination plan that includes a sample analysis plan, or process knowledge, that meets Federal and State requirements for hazardous waste designation 40 CFR 261, WAC 173-303-100.

h. Provisions to coordinate with Project ECC for profiling and disposal of all Hazardous Waste. The Project ECC must be present to sign the Uniform Hazardous Waste Manifest for all Hazardous Waste shipped off of Corps of Engineers property.

i. Demobilization plan that describes how the contractor will ensure no expired, used, or unused products are left on site.

3.1.3 Disposal of Hazardous Waste

The Contractor shall coordinate with the Project ECC for the disposal of all hazardous waste. The following shall apply for all Hazardous Waste:

a. Hazardous waste generated at the project is required to be applied to the projects generator status. An inventory sheet of all materials being placed in a hazardous waste package shall be maintained and a copy provided to the Project ECC. Required information on this inventory sheet is: date placed in package, type of material, quantity, name of person disposing of waste.

b. Contractor shall coordinate with Project ECC to determine proper container type and marking requirements in accordance with 49 CFR 178 prior to the generation of any hazardous waste. The Project ECC will designate a Satellite Accumulation Area (SAA) for the Contractor to use while generating hazardous waste.

c. When the Contractor is done filling the hazardous waste container or when 55-gallons of waste have been accumulated, the Contractor shall inform the Contracting Officer, who will notify the project ECC. The project ECC will then arrange for movement of the waste to a designated Government "less than 90-day" hazardous waste storage area (could be "less than 180-day" storage area depending on the generator status at the project, see Project ECC for specific guidance), 40 CFR 262, WAC 173-303-200.

d. Contractor shall coordinate with the Project ECC to expedite off site shipment of hazardous waste. If, for any reason, the hazardous waste cannot be shipped off-site in "less than 90-days" the Contracting Officer and Project ECC shall be notified immediately. Project ECC will be required to sign all waste shipping records. The

cost of disposal is the responsibility of the Contractor.

e. Contractor shall not abandon or otherwise leave any hazardous materials or hazardous waste on government projects.

3.1.4 Universal Waste Disposal

Dispose of all used batteries, light bulbs, and elemental mercury ampules in accordance with Federal and State regulations, 40 CFR 273, WAC 173-303 -573.

a. All batteries shall have the terminals taped to secure from arcing prior to being placed in the Used Battery Container. Container shall be labeled with the words "Used Batteries".

b. Used light bulbs that would otherwise be regulated as hazardous waste (e.g. florescent bulbs, mercury or sodium vapor, HID, etc.) shall be stored in a manner that minimizes breakage. Container shall be labeled with the words "Used Bulbs" or "Used Lamps".

c. Mercury switches or other small ampules of elemental mercury shall be stored in a manner which prevents breakage. Container shall be closed and labeled with the words "Used Mercury-Containing Equipment".

3.1.5 Fuel And Lubricants

a. Conduct storage, fueling, and lubrication of equipment and motor vehicles in a manner that affords the maximum protection against spill and evaporation.

b. Manage and store fuel, lubricants, and oil in accordance with all Federal, State, Regional, and local laws and regulations.

c. Store used lubricants and used oil to be discarded in marked, corrosion-resistant containers and recycle or dispose of in accordance with 40 CFR 279, Used Oil regulations.

d. Coordinate with Project ECC for profiling and disposal of all Fuel and Lubricants to include Oil. The Project ECC must be present to sign the Uniform Hazardous Waste Manifest for all Hazardous Waste shipped off of Corps of Engineers property.

e. Storage of fuel on the project site is not allowed. Bring fuel to the project site each day that work is performed.

f. Special measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, and waste washings from entering public lands or waters. Provide and utilize the following prevention/cleanup materials during the course of this contract:

1. If the fuel dispensing or storage tanks are not double walled, Contractor shall utilize secondary containment. All secondary containment shall be capable of containing a minimum of 100 percent of the holding tank without release plus free board in compliance with 40 CFR 112.

2. Emergency spill kits shall be immediately available to enable rapid cleanup with sufficient quantities and types of spill control materials to contain any spills that can be anticipated.

Contractor shall be responsible for ascertaining the types/quantities of spill equipment required based on types and quantities of chemicals, oils, POLs, they will use and/or what they will be working on.

3. Emergency spill absorbent mats (10-18" x 18" or appropriately sized) shall be carried on board or be in the immediate vicinity of all equipment performing work. Mats shall be of a quilted cotton pillow design, and absorbent (not adsorbent) filled, to encapsulate hydrocarbons (oils, coolants and solvents).

3.1.6 Wastewater

Do not allow wastewater from Contractor activities (such as on-site material processing, concrete curing, foundation and concrete clean up, water used in concrete trucks, forms, etc.) to enter surface waters or to be discharged to the ground without first applying for and receiving authorization from the EPA (surface waters)or a state authority (ground waters). Wastewater shall be collected and disposed off-Government property in accordance with all Federal, State, and local regulations.

3.2 LAND RESOURCES

Confine all activities to areas defined by the Drawings and Specifications. Prior to the beginning of any Contractor activities, identify any land resources to be preserved within the work area. Land resources include trees, shrubs, vines, grasses, topsoil, and landforms. Do not remove, cut, deface, injure, or destroy land resources without approval, except in areas indicated on the drawings or specified to be cleared. Do not fasten or attach ropes, cables, or guys to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Remove stone, soil, or other materials displaced into uncleared areas.

3.2.1 Work Area Limits

Prior to commencing Contractor activities, mark the areas that need not be disturbed under this Contract. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before Contractor operations commence. Where Contractor operations are to be conducted during darkness, any markers shall be visible in the dark. Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms, and other landscape features indicated and defined on the Drawings to be preserved shall be clearly identified by marking, fencing, wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during Contractor operations outside the limits of the approved work area.

3.3 WATER RESOURCES

Monitor all water areas affected by Contractor activities to prevent pollution of surface and ground water. The Contractor shall be responsible for compliance with applicable Federal and State water quality standards and the conditions of any permits and clearances obtained for the work. Do

not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. No water courses shall be polluted by, or have existing pollution contributed to with, any petroleum products, fuels, oils, lubricants, bitumen, sandblast grit, paint chips, calcium chloride, insecticides, herbicides, or other toxic materials harmful to life. Chemical emulsifiers, dispersants, coagulants, or other cleanup compounds shall not be used without prior written approval.

3.3.1 Excess Material Deposits

Do not allow deposit of any materials, effluents, trash, garbage, oil, grease, chemicals, or other contaminants. If any unwanted material is dumped in unauthorized areas, remove the material and restore the area to a condition approximating the adjacent undisturbed area. Excavate, remove, and restore the contaminated ground area as directed.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed shall be in accordance with all Federal and State air emission and performance laws and standards.

3.4.1 Fugitive Dust

The owner or operator of a source or activity that generates fugitive dust must take reasonable precautions to prevent dust from becoming airborne and must maintain and operate the source to minimize emissions in accordance with all Federal and State air regulations.

3.4.2 Ozone depleting substances (ODS)

Only EPA certified technicians will be allowed to repair or service ODS equipment. No person maintaining, servicing, repairing or disposing of appliances may knowingly vent or otherwise release into the environment any Class I or Class II substance used as a refrigerant. Section 608 of the Clean Air Act extended the prohibition on venting to substitute refrigerants, including hydrofluorocarbon (HFC) and perfluorinated compounds (PFC) refrigerants. Furthermore, the equipment used to recover refrigerant from appliances must be EPA certified.

3.4.3 Burning

Burning is prohibited on the Government premises.

3.5 POST FABRICATION AND ASSEMBLY CLEANUP

Clean up all areas used for Contractor operations in accordance with Contract Clause 52.236-12, CLEANING UP.

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CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

ERDC/ITL SR-23-1 (Aug 2023) A/E/C Graphics Standard, Release 2.2

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. A designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

Spare Parts; G, C

Final Shop Drawings; G, GS

Working As-Built Drawings; I, C

Final As-Built Drawings; G, C

Record Drawings; G, GS

Government Issued Items; G, C

1.3 DEFINITIONS

1.3.1 Contract Drawings

Contract drawings are the set of Design Drawings furnished by the Government for this contract. Contract Drawings form a part of the legal contract between the Contractor and Government, and does NOT include Supplemental Drawings.

1.3.2 Shop Drawings

a. Shop drawings are a drawing or set of drawings produced by the contractor, supplier, manufacturer, subcontractor, or fabricator for the following purposes:

1. Manufacturer's or Contractor's drawn version of information shown in the fabrication documents.

2. Drawn to explain the manufacturer fabrication, assembly, and/or installation requirements of the items in the fabrication documents.

b. See SECTION 01 33 00 SUBMITTAL PROCEDURES, paragraph "Format for SD-02 Shop Drawings", for Shop Drawing requirements.

1.3.3 As-Built Drawings

a. As-Built drawings serve as the basis for the creation of the Record Drawings (see paragraph "Record Drawings"). As-Built drawings are maintained by the Contractor to depict actual conditions throughout fabrication, including variations from the Contract Drawings.

b. These variations and additions may result from coordination required by, but not limited to: contract modifications; official responses to Contractor submitted Requests for Information; direction from the Contracting Officer; designs which are the responsibility of the Contractor, and differing site conditions.

1.3.4 Record Drawings

The Record drawing set includes all Contract Drawings and accepted final As-Built drawing updates in CAD format. See SECTION 01 33 00 SUBMITTAL PROCEDURES, paragraph "CAD File Requirements".

PART 2 PRODUCTS

2.1 SPARE PARTS

a. Furnish all spare parts identified, identified in the Plans and Specifications to be furnished by the Contractor. See the following plans and specifications for information on required spare parts:

1. SECTION 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2).

2. SECTION 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1).

3. Plan Sheet G-004 TRANSFORMER REQUIREMENTS SUMMARY SHEET.

b. Failure of an item to appear in the references above, does NOT relieve the Contractor of responsibility to furnish all spare part(s), identified in the Plans and Specifications to be delivered by the Contractor, at no additional cost to the Government. Notify the COR of any discrepancy between the above list and the technical Plans and Specifications, in order to compile a more complete listing.

PART 3 EXECUTION

3.1 FINAL SHOP DRAWINGS

a. Upon completion of the work under this contract, submit FINAL SHOP DRAWINGS for review and approval. <BLD>Submit in both PDF file format and Bentley DGN format</BLD>. Submit all drawings in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES, paragraph "Format for SD-02 Shop Drawings", and paragraph "CAD File Requirements", as specified. The drawings shall show all changes and revisions, including any field

changes, made up to the time that the work is completed and accepted.

b. Furnish a complete set of Shop Drawings for all Shop drawings produced by the Contractor in performance of this contract. Submittal of concrete placement drawings, concrete reinforcement drawings, and concrete formwork drawings are not required.

c. Furnish an index drawing for all Shop drawing submittal sets. Index shall include the following for each Shop drawing:

1. Sheet Number.

2. File Number.

3. Drawing Title.

4. CAD Filename.

d. For each index drawing, furnish a digital spread sheet (compatible with Microsoft Excel), and include the following:

1. Index drawing information above.

2. Contractor Firm name.

3. Title Block information as specified in SECTION 01 33 00 SUBMITTAL PROCEDURES, paragraph "Format for SD-02 Shop Drawings".

3.2 WORKING AS-BUILT DRAWINGS

Maintain a current and accurate record of the work as actually constructed in the form of working as-built drawings.

a. Mark as-built conditions on the contract drawings to show all work performed by the Contractor.

b. As-built drawings shall incorporate all VARIATIONS from the design and modifications to the contract, however minor. Blue color shall be used to mark information added to the drawings and red color shall be used to mark information deleted from the drawings. Green color may be used for notes to designer.

c. Maintain contract drawings on-site during fabrication. The completeness and accuracy of the marked as-built drawings must be verified by Government Quality Assurance personnel prior to submission of progress payment requests. All variations shall be noted on the updated As-Built drawings.

3.2.1 Submission of Working As-Built Drawings

Prior to demobilizing from the project, the Contractor shall provide one PDF copy, or Bentley Navigator copy of the working as-built drawings to the Contracting Officer showing the color markups.

3.3 FINAL AS-BUILT DRAWINGS

At the completion of the work, submit, in accordance with FAR CLAUSE 52.211-10, a copy of the Final As-Built Drawings, after all As-Built conditions from the working as-built drawings have been incorporated in

the CAD drawings. Submit in PDF file format, or Bentley Navigator.

In preparation for submitting Record Drawings, once the Final As-Built Drawings are approved, populate the CAD File Status Field with "Record Drawing" to comply with the A/E/C Graphic Standards ERDC/ITL SR-23-1, Border Sheet Status Section.

3.4 RECORD DRAWINGS - CAD FILES

After approval of the Final As-Built Drawings submittal, the Contractor shall create the CAD Record Drawings to update the Contract Drawings with the as-built conditions. The Record Drawing files shall be in the same drawing format as initially provided by the Government. The Government will provide all original CAD files of the contract drawings, in Bentley DGN format.

3.4.1 Drawing Submittal Requirements

Record Drawings submittal shall meet requirements of SECTION 01 33 00 SUBMITTAL PROCEDURES, paragraph "CAD File Requirements".

3.5 GOVERNMENT ISSUED ITEMS

Return to the Government all items issued to the Contractor from the Government, including but not limited to the following: keys, ID and security badges, radios, pagers, and excess/unused Government Furnished Property/Equipment. Submit documentation signed by the Contractor and Contracting Officer indicating items have been returned or fully accounted for. Format of submittal will be discussed and agreed upon at the Pre-Work Meeting.

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PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having an "I" designation are for information only. When used, a designation following the "G" or "I" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Preliminary O&M Manuals and Parts Catalogs for Data Package (4); G, C, HDC

Draft O&M Manuals and Parts Catalogs for Data Package (4); G, C, HDC

O&M Database; G, C, HDC

SD-11 Closeout Submittals

Final O&M Manuals and Parts Catalogs (HC) for Data Package (4); G, C, HDC

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors shall compile and prepare preliminary O&M data and deliver to the Contractor prior to the training of Government personnel. Compile and prepare both a draft version and a final version of aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information based on the O&M Data Package called out in the individual technical specifications and in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this SECTION, SECTION 01 78 00.00 28 CLOSEOUT SUBMITTALS (only for SD-11 submittals), and SECTION 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.2.2 Package Content, Types, and Number of Copies

Data package content shall be as shown in the paragraph SCHEDULE OF O&M DATA PACKAGE ITEMS below. Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections must use Data Package (4). Different Data Package items are required for each O&M Data Submittal. These items are detailed in the tables under paragraph SCHEDULE OF O&M DATA PACKAGE ITEMS below. O&M Data types are defined as follows:

1. Preliminary O&M Data - Covers the equipment required to be included in the O&M manuals as specified in the technical specifications. Electronically submit the Preliminary O&M Manuals and Parts Catalogs, for each type and class of equipment, a minimum of 60 calendar days prior to initial commissioning of equipment. Resubmit corrected and additional data as directed by the Contracting Officer if requested.

2. Draft O&M Data - Covers the equipment required to be included in the O&M manuals as specified in the technical specifications. Electronically submit the Draft O&M Manuals and Parts Catalogs, for each type and class of equipment, a minimum of 30 calendar days prior to initial commissioning of equipment. Resubmit corrected and additional data as directed by the Contracting Officer if requested.

3. Final O&M Data - Within 30 calendar days after final approval of all draft submissions of all O&M data requirements, submit five (5) Final O&M Manuals and Parts Catalogs (HC) copies for approval, for each type and class of equipment. If the final O&M Manuals are "Returned for Correction," four (4) of the five (5) sets of manuals will be returned to the Contractor with all submitted final binders. The final submittal, after corrections, consists of five (5) copies of the approved O&M Manuals. If final O&M Manuals are "Approved," the Government will retain all five (5) copies and return a signed ENG Form 4025 to the Contractor.

1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2.4 Digital Copies

Assemble data packages into digital Operation and Maintenance Manuals. Assemble each manual into a composite digitally indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Digital files must be searchable. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains operation, maintenance and record files, project record documents, and training videos. Include a complete digitally linked operation and maintenance directory. Page numbering, indexing and the marking out of irrelevant parts shall be consistent with hard copies of the O&M Manuals. All documents shall be "Read Only." Label all CDs

with the following information:

1. Name of project.

2. Contract number.

3. Name and address of Contractor.

4. Specific item or materials covered by the manual.

5. Date of submittal.

1.2.4.1 Organization

Bookmark Product and Drawing Information documents using the current version of CSI Masterformat numbering system, and arrange submittals using the specification sections as a structure. Use CSI Masterformat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

1.2.5 Hard Copies

The final O&M submission shall be an assembly of all draft copies and other data required. The submittal shall consist of as many binders as required with a maximum thickness per binder of three (3) inches. The binders shall have a durable leatherette cover and shall be designed for 8-1/2 by 11-inch sheets with binding either of telescoping posts and slide-lock or with fastening using screw posts. Either type of binding provided shall be suitable for ready replacement of sheets. Plastic ring-type loose-leaf binders will not be acceptable. Covers and spines of binders shall bear permanent printed markings listing the following:

(1) Name of project.

(2) Contract number.

(3) Name and address of Contractor.

(4) Specific item or materials covered by the manual.

(5) Date of submittal.

Shop drawings, assembly drawings, wiring diagrams and/or schematics utilizing previously approved shop drawings or specially prepared drawings for these manuals or parts catalogs shall be of a size that requires folding only in left-to-right coordinate as a manual or catalog is opened. Each sheet in the binder shall be numbered and an index provided for ready reference to the data. Each manual shall contain a master table of contents. The master table of contents shall contain all chapters, appendixes, and a master index and shall be included in the front of the first volume if there is more than one volume. Each subsequent volume shall contain an index for the contents within that respective volume. Each volume shall not be broken between chapters, appendixes, and indexes. All chapters, appendixes, and indexes shall be adequately separated and identified by standard line indexes. All standard catalog cuts, manufacturer's printed data or descriptive literature, parts sheets, illustrations, etc., shall either be original manufacturer sheets or reproduced copies equal in clarity and durability to the original copies. At least one (1) copy of such manuals or parts catalogs shall

contain all original copies of such data. Thermofax and similar nonpermanent copies are not acceptable.

1.3 O&M DATABASE

Develop an editable, digital spreadsheet based on the equipment in the Operation and Maintenance Manuals that contains the information required to start a preventive maintenance program. As a minimum, provide list of system equipment, location installed, warranty expiration date, manufacturer, model, and serial number.

1.4 SCHEDULE OF O&M DATA PACKAGE ITEMS

Furnish the O&M data packages specified in individual technical sections. For Data Package information requirements see paragraph TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES. The aggregate list of Data Package Items is as follows:

a. Safety precautions

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Contractor information

f. Spare parts and supply list

g. Normal operations

h. Environmental conditions

i. Lubrication data

j. Preventive maintenance plan and schedule

k. Removal and replacement instructions

l. Parts identification

m. Operator prestart

n. Startup, shutdown, and post-shutdown procedures

o. Emergency operations

p. Troubleshooting guides and diagnostic techniques

q. Wiring diagrams and control diagrams

r. Product submittal data

s. O&M submittal data

t. Testing equipment and special tool information

u. Testing and performance data

v. Operator service requirements

w. Corrective maintenance man-hours

x. Personnel training requirements

y. Manufacturer's instructions

z. Consumables

1.4.1 O&M Data Package 4

Furnish the following items for each O&M Data Package 4 submittal:

Preliminary O&M Data Items	Draft O&M Data Items	Final O&M Data Items
a, b, c, g, i, j, m, n, o, p, q, s, v, w, x	a, b, c, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x	a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z

1.5 O&M DATA PACKAGES FOR MAJOR EQUIPMENT

Refer to the following table to determine which Data Package is required for each type of major equipment, and which submittals are required for that Data Package. For each O&M Data submittal required, submit all items in the corresponding Data Package table of paragraph LIST AND SCHEDULE OF O&M DATA PACKAGE ITEMS above. (For example, Spare T1 requires Data Package 4, so the Preliminary O&M Data Submittal for a Spare T1 would require items a, b, c, g, i, j, m, n, o, p, q, s, v, w, and x based on the Data Package 4 table above.) For equipment that does not require a Preliminary O&M Data Package, submit only the manufacturer's standard O&M Manual(s).

O&M DATA PACKAGES TABLE FOR MAJOR EQUIPMENT

EQUIPMENT	DATA PACKAGE	PRELIMINARY O&M DATA	DRAFT O&M DATA	FINAL O&M DATA
Spare T1	#4	YES	YES	YES
Spare T2	#4	YES	YES	YES

1.6 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.6.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.6.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.6.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.6.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures, including the control sequence for each procedure.

1.6.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment. Include functional descriptions of operating parts.

1.6.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.6.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.6.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.6.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.6.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph OPERATOR SERVICE REQUIREMENTS:

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

d. Where the Contractor or the supplier has installed a lubricant or oil prior to shipment to the project, the "Brand Name" as well as the specification must be indicated.

1.6.2.2 Consumables

Provide a list of all consumable (grease, oil, filters, etc.) products used in equipment provided under this contract. Where the Contractor has installed a consumable product prior to Government acceptance, provide the "Brand Name" as well as the specification for each product. Include the following information:

a. Manufacturer's name and contact information.

b. Manufacturer's model number, part number, and serial number as applicable.

c. Current sources/vendors with contact information.

d. Current prices for each consumable.

1.6.2.3 Preventive Maintenance Plan and Schedule

Include manufacturer's schedules for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.6.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.6.3.1 Cleaning Recommendations

Include detailed instructions on recommended cleaning methods, practices and frequency.

1.6.3.2 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.6.3.3 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.6.3.4 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards. Include recommended clearances, bolt torques, pressure settings, etc.

1.6.3.5 Removal and Replacement Instructions

Include step-by-step procedures and a list of required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.6.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours, including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.6.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.6.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.6.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.6.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.6.5.4 Parts Identification

a. Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Parts identification lists shall contain the following information:

1. Special hardware requirements, such as requirement to use high-strength bolts and nuts.

2. Identification of all parts by manufacturer's make, model, serial number, and National Stock Number (NSN).

3. Manufacturer's name, address, phone number, and website where parts can be ordered to allow reordering without further identification.

4. Current sources\vendor names for the parts, their respective addresses and telephone numbers.

5. Purchase price, where applicable.

6. Current replacement costs for each part.

7. Clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part.

8. Cross referencing of manufacturer's reference numbers with Contractor's reference numbers and shop drawings where applicable.

b. Parts shown in the listings shall be grouped by components, assemblies and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.6.5.5 Spare Parts and Supply Lists

a. When specified, include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. Identify spare parts and supplies that have a long lead-time to obtain.

b. All spare parts lists, for both recommended spare parts and those provided under this contract, shall contain the information identified in paragraph PARTS IDENTIFICATION above in addition to the following:

1. Full description, nomenclature, and serial number of each part.

2. Required number of each part for normal equipment operation.

3. Recommended list of spare parts to be stocked at the Project.

4. Actual spare parts supplied under this contract.

1.6.5.6 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of an air conditioning system.

1.6.5.7 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.6.5.8 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests

and on special tools needed for the operation, maintenance, and repair of components.

1.6.5.9 Testing and Performance Data

Include completed pre-functional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for re-testing and blank test forms.

1.6.5.10 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the Project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.7 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.7.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.7.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.7.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.7.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures, including the control sequence for each procedure.

1.7.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment. Include functional descriptions of operating parts.

1.7.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.7.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.7.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.7.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.7.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph OPERATOR SERVICE REQUIREMENTS:

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

d. Where the Contractor or the supplier has installed a lubricant or oil prior to shipment to the project, the "Brand Name" as well as the specification shall be indicated.

1.7.2.2 Consumables

Provide a list of all consumable (grease, oil, filters, etc.) products used in equipment provided under this contract. Where the Contractor has installed a consumable product prior to Government acceptance, provide the "Brand Name" as well as the specification for each product. Include the following information:

a. Manufacturer's name and contact information.

b. Manufacturer's model number, part number, and serial number as applicable.

c. Current sources/vendors with contact information.

d. Current prices for each consumable.

1.7.2.3 Preventive Maintenance Plan and Schedule

Include manufacturer's schedules for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide

manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.7.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.7.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.7.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.7.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards. Include recommended clearances, bolt torques, pressure settings, etc.

1.7.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list of required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.7.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours, including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.7.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.7.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.7.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.7.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.7.5.4 Parts Identification

a. Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Parts identification lists shall contain the following information:

1. Special hardware requirements, such as requirement to use high-strength bolts and nuts.

2. Identification of all parts by manufacturer's make, model, serial number, and National Stock Number (NSN).

3. Manufacturer's name, address, phone number, and website where parts can be ordered to allow reordering without further identification.

4. Current sources\vendor names for the parts, their respective addresses and telephone numbers.

5. Purchase price, where applicable.

6. Current replacement costs for each part.

7. Clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part.

8. Cross referencing of manufacturer's reference numbers with Contractor's reference numbers and shop drawings where applicable.

b. Parts shown in the listings shall be grouped by components, assemblies and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.7.5.5 Spare Parts and Supply Lists

a. When specified, include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. Identify spare parts and supplies that have a long lead-time to obtain.

b. All spare parts lists, for both recommended spare parts and those provided under this contract, shall contain the information identified

in paragraph PARTS IDENTIFICATION above in addition to the following:

1. Full description, nomenclature, and serial number of each part.

2. Required number of each part for normal equipment operation.

3. Recommended list of spare parts to be stocked at the Project.

4. Actual spare parts supplied under this contract.

1.7.5.6 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of an air conditioning system.

1.7.5.7 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.7.5.8 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.7.5.9 Testing and Performance Data

Include completed pre-functional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for re-testing and blank test forms.

1.7.5.10 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the Project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.8 CONTENT

The O&M manuals shall be structured to address each of the following topics in order for each system. When the topic does not apply to a particular system the topic name will be included in the manual with the words "DOES NOT APPLY."

1.8.1 Warning Page

A warning page shall be provided to warn of potential dangers (if they exist), such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, or high pressures. The warning page shall be placed inside the front cover, in front of the title page.

1.8.2 Index

Each manual shall have a master index at the front identifying all manuals and volumes and subject matter by system name for each. Following the master index, each manual shall have an index of its enclosures listing each volume, tab numbers, etc., as necessary to readily refer to a particular operating or maintenance instruction. Rigid tabbed fly leaf sheets shall be provided for each separate product and/or piece of equipment under each system in the manual. When a manual is divided into volumes, each volume shall have a master index at its front, followed by an index for the specific volume listing in detail all enclosed instructions for materials, individual pieces of equipment, and systems. All pages shall be numbered with the referenced number included in the index.

1.8.3 Description

Narrative and technical descriptions of the system and of the interrelations with other systems. Included with this shall be a transformer summary technical data sheet.

1.8.4 Photographs

Full page color photographs shall be provided of the manufacturing process, to include the following:

a. Winding fabrication

b. Core fabrication

c. Core and winding assembly

d. Tank manufacturing (including interior fabrication)

e. Completely assembled transformer, including fall arrest post

1.8.5 Operation Data

The operation data shall include specific operating instructions, functional description of operating parts, and special precautions or procedures to be considered. The Contractor shall be responsible for the necessary coordination between his subcontractors, suppliers, and manufacturers to assure complete submittals on individual interrelated equipment components. The data shall include the following:

a. Check List Prior to start-up. Precautions and prechecks prior to start-up of equipment and/or system, including safety devices, monitoring devices and control sequence shall be provided.

b. start-up and Operation. Step-by-step sequential procedures for start-up and normal operation checks for satisfactory operation shall be provided. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and flagged for the attention of the operator. Procedures shall include test, manual or normal, and automatic modes.

c. Shutdown. Procedures for normal and emergency shutdown of equipment and/or systems shall be provided. The instructions shall

include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for start-up at a later time. Procedures shall include test, manual or normal, and automatic modes.

d. Normal Operating Conditions. A tabular listing of the normal operating conditions of each individual component, including the settings, operating temperature, valve positions, etc.

1.8.6 Maintenance Procedures

Recommended procedures shall indicate preventive maintenance, lubrication, and good housekeeping practices which should be performed by operating personnel as well as more complex maintenance procedures which would normally be performed by trained maintenance personnel only, including instructions for oil-filling and drying the oil-filled transformer. The procedures shall be presented with a schedule indicating time frames or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off line, putting equipment on line, or putting equipment on standby. The instructions shall include all necessary material, equipment, and system data to perform maintenance work and shall include, but not be limited to, manufacturers bulletins, catalogs, and descriptive data; certified performance curves, copies of approved test plans, including logs and records of performance acceptance test results, and actual adjustments made during final acceptance and inspection; system layouts, including block diagrams, wiring, control, and isometric diagrams; schematic items within the facility; interrelationships with other items of system; and a list of special tools required.

1.8.7 Repairs

Repair procedures shall be presented with a step-by-step procedure for locating and correcting the trouble. A "shop manual" may be used for this purpose. The procedures shall clearly indicate a major repair activity which should only be performed in a shop or factory versus normal repair work that may be performed onsite or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by Government personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel. Repair procedures shall include such items as bushing removal and installation procedures, weld leaks, and gasket replacement. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Column 1 - Trouble

Column 2 - Probable Cause(s)

Column 3 - Correction

1.8.8 Maintenance Schedule

A separate schedule of all required periodic maintenance and testing shall

be included. This schedule shall list by frequency of occurrence all lubricants and special adjustments required. The types and amounts of lubrication must be specified. The Contractor shall verify that the furnished maintenance schedule agrees with the published manufacturer's data.

1.8.9 Catalog Data Sheets

An index of the catalog data sheets shall be provided, and the data sheets for each device or equipment tabbed, or otherwise identified, to provide an easy means for accessing the data sheets within the manual. A cross-reference between items described in catalogs, instructions, and the shop drawings shall be provided to facilitate ease of location of parts described. Standard catalog data sheets will not be acceptable unless irrelevant parts are marked out (with black "X") and relevant parts clearly identified. Any data on catalog sheets which does not directly relate to purchased equipment shall be marked out. Parts shall be so identified that they can be readily ordered from local area industrial supply outlets if not of special manufacture. Highlighting and hand-written notes will not be acceptable for identification purposes. Catalog data sheets shall be inserted into the manual such that positive identification of all parts on catalog data sheets are clearly identified by:

a. Part Name. A clear and descriptive name shall be given to each component in the piece of equipment.

b. Manufacturer and Part Number. The name, address, and telephone number of the manufacturer shall be given along with the catalog part number.

c. Safety Data Sheet (SDS). A copy of the SDS for the transformer oil shall be included with the catalog data sheets.

1.8.10 Spare Parts Listing

The spare parts listing shall be inserted in an appendix at the end of the manual following the catalog data sheets. This appendix shall be for spare parts listing only. The spare parts listing shall clearly state the spare parts supplied and a list of recommended spare parts to be stocked. The price for each spare part furnished shall be provided, separate from the O&M Manual. The spare parts listing shall clearly identify:

a. Part Name. A clear and descriptive name shall be given to each component listed as a spare part in the piece of equipment.

b. Manufacturer and Part Number. The name, address, and telephone number of the manufacturer shall be given along with the catalog part number.

c. Quantity. The quantity of each part listed as a spare part shall be given.

d. Reference to Catalog Data Sheets. Each spare part shall be referenced to the corresponding catalog data sheet by page number.

1.8.11 Transformer Drawings

The final approved versions of the transformer manufacturer drawings shall

be included as required in paragraph "SPECIFIC REQUIREMENTS".

1.8.12 Transformer Factory Test Reports

A copy of the approved transformer factory test reports including the results of any oil tests, shall be included.

1.8.13 Design Data Review Report

A copy of the transformer manufacturer Design Data Review Report shall be included.

1.8.14 Seismic Calculations

A copy of the transformer seismic calculations shall be included.

PART 2 PRODUCTS (Not Applicable)

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-- End of Section --

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SECTION 26 05 19.00 26

INSULATED WIRE AND CABLE

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This Section covers the requirements for all uninsulated conductors and all insulated wire and cable used during the manufacture and site assembly of the generator step-up (GSU) power transformers specified in Sections 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2), 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1), and 48 20 00.04 26 TRANSFORMER SHIPMENT, HAULING AND SITE ASSEMBLY, including all wire and cable in the control and power cabinets and extending from these cabinets to all transformer mounted devices.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013; R2024) Standard Specification for Soft or Annealed Copper Wire
ASTM B33	(2010; R 2020) Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B8	(2023) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B172	(2017; R 2024) Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors
ASTM B174	(2017; R 2024) Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

30 CFR 7.407	Test for Flame Resistance of Electric Cables and Cable Splices

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements

NEMA WC 57/ICEA S-73-532	(2021) Control, Thermocouple, Extension, and Instrumentation Cables
NEMA WC 70/ICEA S-95-658	(2022) Power Cables Rated 2000 Volts or less for the Distribution of Electrical Energy

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

ANSI/NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code

UL SOLUTIONS (UL)

UL 44	(2018; Reprint May 2021) UL Standard for Safety Thermoset-Insulated Wires and Cables
UL 62	(2018) UL Standard for Safety Flexible Cords and Cables
UL 1581	(2019; Reprint Nov 2023) UL Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit not later than 180 days after Notice of Award:

Insulated Wire and Cable; G HDC

Signal and Communications Cable; G HDC

Control Panel Shop Wiring; G HDC

Switchboard Wire; G HDC

Ground Conductors; G HDC

Wire Marking; G HDC

Terminations; G, HDC

Flexible And Portable Cable; G, HDC

SD-06 Test Reports

Submit in RMS within 10 days after completion of the tests:

Factory Inspection and Tests; G HDC

Dielectric Withstand Test; G HDC

Shield Resistance Test; G HDC

Conductor Continuity Test; G, HDC

Shield Continuity Test; G, HDC

1.4 FACTORY INSPECTION AND TESTS

1.4.1 General

Perform factory inspection and tests of wire and cable by and at the plant of the manufacturer. Ensure testing complies with Section 6 of NEMA WC 57/ICEA S-73-532 or Section 6 of NEMA WC 70/ICEA S-95-658 as applicable. Include specific tests required for particular materials, components, and completed cables as specified in the sections of the above standards applicable to those materials, components, and cable types. Also perform tests in accordance with the additional requirements specified below.

1.4.2 Flame Tests

For all other single-conductor cables and individual conductors of multiple-conductor cables, provide cables that have passed UL 1581 (VW-1 or FT1) flame tests. If such tests have previously been performed on identical cables of the same design and is indicated in the product data, these tests need not be repeated.

1.4.3 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, partial discharge tests, dissipation factor tests, or DC high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

PART 2 PRODUCTS

2.1 INSULATED WIRE AND CABLE

2.1.1 Wire and Cable

Provide wire and cable in accordance with the requirements specified herein. Provide insulated wire and cable that is UL listed. Characteristics including conductor size, stranding, number of conductors, rated circuit voltage, cabling, and other requirements for each type of service are to be as indicated on the drawings, or as specified under the detailed requirements of these specifications for the particular assembly or use, unless otherwise stated.

2.1.2 Governing Standards

Materials, fabrication, assembly, and tests, unless otherwise specified, must conform to the applicable requirements of NEMA WC 57/ICEA S-73-532 and NEMA WC 70/ICEA S-95-658 as applicable.

2.2 MATERIALS

2.2.1 Submittal Requirements

Submit catalog data sufficient to demonstrate compliance with the specifications requirements for all wire and cable types to be provided.

2.2.2 Rated Circuit Voltages

Provide wire and cable with a minimum 600 volt rated circuit voltages in accordance with NEMA WC 70/ICEA S-95-658 unless specified otherwise.

2.2.3 Conductors

2.2.3.1 Material for Conductors

Provide conductors that conform to all the applicable requirements of Section 2 of NEMA WC 70/ICEA S-95-658, annealed copper conforming to ASTM B3unless specified otherwise. Copper conductors must be bare, or tin- or lead-alloy-coated, if required by the type of insulation used. Tin-coated copper conductors must conform to ASTM B33. Tinned stranded wire must have each strand individually tinned, and not tinned as a single wire after stranding.

2.2.3.2 Conductor Size

Minimum wire sizes are No. 12 AWG for power and lighting circuits and 480V AC circuits; No. 10 AWG for current transformer secondary circuits; No. 12 AWG for potential transformer circuits; No. 14 AWG for relaying, control, and annunciation circuits; and No. 16 AWG for RTD, RTU, and PLC circuits.

2.2.3.3 Stranding

Provide conductor stranding classes cited herein as defined in Appendix G of NEMA WC 70/ICEA S-95-658. Provide solid conductors for 120 volt lighting and receptacles no. 10 AWG and smaller. For all other uses of any size provide Class B or Class C stranding as defined in Table 1 of ASTM B8. For any conductors used between stationary and moving devices, such as hinged doors or panels, provide Class H or K stranding as defined in Appendix G of NEMA WC 70/ICEA S-95-658.

2.2.4 Insulation

2.2.4.1 Insulation Voltage Rating and Insulation Level

The minimum rated voltage of the insulation for all circuits operating below 600 volts is 600 volts, with 100 percent insulation level, unless otherwise specified.

2.2.4.2 Insulation Material

Except as otherwise specified under paragraph SPECIAL WIRE AND CABLE, insulation material must be cross-linked thermosetting type (XLPE or

XLPO), or an ethylene-propylene rubber (EPR) type, meeting the requirements of Section 3 of NEMA WC 70/ICEA S-95-658. Cables accepted as a variance for No. 18 under paragraph WIRE SIZE may have a non-PVC thermoplastic insulation and must be UL Listed. Polyvinyl Chloride (PVC) insulation will not be accepted.

2.2.4.3 Insulation Thickness

a. Single-Conductor Cables - Provide insulation thickness for single-conductor cables that complies with NEMA WC 70/ICEA S-95-658 Section 3.3 Tables for Insulation Classes R, X, and E.

b. Multiple-Conductor Control Cables - Provide insulation thickness of the individual conductors of multiple-conductor (multiconductor) cables that complies with NEMA WC 70/ICEA S-95-658 Section 3.3 Tables for Insulation Classes R, X, or E for cables used for power, or NEMA WC 57/ICEA S-73-532 Section 3.3 Tables for insulations XLPE, ER, SR, CSPE, or EP composites for cables used for control and related purposes.

2.2.4.4 Insulation Shielding

Provide shielding, where specified for control cables, which complies with Section 4.1 of NEMA WC 57/ICEA S-73-532.

2.2.5 Jackets

Provide jackets meeting the requirements of Section 4.2 of NEMA WC 57/ICEA S-73-532 or Section 4.1 of NEMA WC 70/ICEA S-95-658 as applicable for all cables. Individual insulated conductors listed in UL 44 Table 19 as optional or none for jacket type need not be jacketed. Individual conductors of multiple-conductor cables are required to have jackets only if they are necessary for the conductor to meet other specifications herein. For jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, provide jackets in direct contact and adhered or vulcanized to the conductor insulation. For multiple-conductor cables and shielded single-conductor cables, provide a common overall jacket, tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.2.5.1 Jacket Material

Provide jackets of one of the materials listed below, in accordance with the applicable paragraphs of NEMA WC 70/ICEA S-95-658. Polyvinyl chloride compounds will not be permitted. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. Black neoprene (CR).

b. Chlorosulfonated polyethylene (CSPE).

c. Chlorinated polyethylene (CPE).

d. Low smoke zero halogen (LSZH).

e. Crosslinked polyolefin (XLPO).

2.2.5.2 Jacket Thickness

Ensure the minimum thickness of the jackets at any point is not less than 80 percent of the respective nominal thicknesses specified in the tables in Section 4.1 of NEMA WC 70/ICEA S-95-658 as applicable.

2.2.6 Cabling

Assemble individual conductors of multiple-conductor cables with flame-and moisture-resistant fillers, binders, and a lay conforming to Section 5 of NEMA WC 57/ICEA S-73-532 or Section 5 of NEMA WC 70/ICEA S-95-658 as applicable, except that flat twin cables will not be permitted. Provide non-hygroscopic fillers compatible with the cable insulation, jacket, and other components of the cable in the interstices of multiple-conductor round cables, with a common covering where necessary to give the completed cable a substantially circular cross section. Provide rubber-filled or other approved type of binding tape that is compatible with the other components of the cable and be lapped at least 10 percent of its width.

2.2.7 Dimensional Tolerance

Ensure outside diameters of single-conductor cables and of multiple-conductor cables do not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

2.2.8 Color-Coding

Use the same color-code method for each cable type. Colored braids are not permitted. Provide control cable color-coding that complies with Table E-2 of NEMA WC 57/ICEA S-73-532. The required color-coding for 208/120 volt power systems is black for Phase A, red for Phase B, blue for Phase C, and white for grounded neutral. For 480/277 volt power systems the required color-coding is brown for Phase A, orange for Phase B, yellow for Phase C, and gray for grounded neutral. Green may be used only for grounding conductors if insulated.

2.3 SPECIAL WIRE AND CABLE

2.3.1 Control Panel Shop Wiring

Provide wiring for factory assembled control panels or factory assemblies of electrical components for miscellaneous equipment that complies with NEMA WC 57/ICEA S-73-532, and NEMA WC 70/ICEA S-95-658, as applicable. Provide only single conductor stranded copper wires in accordance with Section 2 of NEMA WC 57/ICEA S-73-532 with the insulation rated 600 volts having a thickness in accordance with Section 3 of NEMA WC 70/ICEA S-95-658. Provide class C conductor stranding, except for hinge wire provide Class D or Class K as defined in Appendix G of NEMA WC 70/ICEA S-95-658. Minimum conductor size is No. 16 AWG. Ensure the completed installation conforms to all requirements of NFPA 70.

2.3.2 Switchboard Wire

Provide only single conductor 600-volt Type SIS in control switchboards meeting the requirements of UL 44, with Class K stranding as defined in Appendix G of NEMA WC 70/ICEA S-95-658.

2.3.3 Signal and Communications Cable

Provide signal and communications cable that conforms to the applicable requirements of UL 44 and NEMA WC 57/ICEA S-73-532. Provide tinned copper conductors conforming to Section 2.3 of NEMA WC 57/ICEA S-73-532 with Class C or Class K stranding as defined in Appendix G of NEMA WC 70/ICEA S-95-658. Minimum conductor size is No. 16 AWG or No. 18 AWG for PLC terminations. Provide thermoset insulation rated for 600 volts conforming to NEMA WC 57/ICEA S-73-532 Section 3.3 Tables for insulations XLPE, SR, CSPE, or EP composites. Overall shielding may utilize aluminum-polymer tape to provide 100 percent coverage. Provide a drain wire in continuous contact with the shield as described in NEMA WC 57/ICEA S-73-532 Section 4.1 for metal thickness of 0.001 inch or less. Provide overall shields for multiple-shielded pair or triplet cables, with a thermoset jacket in accordance with Section 4.2 and Table 4-1 of NEMA WC 57/ICEA S-73-532, color coded in accordance with Appendix E of NEMA WC 57/ICEA S-73-532. Polyvinyl chlorine (PVC) insulation or jacketing will not be accepted. Provide individual conductors and cable assemblies that have passed the flame tests described in paragraph FLAME TESTS.

2.3.4 Ground Conductors

Provide ground conductors that are bare, soft-drawn copper cables sized in accordance with NFPA 70, or NEMA WC 70/ICEA S-95-658 Section 5 as applicable. The ground conductor may be integral to a 3-conductor cable assembly where applicable. Provide solid for separate ground conductors size No. 10 and smaller. Provide class A stranded ground conductors size No. 6 and larger, but may be Class B stranded for sizes #1 and larger.

2.3.5 Flexible and Portable Cable

Stranding must comply with ASTM B172 or ASTM B174. Individual conductors and cables must also have passed the flame tests described in paragraph FLAME TESTS or the MSHA flame test of 30 CFR 7.407. Flexible and portable cables rated 600 volts must be Type SOOW or equivalent with oil-resistant thermoset insulation, suitable for outdoor use, conforming to the requirements of UL 62. Cables listed as Welding Cable will not be accepted.

2.4 TERMINATIONS

Provide terminals and lugs approved for connection to the conductor material using ring tongue terminals. Provide long barrel, NEMA two-hole or four-hole compression-type terminals for cables No. 2 AWG and larger. Provide terminations for the 6 AWG ground conductors required for paragraph GROUNDING CONNECTIONS FOR LONG TERM STORAGE of 48 20 00.04 26 TRANSFORMER SHIPMENT, HAULING AND SITE ASSEMBLY. The terminations need to be NEMA two-hole irreversible compression-type terminals to fit the transformer tank ground pad, and the terminals on the low-voltage, high-voltage and high-voltage neutral bushings.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

3.1.1 Control and Power Cabinet Wiring

Care must be taken when laying out the control and power cabinet wiring to maintain an adequate distance between the signal wiring and higher voltage wiring, to maintain signal quality. Plastic adhesive-backed cable ties for use in securing wire bundles are not allowed. Hinge wires must be used between stationary panels and swing doors, and must be formed in wire loops that will provide rotation around the longitudinal axis of the conductors.

3.1.2 Wiring Around the Transformers

Size and install all wire and cable in accordance with NFPA 70 requirements. Furnish all necessary materials, tools, and equipment for proper handling and installation of wires and cables. Except for spares, connect each wire and cable to the associated equipment at both ends. Run continuous cable without splices between the equipment termination points. Tape over exposed ends on spares and label as "spare". Remove and replace any cable that was damaged during installation. Install all supporting devices and terminations required for the wire and cable to complete the circuits.

3.1.3 Phasing

Make all terminal connections for power cables and conductors in such manner that the phasing is as marked on the equipment, and indicated on the approved shop drawings. Verify phasing on existing wiring before disconnecting and removing, and that phasing on new wiring is the same rotation as presently existing. Normal phasing for existing equipment is A-B-C from left to right, from top to bottom and from front to back when facing the front of the equipment. After cables have been terminated and the connection torqued, insulate all exposed parts to the cable's voltage rating.

3.1.4 Cable Pulling Requirements

Pull all wire and cable in a manner which will preclude damage to the conductor, insulation or jacket. Pull wire and cable by the conductor as far as is practicable and not solely by the jacket or sheath. Do not exceed the manufacturer's recommended maximum pulling tension. Use strain gages when pulling cable if any kind of mechanical pulling device is required for installation. Use caution to avoid exceeding the side wall rating of the cable. Remove and replace all cable or conductor that are damaged during installation with equivalent cable or conductor. Installation of wire and cable includes installation of all supporting devices and all terminations and identifications required to complete the circuits as shown on the drawings and as required.

3.1.5 Installation in Conduit

Verify conduit is verified to be clean, dry and free of any metal burrs or shavings by pulling a clean, dry, tight fitting rag through each run prior to pulling cables. Only approved lubricants may be used to facilitate pulling of conductors. Install wire in conduit in accordance with the requirements for conduit fill in NFPA 70. All sharp edges in conduit and

conduit body joints must be removed before pulling SIS or other wires in the conduit to avoid damaging the insulation.

3.1.6 Bends

The minimum radius to which an insulated conductor or a multiconductor cable may be bent, without specific approval, whether permanently or temporarily during installation, is 12 times the overall diameter of the completed cable for tape shielded cables and 10 times the overall diameter for other cables. For multiconductor cable, follow manufacturer's recommendation for type of cable involved.

3.1.7 Splices

Wire splices are not permitted.

3.1.8 Terminations

Maintain the shield and shield insulating jacket of shielded signal cables and conductors, if applicable, to a point as close to the terminals as possible. Do not strip the shield insulating jacket from the shield except where necessary to make the ground connection. Ground control and signal cable shields at one location only. Terminate all spare conductors on an available unused terminal of a terminal block and label as SPARE at both ends, or wrap the exposed ends in insulating tape if left unterminated and labeled as SPARE at both ends. All wiring for external connections to the power plant are to be terminated on the left side of the terminal blocks in the transformer control and power cabinets.

3.1.9 Wire Marking

Use non-metallic tube type markers at each termination to identify wires and individual conductors of control and power cables. Install markers in a uniform position on the wire and ensure the legends are visible when the wires are terminated on terminal blocks or at the equipment. Provide tubing sized to fit the wire being marked and that has black marking on a light colored background. Provide tube-type markers at each terminating end of the conductor that are suitable for contact with the type of insulation material used. Provided markers that will not stain or discolor when subjected to an accelerated aging test while in contact with wire insulating materials or ultraviolet light.

3.1.9.1 Marking

Provide tubing sized to fit the wire or cable being marked, having black marking on a light colored background, and suitable for contact with the type of insulation or jacket material used. Provide markers tested by an independent testing laboratory or by the manufacturer to indicate that the markers will not stain or discolor when subjected to an accelerated aging test while in contact with wire and cable materials and ultraviolet light exposure.

3.1.10 Ground Conductors

Include a separate continuous ground conductor for all circuits, unless the ground conductor is an integral part of a multiple conductor cable. Support exposed ground cable runs to follow conduit using corrosion resistant clamps or clips. Drilling of equipment housings or frames will be permitted only when approved.

3.2 ACCEPTANCE TESTING

3.2.1 Testing

after completion of the wiring on each transformer, perform testing per ANSI/NETA ATS recommended procedures.

a. Submit Test Reports in accordance with referenced standards in this section.

b. After completion of the installation and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

c. Provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

d. Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Use feeder breakers, circuit breakers , and other disconnecting devices to isolate the circuits under test.

e. Retain suitable and complete records indicating the insulation-resistance tests, high voltage tests, continuity tests, and conductor identification markings. Include a record of all tests performed during the transformer factory acceptance test for each transformer in the factory acceptance test report for each transformer, as required in Sections 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2), and 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1). After installation, but just prior to terminal connection, perform the following tests on each transformer:

(1) Perform a Conductor Continuity Test on each wire and each individual conductor of a multiconductor cable to insure correct connections end-to-end.

(2) Perform a Shield Continuity Test on each cable shield.

(3) Perform a Shield Resistance Test on each cable shield. Shield resistance must be less than 10 ohms per 1000 feet of cable.

(4) Perform an Dielectric Withstand Test on each conductor with respect to ground on each conductor with respect to ground and adjacent conductors, per the requirements of NEMA ICS 1, paragraph 8.4.

3.2.2 Acceptance

Final acceptance will depend upon the successful performance of wire and cable under test. Conductors will not be energized until the final test reports are reviewed and approved by the Contracting Officer Representative (COR).

-- End of Section --

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3.7 TRANSFORMER SHIPMENT, HAULING AND SITE ASSEMBLY

ATTACHMENTS:

T2 Doble Report

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SECTION 48 19 23.04 26

CLASS II GSU POWER TRANSFORMER (T2)

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This Section covers the manufacturing and factory testing of Two (2) single-phase generator step-up (GSU) power transformers rated 82,000 / 109,334 kVA, 500 kV high-voltage (H), 13.2 kV low-voltage (X & Y), Class ONAN/ONAF cooling, for delivery f.o.b. to Little Goose Lock & Dam storage yard. Each transformer shipment, hauling, site reassembly, field testing are as required in SECTION 48 20 00.04 26, TRANSFORMER SHIPMENT, HAULING AND SITE ASSEMBLY. Throughout this Section, the transformer tank layout is identified on by Segments 1 through 4, as defined in IEEE C57.12.10, Figure 1, and indicated on the drawings.

1.2 GENERAL INFORMATION

1.2.1 Transformer Location

The single-phase transformers specified in this section will be spare transformers for Little Goose, Lower Granite, and Lower Monumental dams. These transformers are meant to be a spare for the single-phase T2 Bank transformers at the three Projects. Contract Drawing G-003 of Volume, shows the site map and the storage yard where the spare transformers will be placed. The spare transformers will placed on concrete pads in the storage yard. See supplemental drawing LMP-5-6-1A5/1 for details on the existing transformer mounting pads.

1.2.2 Ratings

Size the new single-phase power transformers per the requirements of paragraph, "Ratings and Electrical Characteristics", to match the impedance, capacitance, and ratings of the existing single phase transformers.

1.3 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022; Supp 1 2023; Supp 2 2023) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2024) Unified Inch Screw Threads (UN, UNR, and UNJ Thread Form)
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.24	(2022) Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500, and 2500
ASME B31.1	(2024) Power Piping
ASME BPVC SEC IX	(2023) BPVC Section IX-Welding, Brazing and Fusing Qualifications

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A343/A343M	(2014; R 2019) Standard Test Method for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method and 25-cm Epstein Test Frame
ASTM A664	(2015; R 2022) Standard Practice for Identification of Standard Electrical Steel Grades in ASTM Specifications
ASTM A717/A717M	(2012; R 2022) Standard Test Method for Surface Insulation Resistivity of Single-Strip Specimens
ASTM A876	(2017; E 2017) Standard Specification for Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
ASTM D923	(2015; R 2023) Standard Practices for Sampling Electrical Insulating Liquids
ASTM D1535	(2014; R 2023) Standard Practice for Specifying Color by the Munsell System
ASTM D3487	(2024) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2020) Standard Symbols for Welding, Brazing, and Nondestructive Examination
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS D1.6/D1.6M	(2017) Structural Welding Code - Stainless Steel

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 693	(2018) Recommended Practice for Seismic Design of Substations
IEEE 1427	(2020) Guide for Recommended Electrical Clearances and Insulation Levels in Air Insulated Electrical Power Substations
IEEE C57.12.00	(2021) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.10	(2017) Requirements for Liquid-Immersed Power Transformers
IEEE C57.12.70	(2020) Standard Terminal Markings and Connections for Distribution and Power Transformers
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2021) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(2016) Standard Requirements for Instrument Transformers
IEEE C57.19.00	(2023) Standard General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
IEEE C57.19.01	(2017) Performance Characteristics and Dimensions for Power Transformer and Reactor Bushings
IEEE C57.104	(2019; E 2019) Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers
IEEE C57.113	(2023) Recommended Practice for Partial Discharge Measurement in Liquid-Filled Power Transformers and Shunt Reactors
IEEE C57.116	(2022) Guide for Transformers Directly

	Connected to Generators
IEEE C57.149	(2012) Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers
IEEE C57.152	(2013) Guide for Diagnostic Field Testing of Fluid-Filled Power Transformers, Regulators, and Reactors

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
ANSI C80.1	(2020) American National Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA FB 1	(2014) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA MW 1000	(2023) Magnet Wire
NEMA SG 4	(2009; R 2013) AC High-Voltage Circuit Breakers

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code

UL SOLUTIONS (UL)

UL 248-8	(2011; Reprint Aug 2020) Low-Voltage Fuses - Part 8: Class J Fuses
UL 360	(2013; Reprint Jan 2024) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 489	(2025) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(2024) Industrial Control Equipment
UL 508A	(2018; Reprint Jul 2022) UL Standard for Safety Industrial Control Panels

UL 514B	(2012; Reprint Mar 2024) UL Standard for Safety Conduit, Tubing and Cable Fittings
UL 969	(2017; Reprint May 2023) UL Standard for Safety Marking and Labeling Systems
UL 1203	(2023; Reprint May 2024) UL Standard for Safety Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
UL 4248-8	(2024) Fuseholders - Part 8: Class J

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00, "SUBMITTAL PROCEDURES", unless otherwise indicated below:

SD-01 Preconstruction Submittals

Welding Quality Control Plan; G, HDC

Submit for approval the welding quality control plan a minimum of 60 calendar days prior to the start of tank manufacturing. (see paragraph "Welding Quality Control Plan").

SD-02 Shop Drawings

a. Outline and Assembly Drawings; G, HDC

Submit outline and assembly drawings of the transformer for approval no later than 240 calendar days prior to the start of transformer fabrication to demonstrate that the equipment will conform to the requirements and intent of the specifications.

b. Detail Drawings; G, HDC

Submit detail drawings for approval not later than 180 calendar days prior to the start of transformer fabrication to demonstrate that the equipment will conform to the requirements of the specifications.

SD-03 Product Data

Submit for approval the product data no later than 120 calendar days prior to the start of transformer fabrication to demonstrate that the welding materials will conform to the requirements of the specifications.

a. Welding Electrodes and Rods; G, HDC

b. Shielding Gas; G, HDC

SD-05 Design Data

a. Transformer Design Data Review Report; G, HDC

Submit for approval a transformer design data review report within 14 calendar days of the design data review meeting, to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications.

b. Descriptive Data; G, HDC

Submit for approval the descriptive data and catalog data of all accessory devices, ancillary equipment and gaskets to be provided with the transformer within 210 calendar days after date of award, to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. (see paragraph "Descriptive Data")

c. Spare Parts List; G, HDC

Submit for approval a listing of all required spare parts to be provided with the transformer within 210 calendar days after date of award. (see paragraph "SPARE PARTS")

d. Structural Design Criteria and Seismic Calculations; G, HDC

Submit for approval the structural design criteria and seismic calculations within 45 calendar days after outline and assembly drawing approval. Perform design criteria and calculations utilizing civil or structural engineers who are presently registered professional engineers (PE) in any state or territory of the United States, and provide a cover sheet for the submittal which is stamped or sealed and signed by a PE.

e. Cabinet Heater Sizing Calculations; G, HDC

Submit for approval the calculations not later than 180 calendar days prior to the start of transformer fabrication to verify the ratings of the transformer control and power cabinet heaters, based upon the cabinet sizes, cabinet material, and the regional ambient temperature conditions as shown in Contract Drawing G-005. See paragraph "Lighting, Convenience Receptacle, and Cabinet Heaters" for information.

SD-06 Test Reports

a. Transformer Factory Acceptance Test Report; G, HDC

Submit for approval the transformer factory acceptance test report not later than 14 calendar days following completion of the factory acceptance tests. (see paragraph "Factory Acceptance Test Report").

b. Bushing Design Tests; G, HDC

Submit for approval the transformer bushing design test reports not later than 30 calendar days following completion of the tests (see paragraph "Bushing Design Tests"). If certified copies of bushing design tests previously conducted within ten (10) years are submitted in-lieu of new test results, submit them when the bushing selection is made, but not later than 60 calendar days

prior to the performance of transformer factory acceptance tests.

c. Bushing Routine Tests; G, HDC

Submit for approval the transformer bushing routine test reports not later than 30 calendar days following completion of the tests. (see paragraph "Bushing Routine Tests").

d. Bushing Current Transformer Tests; G, HDC

Submit for approval the transformer bushing current transformer test reports not later than 30 calendar days following completion of the tests. (see paragraph "Bushing Current Transformer Tests").

g. Weld Inspection and Test Report; G, HDC

Submit for approval the weld inspection and test report not later than 14 calendar days following completion of the weld inspections and tests. (see paragraph "Weld Inspections, Tests and Weld Inspector Qualifications").

SD-07 Certificates

a. Transformer Oil Certification; G, HDC

Submit for approval the transformer oil certification documents a minimum of 7 calendar days prior to the delivery of transformer oil to the Little Goose Lock & Dam "Storage Yard". (see paragraph "Quantity and Transformer Oil Certification").

b. Notification of the Date of the Transformer Design Data Review Meeting; G, HDC

Notify the COR 30 calendar days in advance of when the transformer manufacturer will be ready for performance of a design data review meeting, to be held at the manufacturer's facility. If the meeting is to be held in a foreign country, notify the COR in writing of the meeting dates a minimum of 60 days prior to the proposed meeting date.(see paragraph "TRANSFORMER DESIGN DATA REVIEW MEETING").

c. Notification of the Date of Factory Tests; G, HDC

For transformer manufacturers located in the United States, notify the COR 30 calendar days in advance of when the transformer manufacturer will be ready for factory acceptance tests, so that the tests may be witnessed by a Government Representative at the manufacturer's facility.(see paragraph "TRANSFORMER FACTORY ACCEPTANCE TESTS").

For transformer manufacturers located in foreign countries, notify the COR 60 calendar days in advance of when the transformer manufacturer will be ready for factory acceptance tests, so that the tests may be witnessed by a Government Representative at the manufacturer's facility.(see paragraph "TRANSFORMER FACTORY ACCEPTANCE TESTS").

d. Welder Qualifications; G, HDC

Submit for approval the welding operators and welders qualifications a minimum of 60 calendar days prior to their performance of work. (see paragraph "Welder Qualifications").

e. Weld Inspector Qualifications; G, HDC

Submit for approval the qualifications for the Contractor's Quality Assurance personnel responsible for performing weld inspections a minimum of 60 calendar days prior to the performance of weld inspections. (see paragraph "Inspection and Weld Inspector Qualifications").

SD-08 Manufacturer's Instructions

a. Factory Test Procedures; G, HDC

Submit for approval the transformer factory test procedures a minimum of 60 calendar days prior to the performance of the factory acceptance tests. (see paragraph "TRANSFORMER FACTORY ACCEPTANCE TESTS").

b. Welding Procedures; G, HDC

Submit for approval the welding procedures and specifications, and copies of test reports, a minimum of 60 calendar days prior to the performance of work. (see paragraph "Welding Procedure").

c. Prequalified Weld Procedures; G, HDC

Submit for approval the applicable prequalified weld procedures per the requirements of AWS a minimum of 60 calendar days prior to the performance of work. (see paragraph "Welding Procedure").

1.5 TRANSFORMER WARRANTY REQUIREMENTS

1.5.1 General Warranty Requirements

In addition to the requirements outlined in FAR 52.246-18, provide a manufacturer’s warranty for the power transformers for a period of 5 years from the date of final acceptance of the work. Provide a warranty certificate for each transformer indicating the date of expiry, to be included in the final Operations and Maintenance Instructions. The following transformer issues will also be considered warranty repair items:

a. Transformer gassing quantities or rates exceeding the DGA Status 1 level as defined in Figure 2 Tables 1 through 4 of IEEE C57.104.

b. Transformer oil leaks, at welded joints as well as gasketed connections and valve stem packing.

c. Paint failures resulting in visible loss of adhesion through bubbling, flaking, peeling, or any visible rust due to paint failure.

d. Transformer bushing dielectric integrity and oil leaks.

e. Transformer control cabinet heater functionality.

1.5.2 Devices Exempt from the Transformer Full Warranty Period

Transformer ancillary devices which are not manufactured by the transformer manufacturer are subject to the device manufacturer's standard warranty period, and are exempt from the 5 year duration of the transformer warranty period. All ancillary devices which are not manufactured by the transformer manufacturer, such as gauges, have a minimum 1-year warranty or the part's manufacturer's guaranteed warranty, whichever is higher of the two.

PART 2 PRODUCTS

2.1 TYPE AND RATING

2.1.1 General

The transformers to be furnished under these specifications must be single-phase, three-winding, with one high-voltage and dual low-voltage windings, oil-immersed type suitable for outdoor operation. The transformers must be self-cooled/forced air-cooled type, Class ONAN/ONAF, and must be of a design that has an established record of satisfactory operation with the type of oil preservation system specified, and manufactured suitable for shipment by sea transportation, railcar, and trucking by heavy hauler. The transformers are a step-up transformer to be used in direct connection with electrical power generators and will be subject to backfeed mode as defined in IEEE C57.116. The transformer design must be of a design that has an established record of satisfactory operation in this type of configuration.

2.1.2 Transformer Limiting Dimensions and Equipment Arrangement

Provide transformers with the layout, equipment arrangement and dimensional requirements as indicated on contract drawings.

2.1.3 Requirements

Except as otherwise specified herein, the transformers, accessories, and spare parts must conform to the applicable requirements of IEEE C57.12.00, IEEE C57.12.10, IEEE C57.12.70, IEEE C57.12.80 and IEEE C57.12.90, and IEEE C57.116.

2.1.4 Standard Products

Provide material and equipment which are standard products from a manufacturer that is regularly engaged in their production, and are items that have been commercially available for at least 3 years prior to bid opening, unless otherwise specifically approved. All materials must conform to the requirements of these specifications. Materials must be of industrial quality, free from defects and imperfections, presently being manufactured, and of the classification and grades designated. If the Contractor desires for any reason to deviate from the standards designated in these specifications, submit for approval a statement describing the exact nature of the deviation, including complete specifications for the materials that are being proposed for use.

2.1.5 Descriptive Data

Submit for approval descriptive data for all transformer equipment, which includes catalog and technical data of sufficient detail to verify

conformance with the requirements, herein. Highlight or circle the catalog and technical data for the specific device and model, and provide ordering information and cut sheets. The descriptive data is to include the following at a minimum:

1. Electrical core steel, including country of origin
2. Winding conductors, including country of origin
3. Gasket type and material
4. Valves (each type)
5. Oil sampling device
6. Radiators
7. Cooling fans (including wiring connection methods)
8. Nitrogen regulator cabinet and nitrogen bottles if providing a nitrogen gas pressure system of oil preservation
9. Bushings (each type and rating)
10. Core ground bushings
11. Bushing current transformers
12. Bushing current transformer terminal boxes
13. Thermowells
14. Oil level indicator
15. Oil temperature indicator
16. Winding temperature indicator, including associated equipment
17. Pressure relief device, including discharge piping
18. De-energized tap changer, including operating handwheel
19. Rapid Pressure Rise Relay and Seal-in
20. Personal fall arrest system
21. Insulating oil, including vendor and inhibitor
22. Control and power cabinet vibration isolators
23. Fiber-optic probes
24. Fiber-optic tank feed-through plate and connectors
25. Auxiliary power transformer and mounting cabinet
26. Magnetic contactors
27. Molded-case circuit breakers (each type and rating)
28. 480 VAC circuit breaker locking provisions
29. Auxiliary relays
30. Undervoltage relays
31. Control and instrument switches
32. Terminal blocks (each type)
33. Fuses
34. Fuse holders
35. Wire duct
36. Cabinet lighting
37. GFCI receptacle
38. Cabinet heaters
39. Cabinet grounding busbar
40. Cabinet ventilation
41. Thermostat / humidistat
42. Insulated wire and cable (each type) and signal cable
43. Wire labeling method
44. Device nameplate method
45. Conduit and fittings
46. Junction boxes
47. Impact recorders for shipment (analog & digital)

If providing a conservator tank system of oil preservation include descriptive data of the following:

48. Conservator tank bladder
49. Dehydrating breather

50. Buchholz relay

2.1.6 Ratings and Electrical Characteristics

The ratings and electrical characteristics of the transformers must be as follows:

a. Continuous rating, at the 65 degrees-C temperature rise, of the high-voltage winding at all taps, kVA:

(1) ONAN Rating: 82,000
(2) ONAF Rating: 109,334

b. Continuous rating, at the 65 degrees-C temperature rise, of each low-voltage winding, kVA:

(1) ONAN Rating: 41,000
(2) ONAF Rating: 54,667

b. Frequency, Hz: 60

c. Number of phases: 1

d. Rated voltage, kV:

(1) High-voltage windings: 500
(2) Low-voltage winding X: 13.2
(3) Low-voltage winding Y: 13.2

e. Winding connections (external to the transformer):

(1) High-voltage windings: Grounded-Wye
(2) Low-voltage windings: Ungrounded Delta

f. Impedance, at ONAN rated current between the high-voltage winding and each low-voltage winding, subject to IEEE tolerances, percent:
9.2% (H-X)
9.2% (H-Y)

g. Impedance, at ONAN rated current, between the low-voltage windings (X-Y), as high as feasible for an economic design, but not less than, percent: 20.9%

g. Polarity: Subtractive

h. Basic impulse insulation levels (BIL), kV:

(1) Line ends of the high-voltage windings, not less than: 1425
(2) Neutral ends of the high-voltage windings, not less than: 150
(3) Low-voltage windings, not less than: 110

i. Taps in low voltage windings: None

j. Taps (full capacity) in high voltage winding

(1) Tap 1, percent of high-voltage rating: 107.5
(2) Tap 2, percent of high-voltage rating: 105.0
(3) Tap 3, percent of high-voltage rating: 102.5
(4) Tap 4, percent of high-voltage rating: 100.0

(5) Tap 5, percent of high-voltage rating: 97.5

k. Maximum no-load losses at rated voltage and frequency, kW: 52

l. Maximum load losses at maximum ONAN rated kVA and 1.0 power factor, with each low-voltage winding equally loaded, kW: 175

m. Maximum average sound level at rated voltage and frequency, with all cooling groups in operation, dB: 74

n. Maximum Oil Volume, GAL: 10,667

o. Maximum transformer total weight, completely assembled and oil filled with all accessories installed, pounds: **355,000**

p. The transformers' capacitances must match those of the existing transformers and be designed to be compatible with bank of single-phase shell-type transformers. See the T2 Doble Report attachment at the end of the specifications.

2.1.7 Transformer Type

The existing transformers in T2 Bank are shell-type transformers. A shell-form or core-form type transformer design is acceptable and must meet requirements described in these specifications. The transformers design must fit each existing Project connections without modifications to existing equipment and the weight must fit the intake deck loading limitations and any oil quantity restrictions if any. The new transformers must fit within the allowable space and for example, without extending into space for gantry crane. The transformers must be designed to be compatible for operation with the existing single phase shell-type transformers in T2 Bank. The transformers must be able to be transported from manufacturer's location to Little Goose Lock & Dam Storage Yard.

2.1.8 Unusual Service Conditions

2.1.8.1 Magnetic Fields

The transformers will be subject to the following unusual service conditions, as defined by IEEE C57.12.00, paragraph 4.3:

The transformers' high-current low-voltage bushings will be connected to isolated-phase bus ducts and will exhibit strong magnetic fields during operation, which may cause circulating currents in the transformer tank covers and bus duct housings. Corrective measures must be taken during manufacturing to utilize non-magnetic metals in the cover around the bushings and the bushing housing flanges.

2.1.8.2 Backfeed Mode

The transformers must be designed to operate under IEEE C57.116 related service conditions with the transformers being used as a generator step-up transformer and will be subject to periods of backfeed operation.

2.1.9 Impedance Tolerance

The impedance tolerance between the supplied single-phase transformers and the specified impedance must be limited to a maximum of 3 percent, at the ONAN self-cooled rating, to reduce circulating currents when wye-connected

and assure proper operation of the transformers differential relaying.

2.2 STRUCTURAL DESIGN CRITERIA AND SEISMIC CALCULATIONS

Provide Structural design criteria and seismic calculations for the transformer, to include the main tank and all major components such as bushings, cooling equipment, oil preservation equipment, and cabinets.

2.2.1 Structural Design Criteria

Structural design criteria must include the following:

a. Indicate the industry design standards (ASCE or IEEE) and allowable stresses or capacities to which steel plate, structural steel shapes, welds, bolts and studs must conform.

b. Indicate the industry standards (ASCE or IEEE) used in developing the seismic forces and analysis techniques used in the design of the transformer and transformer components.

c. Provide the seismic design for equipment restraint in accordance with Chapter 13, "Seismic Design Requirements for Nonstructural Components," of ASCE 7-22 with the seismic design force computed as per Section 13.3 "Seismic Demands on Nonstructural Components". Provide electrical equipment restraint in accordance with the provisions in IEEE 693 Annex D, or Section 13.3 of ASCE 7-22 whichever produces the more adverse seismic effects. For ASCE 7-22, use a spectral acceleration S_{DS} = 0.32, I_P = 1.5 and z=h=1. Use a moderate seismic qualification level For IEEE 693.

d. Provide wind load calculations based upon Exposure Category "D" of ASCE 7-22. Base the effect of wind load forces upon ASCE 7-22, or 40 psf, whichever is greater.

2.2.2 Transformer Mounting

The transformers must be manufactured with structural bases that meets the requirements of paragraph "Transformer Steel Base, and that rests on the existing concrete pedestals with a steel plate cap as shown in supplemental drawing LMP-5-6-1A5/1.

2.3 THERMAL DESIGN

The temperature rise above ambient temperature of the transformers or parts thereof, when tested in accordance with its ratings, must not exceed the limits of observable temperature rise for oil immersed apparatus as stated in IEEE C57.12.00 (paragraph 5.11.1). The winding temperature rise by resistance must not exceed 65 degrees-C, and the hottest spot winding temperature rise must not exceed 80 degrees-C on the tap connections that give the highest losses, at all self-cooled and forced-air cooled ratings. The transformers must be designed for satisfactory continuous operation with any combination of simultaneous loads on the low-voltage windings within their ratings, and also for the case where either low-voltage winding carries maximum rated load and the other low-voltage winding carries no load.

2.4 CORE

The transformers' core steel laminations must be high-quality, non-aging,

cold-rolled, grain-oriented steel especially suitable for the purpose, meeting the requirements of ASTM A664 and ASTM A876, and the following:

a. Lamination maximum thickness of 0.270 mm, and the design flux density less than 1.75 Tesla.

b. Electrical core steel core loss, rms exciting power, rms and peak exciting current, and ac permeability design tested in accordance with ASTM A343/A343M, with the design test reports included with the descriptive data.

c. Each roll of sheet steel used must have the surface insulation resistivity tested in accordance with ASTM A717/A717M.

d. The core must be assembled with interleaved joints, and rigidly clamped to ensure mechanical strength to support the windings and to prevent shifting of the laminations during shipment, and also to reduce vibration during operation.

2.5 WINDINGS

The single-phase transformers must be manufactured with windings meeting the requirements of paragraph "Ratings and Electrical Characteristics", consisting of one high-voltage winding (H) and two low-voltage windings (X and Y). Consideration must be given to all factors of service, such as high dielectric and mechanical strength of insulation, coil characteristics, and minimum restrictions to free circulation of oil. Coils must be made up, shaped, and braced to provide for expansion, contraction, and shrinkage due to temperature changes and aging in service in order to avoid abrasion of insulation and to provide resistance to movement and distortion caused by abnormal operating conditions. The insulation of the coils must be designed to withstand possible transient voltages that occur when the transformers are operated in backfeed mode and the secondary windings (hi side) are exposed to typical system transients as described in IEEE C57.116, clause 11. Barriers must be provided between windings and core and between high-voltage and low-voltage windings. End coils must have additional protection against normal line disturbances. The windings must meet the following requirements:

a. Winding conductors manufactured from high-conductivity copper magnet wire meeting the applicable requirements of NEMA MW 1000.

b. Winding assembly of a circular coil fabrication if the transformers are a core-form design.

c. Conductor insulation consisting of thermally upgraded Kraft paper.

d. A de-energized tap changer with taps located in the high-voltage windings. The tap changer contacts must be silvered, and capable of withstanding the full short circuit current of the transformers without injury.

e. Basic impulse insulation level (BIL) of the windings as specified in paragraph "Ratings and Electrical Characteristics", and capable of withstanding IEEE Standard dielectric tests, in accordance with paragraph "Power Transformer Tests", corresponding to the specified winding insulation levels.

f. Capable of withstanding without injury the mechanical and thermal stresses caused by short circuits on the external terminals of any winding or windings, with rated voltages maintained across the terminals of all other windings intended for connection to sources of energy, under the conditions listed in IEEE C57.12.00 (paragraph 7.1.1).

g. Fiber-optic probes embedded in the calculated hottest spot for each high and low-voltage winding duct spacers for direct winding temperature measurement, with quantities and distribution as required in paragraph "Transformer Fiber-Optic Winding Temperature Measurement."

2.6 TANK

2.6.1 FABRICATION

The transformers must be manufactured with an oil-tight steel tank, with oil-tight covers per the requirements of IEEE C57.12.10 (paragraph 5.8), with the following features:

a. The main transformer tanks and any attached compartment that is subjected to operating pressures designed and manufactured to withstand, without leakage or permanent deformation, an internal maximum operating pressure not less than 10 psi.

b. Manufactured for vacuum filling (essentially full vacuum) in the field, with all valves, fittings and piping affected by vacuum filling rated for such filling.

c. Welded joints between the tank and cover, and between tank sections, designed to prevent weld splatter from entering the inside of the tank during the welding process.

d. Positioning guides inside the tank to assure the core and windings are in the correct position during the assembly process, and provide additional rigidity during transportation.

e. One or more unobstructed manholes in the cover with minimum dimensions of 24 inches by 24 inches, or 24 inches minimum diameter, to afford easy personnel access to the inside of the tank and the upper portions of the core and coils.

f. Handhole access covers in the tank sidewall for access to low-voltage bushing bottom connection, and the de-energized tap changer switch mechanism for future maintenance.

g. If providing a conservator tank oil preservation system, the tank must include the necessary pressure equalizing valves to allow for oil-filling under vacuum.

2.6.2 Lifting, Moving and Jacking Facilities

2.6.2.1 Lifting Facilities

Design loads for lifting facilities must have a safety factor of five in accordance with IEEE C57.12.10 (paragraph 5.3.1). Lifting facilities must positively keep the lifting cable in place even when the cable is slack. Provide transformers with the following lifting facilities:

a. Lifting attachments on the tank cover.

b. Adequate means for lifting the core and coil assembly from the tanks for a core-form design.

c. Lifting facilities and pivot points on the tanks adequate for lifting and pivoting the transformers from the shipping position to the upright position for a shell-form design.

d. Lifting facilities on the tanks adequate for lifting the complete transformer filled with oil. The lifting facilities will also be used for securing of the transformers during shipment.

2.6.2.2 Moving Facilities

Furnish moving facilities in accordance with IEEE C57.12.10 (paragraph 5.3.3).

2.6.2.3 Jacking Facilities

Provide transformers manufactured with jacking facilities to permit jacking the fully assembled transformer filled with oil per the requirements of IEEE C57.12.10 (paragraph 5.3.4). The design loads for jacking facilities must be a minimum of five times the actual loads to allow for possible unequal jacking forces.

2.6.3 Gasketing

2.6.3.1 General

Gaskets between metal surfaces must be set in expansion-limiting grooves so that all contact surfaces are metal-to-metal when tightened. The gaskets must be made of Nitrile NBR (Buna N), with the exception that gaskets for the low-voltage bushings must be fluoroelastomeric rubber, with a Durometer rating between 50 and 70. Circular cross-section gaskets are not acceptable for use in gasket grooves of rectangular cross-section.

2.6.3.1.1 Low-voltage Bushings

The low-voltage bushing gaskets but meet the following requirements:

a. Meets the requirements of ASTM D-1418, designation FKM, Type 2.
b. Must be manufactured with 100% virgin FKM Fluoroelastomer polymer
c. Rated for application in temperature range of -20F to +400F
d. Durometer hardness of 70 (+/- 2)
e. Minimum fluorine content: 66%

2.6.3.2 Sizing

Gasket sizing for rectangular cross-section grooves must be accomplished as follows:

a. Gasket thickness is chosen so that approximately 25-percent of the gasket cross-section protrudes above the depth of the groove, referred to as the 'gasket compression area'.

b. The width of the groove minus the width of the gasket determines the space available for gasket expansion during compression. The amount of groove space available for gasket expansion during the

compression process is referred to as the 'gasket expansion area', which must be greater than the gasket compression area to avoid pinching of the gasket between the metal surfaces when tightened.

c. Proper sizing coordination between the gasket groove and the gasket cross-sections results in 25-percent gasket compression, with a remaining gasket expansion area after tightening of between 5 and 10-percent.

2.6.4 Valves

Provide valves that conform with IEEE C57.12.10 (paragraph 5.1.8), are of ball-type stainless steel construction conforming to MSS SP-72, circular flanged mounting, with reinforced PTFE valve seats, unless otherwise specifically indicated. The valves must be of full-port design, designed for use with insulating oil with a 120 degrees Celsius minimum temperature rating and include hasps for locking the handle. Provide the following valves:

a. Upper filter connection. A 1.5-inch valve with a 1.5-inch female NPT threaded open-end connection and a threaded plug, located on the tank sidewall such that it can be used to fill the transformers with oil while the transformers are under vacuum.

b. Vacuum pump connection. A 3-inch valve with a 3-inch circular-flanged open-end connection, located on the tank cover for use in connecting a vacuum pump during the vacuum filling process. Provide a gasketed blind flange cover with an integral 3-inch NPT female connection and threaded plug for the valve open-end connection.

c. Main drain. A 3-inch valve with a 3-inch circular-flanged open-end connection, located at the extreme bottom of the tank for use in gravity draining of the transformer. Provide a gasketed blind flange cover with an integral 3-inch NPT female connection and threaded plug for the valve open-end connection.

d. Oil sampling valve. A 1-inch valve, with a 1/2-inch NPT threaded open-end connection and a 1/2-inch threaded sampling device, complete with protective cover. This valve may be located at the main drain valve location..

e. Lower filter connection. A 1.5-inch valve with a 1.5-inch female NPT thread open-end connection and a threaded plug, located at the extreme bottom of the tank.

f. Tank air vents. Threaded plugs for venting the radiators. If providing a conservator tank oil preservation system, valves must be provided for venting of the conservator tank. Schrader valves are not acceptable for use as vent valves.

g. If providing a conservator tank system of oil preservation provide a conservator tank drain valve. A valve must be located at the bottom of the conservator tank for use in gravity draining.

h. If providing a nitrogen gas pressure system of oil preservation provide a nitrogen gas connection. Two 1/2-inch valves for connection of the nitrogen generator system tubing.

i. Radiator drain. A 1/4-turn valve at the lowest point of each

radiator to permit draining, with an NPT threaded open-end connection and threaded plug.

j. Isolation valves.

(1) Radiators. At the inlet and outlet of each radiator to permit removal without draining the oil from the tank. Radiator isolation valves at the transformer tanks may be of a butterfly type.

(2) Rapid pressure rise relay. 1.5-inch isolating valve for the rapid pressure rise relay.

(3) Gas-in-oil monitor interface valve. Two 2-inch valves for future connection to the gas-in-oil monitor

(4) Conservator tank. If providing a conservator tank system, provide a valve isolating the conservator tank from the main transformer tanks, and isolating the Buchholz relay. Isolation valves adjacent to the Buchholz relay may be of a butterfly design.

2.6.5 Connections

2.6.5.1 General

All bolts, studs, machine screws, nuts, and tapped holes designed for customer connection must be in accordance with ASME B1.1 (inch fasteners). Bolting hardware must be Grade 8 minimum, or equivalent, and and all hardware not internal to the tank must be galvanized. Threads for sizes 1/4-inch to 1-inch, inclusive, must be NC or UN series. The sizes and threads of all valves, pipe and fittings, conduit and fittings, tubing and fittings, and connecting equipment, must be in accordance with ASME B1.20.1. Manufacturers' standard threads and construction may be used on small items which are integrally replaceable, except that threads for external connections to these items must meet the above requirements.

2.6.5.2 Stainless Steel

All stainless steel connecting hardware must be installed using an anti-galling compound such as molybdenum disulfide on the threads prior to connection, or the nuts may be of a Nitronic 60 grade material.

2.6.6 Steel Pipe and Fittings

Steel pipe must conform to ASTM A53/A53M, Grade A, Weight Class XS. Dimensions of terminating flanges must conform to ASME B16.1 and ASME B16.24. For a conservator tank system, if the bushing turret design is such that any gasses generated may accumulate within the turret enclosure, piping must be provided for the purposes of venting these gases to the conservator tank piping, passing through the Buchholz relay.

2.6.7 Grounding

The transformer tanks must include four ground pads, with grounding provisions in accordance with IEEE C57.12.10 (paragraph 5.5).

2.6.8 Portable Fall Arrest System

2.6.8.1 Portable Fall Arrest System Anchor Post

Provide one portable fall arrest system anchor post. The anchor post must have the following features:

a. Three-stage, four-position telescoping design of aluminum construction.

b. Provision of three independent swivel tie-off points, with horizontal lifeline attachment.

c. Base leveling screws allowing the system to be plumbed to vertical for working stability on inclines up to 15-degrees.

d. Designed for attachment to a uni-anchor mounting plate.

2.6.8.2 Anchor Post Accessories

Provide the following accessories with the portable fall arrest system anchor post:

a. Rescue Davit Arm, with quick mount winch and cable.

b. Carrying bag for the anchor post assembly.

c. Carrying bag for the Davit Arm with mounted winch.

2.6.8.3 Mounting Plates

Provide two portable fall arrest system anchor post mounting plates welded on the transformer covers, located so that the center of each manhole access cover is 36-inches from the mounting plate. The mounting plates must be designed for use with the portable fall arrest system anchor post indicated above.

2.6.9 Transformer Steel Base

The transformers must be manufactured with an integral structural steel base designed for meeting the following requirements:

a. Suitable for resting on the existing concrete pedestals with steel caps as shown on supplemental drawings LMP-5-6-1A5/1, and LGB-I-003, Volume 1.

b. Capable of supporting the weight of the assembled and oil filled transformers on the existing concrete pedestals with steel caps.

c. Manufactured to be suitable for moving on rollers or skids when the transformers are completely assembled and filled with oil, permitting moving the transformers in a direction parallel to either centerline, with suitable pulling eyes provided.

d. Spare must directly bear on steel bearing plates of the storage structure and on the foundation plates in operating locations. Provide at minimum provisions for six (6) 1-inch diameter anchors to be installed in the locations shown in resource drawings and adequate clearance to install the anchors.

2.7 COOLING EQUIPMENT

2.7.1 Radiators

Provide transformers manufactured with radiators to cool the oil at a 82,000 kVA continuous load, without any cooling groups in operation. The radiators must meet the following requirements:

a. Located on the tanks to ensure uniform circulation of the oil through the windings, with valves installed on each connection to the main tanks so that the radiators may be removed for repairs without taking the transformers out of service.

b. Fully hot-dip galvanized on the outside and remain unpainted.

c. Designed and manufactured to withstand essentially full vacuum to permit filling of the transformers under vacuum with the radiators in-place and radiator valves open.

d. Provisions for draining and venting each radiator, 1/4-turn ball valve for draining each radiator, and lifting eyes for handling.

e. The welding and fittings must be smooth, both inside and out, so as to present no obstruction to the flow of oil inside, with full penetration welds on the outside of the radiators such that there will be no crevices in which water might collect.

2.7.2 Cooling Fans

Horizontal-draft cooling fans must be provided so that the continuous forced-air-cooled capacity of the transformers will be at least 109,334 kVA without exceeding the allowable temperature rise specified in paragraph "Ratings and Electrical Characteristics". Locate the cooling fans to direct the air stream against the radiator and to prevent recirculation of discharged air. Provide cooling fans that meet the following requirements:

a. Balanced cast aluminum fan blades.

b. Hot-dip galvanized steel basket-type fan blade guards.

c. Fan motors to have IP55 enclosure rating.

d. Fan motor housing painted with epoxy primer and aliphatic urethane top-coat.

e. Individual thermal overload protection with automatic-reset.

f. Fan motors with permanently lubricated, double-sealed ball bearings.

g. Fan motors with Class F insulation, Class B temperature rise.

2.7.3 Power Supply Equipment

The power supply for fan motors will be Government-furnished, 480 V, three-wire, 3 phase, 60 Hz, as indicated on the contract drawings. One 3-pole, 600 V, molded case circuit breaker of proper current rating must be provided in the power cabinet for the supply circuit.

2.7.4 Cooling Control Equipment

All necessary protective and control equipment for the fan motors must be furnished and installed in the control and power cabinets for each transformer (see paragraph "CONTROL AND POWER CABINET EQUIPMENT").

2.8 BUSHINGS

2.8.1 General Bushing Requirements

Provide transformers with one high-voltage, four low-voltage, and one neutral leads brought out from the tank through bushings as specified below. Bushings of the same voltage and current rating must be interchangeable and as applicable, conform to IEEE C57.19.00 and IEEE C57.19.01. All bushings must meet the following requirements:

a. Of recent manufacture and of a type and style currently being manufactured.

b. Nameplate rated and tested for use at 60 Hz rated frequency.

c. Rated for outdoor service, with UV resistant insulating sheds for bushings which will be exposed to direct sunlight.

d. Manufactured so that there will be no stressing of any parts due to temperature changes, and means provided to accommodate conductor expansion.

e. Gastight and oiltight when installed on the transformer tanks.

f. The power factor of each bushing must meet the requirements of IEEE C57.19.01, Table 6, or as otherwise specifically required herein.

2.8.2 High-Voltage and High-Voltage Neutral Bushings

The high-voltage and neutral bushings must be designed to withstand the standard withstand test voltages as indicated in Table 1 of IEEE C57.19.01, and tested in accordance with paragraph "Bushing Tests". The bushings must be ABB Type O Plus C Type and meet the following requirements:

a. Designed for use in an air-to-oil power transformer applications.

b. Constructed with a normally grounded test tap.

2.8.2.1 High-Voltage Bushing Ratings

a. Insulation class, kV: 500

b. BIL rating, kV: 1,550

c. Minimum current rating, Amperes: 1,600

d. Creepage distance: Light contamination

e. Drawing number: T550W2000VV

2.8.2.2 High-Voltage Neutral Bushing Ratings

a. Insulation class, kV: 25

b. BIL rating, kV: 150

c. Minimum current rating, Amperes: 1,200

d. Creepage distance: Light contamination

e. Drawing number: T025W0412AT

2.8.3 Low-Voltage Bushings

Low-voltage bushings must meet the requirements of IEEE C57.19.01 (1991), and must be tested in accordance with paragraph "Bushing Tests". The bushings must be of solid bulk construction of a low-corona design for vertical mounting, and the exterior shell above the mounting flange must be of porcelain construction and formed in one piece. Viton gaskets must be used for the installation of all low-voltage bushings. All low-voltage bushings must be rated as follows:

a. Insulation class, kV: 25

b. BIL rating, kV: 150

c. Minimum current rating, Amperes: 7,500

d. Thermal rating, degrees Celsius temperature rise: 125

e. Drawing number: T025B0750EC

2.8.4 High-Voltage and Neutral Bushing Terminals and Connections

The high-voltage and neutral bushings must have threaded copper terminal stud with dimensions in compliance with IEEE C57.19.01.

2.8.5 Core Ground Bushings

The transformers must be manufactured with two external bushings for core grounding; one for the main core connection to ground, and one for the core frame connection to ground. The bushings must be mounted adjacent to each other and located on the transformer tank covers, protected with a removable weatherproof metal cover with device nameplates. The bushings must be manufactured with an integral cast copper stud, with an insulating body of either epoxy or solid porcelain, and include a bolted-flange so that they can be removed for maintenance without having to enter the tank. The stud must be silver plated, with tapped holes for connection of removable grounding straps between the bushing bottom terminal and the core and tank wall. The minimum ground wire size from each bushing top terminal to the tank must be #4 AWG equivalent. The core ground bushings must have the following minimum nameplate ratings:

a. Insulation class, kV: 2.5

b. BIL rating, kV: 45

c. Minimum current rating, Amperes: 100

2.8.6 SFRA Test Shipping Bushings

For the purposes of performing SFRA testing with the transformers in the shipping configuration, each shipping cover installed after the bushings have been removed for shipment must include a bushing that is connected to the winding leads, so that the SFRA tests can be performed just prior to each transformer shipment and immediately after each transformer delivery to the Little Goose Lock & Dam "Storage Yard" for each transformer. This assembly permits the SFRA testing on the transformers without having to gain entrance into, or modifying the transformer shipping assembly. The winding leads must be appropriately braced inside the transformer tanks to assure there is no movement during shipment which could damage the bushings, or potentially alter the SFRA test results. During shipment, the external terminals of these bushings must be grounded to the tank. Testing must be performed per the requirements of paragraph "Sweep Frequency Response Analysis Tests". Each temporary SFRA Test Shipping Bushings must be of the same manufacture and rating as the core ground bushings.

2.8.7 Shipment and Storage

2.8.7.1 Shipment

For bushings shipped separate from the transformers, each bushing must be crated and packed per the manufacturer's requirements in such a manner to protect the bushing from damage due to moisture, breakage and vibration damage during transit.

2.9 BUSHING-TYPE CURRENT TRANSFORMERS

All bushing-type current transformers must conform to the requirements of IEEE C57.13 and additional requirements in NEMA SG 4, and have revenue metering accuracy classifications as required in Table 6 of IEEE C57.12.10, unless otherwise specifically indicated. The continuous thermal rating factor must be a minimum of 1.33, based upon a 30 degree Celsius average ambient air temperature.

2.9.1 High-Voltage Bushing Current Transformers

Provide two 1200:5, multi-ratio bushing-type current transformers for each transformer high-voltage bushings.

2.9.2 Low-Voltage Bushing Transformers

Provide bushing current transformers on the low-voltage bushings as required for the winding temperature monitoring equipment.

2.10 LOW-VOLTAGE BUSHING THROAT ENCLOSURE

Provide transformers with circular flanged connections that are at same location and height to bolt to the existing bus housings and bushing enclosures.

2.11 TRANSFORMER MOUNTED ACCESSORIES

2.11.1 General

Dials, indicators, and gages installed on the transformers must have glass faces, and be mounted at a height of approximately 60 inches above the

base of the transformers, unless otherwise indicated, and arranged for convenient reading standing at the level of the base. The following accessory devices must be included in the price for the transformers, and meet the requirements of IEEE C57.12.10 (paragraph 5.1), unless otherwise indicated.

2.11.2 Liquid Level Indicator

Provide one magnetic-type liquid level indicator located on the tank sidewall or on the constant-pressure, reservoir tank if a conservator tank system is provided. The liquid level indicator must be equipped with three circuit-closing low-level alarm contacts suitable for use with an ungrounded 125 V dc circuit. The indicator must have a 6-inch dial face with a field-replaceable case, with the dial marked to indicate the 25 degrees Celsius oil level and the maximum and minimum oil levels.

2.11.3 Thermowells

Provide a total of five top oil thermowells and one bottom oil thermowell housed in weatherproof enclosures, with functionality as indicated on Contract drawing E-109 for each transformer. The thermowell locations must be designed such that they are always submerged in the insulating oil during transformer operation. Thermowells must be provided for the following:

a. One thermowell for use with the analog liquid temperature indicator, located on the tank sidewall near the top oil level in the path of the hottest oil.

b. Two thermowells for use with the analog winding temperature indicators, one for each low-voltage winding, located on the tank sidewall near the top oil level in the path of the hottest oil.

c. Three spare thermowells with NPT plugs. One must be for future use with the transformers temperature monitor for top oil temperature, located on the tank sidewall near the top oil level in the path of the hottest oil. One must be for future use with the transformer temperature monitor for bottom oil temperature, located on the tank sidewall.

2.11.4 Analog Temperature Indicating Equipment

The analog indicating equipment must be located on the tank sidewall as shown on the Contract drawings, with functionality as indicated on the control schematics.

2.11.4.1 Liquid Temperature Indicator

Provide one dial-type indicating thermometer for liquid temperature indication with a bourdon-tube sensing element for each transformer. The dial indicator must cover a range of 0 to 120 degrees Celsius and be equipped with two adjustable circuit closing alarm contacts suitable for use with an ungrounded 125 V dc circuit. One switch contact must be used for top oil over-temperature alarm set at 90 degrees Celsius.

2.11.4.2 Winding Temperature Equipment

a. General. Provide Two winding temperature indicators (WTI), with associated equipment, for use in remote indicating of the temperature

of each low-voltage winding (X and Y), and for use as an over-temperature trip backup to the future transformer temperature monitor for each transformer. The WTI equipment must be responsive to the current in the phase winding and to the top oil temperature, indicating the approximate hot-spot temperature of the winding, and provided with a means for calibration. Each WTI must include the following:

(1) A bourdon-tube sensing element located in the thermowell for operation of a dial indicator.

(2) A current transformer installed at each low-voltage winding which supplies current to a balancing autotransformer, proportional to the transformer load.

(3) A means for calibration connected each low-voltage winding current transformer and the thermowell heaters.

(4) Thermowell heating elements powered from the current balancing autotransformer, which simulates the winding temperature rise by adding the rise from the heating elements to the top oil temperature.

(5) An ungrounded three-wire 100-ohm platinum resistance temperature detector, which will be used with existing remote temperature recording or logging.

b. Dial Indicator and Switches. The WTI must have four electrically-independent, self-resetting contacts suitable for use on 125 V ungrounded dc circuits. Three switch contacts must be used as follows:

(1) One switch contact for cooling fan control. The setting of this contact is to be determined based on the results of the factory temperature rise tests.

(2) One switch contact for winding over-temperature alarm , set at 110 degrees Celsius.

(3) One switch contact for winding over-temperature trip set 117 degrees Celsius.

c. Leads. The leads from the WTI equipment must be routed through watertight and oiltight conduit fittings, and terminated in the transformer control cabinets. The connecting leads between the RTD elements and control cabinet terminal blocks must be soldered.

2.11.5 Rapid Pressure Rise Relay

Provide a rapid pressure rise relay and all connecting hardware required for each transformer. The rapid pressure rise relay must be designed for operation in oil space and have the following features:

a. Constructed of a die cast aluminum housing with ANSI 70 epoxy paint coating and an IP65 rating, designed for horizontal flange mounting.

b. Ambient operating range from -40 degrees Fahrenheit to 180 degrees Fahrenheit.

c. Rated pressure range of -14.7 to 20 pounds per square inch gauge.

d. A snap action, SPDT switch rated for 1/2 amp at 125V DC (resistive).

e. ANSI connector assembly with cable grip parts provided. Type SOOW, 16 gauge, 3 conductor cable to be provided and custom fit on-site at an estimated length of 40 feet (to be field verified by contractor).

2.11.6 Rapid Pressure Rise Seal-In Relay

Provide a rapid pressure rise seal-in relay rated for 125V DC operation to latch in the momentary switch actuation from the existing rapid pressure rise relay, to be installed in the transformer control cabinets, with the following features:

a. Designed specifically for use as a seal-in relay for the rapid pressure rise relay

b. LED Status indicating light and an LED Trip indicating light.

b. Two output relays with contacts rated for 8A at 250 Vac.

c. Reset button to unlatch the relays.

d. Redundant make/break circuit requirements that protect against false trips.

e. Surrounding air temperature range of -49 degrees Fahrenheit to 158 degrees Fahrenheit.

2.11.7 Pressure Relief Device

2.11.7.1 General

Provide each transformer tank with a self-resetting, mechanical-type high-flow pressure relief device mounted on the tank cover to automatically relieve internal pressure, and to protect the tank against rupture due to arcing below the surface of the oil. One pressure relief device must be provided for a volume of insulating oil contained within the main tank of less than 10,000 gallons, and two pressure relief devices must be provided for a volume of oil greater than 10,000 gallons. The relief device must be capable of withstanding full vacuum without rupture or loss of accuracy, constructed to minimize oil discharge during operation, and to exclude air and water after it opens. It must be equipped with a metal semaphore-type visual indicator and an alarm contact suitable for operation on a 125 V dc ungrounded circuit. The pressure relief device must have an oil-directed cover.

2.11.7.2 Oil Discharge Piping

Provide metal oil discharge piping for directing the oil discharged from the pressure relief device to the base of each transformer tank, of metal construction and sized to match the discharge outlet of the pressure relief device. The discharge piping must extend to approximately 24-inches above the base of the transformer, with mounting supports to the transformer tanks not spaced more than 36 inches apart, and the piping

outlet provided with a screen with a maximum hole size of 1/8-inch to discourage entry by animals, birds, and insects. The manufacturing details of the oil discharge piping must be included in the manufacturer's shop drawings.

2.11.8 Gas and Oil Actuated Relay (Buchholz)

If providing a conservator tank system of oil preservation, each transformer must be provided with a gas and oil actuated relay (Buchholz relay) located in the pipe connecting each transformer tank to the constant-pressure, reservoir tank. The relay must conform to the requirements in this paragraph. Pipe-work must be so arranged that all gas arising from the transformers must pass into the relay, and the size and arrangement of pipe-work must conform with the recommendations of the relay manufacturer. A flanged, flexible section of oil pipe must be provided between the Buchholz relay and the transformer tanks. The relay must have the following features:

a. The relay must be manufactured of a corrosion-resistant, oil-tight alloy casting, have flanged housing connections, and must have graduated inspection glass windows that enable the volume of gas and the contact system to be inspected.

b. Two floats (one for gas accumulation and one for low oil level) and one flap with counterbalance weight for the detection of oil speed.

c. A push-button for testing the relay electric circuits.

d. A pneumatic test device.

e. The relay must have independent alarm contacts wired back to the transformer control cabinets that close on collection of gas or at low oil level, and contacts that close following an oil surge. Mercury-based contacts will not be acceptable. The normally-open, electrically separate alarm and tripping contacts must not be exposed to oil, and must have a rated nominal current of 2A a.c./d.c. and a rated nominal voltage of 240V a.c./d.c.

f. Operation of the relay must be immune to seismic disturbances.

2.11.9 De-Energized Tap Changer Control

Provide each transformer with an external, manually operated tap changer for changing connections to the taps in the high-voltage windings when the transformers are de-energized. The tap changer control must have the following features:

a. Include an operating hand wheel, indicating pointer and dial, and means for locking the tap changer in any desired tap position.

b. The operating hand wheel must be mechanically interlocked with the tap mechanism to prevent its removal when the mechanism is not in a completed tap position.

c. Transmission of motion from the operating hand wheel shaft to taps by interaction of rigid members.

d. The tap changing mechanism must render it impossible to leave a winding open or short circuited when the operating wheel is placed in

a locked position.

2.11.10 Contacts and Devices

The contacts of all relays, gages, and thermometers must be insulated from ground and must be of a positive snap-action type. Alarm contacts must be suitable for operation on 125 V dc ungrounded circuits and rated 0.5 amperes (resistive) at 125 V dc.

2.12 INSULATING OIL

2.12.1 Quantity and Transformer Oil Certification

Provide all the oil required to fill the transformers to the proper operating levels at Little Goose as well as the oil required for factory tests. Submit for approval the transformer oil certification documents prior to prior to the factory tests and delivery of the transformer oil to the Little Goose Lock & Dam "Storage Yard", indicating that the oil furnished for placing the transformers in service will meet the requirements specified below.

2.12.2 Type of Oil

The grade of insulating oil furnished must be unused, produced from a naphthenic base crude petroleum specifically prepared and refined for use in electrical equipment as an insulating and cooling medium. Paraffinic and paraffinic-blends are not acceptable. Except for the oxidation inhibitor, the insulating oil must be free from additives of every kind, either natural or synthetic in any quantity, such as silicone or ester oil contamination from hoses or processing equipment.

2.12.3 Chemical, Physical and Electrical Characteristics

The insulating oil provided must have all tests performed per the requirements of ASTM D3487, Table 1, Type II, with an oxidation inhibitor content of between 0.25 and 0.30 percent by mass, prior to shipment.

2.12.4 Sampling

Samples for testing must be obtained as specified in ASTM D923.

2.12.5 Testing

Chemical, physical, and electrical tests must be conducted by the Contractor in accordance with the test methods listed in ASTM D3487, Table 1. A PDF copy of the test reports must be submitted for approval prior to shipment of the oil.

2.13 OIL PRESERVATION SYSTEM

2.13.1 General

Provide transformers with either an inert-gas pressure system or a constant oil pressure system. Any oil preservation system provided must meeting the dimensional requirements shown in the Contract drawings.

2.13.2 Inert-Gas Pressure System

2.13.2.1 General

An inert-gas pressure system is the preferred oil preservation system. If the transformers are provided with an inert-gas pressure system, the system must conform to all the requirements listed in section "Inert-Gas Pressure System." The system must consist of a nitrogen cylinder regulator enclosure that holds two cylinders, one of which is connected to the single regulator and supplies the blanket space and all associated stainless-steel piping and two 1/2-inch stainless-steel ball valves located at the top of the tank for connection of the nitrogen piping. The nitrogen gas must be supplied from the high-pressure cylinders through a pressure regulator, conforming to the requirements of IEEE C57.12.00 paragraph 6.6.3. Two cylinders of nitrogen gas must be furnished with the transformer for use with the regulating equipment and must remain the property of the Government.

2.13.2.2 Additional Gas Space

Use the vacuum bracing, and, if required, an additional external gas expansion tank to implement the inert-gas pressure system.

2.13.2.3 Pressure Regulating Equipment

The pressure regulator must be of a make and type which has been in successful operation with transformers for a period of not less than five years. All fittings and tubing for nitrogen connections between the pressure regulating equipment and transformer tanks must be furnished with the transformer, and must be stainless steel flex tubing manufactured at the correct length for the routing and application with integral screw-on fittings, and matching terminations. The tubing must be anchored to the transformer tanks along its length a maximum of every 36-inches. The pressure regulating equipment must maintain the transformers' nitrogen pressure as follows:

a. Low pressure regulator: 0.5 psi

b. High pressure regulator: 5.0 psi

c. Pressure relief valve: 6.5 psi

2.13.2.4 Alarm functions

Alarm contacts suitable for use on a 125 V dc ungrounded circuit, wired back to the control cabinet to indicate the following:

a. Empty cylinder alarm: 200 psi

b. Low pressure alarm: 0.25 psi

c. High pressure alarm: 8.5 psi

2.13.2.5 Enclosure

A NEMA 3R rated steel enclosure mounted as low as possible on the transformer tanks containing the gas cylinders and pressure regulating equipment, meeting the requirements of NEMA 250 with the following features:

a. A gasketed window permitting viewing of the gauges without opening the door.

b. A removable stainless steel floor with a 'lipless' threshold.

c. A means for locking of the door.

d. A door activated light.

e. A thermostatically controlled heater.

f. A GFCI outlet.

g. The enclosure must be grounded to the transformer tanks by means of a bonding jumper.

2.13.3 Air Cell, Constant-Pressure, Reservoir Tank System

2.13.3.1 General

If the transformers are provided with a conservator tank system of oil preservation, the system must conform to all the requirements listed in section "Air Cell, Constant-Pressure, Reservoir Tank System." The system must consist of one oil reservoir mounted on the transformer tanks, with the location and height coordinated with the high-voltage bushing turrets. The dimensions of the transformers must fit within the dimensional requirements shown in the Contract drawings. The tank must also meet all electrical clearances as required in IEEE 1427 from the high voltage equipment when installed in place. The reservoir tank must be designed for full vacuum during vacuum treatment and oil-filling, with valves provided for equalizing the pressure to the air bladder during these processes. The reservoir must be provided with a sump chamber to collect any impurities, and a minimum of two locations within the tank for suspending the air bladder, other than the flanged air vent connection. The reservoir liquid level indicator must be arranged to close the set of low-level alarm contacts when the oil level becomes too low or the air bladder sinks.

2.13.3.2 Air Bladder

The oil reservoir must contain an air bladder arranged to prevent direct contact between the oil and air. The air bladder material must be nylon-impregnated nitrile rubber designed for long life and for service in contact with hot oil, and must include a minimum of two integral straps used for suspending the air bladder from the inside top of the reservoir tank. The air bladder must be vented through a weather-tight maintenance-free electronic dehydrating breather provided with a suitable desiccant. Dimensions and drawings of the air bladder must be included in the descriptive data.

2.13.3.3 Dehydrating Breather

Provide one maintenance-free dehydrating breather for each conservator tank, utilized for removing atmospheric moisture from the air drawn into the reservoir tank air bladder, must be located on the transformer tanks at a height of approximately 48 inches above the base of the transformers. The hygroscopicity must be based upon a silica gel and sensor-controlled heated high-grade steel filter. During normal

operation, the silica gel dries the air entering the piping to the reservoir tank. When the relative humidity exceeds a selected value, the self-regulating heating element inside the dehydrating breather is activated, and extracts moisture from the silica gel, which condenses and drips out of the filter system. The vent piping connecting the oil reservoir air bladder to the maintenance free dehydrating breather must be metal, of 1-1/2-inch minimum diameter, and galvanized inside and out to help reduce corrosion. Provide a maintenance free dehydrating breather with the following characteristics:

a. Visual sight inspection glass.

b. Sealed control housing suitable for outdoor operation.

c. Designed for ambient temperature operation between -40 and 80 degrees C.

d. Status indicators for Power On, Heater On, and Device Malfunction, with one normally closed contact for Device Malfunction annunciation.

e. Supply voltage of 120 V AC - 240 V AC, 60 Hz

f. Filter heating system

g. Test button

h. Analog output: 4-20 mA

2.14 TRANSFORMER CONTROL AND POWER CABINETS

2.14.1 General

Provide the transformers with control and power cabinets, mounted on the transformer Segment 3 tank sidewall, as indicated. The fabrication of each cabinet must conform to the requirements of UL 508, UL 508A, and NEMA 250. The cabinets must be manufactured such that all 480 V ac wiring and equipment reside only in the power cabinet, and the control cabinet only includes wiring and equipment at maximum operating voltages of 125 V dc or 120 V ac. The cabinets must have the following features:

a. Environmental enclosure rating of NEMA Type 4.

b. Fabricated out of type 304 stainless steel that will remain unpainted on the exterior.

c. No. 12 Manufacturer's Standard Gage minimum thickness.

d. Rainproof enclosure vents of NEMA Type 3R construction, installed on the control cabinet enclosure back panel.

e. Bundled wire runs within the cabinet, routed through low-smoke, halogen-free wiring duct with slotted walls and interior corner guards to protect the wiring.

f. "Piano-hinges" will not be acceptable for cabinet doors.

g. Cabinet interiors powder-coated white.

h. Solar shielding provided on the top, front and side panels of the

enclosures, with cut-outs as required for the enclosure door viewing windows.

i. Door handles provided with provisions for locking, with all doors keyed the same.

j. Ground bonding jumper from each cabinet to the main transformer tanks.

2.14.2 Cabinet Mounting and Conduit Interface Provisions

The control and power cabinets must be configured as indicated on the contract drawings. A structural steel framework must be provided for mounting of the control and power cabinet assemblies to the transformer tanks' cabinet mounting frame rails, utilizing vibration isolation mounts. The vibration isolation mounts must be natural rubber with integral mounting stud provisions, sized for the maximum anticipated load of the cabinet assembly, and be a standard commercially available product for the purpose. Removable, gasketed plates must be provided in the bottom of the control and power cabinets, to which the external conduit connections to the Project will be installed. All wire and cable entering the control and power cabinets must be through conduit, and all conduit connections to the cabinets made through the base bottom plate of the cabinets.

2.14.3 Control Cabinet Requirements

Provide control cabinets with device layouts must be as indicated on contract drawings, and have the following features:

a. Devices mounted on the back of hinged panel doors that are not visible from the panel door fronts mounted such that device mounting screws do not penetrate the panel doors.

b. Provide windows in the control cabinet doors made of tempered glass, utilizing Claytonrite style rubber seals installed with silicone sealant so as to provide a waterproof installation.

c. Provide a 2-inch diameter wiring access hole between the power and control cabinets near the base of the cabinets, with protective bushings, for the routing of 120 V ac power from the control cabinet to the power cabinet for heaters and lights, and the permissive wiring to fan contactors.

d. Provide terminal blocks and wiring layouts such that all wiring for interconnection to the Project are located in the same vicinity near the base of the cabinet.

e. Provide two internal swing-panels for future installation of the transformers temperature monitor controls and annunciators.

f. Provide a 90-degree hinged, fold-down computer tray on the inside of the control cabinet door, with a means of securing the tray in the upright position.

2.14.4 Power Cabinet Requirements

Provide all 480 V ac protective and control equipment for the cooling fans, including the molded-case circuit breakers, contactors, and power

terminal blocks in each transformer's power cabinet, as indicated, conforming to the applicable requirements of NEMA ICS 2. The 480 V ac Government power supply will route through conduit connected directly from the Project to the base of the power cabinet, as indicated on contract drawings.

2.14.5 Device Nameplates

Provide an engraved nameplate for each item mounted in the transformer control and power cabinets that are comprised of anodized aluminum or stainless steel, engraved and provided with black lettering. Each nameplate must be fastened to the panels in proper locations, with either corrosion-resistant black finished round head screws, or on screw posts with corrosion-resistant black finished nuts. Nameplates must not be fastened to the wire ducts or duct covers. Labeling and marking must meet the requirements of UL 969, paragraph 7.3, "Marking and labeling systems for hazardous locations products".

2.15 CONTROL AND POWER CABINET EQUIPMENT

2.15.1 Cooling Control Equipment

2.15.1.1 General

The control equipment must be fully automatic, and manufactured to start and stop the fan motors as each transformer's winding temperature requires. The controls must de-energize all fans in the event of a transformer shutdown operation, as indicated. Provide additional circuit breakers for branch circuit protection of cooling circuits as required. All cooling control equipment must meet the applicable requirements of the NFPA 70.

2.15.1.2 Stages of Cooling

The cooling control circuits must provide for the following:

a. Provide transformers that are-self cooled through natural convection of the oil with no cooling fans in operation, capable of operation at the 100% base nameplate rating (ONAN) without exceeding the maximum allowable temperature rise.

b. Provide a winding temperature indicator fan contacts to activate the forced-air cooling group when the transformers are operating at a winding temperature corresponding to a load equal to the 100% self-cooled (ONAN) rated condition, as obtained during performance of the factory temperature rise testing.

c. When the maximum safe winding temperature for continuous operation has been reached, the winding temperature indicator alarm contact must provide an alarm for "Winding High Temperature" indication. This winding temperature setting must be at 110 degrees-C.

d. When the maximum allowable winding temperature has been reached, the analog winding temperature indicator must initiate a transformer shutdown utilizing the lockout relay in the powerhouse and set at a temperature of 117 degrees-C.

2.15.2 Transformer Fiber Optic Probes and Connectors

Fiber optic probes must be installed in each transformer's windings and terminated at the fiber-optic feed-through plate interface on the tank for future use with a temperature monitor. The fiber-optic probes must be made of non-conducting materials allowing for them to be immersed in oil and held in close contact to transformer windings for direct accurate measurement of temperature. The probes, connectors and their installation must meet the following requirements:

a. The probes must function based on the principles of Gallium Arsenide (GaAs), be capable of measuring transformer temperatures from -40 degrees Celsius to 200 degrees Celsius.

b. The fiber-optic jacket must feature a continuous slit to allow for complete oil immersion.

c. Utilize Fiber-optic feed-thru connectors at a tank wall plate, for connection of the internal fiber-optic probes to the fiber-optic extension cabling.

d. Feed-through connectors with internal sealing using glass metal soldering.

e. Stainless steel tank wall plate interface for the feed-thru connectors, including a removable, weatherproof cover.

f. Provide 2-inch conduit from the feed-through wall plate interface down to the control cabinets for routing of fiber-optic extension cables.

g. Provide the necessary extension cables from the wall plate to the control cabinets.

2.15.3 Auxiliary Power Transformer

The auxiliary power transformer must be 480 V AC primary - 120 V AC secondary, single-phase, conforming to the requirements for general purpose transformers in UL 508, and must be mounted on the transformer tanks adjacent to the power cabinet, as indicated. The auxiliary transformer will be used to power all AC circuits rated below 480 VAC as indicated. The Volt-Ampere capacity must be coordinated with the connected control circuits, and indicated on the shop drawings. The auxiliary power transformer must have the following characteristics:

a. Isolating transformer design, with an electrostatic shield

b. Housed in a NEMA Type 3R rated enclosure

c. Manufactured with all copper windings with a 200 degrees-C rated insulation system

d. Finger-safe terminals

2.15.4 Magnetic Contactors

The rating, performance and service characteristics must conform to the requirements of NEMA ICS 2 for contactors with continuous current ratings for the duty indicated. Contactors for motor control must be rated for

full-voltage starting (Class A controllers). Provide NEMA Size 2 contactors as a minimum, and must be rated for at least 200,000 complete operations under rated load without more than routine maintenance. The interruption arc and flame must be minimized by suitable arc chutes or other means so that no damage will be done to other portions of the device. The arc chutes, if provided, must be easily removable without removing or dismantling other parts. The contacts must be easily removable. All current-carrying contact surfaces must be silver-surfaced or of other approved material to prevent the formation of high resistance oxides. The contactor must operate without chatter or perceptible hum while energized. Coils must be rated for continuous operation for 120 V ac circuits. Alternating-current contactors must be three-pole, except where otherwise noted, and must be insulated for 600 V ac and of the electrically-operated, magnetically-held type.

2.15.5 Molded-Case Circuit Breakers

2.15.5.1 General

Provide Molded case circuit breakers that are listed to UL 489, and have voltage ratings and interrupting ratings hereinafter stated. They must be the manually-operated, quick-make, quick-break, automatic-trip, bolt-in, heavy-duty, industrial type. All poles of each breaker must be operated simultaneously by means of a common handle, and must be enclosed in a common molded plastic case. Single pole trip units with handle ties are not permitted. The operating handles must clearly indicate whether the breakers are in "On," "Off," or "Tripped" position. Miniature circuit breakers, circuit breakers listed for residential and commercial use, and plug-in type breakers are not acceptable.

2.15.5.2 Trip Units

The circuit breakers must be of the automatic type provided with combination thermal and instantaneous magnetic or solid state trip units, with instantaneous trip units set at approximately 10 times the continuous ratings of the circuit breakers. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval.

2.15.5.3 480 V ac Circuits

Circuit breakers for 480 V ac circuits must be rated 600 V ac, must have a minimum interrupting capacity of 18,000 Amperes at 480 V ac, and must come equipped with an integrated trip-handle padlocking provision.

2.15.5.4 120 V ac Circuits

Circuit breakers for 120 V ac circuits, must be rated not less than 250 V dc, and either 120/240 or 240 V ac, with a minimum NEMA interrupting capacity of 10,000 Amperes symmetrical.

2.15.5.5 125 V dc Circuits

Circuit breakers for 125 V dc circuits must be of the heavy duty type conforming to the applicable requirements of UL 489, rated for not less than 125/250 or 250 V dc operation with a minimum NEMA interrupting capacity of 10,000 A dc.

2.15.6 Control and Instrument Switches

Control and instrument switches must be of the rotary switchboard type with handles on the front and the operating mechanisms on the rear of the panels, and have the following features:

a. Suitable for operation on 600 V ac or 250 V dc circuits, capable of satisfactorily withstanding a life test of at least 10,000 operations at rated current, and capable of continuously carrying 20 Amperes without exceeding a temperature rise of more than 30 degrees Celsius above ambient.

b. Provided with ample contact stages to perform the functions of the control system.

c. Self-aligning contacts which operate with a wiping action.

d. A positive means of maintaining high-pressure on closed contacts.

e. Compression springs or pivoted joints must not be depended upon to carry current.

f. The covers or plates on the switches must be readily removable for inspection of contacts.

g. A single-breaking inductive load minimum interrupting rating of 1.5 Amperes for 125 V dc, or 10 Amperes for 120 V ac.

h. An escutcheon clearly marked to show each operating position, with the switch identifications engraved on the escutcheon plate and on a separate nameplate.

2.15.7 Terminal Blocks

Provide terminal blocks for control signal and current transformer secondaries with the following features:

a. Washer-head screw type, designed for connection of two No. 10 AWG conductors to each terminal.

b. Rated, at minimum, for 90 degree C terminations.

c. White or other light colored marking strips for circuit designation, with each connected terminal of each block having the circuit designation or wire number indicated on the marking strip with permanent marking fluid. One reversible or spare marking strip must be furnished with each terminal block.

d. Terminal blocks provided to terminate all external cables, containing at least two spare terminals, or 10 percent of total terminals as spares, whichever is greater, per terminal block.

2.15.7.1 Control Signal Type

Provide terminal blocks for control wiring, with a sliding link disconnect molded or fabricated type with barriers, rated not less than 600 volts with 30 Ampere capacity.

2.15.7.2 Short-Circuiting Type

Provide dedicated short-circuiting type terminal blocks for each current transformer's secondary leads, which will allow for shorting together the secondary leads of the current transformers without opening any circuit.

2.15.7.3 Power Distribution Blocks

Provide power distribution blocks to be used for branch circuits and feeders 600 volts and less with wire size #12 AWG and larger. Power distribution blocks must have lugs suitable for copper conductors, must be two-pole for single-phase circuits (phase and neutral conductors, or two phase conductors), and three-pole for three-phase circuits (three phase conductors).

2.15.8 Fuses and Fuseholders

Provide Class J fuses meeting the requirements of UL 248-8, rated for 600 V AC operation, and be dual-element with a 10 second time-delay at 500 percent overload. Provide Class J fuseholders, meeting the requirements of UL 4248-8, and be of a finger-safe modular type, consisting of a removable fuse carrier which allows fuse replacement away from the base.

2.15.9 Lighting, Convenience Receptacle, and Cabinet Heaters

Provide cabinet lighting, convenience receptacle and heaters that have the following features:

a. Lighting consisting of 120 V ac Size A19 LED bulbs with a medium E26 base, each with integral heat sink and 800 Lumens minimum output, complete with industrial grade socket with bulb safety cage, wiring, and door-activated switches.

b. Provide a 125 V ac, 3-wire, 20 Ampere, hospital grade GFCI type receptacle, inside the control cabinet.

c. Provide industrial grade enclosure heaters in each cabinet to prevent condensation when the outside temperature is as low as -25 degrees Celsius, while maintaining a minimum interior cabinet temperature of 10 degrees Celsius. The enclosure heaters must be mounted on the cabinet side panels towards the bottom, and be of a touch-safe, positive temperature coefficient (PTC) resistor type with an integral fan. The heaters must have a rated operating voltage of 120 V ac, and be thermally sized for the cabinet volume in which they are installed. Submit for approval the Cabinet heater sizing calculations, with considerations given to cabinet sizing and material. Provide a separate humidity and temperature control device which controls the cabinet heaters and independently monitors the relative humidity and enclosure temperature, having the following characteristics:

1) Temperature setting range: 0C - 60C
2) Relative humidity setting range: 50% - 90%
3) Operating voltage: 100 VAC - 240 VAC
4) Switching relay output (minimum): 10A resistive, 1.6A inductive @ 240 VAC
5) Inrush current (minimum): 30A for 10 sec
6) Heaters set at 20 C
7) Humidistat set to 20% relative humidity

2.16 INSULATED WIRE AND CABLE

Provide all insulated wire and cable that conforms to the requirements of Section 26 05 19.00 26 INSULATED WIRE AND CABLE.

2.17 CONDUIT SYSTEMS

2.17.1 General

Run all wiring from the transformer devices and accessories listed below in rigid galvanized steel conduit greater than 1-inch in diameter, installed plumb and level, and terminated at devices, connection boxes and at the control cabinet using fittings suitable for wet locations. Conduit runs used on the transformer tanks' cover must be installed so as to help maintain an obstruction-free walking surface. The conduit systems must be electrically continuous and all threaded joints must have the threads coated with an approved high temperature lithium based, anti-galling conductive joint compound, rated for -70 degrees-C 1800 degrees-C, such as Crouse-Hinds Type HTL high temperature thread lubricant. The use of PTFE (polytetrafluoroethylene) tape at conduit threaded joint connections will not be allowed. Conduit threads must be tapered, and no running threads will be allowed. Conduit runs must be deburred and cleaned of shavings and debris prior to the routing of wire and cable.

2.17.2 Corrosion Protection

Provide conduit, conduit fittings, conduit bodies, and conduit outlet boxes made of ferrous metal materials that is hot-dip galvanized in accordance with ASTM A123/A123M and ASTM A153/A153M.

2.17.3 Conduit and Fittings

a. Rigid Metal Conduit. Provide rigid metal conduit that is zinc-coated both inside and outside by the hot-dip galvanizing method, conforming to the requirements of ANSI C80.1.

b. Rigid Metal Conduit Fittings. Provide threaded fittings for rigid conduit that is made of solid zinc or malleable iron conforming to the requirements of UL 514B and/or NEMA FB 1. Malleable iron fittings must be zinc-coated both inside and outside by hot-dip galvanizing method, with hubs having a grounding screw on the locknut.

c. Liquid-Tight Flexible Metal Conduit. Provide liquid-tight flexible metal conduit that is made from steel strip that is zinc-coated by the hot-dip galvanizing method with a water-proof extruded PVC cover conforming to the requirements of UL 360. The liquid-tight flexible metal conduit must have either have an integral bond wire or be an interlocked design with no bonding wire. Lengths of liquid-tight flexible metal conduit connections to equipment must not exceed 36-inches, and must be securely fastened to the transformer tanks.

d. Liquid-Tight Flexible Metal Conduit Fittings. Provide fittings for liquid-tight flexible metal conduit that is made from steel or malleable iron with a zinc coating and positive bonding, conforming to the requirements of UL 514B.

2.17.4 Conduit Bodies

provide conduit bodies and covers that meet the following requirements:

a. Be made from malleable cast iron, be corrosion resistant and UL listed.

b. For the purposes of mechanical and environmental integrity, all conduit bodies must be raintight and suitable for use in hazardous locations, conforming to UL 1203 installed in outdoor locations subject to adverse environmental conditions.

c. Conduit body covers must attach to the conduit bodies by screw connections and neoprene gaskets.

d. Provide conduit bodies for use in locations to provide for change in conduit direction, access to conductors, and as pull boxes.

2.17.5 Conduit Outlet Boxes

Provide conduit outlet boxes and covers that meet the following requirements:

a. Be made from malleable cast iron, be corrosion resistant and UL listed.

b. For the purposes of mechanical and environmental integrity, all conduit outlet boxes must be raintight and suitable for use in hazardous locations, conforming to UL 1203 installed in outdoor locations subject to adverse environmental conditions.

c. Provide conduit outlet boxes and covers made from malleable cast iron with externally threaded body and internally threaded cover. All conduit entrances must be bossed, drilled, and tapped with tapered NPT threads. Conduit entrances must be located on the bottom or sides of the box to the greatest extent possible to prevent the ingress of water. If required, outlet and junction boxes must be equipped with external mounting lugs.

2.18 SPARE PARTS

Provide all spare parts that are duplicates of the original parts furnished and interchangeable therewith. Furnish the following spare parts, and submit for approval a spare parts list, indicating the quantity furnished, manufacturer, catalog or model number, and the retail cost of each item in US Dollars.

a. One complete set of all gaskets needed to seal all openings into the transformer tanks at the cover, manholes, handholes, openings for accessory devices, openings for each type bushing, and pipe connections for radiators.

b. One complete set of all gaskets required to replace the shipping gaskets, for use during final assembly of the transformer.

c. One complete relay and contactor of each type and rating

d. One pressure relief device (Qty. 1)

e. One liquid level indicator (Qty. 1)

f. One winding temperature indicator (Qty. 1)

g. One oil temperature indicator (Qty. 1)

h. One bushing current transformer, of each type and rating

i. One rapid pressure rise relay and seal in relay (Qty 1)

j. Two fans, complete with motors, cables and connections (Qty. 2)

k. One crated radiator complete with inlet and outlet isolating valves, vent and drain valves, and blank flanges (Qty. 1)

l. Three fiber-optic extension cables that connect from the feed-through wall plate to the control cabinet (Qty. 3)

m. One fuse of each type and rating

n. One pressure regulator for nitrogen-gas equipment (Qty. 1) (if supplying nitrogen blanket type oil preservation system)

o. One Buchholz Relay (Qty.1) (if supplying a COPS type oil Preservation system)

p. One spare valve of each type and size

2.19 NAMEPLATES

Transformer nameplates must be Type 316 stainless steel, with the information chemically etched then filled with baked enamel paint.

2.19.1 Transformer Nameplate

Each transformer nameplate must conform to the requirements of IEEE C57.12.00, Table 6, and also include the following information:

a. Government contract number

b. Transformer X/R ratio

c. Estimated weight of the insulation system

d. The nameplate or an adjacent nameplate must also include the following information for each current transformer furnished: the accuracy class, the primary and all secondary ampere ratings, the thermal rating, and identification of the terminals to which the current rating applies.

2.19.2 Lifting Nameplate

Provide a lifting diagram nameplate mounted on each transformer, adjacent to the transformer nameplate showing the following:

a. Various sling and lift positions required for proper lifting of the core and coil assembly.

b. Lifting or jacking the completely assembled transformer.

c. The overall height required for untanking.

d. Indication that the transformers can be lifted or jacked when filled with oil.

2.19.3 Device Nameplates

Provide nameplates for the following devices that are mounted on each transformer. The nameplate must be permanently affixed onto a bracket adjacent to the device.

a. High-voltage bushings (H1, H0)

b. Low-voltage bushings (X & Y)

c. Core ground bushings

d. Center of gravity markers

e. Winding temperature indicator

f. Oil temperature indicator

g. Thermowells

h. Valves

2.19.4 Additional Transformer Identification

Provide the following additional transformer identification for each transformer:

a. The transformer serial number welded onto the tank, or on the face of the jacking pad nearest the main drain valve, with letters approximately 1-inch in size.

b. The location of the centers of gravity (c.g.) of the completely assembled transformer filled with oil, and for the shipping configuration without oil, permanently marked with weld-on nameplates or tags on two adjacent sides of the transformer tank and identified "c.g. complete" and "c.g. for shipment".

c. Stamping of the serial number on the core frame structure or into the tank immediately adjacent to the transformer nameplate.

d. If the oil level gauge is mounted on the tank sidewall, the 25 degree-C operational oil level must be indicated by either a raised surface weld bead with contrasting paint color, or with an etched nameplate permanently affixed to the tank wall.

PART 3 EXECUTION

3.1 TRANSFORMER DESIGN DATA REVIEW MEETING

3.1.1 General

Conduct a transformer design data review meeting at the transformer manufacturing facility, with representatives of the Contractor,

transformer manufacturer, and the Government representative in attendance, not later than 120 days after contract award. Provide the notification of the date of the transformer design data review meeting, the location, the duration, and the proposed agenda. Notification must be no less than 30 days in advance for domestic travel in the US and 60 days in advance for travel outside the continental US. The intent of the design data review meeting is to:

a. Meet with the manufacturing personnel and tour the manufacturing facility.

b. Discuss the technical specifications which address transformer manufacturing, testing, and shipment.

c. Perform a design data review with transformer manufacturing engineers and key personnel.

3.1.2 Design Data Review Meeting Requirements

The purpose of the design data review portion of the meeting is to help assure prior to official submittals that the key elements of the transformer specification requirements are being met, and to describe the transformer manufacturing and design data features. In preparation for the design data review meeting, the transformer manufacturer must have prepared a transformer design data review report in PDF format for the transformer design, which includes the following elements as a minimum:

a. Transformer nameplate data and ratings

b. Preliminary transformer layout drawing

c. Winding connection diagram

d. Winding design information, including:

(1) Proposed winding material supplier.
(2) Winding manufacturing details, including the turn design, dimensions and weight.
(3) Block diagram of the winding arrangement.
(4) Conductor type
(5) Insulation type
(6) Tabular listing of the calculated and maximum allowable voltage stresses within the windings for chopped-wave and full-wave conditions, including the factory design factor of safety margins.
(7) Block diagram of the windings indicating the various voltage stresses.
(8) Calculated resistance (@ 85 degrees-C reference)
(9) Drying and clamping methods.
(10) Design features added to assure reliable operation in back feed mode.

e. Thermal calculations and distribution throughout the windings, including proposed locations for the fiber-optic temperature probes.

f. Core design information, including:

(1) Proposed core lamination steel supplier
(2) Core manufacturing details, including the number of limbs,

dimensions and weights
(3) Core material type
(4) Joint construction
(5) Banding
(6) Acceptable gap/burrs
(7) Cooling ducts
(8) Rated flux density
(9) Calculated exciting current

g. Calculated short-circuit currents and forces

h. Loss calculations

i. Impedance calculations

j. Accessories, including:

(1) Bushings
(2) Cooling equipment
(3) De-energized tap changer

3.2 TRANSFORMER DRAWINGS

3.2.1 Outline and Assembly Drawings

Submit for approval the transformer outline and assembly drawings to demonstrate that the equipment will conform to the requirements and intent of the specifications, to include the following at a minimum:

a. Transformer nameplate information, for both the main and lifting nameplates as required in paragraph "NAMEPLATES".

b. Outline drawings, indicating the following:

(1) Layout and dimensions of the assembled transformer, including an elevation view for each side of the transformer, a plan view, and details of the tank structural base with the centers of gravity indicated with the transformer empty and filled with oil.

(2) Jacking, lifting and pulling-eye locations.

(3) Locations of all ancillary equipment, dimensioned to the transformer centerlines or edges, as appropriate, including bushings, control and power cabinets, valves, gauges, relays, nitrogen regulator cabinet or conservator tank, radiators and fans, and grounding pads.

(4) Drawing legend and transformer weight information.

(5) A transformer elevation view indicating clearances required for untanking or disassembling.

(6) Information for the transformer oil levels, including: the minimum oil level in the tank without exposing the core and coil assembly, and the corresponding volume of oil to remove at 25 degrees Celsius; the maximum oil level in the tank to allow access to any bottom connected bushings utilizing handhole access covers, and the corresponding volume of oil to remove at 25 degrees Celsius.

c. Transformer winding layout and configuration diagram, consisting of a physical representation of the active assembly installed in the transformer tank, including a sectional elevation view of sufficient detail to identify the following basic features of the core/coil fabrication:

(1) Core legs
(2) High-voltage winding
(3) Low-voltage winding
(4) Winding taps
(5) De-energized tap changer and lead support structure
(6) Bushing configuration and connections
(7) Shielding (if present)
(8) Pressboard
(9) Tank wall surface

d. Control and power cabinets layout, including internal device layouts and component lists.

e. Electrical schematic diagrams which reference the associated detailed wiring connection diagrams, including:

(1) Cooling power schematic diagrams
(2) 120 V ac and 125 V dc control schematic diagrams
(3) Annunciation schematic diagrams
(4) Transformer accessories block schematic diagrams

f. General electrical drawings including:

(1) Wiring and ferruling methods
(2) Wire types, sizes and color coding
(3) Graphic symbols
(4) Device nameplates and marking methods

3.2.2 Detail Drawings

Submit for approval the transformer detail drawings, to include the following at a minimum:

a. Further refinement of the outline and assembly drawings, including the routing of conduit, piping, and locations of junction boxes and external devices.

b. Shipping drawing showing the outline of the transformers disassembled as required for shipment, including the following:

(1) Overall shipping dimensions, including indication of centers of gravity for the transformer in the shipping configuration. All devices remaining installed on the transformer during shipment must be indicated.

(2) Lifting details and overall height required for the slings and crane hook, including recommended sling length and ratings.

(3) Location of temporary covers for bushings, valves and control and power cabinets left installed during shipment.

(4) Method and locations for securing the transformer during

shipment.

(5) Detail indicating the method of installing the SFRA test shipping bushings, their locations, and a description of the method of bracing the winding leads to these bushings during shipment.

(6) Location of impact recorders, shipping gas pressure gauge and pressure regulator system.

(7) A note indicating the requirement for shrink-wrapping of the transformer for shipment, and the type of material used.

c. Wiring connection diagrams showing terminal block and conductor designations, including detailed control and power cabinet interconnections and device locations, based upon the actual equipment arrangement.

d. Seismic anchoring location details.

e. A transformer outline drawing indicating the locations of all gaskets on the transformer, a schedule of each gasket type and size cross-referenced to the location on the outline drawing, and a detail for each design of gasket showing the gasket dimensions, groove dimensions and compression requirements.

f. A transformer outline drawing indicating the locations of typical welds, with structural weldment details for each type of weld.

3.3 TRANSFORMER FACTORY ASSEMBLY

3.3.1 General

Each transformer must be completely assembled and adjusted at the factory, and be subjected to the manufacturer's routine shop tests and other tests as specified below. All parts and accessories must be properly match-marked and identified for ease of re-assembly after delivery to Little Goose Lock & Dam "Storage Yard". After the transformers has been completely assembled and oil-filled, the overall weight of the transformers must be measured using a load cell when lifted with a crane or moved with an air pallet, and the measured weight included in the factory test report, the as-built drawings, and on the final nameplate information.

3.3.2 Welding

3.3.2.1 General

Welding will not be accepted if the welding does not conform to the requirements of this specification, unless otherwise approved by the Government. Develop procedures for the welding all metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified and approved. Weld symbols must be in accordance with AWS A2.4. In all instances requiring adherence with AWS specifications, equivalent country of origin standards will also be accepted. If using equivalent country standard, welding submittals must provide table showing equivalency with AWS standards.

3.3.2.2 Welding Quality Control Plan

Before the start of tank manufacturing, submit for approval a welding quality control plan which describes the methods, equipment, and procedures utilized to ensure quality control including but not limited to material tracking, weld tracking, NDT equipment calibration, non-conformance reports, weld repair, and inspection witness points. Indicate any manufacturer specific requirements used to verify the tank is oil-tight in addition to those required herein.

3.3.2.3 Welder Qualifications

Welding operators and welders must be qualified and, as necessary, requalified for the particular type of weld to be performed. Qualification must be in accordance with AWS D1.1/D1.1M. The welder record of qualification must be submitted and approved. The Contractor must certify by name, the welders and welding operators so qualified including the date of qualification, code, and procedures under which qualified. Certification and testing of welders and operators must be performed by an independent testing company. Prior qualification may be accepted provided the welder has performed satisfactory work within the preceding three months under the code for which qualified, documentation of continuous welding in process and certification of prior qualification from an independent testing company is furnished. If at any time, the work of an operator appears questionable, such operator will be required to pass additional qualification tests to determine their ability to perform the type of welding on which they are engaged. All such additional qualification tests for welding operators and the physical tests of the welded specimens must be witnessed by the Government, unless waived in writing.

3.3.2.4 Welding Materials

Welding materials must comply with AWS specifications. Welding equipment, electrodes, welding wire, and fluxes must be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

3.3.2.5 Welding Procedures

Submit for approval a complete schedule of welding procedures including certified copies of reports of test results, consisting of detailed procedure specifications for each structure to be welded, and tables or diagrams showing the procedure to be used for each required joint. Do not perform welding without an approved procedure. Applicable prequalified weld procedures in AWS D1.1/D1.1M may be submitted for approval. Weld procedures not meeting the requirements of prequalified weld procedures in AWS D1.1/D1.1M may be submitted and qualified through testing under AWS D1.1/D1.1M or ASME BPVC SEC IX. All welds must be made using low-hydrogen welding rods or electrodes/electrode-flux combinations capable of depositing weld metal with a maximum diffusible hydrogen content of 8 mL/100g (H8). If the use of other filler metals is preferred, submit for approval a written justification of why an alternative is preferred and indicate where these welds will be utilized. Perform all welding using the electric-arc method, by a process which will exclude the atmosphere from the molten metal. Submit for approval the product data on welding electrodes and rods and shielding gas. All welded joints must conform to AWS publications, or as otherwise specified or approved, and the qualification plates representing those joints must be tested in

accordance with AWS D1.1/D1.1M or AWS D1.6/D1.6M. All oil piping welds must meet the requirements of ASME B31.1.

3.3.2.6 Preheat and Interpass Temperature

Preheating must be performed as required by Section 3 of AWS D1.1/D1.1M, or as otherwise specified except that the temperature of the base metal must be at least 70 degrees Fahrenheit.

3.3.2.7 Weld Inspections, Tests and Weld Inspector Qualifications

a. All welds must be visually inspected to ensure conformance to the requirements of this specification, the appropriate section of AWS D1.1/D1.1M, and the approved welding procedure. Submit for approval the weld inspector qualifications, meeting the requirements of AWS D1.1/D1.1M and ANSI/ASNT CP-189, for the personnel responsible for inspections. Inspections must be performed visually, and during the transformer leak tests per the requirements of paragraph "Pressure Test". If the weldment is determined to be the cause of failure to pass the pressure test, the Government reserves the right to either a Non-Destructive Examination or Destructive Examination of any welds with the cost borne by the Contractor.

b. The following tests must be performed on all welds, and the results included in a Weld Inspection and Test Report:

(1) Dye penetrant test performed on all welds.

(2) Magnetic particle test performed on all lifting lug welds.

(3) Ultrasonic test performed on 25-percent of all full penetration welds.

3.3.3 Manufacturing Inspection by Government Personnel

Manufacturing inspections of each transformer may be performed by a representative of the Contracting Officer, at the option of the Government. These inspections would be performed at, but not necessarily limited to, the following manufacturing hold points:

a. Manufacturing facility inspection during the Design Data Review Meeting.

b. Weld inspection during tank manufacturing, to include dye penetrant, magnetic particle and ultrasonic testing.

c. Inspection of the windings after completed, but prior to being landed on the core. During this inspection, winding and core material bill of material information must be provided, and the materials inspected, for comparison with the manufacturer's design data to assure conformance.

d. Inspection of the completed core and coil assembly prior to tanking. Winding and core assembly drawings, including the lead support structure, must be made available during performance of these inspections.

e. Completely assembled transformers during performance of the factory acceptance tests.

3.4 FACTORY CLEANING AND PAINTING

3.4.1 General

All interiors and exteriors of the tanks, enclosures, cabinets, and other metal parts which are not galvanized or of corrosion resistant material and are exposed to oil or weather must be thoroughly cleaned and painted. Cleaning must be by degreasing and abrasive blasting or other means to remove all grease, scale, corrosion, and foreign substances. All paint must be lead-free.

3.4.2 Interior Surfaces

All interior surfaces of the main tanks must be given at least one priming coat and one finish coat of oil-resistant paint or enamel. The interior tank color must be white. After painting of the tank interiors, the surfaces must be allowed to cure for one week prior to the introduction of insulating oil.

3.4.3 Exterior Surfaces

All exterior surfaces of the transformers, except as otherwise indicated, must be given a primer and two finish coats of paint in the factory. The paint color must be Munsell 5BG 7/0.4 high gloss (ANSI No. 70 gray), per the requirements of ASTM D1535, and must consist of a polyurethane top coat over an epoxy base coat. The dry film thickness of the primer must be a minimum of 1.5 mils, and that of the top and base finish coats a minimum of 3.5 mils. At minimum, supply one gallon of primer and one gallon of the polyurethane paint, from the same batch used on the transformer, for transformer field paint repairs. All SDS information must be provided with the touch-up paint, in the English language, and included in the Operations and Maintenance Manual. With prior approval of the Contracting Officer, other comparable paint types may be used. The cover surface of the transformer tanks must have a non-slip additive added to the paint, so that the color is the same as the tank color.

3.4.4 Machined Surfaces

All machine finished or corrosion-resistant surfaces must remain unpainted, and be thoroughly cleaned, coated with a suitable, easily removed, corrosion resistant compound, and wrapped or otherwise protected from damage in shipment.

3.5 TRANSFORMER FACTORY ACCEPTANCE TESTS

3.5.1 General

Perform all routine power transformer tests as indicated in IEEE C57.12.00, Table 17 on each transformer, fully assembled with all components installed which are being provided for the final assembled transformer. In addition to the required routine tests, the following design tests and specific test requirements must be performed, unless otherwise specifically indicated. Do not perform any power transformer acceptance tests until all submittals required up to the point of factory testing have been reviewed by the Government and given an Action Code 'A' or 'B' approval. The factory acceptance tests, including test equipment, test methods, measurements, and computations, must be in accordance with the applicable requirements of IEEE C57.12.00, IEEE C57.12.80 and

IEEE C57.12.90, unless otherwise specified, and submit for approval the Factory Test Procedures. Except where otherwise specified in the Standards, all measurements and tests involving alternating voltage must be made with 60 Hz sine wave voltage. The cost of performing all tests must be borne by the Contractor and must be included in the unit prices for the items of the Schedule. The Government representative will witness all tests required herein unless waived in writing, and do not ship any transformer, or parts until it has been released for shipment by the COR. Submit the notification of the date of factory tests as follows so that arrangements can be made for the Government representative to be present at the tests:

a. **For transformer manufacturers located in the United States**, notify the COR 30 calendar days in advance of when the transformer manufacturer will be ready for factory acceptance tests, so that the tests may be witnessed by a Government Representative at the manufacturer's facility.

b. **For transformer manufacturers located in foreign countries**, notify the COR 60 calendar days in advance of when the transformer manufacturer will be ready for factory acceptance tests, so that the tests may be witnessed by a Government Representative at the manufacturer's facility.

3.5.2 Factory Acceptance Test Report

Submit for approval an electronic PDF copy of the Transformer Factory Acceptance Test Report for each transformer tested, including digital waveform printouts, data files for the SFRA, insulation power factor, and leakage reactance tests, and complete data on all tests performed. The witnessing representatives of the Contractor and the Government must sign reports of all witnessed tests. The certified test reports must include the information as listed in IEEE C57.12.00, paragraph 8.7, and include all additional required tests results with the corresponding digital waveform and color thermal imaging printouts.

3.5.3 Dissolved Gas-In-Oil Analysis

Samples of the transformer insulating oil must be taken from each transformer, and dissolved gas-in-oil analysis tests performed as indicated, herein. Identity of samples and results of analyses must be included in the certified test reports, and the results of all insulating oil tests made available for inspection by the Government representative during the transformer factory acceptance testing.

a. After oil-filling of each transformer, and prior to the performance of any transformer factory acceptance tests.

b. After performance of dielectric tests.

c. After performance of temperature rise tests at each cooling rating.

d. Eight hours after performance of all transformer factory acceptance tests, to allow any possible generated gases to fully disperse within the oil.

3.5.4 Temperature Rise Test

Perform a temperature rise test on one transformer with measurements made

at each cooling rating (ONAN, ONAF). During the temperature rise tests use temporary fiber leads and temporary multi-channel fiber-optic temperature monitor to monitor and record the temperatures on all of the embedded winding fibers. During the temperature rise tests, obtain thermal images of all parts of the transformer utilizing a color infrared camera, and include the thermal images with corresponding temperatures indicating the ambient and hottest temperatures, including loading conditions, in the transformer's factory acceptance test report. The tank wall hot-spot temperature rise must not exceed 70 degrees-C while operating at 100 percent of its forced-air cooled rating.

3.5.5 Core Insulation Resistance

In the case of a core type transformers, the transformer core insulation resistance test must be performed on each transformer at each core ground bushing, for the main core connection to ground, and the core frame connection to ground.

3.5.6 Impulse Tests

All transformer impulse tests must be completed on a winding connection (bushing) before performing tests on a different winding connection. The impulse tests must be made by direct application without 60-Hz excitation. Computer-based waveform recordings must be taken of surge voltages during all impulse tests and of neutral current during the reduced full-wave and full-wave impulse tests, with the digital waveforms adjusted to give the same deflection on reduced-voltage and full-voltage impulse waves to facilitate comparison. Comparisons must also be made of the consecutive chopped-wave impulse waveforms. Waveform comparisons must be printed, and provided in the certified test report. Any deviation in voltage or neutral current wave shape between reduced-voltage and full-voltage full-wave tests, must be explained to the satisfaction of the COR or it may be considered cause for rejection of the transformer.

3.5.7 Induced Voltage Test With Partial Discharge Measurements

3.5.7.1 General

Partial discharge measurements during the induced voltage test must be per the requirements of IEEE C57.12.90, paragraph 10.8, and IEEE C57.113. It is recognized that sizable partial discharge readings during tests are likely to occur from causes external to the transformer, such as partial discharge in the high-voltage test circuit, noise from shop equipment, other tests being performed, and radiation or induction pickup through air between the measuring circuit and the high-voltage test equipment. All reasonable precautions must be taken to minimize such external interference, and if necessary, the manufacturer must demonstrate that this partial discharge is not internal to the transformer. It is permissible to utilize special bushing corona shields during performance of the tests.

3.5.7.2 7,200 Cycle Enhancement Level

During the 7,200-cycle test, the partial discharge level, excluding background noise, must not exceed 500 pico-coulombs. Any variation in corona intensity before and after application of full 7,200-cycle test voltage must be explained to the satisfaction of the Contracting Officer.

3.5.7.3 One-Hour Level

During the one-hour test, the partial discharge level must not exceed 300 pico-coulombs, and the increase in partial discharge levels must not exceed 100 pico-coulombs.

3.5.7.4 Data Reporting

All records, meter readings, and data taken during the above described tests, together with a diagram of the circuit employed, must be incorporated in the certified test report. The measurement of partial discharge using the apparent charge (pico-coulomb) method must be performed during the induced voltage test, and the measurements included with the test report.

3.5.8 Audible Sound Level Test

Perform an audible sound level test and it must not exceed the manufacturer's guaranteed sound level included in the proposal documents. The sound level tests must be performed at the ONAN rating, and at the ONAF rating with all cooling fans in operation. If the sound level exceeds the manufacturer's guaranteed level, the transformers must be modified as required to reduce the sound level and the test repeated. The abatement technique used to reduce the tested sound level to the guaranteed sound level must be subject to approval of the Contracting Officer. All data records taken during the sound level test, including a diagram of the transformer and how the measurements were taken, must be included in the certified test report. The data reporting format must be similar to that indicated in Figures 30 and 31 of IEEE C57.12.90.

3.5.9 Leak Test

Perform a leak test on each transformer tank and radiators when filled with oil. The test pressure must be a minimum of 4 psi, maintained for a minimum of 24 hours with no loss in gas pressure during the test period. The dial gauge used for this test must have a scale of 0 - 10 psi. During the pressure test, an alcohol-based industrial marking chalk, or another similar method of oil leak detection, must be applied to the tank welded seams and all gasketed connections and monitored for oil leaks. After the leak test is completed, all chalk must be cleaned off each transformer.

3.5.10 Leakage Reactance Measurement Test

Perform a leakage reactance measurement tests per the requirements of IEEE C57.152, paragraph 7.2.12, between the high-voltage winding and the low-voltage winding, for use as baseline data for future testing. Voltage, current, and phase angle measurements must be recorded, and the corresponding impedance calculated. Use standard equipment for performance of the leakage reactance test. The proposed test setup and procedures must be included in the factory test procedures submittal.

3.5.11 Sweep Frequency Response Analysis Tests

3.5.11.1 Required Tests

Perform two Sweep Frequency Response Analysis (SFRA) tests at the manufacturing facility on each transformer, per the requirements of IEEE C57.149, at the following manufacturing stages for use as baseline data for future testing and for shipping purposes.

a. After all factory tests have been performed, and while each transformer is still fully assembled and filled with oil.

b. After each transformer has been drained of oil and disassembled for shipment, and in its shipping configuration (see paragraph "SFRA Test Shipping Bushing). The test equipment and connections must be as indicated in paragraph "Test Equipment and Test Parameters", below, with the tests performed at the rated tap position.

3.5.11.2 Test Equipment and Test Parameters

Use a Sweep Frequency Response Analyzer for performance of the SFRA test. The proposed SFRA setup and procedures must be included in the factory test procedures submittal. The excitation source must be capable of providing consistent and controlled peak to peak voltage over the entire frequency range, with the test equipment parameters as follows:

a. A test voltage of 20V peak-to-peak minimum.

b. Testing performed over the 20 Hz to 2 MHz frequency range as a minimum.

c. Frequency response measurements made using a log-based scale for frequency.

d. An interference bandwidth (IBW), or equivalent, of less than 1 Hz at 10Hz used for each measurement frequency.

e. Record the magnitude of the response on a decibel (dB) scale for each measurement point.

f. The dB accuracy within 1 dB at every measurement point, using calibrated equipment.

g. A test set with a dynamic range better than 100 dB.

h. Record the phase, in degrees, for each measurement point, with an accuracy within 1 degree at every measurement point, using calibrated equipment.

i. High frequency coaxial test cables, with a 50 ohm matched impedance.

j. A three lead system, which consists of a signal, a reference and a test measurement lead.

k. All cables of the same length. A consistent ground connection should be available at the bushing end of the leads and be the same length for each cable.

l. The size and type of all temporary grounding leads identified.

3.5.11.3 Test Cable Integrity

Prior to the performance of any SFRA tests, the integrity of the test cables must be tested by a short-circuit test. Each coaxial test cable must be laid together, side-by-side on the floor, with the measurement clips connected together and the ground clips connected together. The

frequency response of the test cables when connected in this fashion should be "flat", with the exception of a gradual "roll-off" above 100 kHz due to pre-fitted cable grounds, and any variation could indicate damage within the coaxial cables. Any anomalies in the cable test results must be brought to the attention of the COR.

3.5.11.4 Test Connections

During performance of the SFRA tests, the test coaxial cables must be directly connected to the transformer bushings. For tall bushings, ground jumpers may be used to facilitate connection of the coaxial cable ground shield to the base of the bushing. All windings must be tested as indicated below, for the 'neutral' (or rated kV) tap position, and for the tap position that includes all of the windings, with each SFRA result identified by the applied and measured terminals. The SFRA tests must be per the requirements of IEEE C57.149, Table 5, Group 2, second column).

3.5.11.5 Data Reporting

Test equipment must be capable of producing a test report file which is in the Extensible Markup Language (XML) format. Test data must be able to be viewed without the editing, reorganizing or reformatting of the data. A simple format of separate measurements being in separate spreadsheet columns is required. The test data must show all waveforms in graphical form with the response in linear scale dB units on the Y-axis and the Frequency in logarithmic scale Hz on the X-axis. The Y-axis must auto-scale and the X-axis must display the range from 20 Hz to 2 MHz, as a minimum. The electronic version of the test report must include the complete data on a CD in the format and organization that will permit the file to be viewed completely using standard spreadsheet software. Data reporting must meet the requirements of IEEE C57.149, paragraph 5.

3.5.11.6 Data Interpretation

SFRA testing produces traces which provides information related to the physical geometry of the test specimen. The factory SFRA tests performed creates baseline data for use in future testing, and helps in recognizing obvious manufacturing defects, such as open circuits, short circuits, and winding deformations.

3.5.12 De-Energized Tap Changer Test

Each transformers' completely assembled de-energized tap changer (DETC) must be subjected to five complete tap changing cycles (end-tap to end-tap) during the process of transformer testing to demonstrate that all linkages, contacts, and indicating mechanisms are properly assembled and aligned and free from excessive slack, deformation, or fragility.

3.5.13 Transformer Turns Ratio Test

For Each transformer perform a transformer turns ratio (TTR) test on each tap in accordance with "Ratio Tests" paragraph of IEEE C57.152 after the completion of the DETC testing.

3.5.14 Insulated Wire and Cable

Perform testing on all insulated wire and cable within each transformer's control and power cabinets, extending to all transformer mounted equipment per the requirements of SECTION 26 05 19.00 26, INSULATED WIRE AND CABLE.

3.6 BUSHING TESTS

3.6.1 General

Bushing tests must be performed in accordance with IEEE C57.19.00 and IEEE C57.19.01. Any bushing that fails to pass all tests to which it is subjected will be rejected. Provide electronic PDF copies of all bushing and bushing current transformer test reports for each transformer.

3.6.2 Bushing Design Tests

Bushing design tests must be performed on one bushing of each type provided in accordance with IEEE C57.19.00, unless these tests have previously been performed on bushings of the same manufacture, design, type, and rating as those being provided within 10 years of the date of this contract, in which case the requirements for repeating these design tests will be waived and certified copies of the test results of satisfactory tests of this kind must be furnished to the Contracting Officer. If any bushing given the impulse tests fails to pass any of the tests, than all bushings of the same type and rating must be subjected to the impulse tests at no additional cost to the Government.

3.6.3 Bushing Withstand Test Voltages

The bushings must be tested per the applicable requirements of IEEE C57.19.01, Table 1.

3.6.4 Bushing Routine Tests

Each new bushing provided must be subjected to routine tests by the bushing manufacturer in accordance with IEEE C57.19.00, Table 3. Power factor tests must be performed on each design bushing per the following requirements:

a. Perform a power factor test at 10 kV for C1. The power factor must not exceed 0.35 percent.

3.6.5 Bushing Current Transformer Tests

Provide electronic PDF copies of all bushing current transformer test data.

3.6.5.1 Routine Tests

Each bushing current transformer is to be given bushing current transformer manufacturer routine tests, including an applied voltage test, in accordance with IEEE C57.13, Annex B.8.

3.6.5.2 Tests Performed After Installation

Each current transformer is to be checked for proper nameplate and polarity markings prior to installation on the transformers, and be given a polarity and ratio check after installation and prior to the performance of the factory acceptance tests to ensure correct installation. The following bushing current transformer tests are to be performed after all other transformer acceptance tests have been completed, and the test results included in the factory acceptance test report:

a. Excitation curves for each turn ratio.

b. Ratio correction factor curves for each turn ratio.

c. The resistance of the secondary winding at 75 degrees Celsius, including the resistance of the secondary leads from the bushing current transformer to the terminal blocks in the control cabinet.

3.7 TRANSFORMER SHIPMENT, HAULING AND SITE ASSEMBLY

Each transformer and it's equipment, accessories, and spare parts must be prepared for shipment f.o.b. Little Goose Lock & Dam, transported, inspected, unloaded, moved into its storage location in the storage yard, re-assembled, oil-filled, and tested per the requirements of SECTION 48 20 00.04 26.

-- End of Section --

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7002634_X3(1)

Report Source **Three-winding Transformer**

Session Test Date 8/8/2023 9:02:56 AM

Nameplate - Three-winding Transformer

Company	US ARMY CORE of ENGINEERS	**Serial Number**	7002634
Location	Lower Monumental	**Special ID**	T2A
Division	CENWD	**Circuit Designation**	
Manufacturer	Westinghouse Electric	**Configuration**	SINGLE
Year Manufactured	1978	**Tank Type**	N2 Blanket
Mfr Location		**Class**	OA/FA
Winding Config [H-L]	Single-Single	**Coolant**	Oil
Winding Config [H-T]	Single-Single	**Oil Volume**	10667 UG
Winding Config [L-T]	Single-Single	**Weight**	352000 LB
Phases	Single	**BIL**	1425 kV
kV	500, 13.2	**VA Rating**	82, 109.3, 122.5, *, MVA

Administration

Test Date	8/8/2023	**Test Time:**	9:02 AM	**Weather**	Sunny
Air Temperature	26.2°C	**Apparatus Temperature**	26°C	**Humidity**	36.288 %
Tester	Bradley Baranek	**Work Order**		**Date Last Tested**	8/24/2022
Verified		**Test Set Type**		**Date Retested**	
Verification Date		**Set Top Serial #**		**Reason**	
Last Sheet #		**Test Set Model**		**Travel Time**	
Purchase Order		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Nameplate Notes

---------- Test Session 7 ----------
Tests performed for benchmark purposes prior to regasketing evolution.

---------- Test Session 8 ----------
Unit was completely regasketed. Oil drained, bushings disconnected and lifted, radiators removed and refinished, and tap changer linkage serviced, and gauges replaced/calibrated. 24 hr hot oil circulation was performed followed by a vacuum dryout evolution. Transformer was filled under vacuum with degassed, reprocessed oil.

---------- Test Session 11 ----------
Tested again because of water in isophase bus 6C. When they attempted to energize, the transformer tripped several relays. MJD

---------- Test Session 12 ----------
Tested again because of water in isophase bus 6C. When they attempted to energize, the transformer tripped several relays. MJD

Session Notes

All tests were performed on as found tap. TAP 3

Arrester Nameplate

Location	Serial #	Manufacturer	Overall Catalog	Unit Catalog	Type	Rated kV	Order
LA-B	58769-3	General Electric	9L16GNP396	9L16GHD305		112	3
LA-M	58769-2	General Electric	9L16GNP396	9L16GHD802A		142	1
LA-T	58769	General Electric	9L16GNP396	9L16GHD802A		142	1

Bushing Nameplate

Designation	Serial #	Manufacturer	Type	C1 %PF	C1 Cap (pF)	C2 %PF	C2 Cap (pF)	Rated kV	Amps
H1	9	Westinghouse Electric	O	0.442	470	*	11511	318	1600
H2	3	Westinghouse Electric	O	0.55	220	*	*	22	400
H2A	SN-H2			*	*	*	*	*	*
H3	SN-H3			*	*	*	*	*	*
X1	X1	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
X2	X2	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
Y1	Y1	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
Y2	Y2	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*

Bushing Additional Details -H1

Designation	H1	**Voltage**	Primary	**Serial #**	9		
Catalog #		**Amps**	1600 A	**BIL**	1550 kV	**Tap**	Y
Class	SERIES 7	**Year**	1978	**Drawing**	264D500GR5		
Style		**Other**		**S.O. Number**	EBM1257		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H2

Designation	H2	**Voltage**	Primary	**Serial #**	3		
Catalog #	2312C29	**Amps**	400 A	**BIL**	150 kV	**Tap**	Y
Class		**Year**	1978	**Drawing**	452C325GR2		
Style		**Other**		**S.O. Number**	EBM-125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -X1

Designation	X1	**Voltage**	Secondary	**Serial #**	X1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**		**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -X2

Designation	X2	**Voltage**	Secondary	**Serial #**	X2		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**		**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -Y1

Designation	Y1	**Voltage**	Tertiary	**Serial #**	Y1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**		**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -Y2

Designation	Y2	**Voltage**	Tertiary	**Serial #**	Y2		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**		**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H2A

Designation	H2A	**Voltage**	Primary	**Serial #**	SN-H2		
Catalog #	EBM1257	**Amps**	*	**BIL**	1550 kV	**Tap**	N
Class	SERIES 7	**Year**		**Drawing**	264D500 GR5		
Style		**Other**		**S.O. Number**	EBM1257		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H3

Designation	H3	**Voltage**	Primary	**Serial #**	SN-H3		
Catalog #	EBM1257	**Amps**	*	**BIL**	1550 kV	**Tap**	
Class	SERIES 7	**Year**		**Drawing**	264D500 GR5		
Style		**Other**		**S.O. Number**	EBM1257		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Overall Tests [M4100 Serial: 71531972]

Use Arrhenius TC: No

	Insulation	V [kV]	I [mA]	Loss [W]	PF*TCF [%]	TCF	Cap (pF)	FRANK™	Manual
1	CH+CHL	10.001	44.227	1.884	0.414	0.972	11731.450		
2	CH	10.001	11.395	0.414	0.353	0.972	3022.765	Deteriorated	
3	CHL (Measured)	10.000	32.813	1.478	0.438	0.972	8704.030	Investigate	
4	CHL	*	32.831	1.470	0.435	0.972	8708.685	Good	
5	CL+CLT	7.500	62.822	2.929	0.453	0.972	16664.300		
6	CL	7.500	62.065	2.916	0.457	0.972	16463.850	Investigate	
7	CLT (Measured)	7.500	0.752	0.009	0.121	0.972	199.397	Investigate	
8	CLT	*	0.757	0.014	0.174	0.972	200.450	Deteriorated	
9	CT+CHT	7.500	18.337	0.775	0.411	0.972	4864.065		
10	CT	7.500	10.278	0.474	0.448	0.972	2726.235	Investigate	
11	CHT (Measured)	7.500	8.057	0.299	0.361	0.972	2137.305	Deteriorated	
12	CHT	*	8.059	0.301	0.363	0.972	2137.830	Good	
13	CH+CL+CT	7.500	83.827	3.840	0.445	0.972	22235.601		
Winding without Attached Bushing Calculation									
CH-C1	CH'		8.668	0.295	0.330	0.972	2299.236		
CL-C1	CL'		62.065	2.916	0.457	0.972	16463.850		
CT-C1	CT'		10.278	0.474	0.448	0.972	2726.235		

FRANK™ Message

2 (Deteriorated) - Power factor results are acceptable compared to the limits.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

For this apparatus, the low power factor limit is 0.1%, the degraded limit is 0.4%, and the high limit is 0.6%.

3 (Investigate) - The power factor results are high for this apparatus.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

6 (Investigate) - The power factor results are high for this apparatus.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

7 (Investigate) - Power factor results are acceptable compared to the limits.

The measured power factor is low compared to the initial test.

the measured power factor compares to the previous test.

This may indicate that the first measurement was erroneous, or that a change in the insulation occurred, but is in a stable condition.

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

8 (Deteriorated) - The calculated watts losses are more than 30% different from the measured watts losses.

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

10 (Investigate) - The power factor results are high for this apparatus.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

11 (Deteriorated) - Power factor results are acceptable compared to the limits.

The capacitance has decreased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the first measurement was erroneous, or that a mechanical change occurred but is in a stable condition.

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

Bushing Test (C1) [M4100 Serial: 71531972]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	9	10.001	1.730	0.075	1.037	0.449	0.442	458.784	470	Good	
H2	3	10.000	0.998	0.044	1.037	0.461	0.55	264.745	220	Investigate	

FRANK™ Message

2 (Investigate) - The C1 upper limit for a "G" rating is0.5%

The C1 lower limit for a "G" rating is0.1%

Please note that the Nameplate value for this bushing is higher than the published limit.

The C1 Capacitance is very high compared to Nameplate.

Bushing Test (C2) [M4100 Serial: 71531972]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	9	0.499	42.937	1.717	1	0.400	*	11389.800	11511	Good	
H2	3	0.499	3.808	0.202	1	0.531	*	1010.225	*	Good	

Bushing Test (C1 (Inv)) [M4100 Serial: 71531972]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H2	3	0.499	1.007	0.043		0.445		266.997		Good	

Bushing Test (C1 - C1 (Inv)) [M4100 Serial: 71531972]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H2	3	*	-0.008	0.001		0.016		-2.253			

Hot Collar Tests

				Standard			Legacy (GST, optional)				
ID	Serial #	Test Mode	Skirt #	V [kV]	I [mA]	Loss [W]	V [kV]	I [mA]	Loss [W]	FRANK™	Manual
X1	X1	UST RB	1	10.000	0.190	0.066	*	*	*	Good	
X2	X2	UST RB	1	10.000	0.173	0.050	*	*	*	Good	
Y2	Y2	UST RB	1	10.000	0.192	0.062	*	*	*	Good	
Y1	Y1	UST RB	1	10.001	0.176	0.054	*	*	*	Good	

Excitation Current & Loss [M4100 Serial: 71531972]

Ref. To 10kV: Yes Components: Yes

	Manufacturer	Type	Steps	Rated kV	Step kV	Step % Change	Oil Volume
DETC-1			5	500.00	12.500	2.500	*

		H1 H2										
Winding : Tap	Test kV	mA	Watts	X	mA	Watts	X	mA	Watts	X	FRANK™	Manual
HV: 3	10	30.811	161.784	L	*	*		*	*			

Winding : Tap	Connections	I_L [mA]	I_R [mA]	I_C [mA]	PF [%]	θ [deg]
HV: 3	H1 H2	20.402	16.178	-5.790	52.508	-58.326
HV: 3		*	*	*	*	*
HV: 3		*	*	*	*	*

dobleTTR™ Tests [H-L]

			True Cap			HV Winding			LV Winding	
			*			Single			Single	
Connections			H1 - H2			-			-	
			H2 - X2			-			-	
Winding : Tap	HV [kV]	LV [kV]	Cal	Ratio 1	Ratio 2	Ratio 3	Min. Lim	Max. Lim	FRANK™	Manual
HV: 3	500.00	13.20	37.879	*	*	*	37.689	38.068		

FRANK™ Message	1 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. TTR results are considered acceptable if the measured value is within 0.6% of the calculated value. Anything outside this range is cause for further investigation.

Leakage Reactance Tests (Single Phase) [H-L] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	**Phase**	**Voltage**	**Current**	**Watts**	**PF meas**	**Ind.**	**Res.**	**Imp.**	**Reac.**	**FRANK™**	**Manual**
DETC-1/3	Phase A	264.825 V	1.352 A	7.9 W	2.206	0.519 H	4.319 Ω	195.712 Ω	195.664 Ω	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	**Phase**	**% Imped.**	**Benchmark**	**Delta Bench.**	**% Reac.**	**Benchmark**	**Delta Bench.**	**D Average (%)**
DETC-1/3	Phase A	9.165	9.2	-0.38	9.163	9.2	-0.404	*

Leakage Reactance Tests (Single Phase) [H-T] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	**Phase**	**Voltage**	**Current**	**Watts**	**PF meas**	**Ind.**	**Res.**	**Imp.**	**Reac.**	**FRANK™**	**Manual**
DETC-1/3	Phase A	269.281 V	1.305 A	5.221 W	1.485	0.548 H	3.063 Ω	206.431 Ω	206.408 Ω	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	**Phase**	**% Imped.**	**Benchmark**	**Delta Bench.**	**% Reac.**	**Benchmark**	**Delta Bench.**	**D Average (%)**
DETC-1/3	Phase A	9.667	9.6	0.698	9.666	9.6	0.687	*

Leakage Reactance Tests (Single Phase) [L-T] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	**Phase**	**Voltage**	**Current**	**Watts**	**PF meas**	**Ind.**	**Res.**	**Imp.**	**Reac.**	**FRANK™**	**Manual**
N/A	Phase A	2.049 V	2.323 A	0.054 W	1.145	0.002 H	10.000 mΩ	882.000 mΩ	882.000 mΩ	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	**Phase**	**% Imped.**	**Benchmark**	**Delta Bench.**	**% Reac.**	**Benchmark**	**Delta Bench.**	**D Average (%)**
N/A	Phase A	20.754	20.942	-0.897	20.754	20.942	-0.897	*

7002635_X3(1)

Report Source **Three-winding Transformer**

Session Test Date 8/9/2023 7:08:31 AM

Nameplate - Three-winding Transformer

Company	US ARMY CORE of ENGINEERS	**Serial Number**	7002635
Location	Lower Monumental	**Special ID**	T2B
Division	CENWD	**Circuit Designation**	
Manufacturer	Westinghouse Electric	**Configuration**	SINGLE
Year Manufactured	1978	**Tank Type**	N2 Blanket
Mfr Location		**Class**	OA/FA
Winding Config [H-L]	Single-Single	**Coolant**	Oil
Winding Config [H-T]	Single-Single	**Oil Volume**	10667 UG
Winding Config [L-T]	Single-Single	**Weight**	352000 LB
Phases	Single	**BIL**	1425 kV
kV	500, 13.2	**VA Rating**	82, 109.3, 122.5, *, MVA

Administration

Test Date	8/9/2023	**Test Time:**	7:08 AM	**Weather**	
Air Temperature	21.7°C	**Apparatus Temperature**	20°C	**Humidity**	48.620 %
Tester	Bradley Baranek	**Work Order**		**Date Last Tested**	8/26/2022
Verified		**Test Set Type**		**Date Retested**	
Verification Date		**Set Top Serial #**		**Reason**	
Last Sheet #		**Test Set Model**		**Travel Time**	
Purchase Order		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Nameplate Notes

---------- Test Session 7 ----------
Tests performed for benchmark purposes prior to regasketing evolution.

---------- Test Session 8 ----------
Unit was completely regasketed. Oil drained, bushings disconnected and lifted, radiators removed and refinished, and tap changer linkage serviced, and gauges replaced/calibrated. 24 hr hot oil circulation was performed followed by a vacuum dryout evolution. Transformer was filled under vacuum with degassed, reprocessed oil.

---------- Test Session 9 ----------
The LOW side X winding is on the North side of transformer, the TERT Y side is on the South side.

---------- Test Session 10 ----------
The LOW side X winding is on the North side of transformer, the TERT Y side is on the South side.

---------- Test Session 11 ----------
The LOW side X winding is on the North side of transformer, the TERT Y side is on the South side. This is a retest because transformer tripped several relays while trying to energize. Problem turned out to be water in isphase bus 6C. MJD

---------- Test Session 12 ----------
The LOW side X winding is on the North side of transformer, the TERT Y side is on the South side.

---------- Test Session 13 ----------
The LOW side X winding is on the North side of transformer, the TERT Y side is on the South side.

---------- Test Session 14 ----------
The LOW side X winding is on the North side of transformer, the TERT Y side is on the South side.

Arrester Nameplate

Location	Serial #	Manufacturer	Overall Catalog	Unit Catalog	Type	Rated kV	Order
LA-B	59662	General Electric	9L16GNP396	9L16GHD305		112	3
LA-M	58662-2	General Electric	9L16GNP396	9L16GHD802A		142	1
LA-T	58662	General Electric	9L16GNP396	9L16GHD802A		142	1

Bushing Nameplate

Designation	Serial #	Manufacturer	Type	C1 %PF	C1 Cap (pF)	C2 %PF	C2 Cap (pF)	Rated kV	Amps
H1	10	Westinghouse Electric	O	0.436	472	*	11316	318	1600
H2	1	Westinghouse Electric	O	0.55	215	*	*	22	400
H2A	SN-H2			*	*	*	*	*	*
H3	SN-H3			*	*	*	*	*	*
X1	X1	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
X2	X2	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
Y1	Y1	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
Y2	Y2	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*

Bushing Additional Details -H1

Designation	H1	**Voltage**	Primary	**Serial #**	10		
Catalog #		**Amps**	1600 A	**BIL**	1550 kV	**Tap**	Y
Class	SERIES 7	**Year**	1978	**Drawing**	264D500GR5		
Style		**Other**	GR. 5	**S.O. Number**	EBM1257		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H2

Designation	H2	**Voltage**	Primary	**Serial #**	1		
Catalog #	2312C29	**Amps**	400 A	**BIL**	150 kV	**Tap**	Y
Class		**Year**	1978	**Drawing**	452C325GR2		
Style		**Other**		**S.O. Number**	EBM-125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -X1

Designation	X1	**Voltage**	Secondary	**Serial #**	X1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**		**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -X2

Designation	X2	**Voltage**	Secondary	**Serial #**	X2		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**		**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -Y1

Designation	Y1	**Voltage**	Tertiary	**Serial #**	Y1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**		**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -Y2

Designation	Y2	**Voltage**	Tertiary	**Serial #**	Y2		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**		**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H2A

Designation	H2A	**Voltage**	Primary	**Serial #**	SN-H2		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**			

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H3

Designation	H3	**Voltage**	Primary	**Serial #**	SN-H3		
Catalog #	EBM1257	**Amps**	*	**BIL**	1550 kV	**Tap**	
Class	SERIES 7	**Year**		**Drawing**	264D500		
Style		**Other**	GR. 5	**S.O. Number**	EBM1257		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Overall Tests [M4100 Serial: 71531972]

Use Arrhenius TC: No

	Insulation	V [kV]	I [mA]	Loss [W]	PF*TCF [%]	TCF	Cap (pF)	FRANK™	Manual
1	CH+CHL	10.001	44.559	1.930	0.430	0.994	11819.899		
2	CH	10.001	11.364	0.430	0.376	0.994	3014.485	Deteriorated	
3	CHL (Measured)	10.000	33.179	1.483	0.444	0.994	8801.050	Investigate	
4	CHL	*	33.195	1.500	0.449	0.994	8805.414	Good	
5	CL+CLT	7.500	63.354	3.135	0.492	0.994	16805.550		
6	CL	7.500	62.613	3.163	0.502	0.994	16608.950	Investigate	
7	CLT (Measured)	7.500	0.736	0.010	0.133	0.994	195.168	Investigate	
8	CLT	*	0.741	-0.028	-0.377	0.994	196.600		
9	CT+CHT	7.500	18.132	0.752	0.412	0.994	4809.75		
10	CT	7.500	10.077	0.455	0.448	0.994	2672.990	Investigate	
11	CHT (Measured)	7.500	8.055	0.292	0.360	0.994	2136.420	Deteriorated	
12	CHT	*	8.055	0.297	0.366	0.994	2136.760	Good	
13	CH+CL+CT	7.500	84.189	4.001	0.472	0.994	22332.399		
Winding without Attached Bushing Calculation									
CH-C1	CH'		8.656	0.306	0.351	0.994	2296.093		
CL-C1	CL'		62.613	3.163	0.502	0.994	16608.950		
CT-C1	CT'		10.077	0.455	0.448	0.994	2672.990		

FRANK™ Message

2 (Deteriorated) - Power factor results are acceptable compared to the limits.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

For this apparatus, the low power factor limit is 0.1%, the degraded limit is 0.4%, and the high limit is 0.6%.

The relative humidity is between 45% and 70%, which may cause some increases in measured watts and power

factor.

If higher than expected results are obtained, clean and dry all porcelain surfaces before retesting, using heat if necessary.

3 (Investigate) - The power factor results are high for this apparatus.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

6 (Investigate) - The power factor results are high for this apparatus.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

7 (Investigate) - Power factor results are acceptable compared to the limits.

The measured power factor is low compared to the initial test.

the measured power factor compares to the previous test.

This may indicate that the first measurement was erroneous, or that a change in the insulation occurred, but is in a stable condition.

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

8 (Unrated) - The calculated watts losses are negative. This may indicate a unintentional guard path or a ground shield between windings.

10 (Investigate) - The power factor results are high for this apparatus.

The measured power factor is low compared to the initial test.

the measured power factor compares to the previous test.

This may indicate that the first measurement was erroneous, or that a change in the insulation occurred, but is in a stable condition.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

11 (Deteriorated) - Power factor results are acceptable compared to the limits.

The capacitance has decreased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the first measurement was erroneous, or that a mechanical change occurred but is in a stable condition.

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry

surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

Bushing Test (C1) [M4100 Serial: 71531972]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	10	10.000	1.744	0.075	1.006	0.432	0.436	462.547	472	Good	
H2	1	10.001	0.965	0.049	1.006	0.516	0.55	255.845	215	Investigate	

FRANK™ Message

2 (Investigate) - The C1 upper limit for a "G" rating is0.5%

The C1 lower limit for a "G" rating is0.1%

Please note that the Nameplate value for this bushing is higher than the published limit.

The C1 Capacitance is very high compared to Nameplate.

Bushing Test (C2) [M4100 Serial: 71531972]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	10	0.499	42.249	1.785	1	0.422	*	11206.150	11316	Good	
H2	1	0.500	3.636	0.192	1	0.527	*	964.409	*	Good	

Hot Collar Tests

				Standard			Legacy (GST, optional)				
ID	Serial #	Test Mode	Skirt #	V [kV]	I [mA]	Loss [W]	V [kV]	I [mA]	Loss [W]	FRANK™	Manual
X1	X1	UST RB	1	10.000	0.205	0.064	*	*	*	Good	
X2	X2	UST RB	1	10.001	0.196	0.058	*	*	*	Good	
Y2	Y2	UST RB	1	10.000	0.175	0.046	*	*	*	Good	
Y1	Y1	UST RB	1	10.001	0.165	0.046	*	*	*	Good	

Excitation Current & Loss [M4100 Serial: 71531972]

Ref. To 10kV: Yes Components: Yes

	Manufacturer	Type	Steps	Rated kV	Step kV	Step % Change	Oil Volume
DETC-1	Westinghouse Electric		5	500.00	12.500	2.500	*

		H1 H2										
Winding : Tap	Test kV	mA	Watts	X	mA	Watts	X	mA	Watts	X	FRANK™	Manual
HV: 3	10	31.238	161.371	L	*	*		*	*			

Winding : Tap	Connections	I_L [mA]	I_R [mA]	I_C [mA]	PF [%]	θ [deg]
HV: 3	H1 H2	20.658	16.137	-6.033	51.659	-58.896
HV: 3		*	*	*	*	*
HV: 3		*	*	*	*	*

Leakage Reactance Tests (Single Phase) [H-L] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	Phase	Voltage	Current	Watts	PF meas	Ind.	Res.	Imp.	Reac.	FRANK™	Manual
DETC-1/3	Phase A	265.486 V	1.356 A	7.704 W	2.14	0.519 H	4.189 Ω	195.696 Ω	195.651 Ω	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	Phase	% Imped.	Benchmark	Delta Bench.	% Reac.	Benchmark	Delta Bench.	D Average (%)
DETC-1/3	Phase A	9.164	9.2	-0.388	9.162	9.2	-0.411	*

Leakage Reactance Tests (Single Phase) [H-T] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	Phase	Voltage	Current	Watts	PF meas	Ind.	Res.	Imp.	Reac.	FRANK™	Manual
DETC-1/3	Phase A	264.339 V	1.28 A	6.092 W	1.801	0.548 H	3.719 Ω	206.531 Ω	206.498 Ω	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	Phase	% Imped.	Benchmark	Delta Bench.	% Reac.	Benchmark	Delta Bench.	D Average (%)
DETC-1/3	Phase A	9.672	9.6	0.747	9.67	9.6	0.731	*

Leakage Reactance Tests (Single Phase) [L-T] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	Phase	Voltage	Current	Watts	PF meas	Ind.	Res.	Imp.	Reac.	FRANK™	Manual
N/A	Phase A	2.055 V	2.327 A	0.053 W	1.111	0.002 H	10.000 mΩ	883.000 mΩ	883.000 mΩ	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	Phase	% Imped.	Benchmark	Delta Bench.	% Reac.	Benchmark	Delta Bench.	D Average (%)
N/A	Phase A	20.778	20.9	-0.585	20.778	20.9	-0.585	*

7002633_X3(1)

Report Source **Three-winding Transformer**

Session Test Date 8/10/2023 6:17:09 AM

Nameplate - Three-winding Transformer

Company	US ARMY CORE of ENGINEERS	**Serial Number**	7002633
Location	Lower Monumental	**Special ID**	T2C
Division	CENWD	**Circuit Designation**	
Manufacturer	Westinghouse Electric	**Configuration**	SINGLE
Year Manufactured	1978	**Tank Type**	N2 Blanket
Mfr Location		**Class**	OA/FA
Winding Config [H-L]	Single-Single	**Coolant**	Oil
Winding Config [H-T]	Single-Single	**Oil Volume**	10667 UG
Winding Config [L-T]	Single-Single	**Weight**	352000 LB
Phases	Single	**BIL**	1425 kV
kV	500, 13.2	**VA Rating**	82, 109.3, 122.5, *, MVA

Administration

Test Date	8/10/2023	**Test Time:**	6:17 AM	**Weather**	Sunny
Air Temperature	25°C	**Apparatus Temperature**	20°C	**Humidity**	38.547 %
Tester		**Work Order**		**Date Last Tested**	
Verified		**Test Set Type**		**Date Retested**	
Verification Date		**Set Top Serial #**		**Reason**	
Last Sheet #		**Test Set Model**		**Travel Time**	
Purchase Order		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Nameplate Notes

---------- Test Session 7 ----------
Tests performed for benchmark purposes prior to regasketing evolution.

---------- Test Session 8 ----------
Unit was completely regasketed. Oil drained, bushings disconnected and lifted, radiators removed and refinished, and tap changer linkage serviced, and gauges replaced/calibrated. 24 hr hot oil circulation was performed followed by a vacuum dryout evolution. Transformer was filled under vacuum with degassed, reprocessed oil.

---------- Test Session 11 ----------
This is a retest because water was found in the 6A isophase bus tube. An attempt to energize transformer failed and several relay actions came in. MJD

7/30/2018 7:47:09 AM
The Steps Up/Neutral Positions/Steps Down values were changed from 16/1/16 to 2/1/2 for tap changer OLTC-1.

Arrester Nameplate

Location	Serial #	Manufacturer	Overall Catalog	Unit Catalog	Type	Rated kV	Order
LA-B	SN-LA-B					*	1
LA-M	SN-LA-M					*	1
LA-T	58614	General Electric				*	1

Bushing Nameplate

Designation	Serial #	Manufacturer	Type	C1 %PF	C1 Cap (pF)	C2 %PF	C2 Cap (pF)	Rated kV	Amps
H0	2-4	Westinghouse Electric	OS	0.55	217	*	*	23	1200
H1	8	Westinghouse Electric	O	0.443	467	*	11578	318	1600
H2	2	Westinghouse Electric	O	0.55	217	*	*	22	400
H3	SN-H3			*	*	*	*	*	*
H4	SN-H0	Westinghouse Electric	OS	*	*	*	*	23	*
HC1	None			*	*	*	*	*	*
X1	X1	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
X2	X2	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
Y1	Y1	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*
Y2	Y2	Westinghouse Electric	SOLID-PORC	*	*	*	*	25	*

Bushing Additional Details -H1

Designation	H1	**Voltage**	Primary	**Serial #**	8		
Catalog #		**Amps**	1600 A	**BIL**	1550 kV	**Tap**	Y
Class		**Year**	1978	**Drawing**	264D500GR5		
Style		**Other**		**S.O. Number**	EBM1257		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H2

Designation	H2	**Voltage**	Primary	**Serial #**	2		
Catalog #		**Amps**	400 A	**BIL**	150 kV	**Tap**	Y
Class		**Year**	1978	**Drawing**			
Style		**Other**		**S.O. Number**	EBM-125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -X1

Designation	X1	**Voltage**	Secondary	**Serial #**	X1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**	Gr. 1	**S.O. Number**	EBM125703		
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -X2

Designation	X2	**Voltage**	Secondary	**Serial #**	X2		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**	Gr. 1	**S.O. Number**	EBM125703		
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -Y1

Designation	Y1	**Voltage**	Tertiary	**Serial #**	Y1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**	Gr. 1	**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -Y2

Designation	Y2	**Voltage**	Tertiary	**Serial #**	Y2		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	N
Class		**Year**	1978	**Drawing**	1359C15		
Style		**Other**	Gr. 1	**S.O. Number**	EBM125703		

Physical Dimensions

Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							

Flange Dimensions

To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H3

Designation	H3	**Voltage**	Primary	**Serial #**	SN-H3		
Catalog #		**Amps**	*	**BIL**	1550 kV	**Tap**	
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**	EBM1257		
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H0

Designation	H0	**Voltage**	Primary	**Serial #**	2-4		
Catalog #		**Amps**	1200 A	**BIL**	150 kV	**Tap**	Y
Class		**Year**	1978	**Drawing**			
Style		**Other**		**S.O. Number**	EMB125703		
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H4

Designation	H4	**Voltage**	Primary	**Serial #**	SN-H0		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**	1978	**Drawing**	2312-C-29		
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -HC1

Designation	HC1	**Voltage**	Primary	**Serial #**	None		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Overall Tests [M4100 Serial: 71531972]

Use Arrhenius TC: No

	Insulation	V [kV]	I [mA]	Loss [W]	PF*TCF [%]	TCF	Cap (pF)	FRANK™	Manual
1	CH+CHL	10.001	44.750	1.880	0.418	0.994	11870.650		
2	CH	10.000	11.390	0.432	0.377	0.994	3021.445	Deteriorated	
3	CHL (Measured)	10.000	33.344	1.437	0.428	0.994	8844.925	Investigate	
4	CHL	*	33.360	1.448	0.431	0.994	8849.205	Good	
5	CL+CLT	7.500	64.653	3.483	0.535	0.994	17150.200		
6	CL	7.500	63.903	3.483	0.542	0.994	16951.050	Investigate	
7	CLT (Measured)	7.500	0.750	0.010	0.134	0.994	199.016	Investigate	
8	CLT	*	0.751	0.000	0.004	0.994	199.150		
9	CT+CHT	7.500	18.658	0.820	0.437	0.994	4949.435		
10	CT	7.500	10.582	0.528	0.496	0.994	2806.970	Investigate	
11	CHT (Measured)	7.500	8.075	0.287	0.354	0.994	2141.970	Deteriorated	
12	CHT	*	8.076	0.292	0.359	0.994	2142.465	Good	
13	CH+CL+CT	7.500	85.991	4.458	0.515	0.994	22811.300		
Winding without Attached Bushing Calculation									
CH-C1	CH'		8.695	0.314	0.359	0.994	2306.576		
CL-C1	CL'		63.903	3.483	0.542	0.994	16951.050		
CT-C1	CT'		10.582	0.528	0.496	0.994	2806.970		

FRANK™ Message

2 (Deteriorated) - Power factor results are acceptable compared to the limits.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

For this apparatus, the low power factor limit is 0.1%, the degraded limit is 0.4%, and the high limit is 0.6%.

3 (Investigate) - The power factor results are high for this apparatus.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

6 (Investigate) - The power factor results are high for this apparatus.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

7 (Investigate) - Power factor results are acceptable compared to the limits.

The measured power factor is low compared to the initial test.

the measured power factor compares to the previous test.

This may indicate that the first measurement was erroneous, or that a change in the insulation occurred, but is in a stable condition.

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

8 (Unrated) - The calculated watts losses are negative. This may indicate a unintentional guard path or a ground shield between windings.

10 (Investigate) - The power factor results are high for this apparatus.

The capacitance has increased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

11 (Deteriorated) - Power factor results are acceptable compared to the limits.

The capacitance has decreased by more than 10% since the first test.

The capacitance is comparable to the previous test.

This may indicate that the first measurement was erroneous, or that a mechanical change occurred but is in a stable condition.

Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor.

Contact your supervisor or Doble.

Bushing Test (C1) [M4100 Serial: 71531972]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	8	10.000	1.726	0.073	1.016	0.431	0.443	457.943	467	Good	
H2	2	10.001	0.969	0.045	1.016	0.468	0.55	256.926	217	Investigate	

FRANK™ Message

2 (Investigate) - The C1 upper limit for a "G" rating is0.5%

The C1 lower limit for a "G" rating is0.1%

Please note that the Nameplate value for this bushing is higher than the published limit.

The C1 Capacitance is very high compared to Nameplate.

Bushing Test (C2) [M4100 Serial: 71531972]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	8	1.999	43.172	1.591	1	0.368	*	11452.100	11578	Good	
H2	2	0.499	3.750	0.182	1	0.485	*	994.981	*	Good	

Bushing Test (C1 (Inv)) [M4100 Serial: 71531972]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H2	2	0.500	0.948	2.610		27.988		224.034		Investigate	

FRANK™ Message

2 (Investigate) - The capacitances measured with the C1 and the inverted C1 tests should be equal. If not, it may indicate a bad connection near one end of the insulation tested which behaves differently depending on the voltage applied. Make sure your own tesr connections were good.The capacitances measured with the C1 and the inverted C1 tests should be equal. If not, it may indicate a bad connection near one end of the insulation tested which behaves differently depending on the voltage applied. Make sure your own tesr connections were good.

Bushing Test (C1 - C1 (Inv)) [M4100 Serial: 71531972]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H2	2	*	0.021	-2.566		-27.520		32.892			

Hot Collar Tests

				Standard			Legacy (GST, optional)				
ID	Serial #	Test Mode	Skirt #	V [kV]	I [mA]	Loss [W]	V [kV]	I [mA]	Loss [W]	FRANK™	Manual
X1	X1	UST RB	1	10.000	0.198	0.050	*	*	*	Good	
X2	X2	UST RB	1	10.000	0.200	0.057	*	*	*	Good	
Y1	Y1	UST RB	1	10.000	0.203	0.073	*	*	*	Good	
Y2	Y2	UST RB	1	10.000	0.186	0.047	*	*	*	Good	

Custom Diagnostic [M4100 Serial: 71531972]

	Test Mode	Connection	V [kV]	I [mA]	Loss [W]	% PF Meas.	Cap./Ind.	Manual
H2C1	UST Blue	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.001	0.971	0.042	0.436	257.60 pF	
H2C1	UST Red	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.000	0.971	0.042	0.436	257.57 pF	
H2C2	UST Blue	Ref. to 10kV, Line Freq. Modulation, 60 Hz	0.499	0.973	0.044	0.447	258.01 pF	
H2C2	UST Red	Ref. to 10kV, Line Freq. Modulation, 60 Hz	0.499	0.973	0.042	0.433	258.06 pF	

Excitation Current & Loss [M4100 Serial: 71531972]

Ref. To 10kV: Yes Components: Yes

	Manufacturer	Type	Steps	Rated kV	Step kV	Step % Change	Oil Volume
DETC-1	Westinghouse Electric		5	500.00	12.500	2.500	*

		H1 H2										
Winding : Tap	Test kV	mA	Watts	X	mA	Watts	X	mA	Watts	X	FRANK™	Manual
HV: 3	10	30.165	159.194	L	*	*		*	*			

Winding : Tap	Connections	I_L [mA]	I_R [mA]	I_C [mA]	PF [%]	θ [deg]
HV: 3	H1 H2	19.761	15.919	-5.828	52.774	-58.147
HV: 3		*	*	*	*	*
HV: 3		*	*	*	*	*

Leakage Reactance Tests (Single Phase) [H-L] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	Phase	Voltage	Current	Watts	PF meas	Ind.	Res.	Imp.	Reac.	FRANK™	Manual
DETC-1/3	Phase A	265.803 V	1.357 A	7.911 W	2.193	0.521 H	4.296 Ω	196.315 Ω	196.268 Ω	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	Phase	% Imped.	Benchmark	Delta Bench.	% Reac.	Benchmark	Delta Bench.	D Average (%)
DETC-1/3	Phase A	9.193	9.2	-0.073	9.191	9.2	-0.097	*

Leakage Reactance Tests (Single Phase) [H-T] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	Phase	Voltage	Current	Watts	PF meas	Ind.	Res.	Imp.	Reac.	FRANK™	Manual
DETC-1/3	Phase A	266.695 V	1.291 A	6.266 W	1.821	0.548 H	3.762 Ω	206.678 Ω	206.644 Ω	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	Phase	% Imped.	Benchmark	Delta Bench.	% Reac.	Benchmark	Delta Bench.	D Average (%)
DETC-1/3	Phase A	9.679	9.6	0.819	9.677	9.6	0.802	*

Leakage Reactance Tests (Single Phase) [L-T] [M4100 Serial: 71531972]

		Test Results								Ratings	
Tap Changer Name / Position	Phase	Voltage	Current	Watts	PF meas	Ind.	Res.	Imp.	Reac.	FRANK™	Manual
N/A	Phase A	2.051 V	2.317 A	0.057 W	1.19	0.002 H	11.000 mΩ	886.000 mΩ	886.000 mΩ	Good	Unrated

		% Impedance			% Reactance			
Tap Changer Name / Position	Phase	% Imped.	Benchmark	Delta Bench.	% Reac.	Benchmark	Delta Bench.	D Average (%)
N/A	Phase A	20.848	20.9	-0.248	20.848	20.9	-0.248	*

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CLASS II GSU POWER TRANSFORMER (T1)

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This Section covers the manufacturing and factory testing of three (3), single-phase generator step-up (GSU) power transformers rated 164,000 / 218,666 kVA, 500 kV high-voltage (H), 13.2 kV low-voltage (X & Y), Class ONAN/ONAF cooling, for delivery f.o.b. to Little Goose Lock & Dam storage yard. Each transformer shipment, hauling, site reassembly, field testing are as required in SECTION 48 20 00.04 26. Throughout this Section, the transformer tank layout is identified by Segments 1 through 4, as defined in IEEE C57.12.10, Figure 1, and indicated on the contract drawings.

1.2 GENERAL INFORMATION

1.2.1 Transformer Location

The single-phase transformers specified in this section will be spare transformers for Little Goose, Lower Granite, and Lower Monumental dams. These transformers are meant to be spares for the single-phase T1 Bank transformers at the three Projects. Contract Drawing G-003, shows the site map and the storage yard where the spare T1 transformers will be placed. The spare transformers will be placed on concrete pads in the storage yard. Supplemental drawings LGP-1-4-2/40 and LGP-1-5-0/21 shows the details on the existing transformer mounting pads.

1.2.2 Ratings

Size the new single-phase power transformers per the requirements of paragraph, "Ratings and Electrical Characteristics", to match the impedance, capacitance, and ratings of the existing single phase transformers.

1.3 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022; Supp 1 2023; Supp 2 2023) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2024) Unified Inch Screw Threads (UN, UNR, and UNJ Thread Form)
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.24	(2022) Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500, and 2500
ASME B31.1	(2024) Power Piping
ASME BPVC SEC IX	(2023) BPVC Section IX-Welding, Brazing and Fusing Qualifications

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A343/A343M	(2014; R 2019) Standard Test Method for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method and 25-cm Epstein Test Frame
ASTM A664	(2015; R 2022) Standard Practice for Identification of Standard Electrical Steel Grades in ASTM Specifications
ASTM A717/717M	(2012; R 2022) Standard Test Method for Surface Insulation Resistivity of Single-Strip Specimens
ASTM A876	(2017; E 2017) Standard Specification for Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
ASTM D923	(2015; R 2023) Standard Practices for Sampling Electrical Insulating Liquids
ASTM D1535	(2014; R 2023) Standard Practice for Specifying Color by the Munsell System
ASTM D3487	(2024) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2020) Standard Symbols for Welding, Brazing, and Nondestructive Examination
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS D1.6/D1.6M	(2017) Structural Welding Code - Stainless Steel

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 693	(2018) Recommended Practice for Seismic Design of Substations
IEEE 1427	(2020) Guide for Recommended Electrical Clearances and Insulation Levels in Air Insulated Electrical Power Substations
IEEE C57.12.00	(2021) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.10	(2017) Requirements for Liquid-Immersed Power Transformers
IEEE C57.12.70	(2020) Standard Terminal Markings and Connections for Distribution and Power Transformers
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2021) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(2016) Standard Requirements for Instrument Transformers
IEEE C57.19.00	(2023) Standard General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
IEEE C57.19.01	(2017) Performance Characteristics and Dimensions for Power Transformer and Reactor Bushings
IEEE C57.104	(2019; E 2019) Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers
IEEE C57.113	(2023) Recommended Practice for Partial Discharge Measurement in Liquid-Filled Power Transformers and Shunt Reactors
IEEE C57.116	(2022) Guide for Transformers Directly Connected to Generators

IEEE C57.149	(2012) Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers
IEEE C57.152	(2013) Guide for Diagnostic Field Testing of Fluid-Filled Power Transformers, Regulators, and Reactors

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
ANSI C80.1	(2020) American National Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA FB 1	(2014) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA MW 1000	(2023) Magnet Wire
NEMA SG 4	(2009; R 2013) AC High-Voltage Circuit Breakers

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1) National Electrical Code

UL SOLUTIONS (UL)

UL 248-8	(2011; Reprint Aug 2020) Low-Voltage Fuses - Part 8: Class J Fuses
UL 360	(2013; Reprint Jan 2024) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 489	(2025) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(2024) Industrial Control Equipment
UL 508A	(2018; Reprint Jul 2022) UL Standard for Safety Industrial Control Panels
UL 514B	(2012; Reprint Mar 2024) UL Standard for

	Safety Conduit, Tubing and Cable Fittings
UL 969	(2017; Reprint May 2023) UL Standard for Safety Marking and Labeling Systems
UL 1203	(2023; Reprint May 2024) UL Standard for Safety Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
UL 4248-8	(2024) Fuseholders - Part 8: Class J

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with SECTION 01 33 00, "SUBMITTAL PROCEDURES", unless otherwise indicated below:

SD-01 Preconstruction Submittals

Welding Quality Control Plan; G, HDC

Submit for approval the welding quality control plan a minimum of 60 calendar days prior to the start of tank manufacturing. (see paragraph "Welding Quality Control Plan").

SD-02 Shop Drawings

a. Outline and Assembly Drawings; G, HDC

Submit outline and assembly drawings of the transformer for approval no later than 240 calendar days prior to the start of transformer fabrication to demonstrate that the equipment will conform to the requirements and intent of the specifications.

b. Detail Drawings; G, HDC

Submit detail drawings for approval not later than 180 calendar days prior to the start of transformer fabrication to demonstrate that the equipment will conform to the requirements of the specifications.

SD-03 Product Data

Submit for approval the product data no later than 120 calendar days prior to the start of transformer fabrication to demonstrate that the welding materials will conform to the requirements of the specifications.

a. Welding Electrodes and Rods; G, HDC

b. Shielding Gas; G, HDC

SD-05 Design Data

a. Transformer Design Data Review Report; G, HDC

Submit for approval a transformer design data review report within 14 calendar days of the design data review meeting, to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications.

b. Descriptive Data; G, HDC

Submit for approval the descriptive data and catalog data of all accessory devices, ancillary equipment and gaskets to be provided with the transformer not later than 210 calendar days prior to the start of transformer fabrication, to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. (see paragraph "Descriptive Data")

c. Spare Parts List; G, HDC

Submit for approval a listing of all required spare parts to be provided with the transformer not later than 210 calendar days prior to the start of transformer fabrication (see paragraph "SPARE PARTS").

d. Structural Design Criteria and Seismic Calculations; G, HDC

Submit for approval the structural design criteria and seismic calculations within 45 calendar days after outline and assembly drawing approval. Perform design criteria and calculations utilizing civil or structural engineers who are presently registered professional engineers (PE) in any state or territory of the United States, and provide a cover sheet for the submittal which is stamped or sealed and signed by a PE.

e. Cabinet Heater Sizing Calculations; G, HDC

Submit for approval the calculations not later than 180 calendar days prior to the start of transformer fabrication to verify the ratings of the transformer control and power cabinet heaters, based upon the cabinet sizes, cabinet material, and the regional ambient temperature conditions as shown in Contract Drawing G-005. See paragraph "Lighting, Convenience Receptacle, and Cabinet Heaters" for information.

SD-06 Test Reports

a. Transformer Factory Acceptance Test Report; G, HDC

Submit for approval the transformer factory acceptance test report not later than 14 calendar days following completion of the factory acceptance tests. (see paragraph "Factory Acceptance Test Report").

b. Bushing Design Tests; G, HDC

Submit for approval the transformer bushing design test reports not later than 30 calendar days following completion of the tests (see paragraph "Bushing Design Tests"). If certified copies of bushing design tests previously conducted within ten (10) years are submitted in-lieu of new test results, submit them when the bushing selection is made, but not later than 60 calendar days

prior to the performance of transformer factory acceptance tests.

c. Bushing Routine Tests; G, HDC

Submit for approval the transformer bushing routine test reports not later than 30 calendar days following completion of the tests. (see paragraph "Bushing Routine Tests").

d. Bushing Current Transformer Manufacturer Routine Tests; G, HDC

Submit for approval the transformer bushing current transformer test reports not later than 30 calendar days following completion of the tests. (see paragraph "Bushing Current Transformer Tests").

g. Weld Inspection and Test Report; G, HDC

Submit for approval the weld inspection and test report not later than 14 calendar days following completion of the weld inspections and tests. (see paragraph "Weld Inspections, Tests and Weld Inspector Qualifications").

SD-07 Certificates

a. Transformer Oil Certification; G, HDC

Submit for approval the transformer oil certification documents a minimum of 7 calendar days prior to the delivery of transformer oil to the Little Goose Lock & Dam "Storage Yard". (see paragraph "Quantity and Transformer Oil Certification").

b. Notification of the Date of the Transformer Design Data Review Meeting; G, HDC

For transformer manufacturers located in the United States, notify the COR 30 calendar days in advance of when the transformer manufacturer will be ready for performance of a design data review meeting, to be held at the manufacturer's facility.(see paragraph "TRANSFORMER DESIGN DATA REVIEW MEETING").

For transformer manufacturers located in foreign countries, notify the COR 60 calendar days in advance of when the transformer manufacturer will be ready for performance of a design data review meeting, to be held at the manufacturer's facility.(see paragraph "TRANSFORMER DESIGN DATA REVIEW MEETING").

c. Notification of the Date of Factory Tests; G, HDC

For transformer manufacturers located in the United States, notify the COR 30 calendar days in advance of when the transformer manufacturer will be ready for factory acceptance tests, so that the tests may be witnessed by a Government Representative at the manufacturer's facility.(see paragraph "TRANSFORMER FACTORY ACCEPTANCE TESTS").

For transformer manufacturers located in foreign countries, notify the COR 60 calendar days in advance of when the transformer manufacturer will be ready for factory acceptance tests, so that the tests may be witnessed by a Government Representative at the manufacturer's facility.(see paragraph "TRANSFORMER FACTORY

ACCEPTANCE TESTS").

d. Welder Qualifications; G, HDC

Submit for approval the welding operators and welders qualifications a minimum of 60 calendar days prior to their performance of work. (see paragraph "Welder Qualifications").

e. Weld Inspector Qualifications; G, HDC

Submit for approval the qualifications for the Contractor's Quality Assurance personnel responsible for performing weld inspections a minimum of 60 calendar days prior to the performance of weld inspections. (see paragraph "Inspection and Weld Inspector Qualifications").

SD-08 Manufacturer's Instructions

a. Factory Test Procedures; G, HDC

Submit for approval the transformer factory test procedures a minimum of 60 calendar days prior to the performance of the factory acceptance tests. (see paragraph "TRANSFORMER FACTORY ACCEPTANCE TESTS").

b. Welding Procedures; G, HDC

Submit for approval the welding procedures and specifications, and copies of test reports, a minimum of 60 calendar days prior to the performance of work. (see paragraph "Welding Procedure").

c. Prequalified Weld Procedures; G, HDC

Submit for approval the applicable prequalified weld procedures per the requirements of AWS a minimum of 60 calendar days prior to the performance of work. (see paragraph "Welding Procedure").

1.5 TRANSFORMER WARRANTY REQUIREMENTS

1.5.1 General Warranty Requirements

In addition to the requirements outlined in FAR 52.246-18, provide a manufacturer’s warranty for the power transformers for a period of 5 years from the date of final acceptance of the work. Provide a warranty certificate for each transformer indicating the date of expiry, to be included in the final Operations and Maintenance Instructions. The following transformer issues will also be considered warranty repair items:

a. Transformer gassing quantities or rates exceeding the DGA Status 1 level as defined in Figure 2 Tables 1 through 4 of IEEE C57.104.

b. Transformer oil leaks, at welded joints as well as gasketed connections and valve stem packing.

c. Paint failures resulting in visible loss of adhesion through bubbling, flaking, peeling, or any visible rust due to paint failure.

d. Transformer bushing dielectric integrity and oil leaks.

e. Transformer control cabinet heater functionality.

1.5.2 Devices Exempt from the Transformer Full Warranty Period

Transformer ancillary devices which are not manufactured by the transformer manufacturer are subject to the device manufacturer's standard warranty period, and are exempt from the 5 year duration of the transformer warranty period. All ancillary devices which as not manufactured by the transformer manufacturer, such as gauges, have a minimum 1-year warranty or the part's manufacturer's guaranteed warranty, whichever is higher of the two

PART 2 PRODUCTS

2.1 TYPE AND RATING

2.1.1 General

Provide single-phase, three-winding, with one high-voltage and dual low-voltage windings, oil-immersed type power transformers suitable for outdoor operation in accordance with this specification. The transformers must be self-cooled/forced air-cooled type, Class ONAN/ONAF, and must be of a design that has an established record of satisfactory operation with the type of oil preservation system specified, and manufactured suitable for shipment by sea transportation, railcar, and trucking by heavy hauler. The power transformers are a step-up transformer to be used in direct connection with electrical power generators and will be subject to backfeed mode as defined in IEEE C57.116.

2.1.2 Transformer Limiting Dimensions and Equipment Arrangement

Provide transformers with the layout, equipment arrangement and dimensional requirements as indicated on contract drawings.

2.1.3 Requirements

Except as otherwise specified herein, the transformers, accessories, and spare parts must conform to the applicable requirements of IEEE C57.12.00, IEEE C57.12.10, IEEE C57.12.70, IEEE C57.12.80 and IEEE C57.12.90, and IEEE C57.116.

2.1.4 Standard Products

Provide material and equipment which are standard products from a manufacturer that is regularly engaged in their production, and are items that have been commercially available for at least 3 years prior to bid opening, unless otherwise specifically approved. Provide all materials that conforms to the requirements of these specifications. Materials must be of industrial quality, free from defects and imperfections, presently being manufactured, and of the classification and grades designated. If the Contractor desires for any reason to deviate from the standards designated in these specifications, submit for approval a statement describing the exact nature of the deviation, including complete specifications for the materials that are being proposed for use.

2.1.5 Descriptive Data

Submit for approval descriptive data for all transformer equipment, which includes catalog and technical data of sufficient detail to verify

conformance with the requirements, herein. Highlight or circle the catalog and technical data for the specific device and model, and provide ordering information and cut sheets. The descriptive data is to include the following at a minimum:

1. Electrical core steel, including country of origin
2. Winding conductors, including country of origin
3. Gasket type and material
4. Valves (each type)
5. Oil sampling device
6. Radiators
7. Cooling fans (including wiring connection methods)
8. Nitrogen regulator cabinet
9. Bushings (each type and rating)
10. Core ground bushings
11. Bushing current transformers
12. Bushing current transformer terminal boxes
13. Thermowells
14. Oil level indicator
15. Oil temperature indicator
16. Winding temperature indicator, including associated equipment
17. Pressure relief device, including discharge piping
18. De-energized tap changer, including operating handwheel
19. Rapid Pressure Rise Relay and Seal-in
20. Personal fall arrest system
21. Insulating oil, including vendor and inhibitor
22. Control and power cabinet vibration isolators
23. Fiber-optic probes
24. Fiber-optic tank feed-through plate and connectors
25. Auxiliary power transformer and mounting cabinet
26. Magnetic contactors
27. Molded-case circuit breakers (each type and rating)
28. 480 VAC circuit breaker locking provisions
29. Auxiliary relays
30. Undervoltage relays
31. Control and instrument switches
32. Terminal blocks (each type)
33. Fuses
34. Fuse holders
35. Wire duct
36. Cabinet lighting
37. GFCI receptacle
38. Cabinet heaters
39. Cabinet grounding busbar
40. Cabinet ventilation
41. Thermostat / humidistat
42. Insulated wire and cable (each type) and signal cable
43. Wire labeling method
44. Device nameplate method
45. Conduit and fittings
46. Junction boxes
47. Impact recorders for shipment (analog & digital)

If providing a conservator tank system of oil preservation include descriptive data of the following:

48. Conservator tank bladder
49. Dehydrating breather
50. Buchholz relay

2.1.6 Ratings and Electrical Characteristics

The ratings and electrical characteristics of the transformers are as follows:

a. Continuous rating, at the 65 degrees-C temperature rise, of the high-voltage winding at all taps, kVA:

(1) ONAN Rating: 164,000
(2) ONAF Rating: 218,666

b. Continuous rating, at the 65 degrees-C temperature rise, of each low-voltage winding, kVA:

(1) ONAN Rating: 82,000
(2) ONAF Rating: 109,333

b. Frequency, Hz: 60

c. Number of phases: 1

d. Rated voltage, kV:

(1) High-voltage windings: 500
(2) Low-voltage winding X: 13.2
(3) Low-voltage winding Y: 13.2

e. Winding connections (external to the transformer):

(1) High-voltage windings: Grounded-Wye
(2) Low-voltage windings: Ungrounded Delta

f. Impedance, at ONAN rated current between the high-voltage winding and each low-voltage winding, subject to IEEE tolerances, percent:

(1) 17.7% (H-X)
(2) 17.7% (H-Y)

g. Impedance, at ONAN rated current, between the low-voltage windings (X-Y), as high as feasible for an economic design, but not less than, percent: 40.5%

h. Polarity: Subtractive

i. Basic impulse insulation levels (BIL), kV:

(1) Line ends of the high-voltage windings, not less than: 1425
(2) Neutral ends of the high-voltage windings, not less than: 150
(3) Low-voltage windings, not less than: 110

j. Taps in low voltage windings: None

k. Taps (full capacity) in high voltage winding

(1) Tap 1, percent of high-voltage rating: 107.5
(2) Tap 2, percent of high-voltage rating: 105.0
(3) Tap 3, percent of high-voltage rating: 102.5
(4) Tap 4, percent of high-voltage rating: 100.0

(5) Tap 5, percent of high-voltage rating: 97.5

l. Maximum no-load losses at rated voltage and frequency, kW: 165

m. Maximum load losses at maximum ONAF rated kVA and 1.0 power factor, with each low-voltage winding equally loaded, kW: 314

n. Maximum average sound level at rated voltage and frequency, with all cooling groups in operation, dB: 80

o. Maximum Oil Volume, GAL: **15,339**

p. Maximum transformer total weight, completely assembled and oil filled with all accessories installed, pounds: **591,500**

q. The transformers' capacitances must match those of the existing transformers and be designed to be compatible with bank of single-phase shell-type transformers. See the T1 Doble Report attachment at the end of the specifications.

2.1.7 Transformer Type

The existing transformers in T1 Bank are shell-form type transformers. Shell-form or core-form type transformers are acceptable and must meet requirements described in these specifications. The transformers design must fit existing powerhouse connections without modifications to existing equipment and must not exceed the weight specified. The new transformers, including all attached accessories, must meet the limiting dimensions specified in the contract drawings. The transformers must be designed to be compatible for operation with the existing single phase shell-type transformer in T1 Bank. The transformer must be able to be transported from manufacturer location to Little Goose Lock & Dam Storage Yard.

2.1.8 Unusual Service Conditions

2.1.8.1 Magnetic Fields

The transformer will be subject to the following unusual service conditions, as defined by IEEE C57.12.00, paragraph 4.3:

The transformers' high-current low-voltage bushings will be connected to isolated-phase bus ducts and will exhibit strong magnetic fields during operation, which may cause circulating currents in the transformer tank cover and bus duct housings. Corrective measures must be taken during manufacturing to utilize non-magnetic metals in the cover around the bushings and the bushing housing flanges.

2.1.8.2 Backfeed Mode

The transformers must be designed to operate under IEEE C57.116 related service conditions with the transformers being used as a generator step-up transformer and will be subject to periods of backfeed operation.

2.1.9 Impedance Tolerance

The impedance tolerance between the supplied single-phase transformers and the specified impedance must be limited to a maximum of 3 percent, at the ONAN self-cooled rating, to reduce circulating currents when wye-connected and assure proper operation of the transformers differential relaying.

2.2 STRUCTURAL DESIGN CRITERIA AND SEISMIC CALCULATIONS

Provide Structural design criteria and seismic calculations for the transformers, to include the main tank, base, and all major components such as bushings, oil preservation system, cooling equipment and cabinets.

2.2.1 Structural Design Criteria

Structural design criteria must include the following:

a. Indicate the industry design standards (ASCE or IEEE) and allowable stresses or capacities to which steel plate, structural steel shapes, welds, bolts and studs must conform.

b. Indicate the industry standards (ASCE or IEEE) used in developing the seismic forces and analysis techniques used in the design of the transformer and transformer components.

c. Provide the seismic design for equipment restraint in accordance with Chapter 13, "Seismic Design Requirements for Nonstructural Components," of ASCE 7-22 with the seismic design force computed as per Section 13.3 "Seismic Demands on Nonstructural Components". Provide electrical equipment restraint in accordance with the provisions in IEEE 693 Annex D, or Section 13.3 of ASCE 7-22 whichever produces the more adverse seismic effects. For ASCE 7-22, use a spectral acceleration S_{DS} = 0.32, I_P = 1.5 and z=h=1. Use a moderate seismic qualification level For IEEE 693.

d. Provide wind load calculations based upon Exposure Category "D" of ASCE 7-22. Base the effect of wind load forces upon ASCE 7-22, or 40 psf, whichever is greater.

2.2.2 Transformer Mounting

The transformers must be manufactured with structural bases that meets the requirements of paragraph "Transformer Steel Base, and that rests on the existing concrete pedestals with a steel plate cap as shown in supplemental drawings LGP-1-4-2/40 and LGP-1-5-0/21.

2.3 THERMAL DESIGN

The temperature rise above ambient temperature of the transformers or parts thereof, when tested in accordance with its ratings, must not exceed the limits of observable temperature rise for oil immersed apparatus as stated in IEEE C57.12.00 (paragraph 5.11.1). The winding temperature rise by resistance must not exceed 65 degrees-C, and the hottest spot winding temperature rise must not exceed 80 degrees-C on the tap connections that give the highest losses, at all self-cooled and forced-air cooled ratings. The transformers must be designed for satisfactory continuous operation with any combination of simultaneous loads on the low-voltage windings within their ratings, and also for the case where either low-voltage winding carries maximum rated load and the other low-voltage winding carries no load.

2.4 CORE

The transformers' core steel laminations must be high-quality, non-aging, cold-rolled, grain-oriented steel especially suitable for the

purpose, meeting the requirements of ASTM A664 and ASTM A876, and the following:

a. Lamination maximum thickness of 0.270 mm, and the design flux density less than 1.75 Tesla.

b. Electrical core steel core loss, rms exciting power, rms and peak exciting current, and ac permeability design tested in accordance with ASTM A343/A343M, with the design test reports included with the descriptive data.

c. Each roll of sheet steel used must have the surface insulation resistivity tested in accordance with ASTM A717/717M.

d. The core must be assembled with interleaved joints, and rigidly clamped to ensure mechanical strength to support the windings and to prevent shifting of the laminations during shipment, and also to reduce vibration during operation.

2.5 WINDINGS

The single-phase transformers must be manufactured with windings meeting the requirements of paragraph "Ratings and Electrical Characteristics", consisting of one high-voltage winding (H) and two low-voltage windings (X and Y). Consideration must be given to all factors of service, such as high dielectric and mechanical strength of insulation, coil characteristics, and minimum restrictions to free circulation of oil. Coils must be made up, shaped, and braced to provide for expansion, contraction, and shrinkage due to temperature changes and aging in service in order to avoid abrasion of insulation and to provide resistance to movement and distortion caused by abnormal operating conditions. The insulation of the coils must be designed to withstand possible transient voltages that occur when the transformers are operated in backfeed mode and the secondary windings (high-side) are exposed to typical system transients as described in IEEE C57.116, clause 11. Barriers must be provided between windings and core and between high-voltage and low-voltage windings. End coils must have additional protection against normal line disturbances. The windings must meet the following requirements:

a. Winding conductors manufactured from high-conductivity copper magnet wire meeting the applicable requirements of NEMA MW 1000.

b. Winding assembly of a circular coil design if the transformers are a core-form design.

c. Conductor insulation consisting of thermally upgraded Kraft paper.

d. A de-energized tap changer with taps located in the high-voltage windings. The tap changer contacts must be silvered, and capable of withstanding the full short circuit current of the transformers without damage.

e. Basic impulse insulation level (BIL) of the windings as specified in paragraph "Ratings and Electrical Characteristics", and capable of withstanding IEEE Standard dielectric tests, in accordance with paragraph "Power Transformer Tests", corresponding to the specified winding insulation levels.

f. Capable of withstanding without damage the mechanical and thermal stresses caused by short circuits on the external terminals of any winding or windings, with rated voltages maintained across the terminals of all other windings intended for connection to sources of energy, under the conditions listed in IEEE C57.12.00 (paragraph 7.1.1).

g. Fiber-optic probes embedded in the calculated hottest spot for each high and low-voltage winding duct spacers for direct winding temperature measurement, with quantities and distribution as required in paragraph "Transformer Fiber-Optic Winding Temperature Measurement."

2.6 TANK

2.6.1 Fabrication

The transformers must be manufactured with an oil-tight steel tank, with oil-tight covers per the requirements of IEEE C57.12.10 (paragraph 5.8), with the following features:

a. The main transformer tanks and any attached compartment that is subjected to operating pressures designed and manufactured to withstand, without leakage or permanent deformation, an internal maximum operating pressure not less than 10 psi.

b. Manufactured for vacuum filling (essentially full vacuum) in the field, with all valves, fittings and piping affected by vacuum filling rated for such filling.

c. Welded joints between the tank and cover, and between tank sections, designed to prevent weld splatter from entering the inside of the tank during the welding process.

d. Positioning guides inside the tank to assure the core and windings are in the correct position during the assembly process, and provide additional rigidity during transportation.

e. One or more unobstructed manholes in the cover with minimum dimensions of 24 inches by 24 inches, or 24 inches minimum diameter, to afford easy personnel access to the inside of the tank and the upper portions of the core and coils.

f. Handhole access covers in the tank sidewall for access to low-voltage bushing bottom connection, and the de-energized tap changer switch mechanism for future maintenance.

2.6.2 Lifting, Moving and Jacking Facilities

2.6.2.1 Lifting Facilities

Design loads for lifting facilities must have a safety factor of five in accordance with IEEE C57.12.10 (paragraph 5.3.1). Lifting facilities must positively keep the lifting cable in place even when the cable is slack. Provide transformers with the following lifting facilities:

a. Lifting attachments on the tank covers.

b. Adequate means for lifting the core and coil assembly from the tanks for a core-form design.

c. Lifting facilities and pivot points on the tanks adequate for lifting and pivoting the transformers from the shipping position to the upright position for a shell-form design.

d. Lifting facilities on the tanks adequate for lifting the complete transformer filled with oil. The lifting facilities will also be used for securing of the transformers during shipment.

2.6.2.2 Moving Facilities

Furnish moving facilities in accordance with IEEE C57.12.10 (paragraph 5.3.3).

2.6.2.3 Jacking Facilities

Provide transformers manufactured with jacking facilities to permit jacking the fully assembled transformer filled with oil per the requirements of IEEE C57.12.10 (paragraph 5.3.4). The design loads for jacking facilities must be a minimum of five times the actual loads to allow for possible unequal jacking forces.

2.6.3 Gasketing

2.6.3.1 General

Gaskets between metal surfaces must be set in expansion-limiting grooves so that all contact surfaces are metal-to-metal when tightened. Provide gaskets made of Nitrile NBR (Buna N), with the exception that gaskets for the low-voltage bushings must be fluoroelastomeric rubber, with a Durometer rating between 50 and 70. Circular cross-section gaskets are not acceptable for use in gasket grooves of rectangular cross-section.

2.6.3.1.1 Low-voltage Bushings

Provide low-voltage bushing gaskets that meet the following requirements:

a. Meets the requirements of ASTM D-1418, designation FKM, Type 2.
b. Manufactured with 100% virgin FKM Fluoroelastomer polymer
c. Rated for application in temperature range of -20F to +400F
d. Durometer hardness of 70 (+/- 2)
e. Minimum fluorine content: 66%

2.6.3.2 Sizing

Gasket sizing for rectangular cross-section grooves must be accomplished as follows:

a. Gasket thickness is chosen so that approximately 25-percent of the gasket cross-section protrudes above the depth of the groove, referred to as the 'gasket compression area'.

b. The width of the groove minus the width of the gasket determines the space available for gasket expansion during compression. The amount of groove space available for gasket expansion during the compression process is referred to as the 'gasket expansion area', which must be greater than the gasket compression area to avoid pinching of the gasket between the metal surfaces when tightened.

c. Proper sizing coordination between the gasket groove and the gasket cross-sections results in 25-percent gasket compression, with a remaining gasket expansion area after tightening of between 5 and 10-percent.

2.6.4 Valves

Provide all valves that conform with IEEE C57.12.10 (paragraph 5.1.8), be of ball-type stainless steel design conforming to MSS SP-72, circular flanged mounting, with reinforced PTFE valve seats, unless otherwise specifically indicated. The valves must be of full-port design, designed for use with insulating oil with a 120 degrees Celsius minimum temperature rating and include hasps for locking the handle. Provide the following valves:

a. Upper filter connection. A 1.5-inch valve with a 1.5-inch female NPT threaded open-end connection and a threaded plug, located on the tank sidewall such that it can be used to fill the transformers with oil while the transformers are under vacuum.

b. Vacuum pump connection. A 3-inch valve with a 3-inch circular-flanged open-end connection, located on the tank cover for use in connecting a vacuum pump during the vacuum filling process. Provide a gasketed blind flange cover with an integral 3-inch NPT female connection and threaded plug for the valve open-end connection.

c. Main drain. A 3-inch valve with a 3-inch circular-flanged open-end connection, located at the extreme bottom of the tank for use in gravity draining of the transformers. Provide a gasketed blind flange cover with an integral 3-inch NPT female connection and threaded plug for the valve open-end connection.

d. Oil sampling valve. A 1-inch valve, with a 1/2-inch NPT threaded open-end connection and a 1/2-inch threaded sampling device, complete with protective cover. This valve may be located at the main drain valve location.

e. Lower filter connection. A 1.5-inch valve with a 1.5-inch female NPT thread open-end connection and a threaded plug, located at the extreme bottom of the tank.

f. Tank air vents. Threaded plugs for venting the radiators. Schrader valves are not acceptable for use as vent valves.

g. Nitrogen gas connection. Two 1/2-inch valves for connection of the nitrogen generator system tubing.

h. Radiator drain. A 1/4-turn valve at the lowest point of each radiator to permit draining, with an NPT threaded open-end connection and threaded plug.

i. Isolation valves.

(1) Radiators. At the inlet and outlet of each radiator to permit removal without draining the oil from the tank. Radiator isolation valves at the transformer tanks may be of a butterfly type.

(2) Rapid pressure rise relay. 1.5-inch isolating valve for the

rapid pressure rise relay.

(3) Gas-in-oil monitor interface valve. Two 2-inch valves for future connection to the gas-in-oil monitor

(4) Conservator tank. If providing a conservator tank system, provide a valve isolating the conservator tank from the main transformer tanks, and isolating the Buchholz relay. Isolation valves adjacent to the Buchholz relay may be of a butterfly design.

2.6.5 Connections

2.6.5.1 General

Provide all bolts, studs, machine screws, nuts, and tapped holes designed for customer connection in accordance with ASME B1.1 (inch fasteners). Bolting hardware must be Grade 8 minimum, or equivalent, and all hardware not internal to the tank must be galvanized. Threads for sizes 1/4-inch to 1-inch, inclusive, must be NC or UN series. The sizes and threads of all valves, pipe and fittings, conduit and fittings, tubing and fittings, and connecting equipment, must be in accordance with ASME B1.20.1. Manufacturers' standard threads and design may be used on small items which are integrally replaceable, except that threads for external connections to these items must meet the above requirements.

2.6.5.2 Stainless Steel

Install all stainless steel connecting hardware using an anti-galling compound such as molybdenum disulfide on the threads prior to connection, or the nuts may be of a Nitronic 60 grade stainless steel.

2.6.6 Steel Pipe and Fittings

Provide steel pipe that conform to ASTM A53/A53M, Grade A, Weight Class XS. Dimensions of terminating flanges must conform to ASME B16.1 and ASME B16.24.

2.6.7 Grounding

Provide transformer tanks with four ground pads, with grounding provisions in accordance with IEEE C57.12.10 (paragraph 5.5).

2.6.8 Portable Fall Arrest System

2.6.8.1 Portable Fall Arrest System Anchor Post

Provide one portable fall arrest system anchor post. The anchor post must have the following features:

a. Three-stage, four-position telescoping design of aluminum design.

b. Provision of three independent swivel tie-off points, with horizontal lifeline attachment.

c. Base leveling screws allowing the system to be plumbed to vertical for working stability on inclines up to 15-degrees.

d. Designed for attachment to a uni-anchor mounting plate.

2.6.8.2 Anchor Post Accessories

Provide the following accessories with the portable fall arrest system anchor post:

a. Rescue Davit Arm, with quick mount winch and cable.

b. Carrying bag for the anchor post assembly.

c. Carrying bag for the Davit Arm with mounted winch.

2.6.8.3 Mounting Plates

Provide two portable fall arrest system anchor post mounting plates welded on the transformer covers, located so that the center of each manhole access cover is 36-inches from the mounting plate. The mounting plates must be designed for use with the portable fall arrest system anchor post indicated above.

2.6.9 Transformer Steel Bases

The transformers must be manufactured with an integral structural steel base designed for meeting the following requirements:

a. Suitable for resting on the existing concrete pedestals with steel caps as shown on supplemental drawings LGP-1-4-2/40, LGP-1-5-0/21, and I-003, Volume 1.

b. Capable of supporting the weight of the assembled and oil filled transformers on the existing concrete pedestals with steel caps.

c. Manufactured to be suitable for moving on rollers or skids when the transformers are completely assembled and filled with oil, permitting moving the transformers in a direction parallel to either centerline, with suitable pulling eyes provided.

d. Spare must directly bear on steel bearing plates of the storage structure and the foundation plates in operating locations. Provide at minimum provisions for six (6) 1-inch diameter anchors to be installed in the locations shown in the resource drawings and adequate clearance to install the anchors.

2.7 COOLING EQUIPMENT

2.7.1 Radiators

Provide transformers manufactured with radiators to cool the oil at a 164,000 kVA continuous load, without any cooling groups in operation. The radiators must meet the following requirements:

a. Located on the tanks to ensure uniform circulation of the oil through the windings, with valves installed on each connection to the main tanks so that the radiators may be removed for repairs without taking the transformers out of service.

b. Fully hot-dip galvanized on the outside and remain unpainted.

c. Designed and manufactured to withstand essentially full vacuum to permit filling of the transformers under vacuum with the radiators

in-place and radiator valves open.

d. Provisions for draining and venting each radiator, 1/4-turn ball valve for draining each radiator, and lifting eyes for handling.

e. The welding and fittings must be smooth, both inside and out, so as to present no obstruction to the flow of oil inside, with full penetration welds on the outside of the radiators such that there will be no crevices in which water might collect.

2.7.2 Cooling Fans

Provide Horizontal-draft cooling fans so that the continuous forced-air-cooled capacity of the transformers will be at least 218,666 kVA without exceeding the allowable temperature rise specified in paragraph "Ratings and Electrical Characteristics". Locate the cooling fans to direct the air stream against the radiator and to prevent recirculation of discharged air. Provide cooling fans that meet the following requirements:

a. Balanced cast aluminum fan blades.

b. Hot-dip galvanized steel basket-type fan blade guards.

c. Fan motors to have IP55 enclosure rating.

d. Fan motor housing painted with epoxy primer and aliphatic urethane top-coat.

e. Individual thermal overload protection with automatic-reset.

f. Fan motors with permanently lubricated, double-sealed ball bearings.

g. Fan motors with Class F insulation, Class B temperature rise.

2.7.3 Power Supply Equipment

The power supplies for fan motors will be Government-furnished, 480 V, three-wire, 3 phase, 60 Hz, as indicated on the contract drawings. Provide two 3-pole, 600 V, molded case circuit breaker of proper current rating in the power cabinet for the supply circuit.

2.7.4 Cooling Control Equipment

Furnish and install all necessary protective and control equipment for the fan motors in the control and power cabinets for each transformer (see paragraph "CONTROL AND POWER CABINET EQUIPMENT").

2.8 BUSHINGS

2.8.1 General Bushing Requirements

Provide transformers with one high-voltage, four low-voltage, and one neutral leads brought out from the tank through bushings as specified below. Bushings of the same voltage and current rating must be interchangeable and as applicable, conform to IEEE C57.19.00 and IEEE C57.19.01. All bushings must meet the following requirements:

a. Of recent manufacture and of a type and style currently being

manufactured.

b. Nameplate rated and tested for use at 60 Hz rated frequency.

c. Rated for outdoor service, with UV resistant, porcelain insulating sheds for bushings which will be exposed to direct sunlight.

d. Manufactured so that there will be no stressing of any parts due to temperature changes, and means provided to accommodate conductor expansion.

e. Gastight and oiltight when installed on the transformer tanks.

f. The power factor of each bushing must meet the requirements of IEEE C57.19.01, Table 6, or as otherwise specifically required herein.

2.8.2 High-Voltage and High-Voltage Neutral Bushings

The high-voltage and neutral bushings must be designed to withstand the standard withstand test voltages as indicated in Table 1 of IEEE C57.19.01, and tested in accordance with paragraph "Bushing Tests". Provide Hitachi Type O Plus C bushings that meet the following requirements:

a. Designed for use in an air-to-oil power transformer applications.

b. Manufactured with a normally grounded test tap.

2.8.2.1 High-Voltage Bushing Ratings

a. Insulation class, kV: 500

b. BIL rating, kV: 1,550

c. Minimum current rating, Amperes: 1,600

d. Creepage distance: Light contamination

e. Drawing number: T550W2000VV

2.8.2.2 High-Voltage Neutral Bushing Ratings

a. Insulation class, kV: 25

b. BIL rating, kV: 150

c. Minimum current rating, Amperes: 1,200

d. Creepage distance: Light contamination

e. Drawing number: T025W0412AT

2.8.3 Low-Voltage Bushings

Low-voltage bushings must meet the requirements of IEEE C57.19.01 (1991), and must be tested in accordance with paragraph "Bushing Tests". The bushings must be of solid bulk design of a low-corona design for vertical mounting, and the exterior shell above the mounting flange must be of porcelain design and formed in one piece. Fluoroelastomeric rubber gaskets must be used for the installation of all low-voltage bushings.

Provide Hitachi Type RJ Bushing that meet the following requirements:

a. Insulation class, kV: 25

b. BIL rating, kV: 150

c. Minimum current rating, Amperes: 10,000

d. Thermal rating, degrees Celsius temperature rise: 125

e. Drawing number: T025B1000DS

2.8.4 High-Voltage and Neutral Bushing Terminals and Connections

Provide high-voltage and neutral bushings with threaded copper terminal stud with dimensions in compliance with IEEE C57.19.01.

2.8.5 Core Ground Bushings

The transformers must be manufactured with two external bushings for core grounding; one for the main core connection to ground, and one for the core frame connection to ground. The bushings must be mounted adjacent to each other and located on the transformer tank covers, protected with a removable weatherproof metal cover with device nameplates. Provide bushings manufactured with an integral cast copper stud, with an insulating body of either epoxy or solid porcelain, and include a bolted-flange so that they can be removed for maintenance without having to enter the tank. The stud must be silver plated, with tapped holes for connection of removable grounding straps between the bushing bottom terminal and the core and tank wall. The minimum ground wire size from each bushing top terminal to the tank must be #4 AWG equivalent. The core ground bushings must have the following minimum nameplate ratings:

a. Insulation class, kV: 2.5

b. BIL rating, kV: 45

c. Minimum current rating, Amperes: 100

2.8.6 SFRA Test Shipping Bushings

For the purposes of performing SFRA testing with the transformers in the shipping configuration, each shipping cover installed after the bushings have been removed for shipment must include a bushing that is connected to the winding leads, so that the SFRA tests can be performed just prior to each transformer shipment and immediately after each transformer delivery to the Little Goose Lock & Dam "Storage Yard". This assembly permits the SFRA testing on the transformers without having to gain entrance into, or modifying the transformer shipping assembly. The winding leads must be appropriately braced inside the transformer tanks to assure there is no movement during shipment which could damage the bushings, or potentially alter the SFRA test results. During shipment, the external terminals of these bushings must be grounded to the tank. Testing must be performed per the requirements of paragraph "Sweep Frequency Response Analysis Tests". Each temporary SFRA Test Shipping Bushings must be of the same manufacture and rating as the core ground bushings.

2.8.7 Shipment

For bushings shipped separate from the transformers, each bushing must be crated and packed per the manufacturer's requirements in such a manner to protect the bushing from damage due to moisture, breakage and vibration damage during transit.

2.9 BUSHING-TYPE CURRENT TRANSFORMERS

All bushing-type current transformers must conform to the requirements of IEEE C57.13 and additional requirements in NEMA SG 4, and have revenue metering accuracy classifications as required in Table 6 of IEEE C57.12.10, unless otherwise specifically indicated. The continuous thermal rating factor must be a minimum of 1.33, based upon a 30 degree Celsius average ambient air temperature.

2.9.1 High-Voltage Bushing Current Transformers

Provide two 1200:5, multi-ratio bushing-type current transformers for each transformer high-voltage bushings.

2.9.2 Low-Voltage Bushing Transformers

Provide bushing current transformers on the low-voltage bushings as required for the winding temperature monitoring equipment.

2.10 LOW-VOLTAGE BUSHING HOUSINGS

Provide transformers that are manufactured with four low-voltage bushing housings as indicated on the contract drawings. Provide housings that bolt to the isophase bus housing and to the transformers. The Government will utilize the existing copper conductors to connect the bushing to the isophase bus when the transformers are installed. Provide a weather proof enclosure with an easy to remove cover that allows full access to the bushing and bus bars.

2.11 TRANSFORMER MOUNTED ACCESSORIES

2.11.1 General

Provide rugged outdoor sealed dials, indicators, and gages installed on the transformers with military connectors, tempered glass faces, stainless steel bezel, and stainless steel housings. Provide dials, indicators, and gages with capillary that have stainless steel armor. The dials, indicators, and gages must be mounted at a height of approximately 60 inches above the base of the transformers, unless otherwise indicated, and arranged for convenient reading standing at the level of the base. Provide the following accessory devices that are included in the price for the transformers, and meet the requirements of IEEE C57.12.10 (paragraph 5.1), unless otherwise indicated.

2.11.2 Liquid Level Indicator

Provide one magnetic-type liquid level indicator located on the tank sidewall, equipped with three circuit-closing low-level alarm contacts suitable for use with an ungrounded 125 V DC circuit. The indicator must have a 6-inch dial face with a field-replaceable case, with the dial marked to indicate the 25 degrees Celsius oil level and the maximum and minimum oil levels.

2.11.3 Thermowells

Provide a total of five top oil thermowells and one bottom oil thermowell housed in weatherproof enclosures, with functionality as indicated on Contract drawing E-109 for each transformer. The thermowell locations must be designed such that they are always submerged in the insulating oil during transformer operation. Thermowells must be provided for the following:

a. One thermowell for use with the analog liquid temperature indicator, located on the tank sidewall near the top oil level in the path of the hottest oil.

b. Two thermowells for use with the analog winding temperature indicators, one for each low-voltage winding, located on the tank sidewall near the top oil level in the path of the hottest oil.

c. Three spare thermowells with NPT plugs. One must be for future use with a transformers temperature monitor for top oil temperature, located on the tank sidewall near the top oil level in the path of the hottest oil. One must be for future use with the transformer temperature monitor for bottom oil temperature, located on the tank sidewall.

2.11.4 Analog Temperature Indicating Equipment

The analog indicating equipment must be located on the tank sidewall as shown on the Contract drawings, with functionality as indicated on the control schematics.

2.11.4.1 Liquid Temperature Indicator

Provide one dial-type indicating thermometer for liquid temperature indication with a bourdon-tube sensing element for each transformer. The dial indicator must cover a range of 0 to 120 degrees Celsius and be equipped with two adjustable circuit closing alarm contacts suitable for use with an ungrounded 125 V DC circuit. One switch contact must be used for top oil over-temperature alarm set at 90 degrees Celsius.

2.11.4.2 Winding Temperature Equipment

a. General: Provide Two winding temperature indicators (WTI), with associated equipment, for use in remote indicating of the temperature of each low-voltage winding (X and Y), and for use as an over-temperature trip backup to the future transformer temperature monitor for each transformer. The WTI equipment must be responsive to the current in the phase winding and to the top oil temperature, indicating the approximate hot-spot temperature of the winding, and provided with a means for calibration. Each WTI must include the following:

(1) A bourdon-tube sensing element located in the thermowell for operation of a dial indicator.

(2) A current transformer installed at each low-voltage winding which supplies current to a balancing autotransformer, proportional to the transformer load.

(3) A means for calibration connected each low-voltage winding current transformer and the thermowell heaters.

(4) Thermowell heating elements powered from the current balancing autotransformer, which simulates the winding temperature rise by adding the rise from the heating elements to the top oil temperature.

(5) An ungrounded three-wire 100-ohm platinum resistance temperature detector, which will be used with existing remote temperature recording or logging.

b. Dial Indicator and Switches: The WTI must have four electrically-independent, self-resetting contacts suitable for use on 125 V ungrounded dc circuits. Three switch contacts must be used as follows:

(1) One switch contact for cooling fan control. The setting of this contact is to be determined based on the results of the factory temperature rise tests.

(2) One switch contact for winding over-temperature alarm , set at 110 degrees Celsius.

(3) One switch contact for winding over-temperature trip set 117 degrees Celsius.

c. Leads: The leads from the WTI equipment must be routed through watertight and oiltight conduit fittings, and terminated in the transformer control cabinets. The connecting leads between the RTD elements and control cabinet terminal blocks must be soldered.

2.11.5 Rapid Pressure Rise Relay

Provide a rapid pressure rise relay and all connecting hardware required for each transformer. The rapid pressure rise relay must be designed for operation in oil space and have the following features:

a. Cunstructed with a die cast aluminum housing with ANSI 70 epoxy paint coating and an IP65 rating, designed for horizontal flange mounting.

b. Ambient operating range from -40 degrees Fahrenheit to 180 degrees Fahrenheit.

c. Rated pressure range of -14.7 to 20 pounds per square inch gauge.

d. A snap action, SPDT switch rated for 1/2 amp at 125V DC (resistive).

e. Military connector assembly with cable grip parts provided. Type SOOW, 16 gauge, 3 conductor cable to be provided and custom fit on-site at an estimated length of 40 feet (to be field verified by contractor).

2.11.6 Rapid Pressure Rise Seal-In Relay

Provide a rapid pressure rise seal-in relay rated for 125V DC operation to latch in the momentary switch actuation from the existing rapid pressure

rise relay, to be installed in the transformer control cabinets, with the following features:

a. Designed specifically for use as a seal-in relay for the rapid pressure rise relay

b. LED Status indicating light and an LED Trip indicating light.

b. Two output relays with contacts rated for 8A at 250 Vac.

c. Reset button to unlatch the relays.

d. Redundant make/break circuit requirements that protect against false trips.

e. Surrounding air temperature range of -49 degrees Fahrenheit to 158 degrees Fahrenheit.

2.11.7 Pressure Relief Device

2.11.7.1 General

Provide each transformer tank with a self-resetting, mechanical-type high-flow pressure relief device mounted on the tank cover to automatically relieve internal pressure, and to protect the tank against rupture due to arcing below the surface of the oil. One pressure relief device must be provided for a volume of insulating oil contained within the main tank of less than 10,000 gallons, and two pressure relief devices must be provided for a volume of oil greater than 10,000 gallons. The relief device must be capable of withstanding full vacuum without rupture or loss of accuracy, designed to minimize oil discharge during operation, and to exclude air and water after it opens. It must be equipped with a metal semaphore-type visual indicator and an alarm contact suitable for operation on a 125 V DC ungrounded circuit. The pressure relief device must have an oil-directed cover.

2.11.7.2 Oil Discharge Piping

Provide metal discharge piping for directing the oil discharged from the pressure relief device to the base of each transformer tank that is sized to match the discharge outlet of the pressure relief device. The discharge piping must extend to approximately 24-inches above the base of the transformers, with mounting supports to the transformer tanks not spaced more than 36 inches apart, and the piping outlet provided with a screen with a maximum hole size of 1/8-inch to discourage entry by animals, birds, and insects. The manufacturing details of the oil discharge piping must be included in the manufacturer's shop drawings.

2.11.8 Gas and Oil Actuated Relay (Buchholz)

If providing a conservator tank system of oil preservation, each transformer must be provided with a gas and oil actuated relay (Buchholz relay) located in the pipe connecting each transformer tank to the constant-pressure, reservoir tank. The relay must conform to the requirements in this paragraph. Pipe-work must be so arranged that all gas arising from the transformers must pass into the relay, and the size and arrangement of pipe-work must conform with the recommendations of the relay manufacturer. A flanged, flexible section of oil pipe must be provided between the Buchholz relay and the transformer tanks. The relay

must have the following features:

a. Provide a relay that is manufactured of a corrosion-resistant, oil-tight alloy casting, have flanged housing connections, and must have graduated inspection glass windows that enable the volume of gas and the contact system to be inspected.

b. Two floats (one for gas accumulation and one for low oil level) and one flap with counterbalance weight for the detection of oil speed.

c. A push-button for testing the relay electric circuits.

d. A pneumatic test device.

e. The relay must have independent alarm contacts wired back to the transformer control cabinets that close on collection of gas or at low oil level, and contacts that close following an oil surge. Mercury-based contacts will not be acceptable. The normally-open, electrically separate alarm and tripping contacts must not be exposed to oil, and must have a rated nominal current of 2A a.c./d.c. and a rated nominal voltage of 240V a.c./d.c.

f. Operation of the relay must be immune to seismic disturbances.

2.11.9 De-Energized Tap Changer Control

Provide each transformer with an external, manually operated tap changer for changing connections to the taps in the high-voltage windings when the transformers are de-energized. The tap changer control must have the following features:

a. Include an operating hand wheel, indicating pointer and dial, and means for locking the tap changer in any desired tap position.

b. The operating hand wheel must be mechanically interlocked with the tap mechanism to prevent its removal when the mechanism is not in a completed tap position.

c. Transmission of motion from the operating hand wheel shaft to taps by interaction of rigid members.

d. The tap changing mechanism must render it impossible to leave a winding open or short circuited when the operating wheel is placed in a locked position.

2.11.10 DGA Mounting Brackets

Provide mounting brackets for installation of a future on-line DGA monitor. Mounting brackets should have multiple holes to accommodate positioning of future upper and lower unistrut mounting brackets to accommodate a DGA monitor that the Government will procure in the future.

2.11.11 Contacts and Devices

The contacts of all relays, gages, and thermometers must be insulated from ground and must be of a positive snap-action type. Alarm contacts must be suitable for operation on 125 V DC ungrounded circuits and rated 0.5 amperes (resistive) at 125 V DC.

2.12 INSULATING OIL

2.12.1 Quantity and Transformer Oil Certification

Provide all the oil required to fill the transformers to the proper operating levels at Little Goose as well as the oil required for factory tests. Submit for approval the transformer oil certification documents prior to prior to the factory tests and delivery of the transformer oil to the Little Goose Lock & Dam "Storage Yard", indicating that the oil furnished for placing the transformers in service will meet the requirements specified below.

2.12.2 Type of Oil

The grade of insulating oil furnished must be unused, produced from a naphthenic base crude petroleum specifically prepared and refined for use in electrical equipment as an insulating and cooling medium. Paraffinic and Paraffinic-blends are not acceptable. Except for the oxidation inhibitor, the insulating oil must be free from additives of every kind, either natural or synthetic in any quantity, such as silicone or ester oil contamination from hoses or processing equipment.

2.12.3 Chemical, Physical and Electrical Characteristics

The insulating oil provided must have all tests performed per the requirements of ASTM D3487, Table 1, Type II, with an oxidation inhibitor content of between 0.25 and 0.30 percent by mass, prior to shipment.

2.12.4 Sampling

Samples for testing must be obtained as specified in ASTM D923.

2.12.5 Testing

Chemical, physical, and electrical tests must be conducted by the Contractor in accordance with the test methods listed in ASTM D3487, Table 1. A PDF copy of the test reports must be submitted for approval prior to shipment of the oil.

2.13 OIL PRESERVATION SYSTEM

2.13.1 General

Provide transformers with either an inert-gas pressure system or a constant oil pressure system. Any oil preservation system provided must meeting the dimensional requirements shown in the Contract drawings.

2.13.2 Inert-Gas Pressure System

2.13.2.1 General

An inert-gas pressure system is the preferred oil preservation system. If the transformers are provided with an inert-gas pressure system, the system must conform to all the requirements listed in section "Inert-Gas Pressure System." The system must consist of a nitrogen cylinder regulator enclosure that holds two cylinders, one of which is connected to the single regulator and supplies the blanket space and all associated stainless-steel piping and two 1/2-inch stainless-steel ball valves located at the top of the tank for connection of the nitrogen piping. The

nitrogen gas must be supplied from the high-pressure cylinders through a pressure regulator, conforming to the requirements of IEEE C57.12.00 paragraph 6.6.3. Two cylinders of nitrogen gas must be furnished with the transformer for use with the regulating equipment and must remain the property of the Government.

2.13.2.2 Additional Gas Space

Use the vacuum bracing, and, if required, an additional external gas expansion tank to implement the inert-gas pressure system.

2.13.2.3 Pressure Regulating Equipment

The pressure regulator must be of a make and type which has been in successful operation with transformers for a period of not less than five years. All fittings and tubing for nitrogen connections between the pressure regulating equipment and the transformer tanks must be furnished with the transformers, and must be stainless steel flex tubing manufactured at the correct length for the routing and application with integral screw-on fittings, and matching terminations. The tubing must be anchored to the transformer tanks along its length a maximum of every 36-inches. The pressure regulating equipment must maintain the transformers' nitrogen pressure as follows:

a. Low pressure regulator: 0.5 psi

b. High pressure regulator: 5.0 psi

c. Pressure relief valve: 6.5 psi

2.13.2.4 Alarm functions

Alarm contacts suitable for use on a 125 V DC ungrounded circuit, wired back to the control cabinet to indicate the following:

a. Empty cylinder alarm: 200 psi

b. Low pressure alarm: 0.25 psi

c. High pressure alarm: 8.5 psi

2.13.2.5 Enclosure

A NEMA 3R rated steel enclosure mounted as low as possible on the transformer tanks containing the gas cylinders and pressure regulating equipment, meeting the requirements of NEMA 250 with the following features:

a. A gasketed window permitting viewing of the gauges without opening the door.

b. A removable stainless steel floor with a 'lipless' threshold.

c. A means for locking of the door.

d. A door activated light.

e. A thermostatically controlled heater.

f. A GFCI outlet.

g. The enclosure must be grounded to the transformer tanks by means of a bonding jumper.

2.13.2.6 External Gas Expansion Tank

If required to implement the inert-gas oil expansion tank, provide an external gas expansion tank located as indicated on the contract drawings.

2.13.3 Air Cell, Constant-Pressure, Reservoir Tank System

2.13.3.1 General

If the transformers are provided with a constant oil preservation system of oil preservation, the system must conform to all the requirements listed in section "Air Cell, Constant-Pressure, Reservoir Tank System." The system must consist of one oil reservoir mounted on the transformer tanks, with the location and height coordinated with the high-voltage bushing turrets. The dimensions of the transformers must fit within the dimensional requirements shown in the Contract drawings. The tanks must also meet all electrical clearances as required in IEEE 1427 from the high voltage equipment when installed in place. The reservoir tank must be designed for full vacuum during vacuum treatment and oil-filling, with valves provided for equalizing the pressure to the air bladder during these processes. The reservoir must be provided with a sump chamber to collect any impurities, and a minimum of two locations within the tank for suspending the air bladder, other than the flanged air vent connection. The reservoir liquid level indicator must be arranged to close the set of low-level alarm contacts when the oil level becomes too low or the air bladder sinks.

2.13.3.2 Air Bladder

The oil reservoir must contain an air bladder arranged to prevent direct contact between the oil and air. The air bladder material must be nylon-impregnated nitrile rubber designed for long life and for service in contact with hot oil, and must include a minimum of two integral straps used for suspending the air bladder from the inside top of the reservoir tank. The air bladder must be vented through a weather-tight maintenance-free electronic dehydrating breather provided with a suitable desiccant. Dimensions and drawings of the air bladder must be included in the descriptive data.

2.13.3.3 Maintenance-Free Dehydrating Breather

Provide one maintenance-free dehydrating breather designed for a generator step-up transformer less than or equal to 200MVA for each conservator tank, utilized for removing atmospheric moisture from the air drawn into the reservoir tank air bladder, must be located on the transformer tanks at a height of approximately 48 inches above the base of the transformers. The hygroscopicity must be based upon a silica gel and sensor-controlled heated high-grade steel filter. During normal operation, the silica gel dries the air entering the piping to the reservoir tank. When the relative humidity exceeds a selected value, the self-regulating heating element inside the dehydrating breather is activated, and extracts moisture from the silica gel, which condenses and drips out of the filter system. The vent piping connecting the oil reservoir air bladder to the maintenance free dehydrating breather must be

metal, of 1-1/2-inch minimum diameter, and galvanized inside and out to help reduce corrosion. Provide a maintenance free dehydrating breather with the following characteristics:

a. Visual sight inspection glass.

b. Sealed control housing suitable for outdoor operation.

c. Designed for ambient temperature operation between -40 and 80 degrees C.

d. Status indicators for Power On, Heater On, and Device Malfunction, with one normally closed contact for Device Malfunction annunciation.

e. Supply voltage of 120 V AC - 240 V AC, 60 Hz

f. Filter heating system

g. Test button

h. Analog output: 4-20 mA

2.14 TRANSFORMER CONTROL AND POWER CABINETS

2.14.1 General

Provide the transformers with control and power cabinets, mounted on the transformers' Segment 3 tank sidewall, as indicated. The fabrication and assembly of each cabinet must conform to the requirements of UL 508, UL 508A, and NEMA 250. The cabinets must be manufactured such that all 480 V AC wiring and equipment reside only in the power cabinet, and the control cabinet only includes wiring and equipment at maximum operating voltages of 125 V DC or 120 V AC. The cabinets must have the following features:

a. Environmental enclosure rating of NEMA Type 4.

b. Fabricated out of type 304 stainless steel that will remain unpainted on the exterior.

c. No. 12 Manufacturer's Standard Gage minimum thickness.

d. Rainproof enclosure vents of NEMA Type 3R construction, installed on the control cabinet enclosure back panel.

e. Bundled wire runs within the cabinet, routed through low-smoke, halogen-free wiring duct with slotted walls and interior corner guards to protect the wiring.

f. "Piano-hinges" will not be acceptable for cabinet doors.

g. Cabinet interiors powder-coated white.

h. Solar shielding provided on the top, front and side panels of the enclosures, with cut-outs as required for the enclosure door viewing windows.

i. Door handles provided with provisions for locking, with all doors keyed the same.

j. Ground bonding jumper from each cabinet to the main transformer tanks.

2.14.2 Cabinet Mounting and Conduit Interface Provisions

The control and power cabinets must be configured as indicated on the contract drawings. Provide a structural steel framework for mounting the control and power cabinet assemblies to the transformer tanks' cabinet mounting frame rails, utilizing vibration isolation mounts. The vibration isolation mounts must be natural rubber with integral mounting stud provisions, sized for the maximum anticipated load of the cabinet assembly, and be a standard commercially available product for the purpose. Removable, gasketed plates must be provided in the bottom of the control and power cabinets, to which the external conduit connections to the Project will be installed. All wire and cable entering the control and power cabinets must be through conduit, and all conduit connections to the cabinets made through the base bottom plate of the cabinets.

2.14.3 Control Cabinet Requirements

Provide control cabinets with device layouts must be as indicated on contract drawings, and have the following features:

a. Devices mounted on the back of hinged panel doors that are not visible from the panel door fronts mounted such that device mounting screws do not penetrate the panel doors.

b. Provide windows in the control cabinet doors made of tempered glass, utilizing Claytonrite style rubber seals installed with silicone sealant so as to provide a waterproof installation.

c. Provide a 2-inch diameter wiring access hole between the power and control cabinets near the base of the cabinets, with protective bushings, for the routing of 120 V ac power from the control cabinet to the power cabinet for heaters and lights, and the permissive wiring to fan contactors..

d. Provide terminal blocks and wiring layouts such that all wiring for interconnection to the Project are located in the same vicinity near the base of the cabinet.

e. Provide two internal swing-panels for future installation of the transformers temperature monitor controls and annunciators.

f. Provide a 90-degree hinged, fold-down computer tray on the inside of the control cabinet door, with a means of securing the tray in the upright position.

2.14.4 Power Cabinet Requirements

Provide all 480 V AC protective and control equipment for the cooling fans, including the molded-case circuit breakers, contactors, and power terminal blocks in each transformer's power cabinets, as indicated, conforming to the applicable requirements of NEMA ICS 2. The 480 V AC Government power supply will route through conduit connected directly from the Project to the base of the power cabinet, as indicated on contract drawings.

2.14.5 Device Nameplates

Provide an engraved nameplate for each item mounted in the transformer control and power cabinets that are comprised of anodized aluminum or stainless steel, engraved and provided with black lettering. Each nameplate must be fastened to the panels in proper locations, with either corrosion-resistant black finished round head screws, or on screw posts with corrosion-resistant black finished nuts. Nameplates must not be fastened to the wire ducts or duct covers. Labeling and marking must meet the requirements of UL 969, paragraph 7.3, "Marking and labeling systems for hazardous locations products".

2.15 CONTROL AND POWER CABINET EQUIPMENT

2.15.1 Cooling Control Equipment

2.15.1.1 General

The control equipment must be fully automatic, and manufactured to start and stop the fan motors as each transformer's winding temperature requires. The controls must de-energize all fans in the event of a transformer shutdown operation, as indicated. Provide additional circuit breakers for branch circuit protection of cooling circuits as required. All cooling control equipment must meet the applicable requirements of the NFPA 70.

2.15.1.2 Stages of Cooling

The cooling control circuits must provide for the following:

a. Provide transformers that are self-cooled through natural convection of the oil with no cooling fans in operation, capable of operation at the 100% base nameplate rating (ONAN) without exceeding the maximum allowable temperature rise.

b. Provide a winding temperature indicator fan contacts to activate the forced-air cooling group when the transformers are operating at a winding temperature corresponding to a load equal to the 100% self-cooled (ONAN) rated condition, as obtained during performance of the factory temperature rise testing.

c. When the maximum safe winding temperature for continuous operation has been reached, the winding temperature indicator alarm contact must provide an alarm for "Winding High Temperature" indication. This winding temperature setting must be at 110 degrees-C.

d. When the maximum allowable winding temperature has been reached, the analog winding temperature indicator must initiate a transformer shutdown utilizing the lockout relay in the powerhouse and set at a temperature of 117 degrees-C.

2.15.2 Transformer Fiber-Optic Probes and Connectors

Fiber optic probes must be installed in each transformer's windings and terminated at the fiber-optic feed-through plate interface on the tanks for future use with a temperature monitor. The fiber-optic probes must be made of non-conducting materials allowing for them to be immersed in oil and held in close contact to transformer windings for direct accurate measurement of temperature. Provide probes, connectors and their

installation that meet the following requirements:

a. Provide probes that function based on the principles of Gallium Arsenide (GaAs), be capable of measuring transformer temperatures from -40 degrees Celsius to 200 degrees Celsius.

b. The fiber-optic jacket must feature a continuous slit to allow for complete oil immersion.

c. Utilize Fiber-optic feed-thru connectors at a tank wall plate, for connection of the internal fiber-optic probes to the fiber-optic extension cabling.

d. Feed-through connectors with internal sealing using glass metal soldering.

e. Stainless steel tank wall plate interface for the feed-thru connectors, including a removable, weatherproof cover.

f. Provide 2-inch conduit from the feed-through wall plate interface down to the control cabinets for routing of fiber-optic extension cables.

g. Provide the necessary extension cables from the wall plate to the control cabinets.

2.15.3 Auxiliary Power Transformer

The auxiliary power transformer must have 480 V AC primary - 120 V AC secondary, single-phase, conforming to the requirements for general purpose transformers in UL 508, and must be mounted on the transformer tanks adjacent to the power cabinet, as indicated. The auxiliary transformer will be used to power all AC circuits rated below 480 VAC as indicated. The Volt-Ampere capacity must be coordinated with the connected control circuits, and indicated on the shop drawings. The auxiliary power transformer must have the following characteristics:

a. Isolating transformer design, with an electrostatic shield

b. Housed in a NEMA Type 3R rated enclosure

c. Manufactured with all copper windings with a 200 degrees-C rated insulation system

d. Finger-safe terminals

2.15.4 Magnetic Contactors

The rating, performance and service characteristics must conform to the requirements of NEMA ICS 2 for contactors with continuous current ratings for the duty indicated. Contactors for motor control must be rated for full-voltage starting (Class A controllers). Provide NEMA Size 2 contactors as a minimum, and must be rated for at least 200,000 complete operations under rated load without more than routine maintenance. The interruption arc and flame must be minimized by suitable arc chutes or other means so that no damage will be done to other portions of the device. The arc chutes, if provided, must be easily removable without removing or dismantling other parts. The contacts must be easily removable. All current-carrying contact surfaces must be silver-surfaced

or of other approved material to prevent the formation of high resistance oxides. The contactor must operate without chatter or perceptible hum while energized. Coils must be rated for continuous operation for 120 V ac circuits. Alternating-current contactors must be three-pole, except where otherwise noted, and must be insulated for 600 V ac and of the electrically-operated, magnetically-held type.

2.15.5 Molded-Case Circuit Breakers

2.15.5.1 General

Provide Molded case circuit breakers that are listed to UL 489, and have voltage ratings and interrupting ratings hereinafter stated. They must be the manually-operated, quick-make, quick-break, automatic-trip, bolt-in, heavy-duty, industrial type. All poles of each breaker must be operated simultaneously by means of a common handle, and must be enclosed in a common molded plastic case. Single pole trip units with handle ties are not permitted. The operating handles must clearly indicate whether the breakers are in "On," "Off," or "Tripped" position. Miniature circuit breakers, circuit breakers listed for residential and commercial use, and plug-in type breakers are not acceptable.

2.15.5.2 Trip Units

The circuit breakers must be of the automatic type provided with combination thermal and instantaneous magnetic or solid state trip units, with instantaneous trip units set at approximately 10 times the continuous ratings of the circuit breakers. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval.

2.15.5.3 480 V AC Circuits

Circuit breakers for 480 V AC circuits must be rated 600 V AC, and have a minimum interrupting capacity of 18,000 Amperes at 480 V AC, and must come equipped with an integrated trip-handle padlocking provision.

2.15.5.4 120 V AC Circuits

Circuit breakers for 120 V AC circuits, must be rated not less than 250 V DC, and either 120/240 or 240 V AC, with a minimum NEMA interrupting capacity of 10,000 Amperes symmetrical.

2.15.5.5 125 V DC Circuits

Circuit breakers for 125 V DC circuits must be of the heavy duty type conforming to the applicable requirements of UL 489, rated for not less than 125/250 or 250 V DC operation with a minimum NEMA interrupting capacity of 10,000 A dc.

2.15.6 Control and Instrument Switches

Control and instrument switches must be of the rotary switchboard type with handles on the front and the operating mechanisms on the rear of the panels, and have the following features:

a. Suitable for operation on 600 V AC or 250 V DC circuits, capable of satisfactorily withstanding a life test of at least 10,000 operations at rated current, and capable of continuously carrying 20

Amperes without exceeding a temperature rise of more than 30 degrees Celsius above ambient.

b. Provided with ample contact stages to perform the functions of the control system.

c. Self-aligning contacts which operate with a wiping action.

d. A positive means of maintaining high-pressure on closed contacts.

e. Compression springs or pivoted joints must not be depended upon to carry current.

f. The covers or plates on the switches must be readily removable for inspection of contacts.

g. A single-breaking inductive load minimum interrupting rating of 1.5 Amperes for 125 V DC, or 10 Amperes for 120 V AC.

h. An escutcheon clearly marked to show each operating position, with the switch identifications engraved on the escutcheon plate and on a separate nameplate.

2.15.7 Terminal Blocks

Provide terminal blocks for control signal and current transformer secondaries with the following features:

a. Washer-head screw type, designed for connection of two No. 10 AWG conductors to each terminal.

b. Rated, at minimum, for 90 degree C terminations.

c. White or other light colored marking strips for circuit designation, with each connected terminal of each block having the circuit designation or wire number indicated on the marking strip with permanent marking fluid. One reversible or spare marking strip must be furnished with each terminal block.

d. Terminal blocks provided to terminate all external cables, containing at least two spare terminals, or 10 percent of total terminals as spares, whichever is greater, per terminal block.

2.15.7.1 Control Signal Type

Provide terminal blocks for control wiring, with a sliding link disconnect molded or fabricated type with barriers, rated not less than 600 volts with 30 Ampere capacity.

2.15.7.2 Short-Circuiting Type

Provide dedicated short-circuiting type terminal blocks for each current transformer's secondary leads, which will allow for shorting together the secondary leads of the current transformers without opening any circuit.

2.15.7.3 Power Distribution Blocks

Provide power distribution blocks to be used for branch circuits and feeders 600 volts and less with wire size #12 AWG and larger. Power

distribution blocks must have lugs suitable for copper conductors, must be two-pole for single-phase circuits (phase and neutral conductors, or two phase conductors), and three-pole for three-phase circuits (three phase conductors).

2.15.8 Fuses and Fuseholders

Provide Class J fuses meeting the requirements of UL 248-8, rated for 600 V AC operation, and be dual-element with a 10 second time-delay at 500 percent overload. Provide Class J fuseholders, meeting the requirements of UL 4248-8, and be of a finger-safe modular type, consisting of a removable fuse carrier which allows fuse replacement away from the base.

2.15.9 Lighting, Convenience Receptacle, and Cabinet Heaters

Provide cabinet lighting, convenience receptacle and heaters that have the following features:

a. Lighting consisting of 120 V AC Size A19 LED bulbs with a medium E26 base, each with integral heat sink and 800 Lumens minimum output, complete with industrial grade socket with bulb safety cage, wiring, and door-activated switches.

b. Provide a 125 V AC, 3-wire, 20 Ampere, hospital grade GFCI type receptacle for the inside the control cabinet.

c. Provide industrial grade enclosure heaters in each cabinet to prevent condensation when the outside temperature is as low as -25 degrees Celsius, while maintaining a minimum interior cabinet temperature of 10 degrees Celsius. The enclosure heaters must be mounted on the cabinet side panels towards the bottom, and be of a touch-safe, positive temperature coefficient (PTC) resistor type with an integral fan. The heaters must have a rated operating voltage of 120 V AC, and be thermally sized for the cabinet volume in which they are installed. Submit for approval the Cabinet heater sizing calculations, with considerations given to cabinet sizing and material. Provide a separate humidity and temperature control device which controls the cabinet heaters and independently monitors the relative humidity and enclosure temperature, which have the following characteristics:

1) Temperature setting range: 0C - 60C
2) Relative humidity setting range: 50% - 90%
3) Operating voltage: 100 VAC - 240 VAC
4) Switching relay output (minimum): 10A resistive, 1.6A inductive @ 240 VAC
5) Inrush current (minimum): 30A for 10 sec
6) Heaters set at 20 C
7) Humidistat set to 20% relative humidity

2.16 INSULATED WIRE AND CABLE

Provide all insulated wire and cable that conform to the requirements of Section 26 05 19.00 26 INSULATED WIRE AND CABLE.

2.17 CONDUIT SYSTEMS

2.17.1 General

Run all wiring from the transformer devices and accessories listed below in rigid galvanized steel conduit greater than 1-inch in diameter, installed plumb and level, and terminated at devices, connection boxes and at the control cabinet using fittings suitable for wet locations. Conduit runs used on the transformer tanks' cover must be installed so as to help maintain an obstruction-free walking surface. The conduit systems must be electrically continuous and all threaded joints must have the threads coated with an approved high temperature lithium based, anti-galling conductive joint compound, rated for -70 degrees-C 1800 degrees-C, such as Crouse-Hinds Type HTL high temperature thread lubricant. The use of PTFE (polytetrafluoroethylene) tape at conduit threaded joint connections will not be allowed. Conduit threads must be tapered, and no running threads will be allowed. Conduit runs must be deburred and cleaned of shavings and debris prior to the routing of wire and cable.

2.17.2 Corrosion Protection

Provide conduit, conduit fittings, conduit bodies, and conduit outlet boxes made of ferrous metal materials that is hot-dip galvanized in accordance with ASTM A123/A123M and ASTM A153/A153M.

2.17.3 Conduit and Fittings

a. Rigid Metal Conduit. Provide rigid metal conduit that is zinc-coated both inside and outside by the hot-dip galvanizing method, conforming to the requirements of ANSI C80.1.

b. Rigid Metal Conduit Fittings. Provide threaded fittings for rigid conduit that is made of solid zinc or malleable iron conforming to the requirements of UL 514B and/or NEMA FB 1. Malleable iron fittings must be zinc-coated both inside and outside by hot-dip galvanizing method, with hubs having a grounding screw on the locknut.

c. Liquid-Tight Flexible Metal Conduit. Provide liquid-tight flexible metal conduit that is made from steel strip that is zinc-coated by the hot-dip galvanizing method with a water-proof extruded PVC cover conforming to the requirements of UL 360. The liquid-tight flexible metal conduit must have either have an integral bond wire or be an interlocked design with no bonding wire. Lengths of liquid-tight flexible metal conduit connections to equipment must not exceed 36-inches, and must be securely fastened to the transformer tanks.

d. Liquid-Tight Flexible Metal Conduit Fittings. Provide fittings for liquid-tight flexible metal conduit that is made from steel or malleable iron with a zinc coating and positive bonding, conforming to the requirements of UL 514B.

2.17.4 Conduit Bodies

Provide conduit bodies and covers that meet the following requirements:

a. Be made from malleable cast iron, be corrosion resistant and UL listed.

b. For the purposes of mechanical and environmental integrity, all

conduit bodies must be raintight and suitable for use in hazardous locations, conforming to UL 1203 installed in outdoor locations subject to adverse environmental conditions.

c. Conduit body covers must attach to the conduit bodies that come with a neoprene gasket, and be attached by screw connections.

d. Provide conduit bodies for use in locations to provide for change in conduit direction, access to conductors, and as pull boxes.

2.17.5 Conduit Outlet Boxes

Provide conduit outlet boxes and covers that meet the following requirements:

a. Be made from malleable cast iron, be corrosion resistant and UL listed.

b. For the purposes of mechanical and environmental integrity, all conduit outlet boxes must be raintight and suitable for use in hazardous locations, conforming to UL 1203 installed in outdoor locations subject to adverse environmental conditions.

c. Provide conduit outlet boxes and covers made from malleable cast iron with externally threaded body and internally threaded cover. All conduit entrances must be bossed, drilled, and tapped with tapered NPT threads. Conduit entrances must be located on the bottom or sides of the box to the greatest extent possible to prevent the ingress of water. If required, outlet and junction boxes must be equipped with external mounting lugs.

2.18 SPARE PARTS

Provide all spare parts that are duplicates of the original parts furnished and interchangeable therewith. Furnish the following spare parts, and submit for approval a spare parts list, indicating the quantity furnished, manufacturer, catalog or model number, and the retail cost of each item in US Dollars.

a. One complete set of all gaskets needed to seal all openings into the transformer tanks at the cover, manholes, handholes, openings for accessory devices, openings for each type bushing, and pipe connections for radiators.

b. One complete set of all gaskets required to replace the shipping gaskets, for use during final assembly of the transformers.

c. One complete relay and contactor of each type and rating

d. One pressure relief device (Qty. 1)

e. One liquid level indicator (Qty. 1)

f. One winding temperature indicator (Qty. 1)

g. One oil temperature indicator (Qty. 1)

h. One bushing current transformer, of each type and rating

i. One rapid pressure rise relay and seal in relay (Qty 1)

j. Two fans, complete with motors, cables and connections (Qty. 2)

k. One crated radiator complete with inlet and outlet isolating valves, vent and drain valves, and blank flanges (Qty. 1)

l. Three fiber-optic extension cables that connect from the feed-through wall plate to the control cabinet (Qty. 3)

m. One fuse of each type and rating

n. One pressure regulator for nitrogen-gas equipment (Qty. 1) (if supplying nitrogen blanket type oil preservation system)

o. One Buchholz Relay (Qty.1) (if supplying a COPS type oil Preservation system)

p. One spare valve of each type and size

2.19 NAMEPLATES

Transformer nameplates must be Type 316 stainless steel, with the information chemically etched then filled with baked enamel paint.

2.19.1 Transformer Nameplate

Each transformer nameplate must conform to the requirements of IEEE C57.12.00, Table 6, and also include the following information:

a. Government contract number

b. Transformer X/R ratio

c. Estimated weight of the insulation system

d. The nameplate or an adjacent nameplate must also include the following information for each current transformer furnished: the accuracy class, the primary and all secondary ampere ratings, the thermal rating, and identification of the terminals to which the current rating applies.

2.19.2 Lifting Nameplate

Provide a lifting diagram nameplate mounted on each transformer, adjacent to the transformer nameplate showing the following:

a. Various sling and lift positions required for proper lifting of the core and coil assembly.

b. Lifting or jacking the completely assembled transformer.

c. The overall height required for untanking.

d. Indication that the transformers can be lifted or jacked when filled with oil.

2.19.3 Device Nameplates

Provide nameplates for the following devices that are mounted on each transformer. The nameplate must be permanently affixed onto a bracket adjacent to the device.

a. High-voltage bushings (H1, H0)

b. Low-voltage bushings (X & Y)

c. Core ground bushings

d. Center of gravity markers

e. Winding temperature indicator

f. Oil temperature indicator

g. Thermowells

h. Valves

2.19.4 Additional Transformer Identification

Provide the following additional transformer identification for each transformer:

a. The transformers serial number welded onto the tank, or on the face of the jacking pad nearest the main drain valve, with letters approximately 1-inch in size.

b. The location of the centers of gravity (c.g.) of the completely assembled transformer filled with oil, and for the shipping configuration without oil, permanently marked with weld-on nameplates or tags on two adjacent sides of the transformer tank and identified "c.g. complete" and "c.g. for shipment".

c. Stamping of the serial number on the core frame structure or into the tank immediately adjacent to the transformer nameplate.

d. The 25 degrees Celsius operational oil level must be indicated on the outside of the tank sidewall by either a raised surface weld bead with contrasting paint color, or with an etched nameplate permanently affixed to the tank wall.

PART 3 EXECUTION

3.1 TRANSFORMER DESIGN DATA REVIEW MEETING

3.1.1 General

Conduct a transformer design data review meeting at the transformer manufacturing facility, with representatives of the Contractor, transformer manufacturer, and the Government representative in attendance, not later than 120 days after contract award. Provide the notification of the date of the transformer design data review meeting, the location, the duration, and the proposed agenda. Notification must be no less than 30 days in advance for domestic travel in the US and 60 days in advance for travel outside the continental US. The intent of the design data review

meeting is to:

a. Meet with the manufacturing personnel and tour the manufacturing facility.

b. Discuss the technical specifications which address transformer manufacturing, testing, and shipment.

c. Perform a design data review with transformer manufacturing engineers and key personnel.

3.1.2 Design Data Review Meeting Requirements

The purpose of the design data review portion of the meeting is to help assure prior to official submittals that the key elements of the transformer specification requirements are being met, and to describe the transformer manufacturing and design data features. In preparation for the design data review meeting, the transformer manufacturer must have submitted a transformer design data review report in PDF format for the transformer design, which includes the following elements as a minimum:

a. Transformer nameplate data and ratings

b. Preliminary transformer layout drawing

c. Winding connection diagram

d. Winding design information, including:

(1) Proposed winding material supplier.
(2) Winding manufacturing details, including the turn design, dimensions and weight.
(3) Block diagram of the winding arrangement.
(4) Conductor type
(5) Insulation type
(6) Tabular listing of the calculated and maximum allowable voltage stresses within the windings for chopped-wave and full-wave conditions, including the factory design factor of safety margins.
(7) Block diagram of the windings indicating the various voltage stresses.
(8) Calculated resistance (@ 85 degrees-C reference)
(9) Drying and clamping methods.
(10) Design features added to assure reliable operation in back feed mode.

e. Thermal calculations and distribution throughout the windings, including proposed locations for the fiber-optic temperature probes.

f. Core design information, including:

(1) Proposed core lamination steel supplier
(2) Core manufacturing details, including the number of limbs, dimensions and weights
(3) Core material type
(4) Joint construction
(5) Banding
(6) Acceptable gap/burrs
(7) Cooling ducts

(8) Rated flux density
(9) Calculated exciting current

g. Calculated short-circuit currents and forces

h. Loss calculations

i. Impedance calculations

j. Accessories, including:

(1) Bushings
(2) Cooling equipment
(3) De-energized tap changer

3.2 TRANSFORMER DRAWINGS

3.2.1 Outline and Assembly Drawings

Submit for approval the transformer outline and assembly drawings to demonstrate that the equipment will conform to the requirements and intent of the specifications, to include the following at a minimum:

a. Transformer nameplate information, for both the main and lifting nameplates as required in paragraph "NAMEPLATES".

b. Outline drawings, indicating the following:

(1) Layout and dimensions of the assembled transformer, including an elevation view for each side of the transformer, a plan view, and details of the tank structural base with the centers of gravity indicated with the transformer empty and filled with oil.

(2) Jacking, lifting and pulling facility locations.

(3) Locations of all ancillary equipment, dimensioned to the transformer centerlines or edges, as appropriate, including bushings, control and power cabinets, valves, gauges, relays, nitrogen regulator cabinet, radiators and fans, and grounding pads.

(4) Drawing legend and transformer weight information.

(5) A transformer elevation view indicating clearances required for untanking or disassembling.

(6) Information for the transformer oil levels, including: the minimum oil level in the tank without exposing the core and coil assembly, and the corresponding volume of oil to remove at 25 degrees Celsius; the maximum oil level in the tank to allow access to any bottom connected bushings utilizing handhole access covers, and the corresponding volume of oil to remove at 25 degrees Celsius.

c. Transformer winding layout and configuration diagram, consisting of a physical representation of the active assembly installed in the transformer tank, including a sectional elevation view of sufficient detail to identify the following basic features of the core/coil fabrication:

(1) Core legs
(2) High-voltage winding
(3) Low-voltage winding
(4) Winding taps
(5) De-energized tap changer and lead support structure
(6) Bushing configuration and connections
(7) Shielding (if present)
(8) Pressboard
(9) Tank wall surface

d. Control and power cabinets layout, including internal device layouts and component lists.

e. Electrical schematic diagrams which reference the associated detailed wiring connection diagrams, including:

(1) Cooling power schematic diagrams
(2) 120 V AC and 125 V DC control schematic diagrams
(3) Annunciation schematic diagrams
(4) Transformer accessories block schematic diagrams

f. General electrical drawings including:

(1) Wiring and ferruling methods
(2) Wire types, sizes and color coding
(3) Graphic symbols
(4) Device nameplates and marking methods

3.2.2 Detail Drawings

Submit for approval the transformer detail drawings, to include the following at a minimum:

a. Further refinement of the outline and assembly drawings, including the routing of conduit, piping, and locations of junction boxes and external devices.

b. Shipping drawing showing the outline of the transformers disassembled as required for shipment, including the following:

(1) Overall shipping dimensions, including indication of centers of gravity for the transformers in the shipping configuration. All devices remaining installed on the transformers during shipment must be indicated.

(2) Lifting details and overall height required for the slings and crane hook, including recommended sling length and ratings.

(3) Location of temporary covers for bushings, valves and control and power cabinets left installed during shipment.

(4) Method and locations for securing the transformers during shipment.

(5) Details indicating the method of installing the SFRA test shipping bushings, their locations, and a description of the method of bracing the winding leads to these bushings during shipment.

(6) Location of impact recorders, shipping gas pressure gauge and pressure regulator system.

(7) A note indicating the requirement for shrink-wrapping of the transformers for shipment, and the type of material used.

c. Wiring connection diagrams showing terminal block and conductor designations, including detailed control and power cabinet interconnections and device locations, based upon the actual equipment arrangement.

d. A transformer outline drawing indicating the locations of all gaskets on the transformer, a schedule of each gasket type and size cross-referenced to the location on the outline drawing, and a detail for each design of gasket showing the gasket dimensions, groove dimensions and compression requirements.

e. A transformer outline drawing indicating the locations of typical welds, with structural weldment details for each type of weld.

3.3 TRANSFORMER FACTORY ASSEMBLY

3.3.1 General

Each transformer must be completely assembled and adjusted at the factory, and be subjected to the manufacturer's routine shop tests and other tests as specified below. All parts and accessories must be properly match-marked and identified for ease of re-assembly after delivery to Little Goose Lock & Dam "Storage Yard". After the transformer has been completely assembled and oil-filled, the overall weight of the transformers must be measured using a load cell when lifted with a crane or moved with an air pallet, and the measured weight must be included in the factory test reports, the as-built drawings, and on the final nameplate information.

3.3.2 Welding

3.3.2.1 General

Welding will not be accepted if the welding does not conform to the requirements of this specification, unless otherwise approved by the Government. Develop procedures for the welding all metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified and approved. Weld symbols must be in accordance with AWS A2.4. In all instances requiring adherence with AWS specifications, equivalent country of origin standards will also be accepted. If using equivalent country standard, welding submittals must provide table showing equivalency with AWS standards.

3.3.2.2 Welding Quality Control Plan

Before the start of tank manufacturing, submit for approval a welding quality control plan which describes the methods, equipment, and procedures utilized to ensure quality control including but not limited to material tracking, weld tracking, NDT equipment calibration, non-conformance reports, weld repair, and inspection witness points. Indicate any manufacturer specific requirements used to verify the tanks are oil-tight in addition to those required herein.

3.3.2.3 Welder Qualifications

Welding operators and welders must be qualified and, as necessary, requalified for the particular type of weld to be performed. Qualification must be in accordance with AWS D1.1/D1.1M. The welder record of qualification must be submitted and approved. The Contractor must certify by name, the welders and welding operators so qualified including the date of qualification, code, and procedures under which qualified. Certification and testing of welders and operators must be performed by an independent testing company. Prior qualification may be accepted provided the welder has performed satisfactory work within the preceding three months under the code for which qualified, documentation of continuous welding in process and certification of prior qualification from an independent testing company is furnished. If at any time, the work of an operator appears questionable, such operator will be required to pass additional qualification tests to determine their ability to perform the welding of work on which they are engaged. All such additional qualification tests for welding operators and the physical tests of the welded specimens must be witnessed by the Government, unless waived in writing.

3.3.2.4 Welding Materials

Welding materials must comply with AWS specifications. Welding equipment, electrodes, welding wire, and fluxes must be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

3.3.2.5 Welding Procedures

Submit for approval a complete schedule of welding procedures including certified copies of reports of test results, consisting of detailed procedure specifications for each structure to be welded, and tables or diagrams showing the procedure to be used for each required joint. Do not perform welding without an approved procedure. Applicable prequalified weld procedures in AWS D1.1/D1.1M may be submitted for approval. Weld procedures not meeting the requirements of prequalified weld procedures in AWS D1.1/D1.1M may be submitted and qualified through testing under AWS D1.1/D1.1M or ASME BPVC SEC IX. All welds must be made using low-hydrogen welding rods or electrodes/electrode-flux combinations capable of depositing weld metal with a maximum diffusible hydrogen content of 8 mL/100g (H8). If the use of other filler metals is preferred, submit for approval a written justification of why an alternative is preferred and indicate where these welds will be utilized. Perform all welding using the electric-arc method, by a process which will exclude the atmosphere from the molten metal. Submit for approval the product data on welding electrodes and rods and shielding gas. All welded joints must conform to AWS publications, or as otherwise specified or approved, and the qualification plates representing those joints must be tested in accordance with AWS D1.1/D1.1M or AWS D1.6/D1.6M. All oil piping welds must meet the requirements of ASME B31.1.

3.3.2.6 Preheat and Interpass Temperature

Preheating must be performed as required by Section 3 of AWS D1.1/D1.1M, or as otherwise specified except that the temperature of the base metal must be at least 70 degrees Fahrenheit.

3.3.2.7 Weld Inspections, Tests and Weld Inspector Qualifications

a. All welds must be visually inspected to ensure conformance to the requirements of this specification, the appropriate section of AWS D1.1/D1.1M, and the approved welding procedure. Submit for approval the weld inspector qualifications, meeting the requirements of AWS D1.1/D1.1M and ANSI/ASNT CP-189, for the personnel responsible for inspections. Inspections must be performed visually, and during the transformer leak tests per the requirements of paragraph "Pressure Test". If the weldment is determined to be the cause of failure to pass the pressure test, the Government reserves the right to either a Non-Destructive Examination or Destructive Examination of any welds with the cost borne by the Contractor.

b. The following tests must be performed on all welds, and the results included in a Weld Inspection and Test Report:

(1) Dye penetrant test performed on all welds.

(2) Magnetic particle test performed on all lifting lug welds.

(3) Ultrasonic test performed on 25-percent of all full penetration welds.

3.3.3 Manufacturing Inspection by Government Personnel

Manufacturing inspections of each transformer may be performed by a representative of the Contracting Officer, at the option of the Government. These inspections would be performed at, but not necessarily limited to, the following manufacturing hold points:

a. Manufacturing facility inspection during the Design Data Review Meeting.

b. Weld inspection during tank manufacturing, to include dye penetrant, magnetic particle and ultrasonic testing.

c. Inspection of the windings after completed, but prior to being landed on the core. During this inspection, winding and core material bill of material information must be provided, and the materials inspected, for comparison with the manufacturer's design data to assure conformance.

d. Transformer manufacturing: Inspection of the completed core and coil assembly prior to tanking. Winding and core assembly drawings, including the lead support structure, must be made available during performance of these inspections.

e. Completely assembled transformers during performance of the factory acceptance tests.

3.4 FACTORY CLEANING AND PAINTING

3.4.1 General

All interiors and exteriors of the tanks, enclosures, cabinets, and other metal parts which are not galvanized or of corrosion resistant material and are exposed to oil or weather must be thoroughly cleaned and painted. Cleaning must be by degreasing and abrasive blasting or other means to

remove all grease, scale, corrosion, and foreign substances. All paint must be lead-free.

3.4.2 Interior Surfaces

All interior surfaces of the main tanks must be given at least one priming coat and one finish coat of oil-resistant paint or enamel. The interior tank color must be white. After painting of the tank interior, the surfaces must be allowed to cure for one week prior to the introduction of insulating oil.

3.4.3 Exterior Surfaces

All exterior surfaces of the transformers, except as otherwise indicated, must be given a primer and two finish coats of paint in the factory. The paint color must be Munsell 5BG 7/0.4 high gloss (ANSI No. 70 gray), per the requirements of ASTM D1535, and must consist of a polyurethane top coat over an epoxy base coat. The dry film thickness of the primer must be a minimum of 1.5 mils, and that of the top and base finish coats a minimum of 3.5 mils. At minimum, supply one gallon of primer and one gallon of the polyurethane paint, from the same batch used on the transformers, for transformer field paint repairs. All SDS information must be provided with the touch-up paint, in the English language, and included in the Operations and Maintenance Manual. With prior approval of the Contracting Officer, other comparable paint types may be used. The cover surface of the transformer tanks must have a non-slip additive added to the paint, so that the color is the same as the tank color.

3.4.4 Machined Surfaces

All machine finished or corrosion-resistant surfaces must remain unpainted, and be thoroughly cleaned, coated with a suitable, easily removed, corrosion resistant compound, and wrapped or otherwise protected from damage in shipment.

3.5 TRANSFORMER FACTORY ACCEPTANCE TESTS

3.5.1 General

Perform all routine power transformer tests as indicated in IEEE C57.12.00, Table 17 on each transformer, fully assembled with all components installed which are being provided for the final assembled transformer. In addition to the required routine tests, the following design tests and specific test requirements must be performed, unless otherwise specifically indicated. Do not perform any power transformer acceptance tests until all submittals required up to the point of factory testing have been reviewed by the Government and given an Action Code 'A' or 'B' approval. The factory acceptance tests, including test equipment, test methods, measurements, and computations, must be in accordance with the applicable requirements of IEEE C57.12.00, IEEE C57.12.80 and IEEE C57.12.90, unless otherwise specified, and submit for approval the Factory Test Procedures. Except where otherwise specified in the Standards, all measurements and tests involving alternating voltage must be made with 60 Hz sine wave voltage. The cost of performing all tests must be borne by the Contractor and must be included in the unit prices for the items of the Schedule. The Government representative will witness all tests required herein unless waived in writing, and do not ship any transformer, or parts until it has been released for shipment by the COR. Submit the notification of the date of factory tests as follows so that

arrangements can be made for the Government representative to be present at the tests:

a. **For transformer manufacturers located in the United States**, notify the COR 30 calendar days in advance of when the transformer manufacturer will be ready for factory acceptance tests, so that the tests may be witnessed by a Government Representative at the manufacturer's facility.

b. **For transformer manufacturers located in foreign countries**, notify the COR 60 calendar days in advance of when the transformer manufacturer will be ready for factory acceptance tests, so that the tests may be witnessed by a Government Representative at the manufacturer's facility.

3.5.2 Factory Acceptance Test Report

Submit for approval an electronic PDF copy of the Transformer Factory Acceptance Test Report for each transformer tested, including digital waveform printouts, data files for the SFRA, insulation power factor, and leakage reactance tests, and complete data on all tests performed. The witnessing representatives of the Contractor and the Government must sign reports of all witnessed tests. The certified test reports must include the information as listed in IEEE C57.12.00, paragraph 8.7, and include all additional required tests results with the corresponding digital waveform and color thermal imaging printouts.

3.5.3 Dissolved Gas-In-Oil Analysis

Samples of the transformer insulating oil must be taken from each transformer, and dissolved gas-in-oil analysis tests performed as indicated, herein. Identity of samples and results of analyses must be included in the certified test reports, and the results of all insulating oil tests made available for inspection by the Government representative during the transformer factory acceptance testing.

a. After oil-filling of each transformer, and prior to the performance of any transformer factory acceptance tests.

b. After performance of dielectric tests.

c. After performance of temperature rise tests at each cooling rating.

d. Eight hours after performance of all transformer factory acceptance tests, to allow any possible generated gases to fully disperse within the oil.

3.5.4 Temperature Rise Test

Perform a temperature rise test on one transformer with measurements made at each cooling rating (ONAN, ONAF). During the temperature rise tests use temporary fiber leads and temporary multi-channel fiber-optic temperature monitor to monitor and record the temperatures on all of the embedded winding fibers. During the temperature rise tests, obtain thermal images of all parts of the transformer utilizing a color infrared camera, and include the thermal images with corresponding temperatures indicating the ambient and hottest temperatures, including loading conditions, in the transformer's factory acceptance test report. The tank wall hot-spot temperature rise must not exceed 70 degrees-C while operating at 100

percent of its forced-air cooled rating.

3.5.5 Core Insulation Resistance

In the case of a core type transformer, the transformer core insulation resistance test must be performed on each transformer at each core ground bushing, for the main core connection to ground, and the core frame connection to ground.

3.5.6 Impulse Tests

All transformer impulse tests must be completed on a winding connection (bushing) before performing tests on a different winding connection. The impulse tests must be made by direct application without 60-Hz excitation. Computer-based waveform recordings must be taken of surge voltages during all impulse tests and of neutral current during the reduced full-wave and full-wave impulse tests, with the digital waveforms adjusted to give the same deflection on reduced-voltage and full-voltage impulse waves to facilitate comparison. Comparisons must also be made of the consecutive chopped-wave impulse waveforms. Waveform comparisons must be printed, and provided in the certified test report. Any deviation in voltage or neutral current wave shape between reduced-voltage and full-voltage full-wave tests, must be explained to the satisfaction of the COR or it may be considered cause for rejection of the transformer.

3.5.7 Induced Voltage Test With Partial Discharge Measurements

3.5.7.1 General

Partial discharge measurements during the induced voltage test must be per the requirements of IEEE C57.12.90, paragraph 10.8, and IEEE C57.113. It is recognized that sizable partial discharge readings during tests are likely to occur from causes external to the transformer, such as partial discharge in the high-voltage test circuit, noise from shop equipment, other tests being performed, and radiation or induction pickup through air between the measuring circuit and the high-voltage test equipment. All reasonable precautions must be taken to minimize such external interference, and if necessary, the manufacturer must demonstrate that this partial discharge is not internal to the transformer. It is permissible to utilize special bushing corona shields during performance of the tests.

3.5.7.2 7,200 Cycle Enhancement Level

During the 7,200-cycle test, the partial discharge level, excluding background noise, must not exceed 500 pico-coulombs. Any variation in corona intensity before and after application of full 7,200-cycle test voltage must be explained to the satisfaction of the Contracting Officer.

3.5.7.3 One-Hour Level

During the one-hour test, the partial discharge level must not exceed 300 pico-coulombs, and the increase in partial discharge levels must not exceed 100 pico-coulombs.

3.5.7.4 Data Reporting

All records, meter readings, and data taken during the above described tests, together with a diagram of the circuit employed, must be

incorporated in the certified test report. The measurement of partial discharge using the apparent charge (pico-coulomb) method must be performed during the induced voltage test, and the measurements included with the test report.

3.5.8 Audible Sound Level Test

Perform an audible sound level test and it must be performed, and must not exceed the manufacturer's guaranteed sound level included in the proposal documents. The sound level tests must be performed at the ONAN rating, and at the ONAF rating with all cooling fans in operation. If the sound level exceeds the manufacturer's guaranteed level, the transformers must be modified as required to reduce the sound level and the test repeated. The abatement technique used to reduce the tested sound level to the guaranteed sound level must be subject to approval of the Contracting Officer. All data records taken during the sound level test, including a diagram of the transformer and how the measurements were taken, must be included in the certified test report. The data reporting format must be similar to that indicated in Figures 30 and 31 of IEEE C57.12.90.

3.5.9 Leak Test

Perform a leak test on each transformer tank and radiators when filled with oil. The test pressure must be a minimum of 4 psi, maintained for a minimum of 24 hours with no loss in gas pressure during the test period. The dial gauge used for this test must have a scale of 0 - 10 psi. During the pressure test, an alcohol-based industrial marking chalk, or another similar method of oil leak detection, must be applied to the tank welded seams and all gasketed connections and monitored for oil leaks. After the leak test is completed, all chalk must be cleaned off each transformer.

3.5.10 Leakage Reactance Measurement Test

Perform a leakage reactance measurement tests per the requirements of IEEE C57.152, paragraph 7.2.12, between the high-voltage winding and the low-voltage winding, for use as baseline data for future testing. Voltage, current, and phase angle measurements must be recorded, and the corresponding impedance calculated. Use standard equipment for performance of the leakage reactance test. The proposed test setup and procedures must be included in the factory test procedures submittal.

3.5.11 Sweep Frequency Response Analysis Tests

3.5.11.1 Required Tests

Two Sweep Frequency Response Analysis (SFRA) tests must be performed at the manufacturing facility, per the requirements of IEEE C57.149, at the following manufacturing stages for use as baseline data for future testing and for shipping purposes for each transformer.

a. After all factory tests have been performed, and while each transformer is still fully assembled and filled with oil.

b. After each transformer has been drained of oil and disassembled for shipment, and in its shipping configuration (see paragraph "SFRA Test Shipping Bushing). The test equipment and connections must be as indicated in paragraph "Test Equipment and Test Parameters", below, with the tests performed at the rated tap position.

3.5.11.2 Test Equipment and Test Parameters

Use a Sweep Frequency Response Analyzer for performance of the SFRA test. The proposed SFRA setup and procedures must be included in the factory test procedures submittal. The excitation source must be capable of providing consistent and controlled peak to peak voltage over the entire frequency range, with the test equipment parameters as follows:

a. A test voltage of 20V peak-to-peak minimum.

b. Testing performed over the 20 Hz to 2 MHz frequency range as a minimum.

c. Frequency response measurements made using a log-based scale for frequency.

d. An interference bandwidth (IBW), or equivalent, of less than 1 Hz at 10Hz used for each measurement frequency.

e. Record the magnitude of the response on a decibel (dB) scale for each measurement point.

f. The dB accuracy within 1 dB at every measurement point, using calibrated equipment.

g. A test set with a dynamic range better than 100 dB.

h. Record the phase, in degrees, for each measurement point, with an accuracy within 1 degree at every measurement point, using calibrated equipment.

i. High frequency coaxial test cables, with a 50 ohm matched impedance.

j. A three lead system, which consists of a signal, a reference and a test measurement lead.

k. All cables of the same length. A consistent ground connection should be available at the bushing end of the leads and be the same length for each cable.

l. The size and type of all temporary grounding leads identified.

3.5.11.3 Test Cable Integrity

Prior to the performance of any SFRA tests, the integrity of the test cables must be tested by a short-circuit test. Each coaxial test cable must be laid together, side-by-side on the floor, with the measurement clips connected together and the ground clips connected together. The frequency response of the test cables when connected in this fashion should be "flat", with the exception of a gradual "roll-off" above 100 kHz due to pre-fitted cable grounds, and any variation could indicate damage within the coaxial cables. Any anomalies in the cable test results must be brought to the attention of the COR.

3.5.11.4 Test Connections

During performance of the SFRA tests, the test coaxial cables must be directly connected to the transformer bushings. For tall bushings, ground

jumpers may be used to facilitate connection of the coaxial cable ground shield to the base of the bushing. All windings must be tested as indicated below, for the 'neutral' (or rated kV) tap position, and for the tap position that includes all of the windings, with each SFRA result identified by the applied and measured terminals. The SFRA tests must be per the requirements of IEEE C57.149, Table 5, Group 2, second column).

3.5.11.5 Data Reporting

Test equipment must be capable of producing a test report file which is in the Extensible Markup Language (XML) format. Test data must be able to be viewed without the editing, reorganizing or reformatting of the data. A simple format of separate measurements being in separate spreadsheet columns is required. The test data must show all waveforms in graphical form with the response in linear scale dB units on the Y-axis and the Frequency in logarithmic scale Hz on the X-axis. The Y-axis must auto-scale and the X-axis must display the range from 20 Hz to 2 MHz, as a minimum. The electronic version of the test report must include the complete data on a CD in the format and organization that will permit the file to be viewed completely using standard spreadsheet software. Data reporting must meet the requirements of IEEE C57.149, paragraph 5.

3.5.11.6 Data Interpretation

SFRA testing produces traces which provides information related to the physical geometry of the test specimen. The factory SFRA tests performed creates baseline data for use in future testing, and helps in recognizing obvious manufacturing defects, such as open circuits, short circuits, and winding deformations.

3.5.12 De-Energized Tap Changer Test

Each transformers' completely assembled de-energized tap changer (DETC) must be subjected to five complete tap changing cycles (end-tap to end-tap) during the process of transformer testing to demonstrate that all linkages, contacts, and indicating mechanisms are properly assembled and aligned and free from excessive slack, deformation, or fragility.

3.5.13 Transformer Turns Ratio Test

For Each transformer perform a transformer turns ratio (TTR) test on each tap in accordance with "Ratio Tests" paragraph of IEEE C57.152 after the completion of the DETC testing.

3.5.14 Insulated Wire and Cable

Perform testing on all insulated wire and cable within each transformer's control and power cabinets, extending to all transformer mounted equipment per the requirements of SECTION 26 05 19.00 26, INSULATED WIRE AND CABLE.

3.6 BUSHING TESTS

3.6.1 General

Bushing tests must be performed in accordance with IEEE C57.19.00 and IEEE C57.19.01. Any bushing that fails to pass all tests to which it is subjected will be rejected. Provide electronic PDF copies of all bushing and bushing current transformer test reports for each transformer.

3.6.2 Bushing Design Tests

Bushing design tests must be performed on one bushing of each type provided in accordance with IEEE C57.19.00, unless these tests have previously been performed on bushings of the same manufacture, design, type, and rating as those being provided within 10 years of the date of this contract, in which case the requirements for repeating these design tests will be waived and certified copies of the test results of satisfactory tests of this kind must be furnished to the Contracting Officer. If any bushing given the impulse tests fails to pass any of the tests, then all bushings of the same type and rating must be subjected to the impulse tests at no additional cost to the Government.

3.6.3 Bushing Withstand Test Voltages

The bushings must be tested per the applicable requirements of IEEE C57.19.01, Table 1.

3.6.4 Bushing Routine Tests

Each new bushing provided must be subjected to routine tests by the bushing manufacturer in accordance with IEEE C57.19.00, Table 3. Power factor tests must be performed on each design bushing per the following requirements:

a. Perform a power factor test at 10 kV for C1. The power factor must not exceed 0.35 percent.

3.6.5 Bushing Current Transformer Manufacturer Routine Tests

Provide electronic PDF copies of all bushing current transformer test data.

3.6.5.1 Routine Tests

Each bushing current transformer is to be given bushing current transformer manufacturer routine tests, including an applied voltage test, in accordance with IEEE C57.13, Annex B.8.

3.6.5.2 Tests Performed After Installation

Each current transformer is to be checked for proper nameplate and polarity markings prior to installation on the transformers, and be given a polarity and ratio check after installation and prior to the performance of the factory acceptance tests to ensure correct installation. The following bushing current transformer tests are to be performed after all other transformer acceptance tests have been completed, and the test results included in the factory acceptance test report:

a. Excitation curves for each turn ratio.

b. Ratio correction factor curves for each turn ratio.

c. The resistance of the secondary winding at 75 degrees Celsius, including the resistance of the secondary leads from the bushing current transformer to the terminal blocks in the control cabinet.

3.7 TRANSFORMER SHIPMENT, HAULING AND SITE ASSEMBLY

Each transformer and it's equipment, accessories, and spare parts must be prepared for shipment f.o.b. Little Goose Lock & Dam, transported, inspected, unloaded, moved into its storage location in the storage yard, re-assembled, oil-filled, and tested per the requirements of SECTION 48 20 00.04 26.

-- End of Section --

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7000942_X3

Report Source **Three-winding Transformer**

Session Test Date 7/28/2023 1:30:30 PM

Nameplate - Three-winding Transformer

Company	US Army Corps of Eng	**Serial Number**	7000942
Location	Lower Monumental	**Special ID**	T1A
Division	CENWD	**Circuit Designation**	T1A
Manufacturer	Westinghouse Electric	**Configuration**	SINGLE
Year Manufactured	1968	**Tank Type**	N2 Blanket
Mfr Location		**Class**	FA
Winding Config [H-L]	Single-Single	**Coolant**	Oil
Winding Config [H-T]	Single-Single	**Oil Volume**	15539 UG
Winding Config [L-T]	Single-Single	**Weight**	591500 LB
Phases	Single	**BIL**	*
kV	288.68, 13.2	**VA Rating**	164, 218.6, *, *, MVA

Administration

Test Date	7/28/2023	**Test Time:**	1:30 PM	**Weather**	Sunny
Air Temperature	30°C	**Apparatus Temperature**	35°C	**Humidity**	20 %
Tester	C. Flores/P. Susin	**Work Order**		**Date Last Tested**	7/29/2019
Verified		**Test Set Type**		**Date Retested**	
Verification Date		**Set Top Serial #**		**Reason**	Routine
Last Sheet #		**Test Set Model**		**Travel Time**	
Purchase Order		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Nameplate Notes

---------- Test Session 2 ----------
H.V. bushing connected to arrestor stack and disconnect.

---------- Test Session 11 ----------
Tests performed for benchmark purposes prior to regasketing evolution.

---------- Test Session 12 ----------
Unit was completely regasketed. Oil drained, bushings disconnected and lifted, radiators removed and refinished, and tap changer linkage serviced, and gauges replaced/calibrated. 20 hr hot oil circulation was performed followed by a vacuum dryout evolution of 237 hrs which removed 767 oz water. Transformer was filled under vacuum with 116F, degassed, reprocessed oil on 11/19/99 from 0700-1630.

---------- Test Session 13 ----------
MY WAY

---------- Test Session 14 ----------
BPA WAY

Arrester Nameplate

Location	Serial #	Manufacturer	Overall Catalog	Unit Catalog	Type	Rated kV	Order
LA-T	56778	General Electric	9L16GNP396	9L16GHD802A		142	1
LA-M	56778-2	General Electric	9L16GNP396	9L16GHD802A		142	1
LA-B	56778-3	General Electric	9L16GNP396	9L16GHD305		112	3

Bushing Nameplate

Designation	Serial #	Manufacturer	Type	C1 %PF	C1 Cap (pF)	C2 %PF	C2 Cap (pF)	Rated kV	Amps
H1	3	Westinghouse Electric	O	0.437	445	*	11530	500	1600
H2	4	Westinghouse Electric	OS	0.79	263	*	*	23	1200
N	HC-SN-1			*	*	*	*	*	*
S1	w			*	*	*	*	*	*
X1	None	Westinghouse Electric	MRJ	*	*	*	*	23	*
X2	None-6	Westinghouse Electric	MRJ	*	*	*	*	23	*
Y1	None-9	Westinghouse Electric	MRJ	*	*	*	*	23	*
Y2	None-10	Westinghouse Electric	MRJ	*	*	*	*	25	*

Bushing Additional Details -S1

Designation	S1	**Voltage**	Primary	**Serial #**	w		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -N

Designation	N	**Voltage**		**Serial #**	HC-SN-1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Overall Tests [M4100 Serial: 99500614]

Use Arrhenius TC: No

	Insulation	V [kV]	I [mA]	Loss [W]	PF*TCF [%]	TCF	Cap (pF)	FRANK™	Manual
1	CH+CHL	10.003	43.844	1.836	0.386	0.923	11629.758		
2	CH	10.002	15.577	0.871	0.516	0.923	4131.826	Deteriorated	
3	CHL (Measured)	10.001	28.255	0.977	0.319	0.923	7494.886	Good	
4	CHL	*	28.267	0.965	0.315	0.923	7497.932	Good	
5	CL+CLT	10.004	73.823	3.308	0.414	0.923	19581.865		
6	CL	10.002	73.148	3.304	0.417	0.923	19402.681	Deteriorated	
7	CLT (Measured)	10.002	0.673	0.006	0.083	0.923	178.548	Investigate	
8	CLT	*	0.675	0.005	0.064	0.923	179.185	Good	
9	CT+CHT	10.002	21.104	1.044	0.456	0.923	5598.017		
10	CT	10.002	11.363	0.703	0.571	0.923	3013.925	Deteriorated	
11	CHT (Measured)	10.002	9.742	0.346	0.327	0.923	2584.060	Good	
12	CHT	*	9.742	0.341	0.323	0.923	2584.091	Good	
13	CH+CL+CT	10.004	100.156	4.828	0.445	0.923	26566.438		
Winding without Attached Bushing Calculation									
CH-C1	CH'		12.832	0.705	0.507	0.923	3403.768		
CL-C1	CL'		73.148	3.304	0.417	0.923	19402.681		
CT-C1	CT'		11.363	0.703	0.571	0.923	3013.925		

FRANK™ Message	2 (Deteriorated) - The power factor results are high for this apparatus. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. For this apparatus, the low power factor limit is 0.1%, the degraded limit is 0.4%, and the high limit is 0.6%. 6 (Deteriorated) - The power factor results are high for this apparatus. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. 7 (Investigate) - The measured power factor is abnormally low for this type of apparatus. This may indicate a change in insulation health. The measured power factor is low compared to the initial test. the measured power factor compares to the previous test. This may indicate that the first measurement was erroneous, or that a change in the insulation occurred, but is in a stable condition. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. 10 (Deteriorated) - The power factor results are high for this apparatus. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble.

Bushing Test (C1) [M7100 Serial: 999900000079]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	3	10.002	1.667	0.078	1.070	0.500	0.437	442.111	445	Good	
H2	4	10.002	1.078	0.088	0.765	0.625	0.79	285.947	263	Investigate	

FRANK™ Message	2 (Investigate) - The C1 upper limit for a "G" rating is1% The C1 lower limit for a "G" rating is0.1% The C1 Capacitance is high compared to Nameplate. The C1 Power Factor is low compared to Nameplate.

Bushing Test (C2) [M7100 Serial: 999900000079]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	3	2.001	43.584	1.850	1	0.425	*	11560.941	11530	Good	
H2	4	0.500	3.837	0.414	1	1.080	*	1017.75	*	Deteriorated	

FRANK™ Message	2 (Deteriorated) - The C2 upper limit for a "G" rating is1% The C2 lower limit for a "G" rating is0.1% The C2 Power Factor is high compared to limit.

Bushing Test (C1+C2) [M7100 Serial: 999900000079]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	3	2.002	45.246	1.962		0.464		12002.001		Good	
H2	4	0.501	4.919	0.504		0.785		1304.805		Good	

Bushing Test (C1 (Inv)) [M7100 Serial: 999900000079]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	3	2.001	1.665	0.071		0.454		441.554		Good	
H2	4	0.500	1.079	0.089		0.631		286.101		Good	

Bushing Test ((C1+C2) - (C1+C2)) [M7100 Serial: 999900000079]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	3	*	0.004	-0.034		0.461		1.051			
H2	4	*	-0.004	-0.002		0.920		-1.108			

Bushing Test (C1 - C1 (Inv)) [M7100 Serial: 999900000079]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	3	*	0.002	0.007		0.046		0.558			
H2	4	*	-0.001	-0.001		-0.007		-0.154			

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Primary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			10	10.079	309.886 mΩ	367.378 mΩ	375.491 mΩ	-2.161

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Secondary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			10	9.998	1.168 mΩ	1.385 mΩ	3.752 mΩ	-63.098

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Tertiary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			10	9.995	1.054 mΩ	1.249 mΩ	7.671 mΩ	-83.713

Surge Arrester Tests

Location	Test Mode	V [kV]	I [mA]	Loss [W]	FRANK™	Manual
LA-B	Undefined	*	*	*		
LA-M	GAR RB	*	*	*		
LA-T	GAR RB	*	*	*		

Excitation Current & Loss [M7100 Serial: 999900000079]

Ref. To 10kV: Yes Components: Yes

	Manufacturer	Type	Steps	Rated kV	Step kV	Step % Change	Oil Volume
DETC-1	W	Manual	5	288.68	12.500	2.500	*

		H1 H2			H2 H1							
Winding : Tap	Test kV	mA	Watts	X	mA	Watts	X	mA	Watts	X	FRANK™	Manual
HV: 3	2	69.051	221.695	L	*	*		*	*			

Winding : Tap	Connections	I_L [mA]	I_R [mA]	I_C [mA]	PF [%]	θ [deg]
HV: 3	H1 H2	54.863	22.170	-10.427	32.106	-71.273
HV: 3	H2 H1	*	*	*	*	*
HV: 3		*	*	*	*	*

TurnsRatio Tests [H-L]

				Serial Number			HV Winding			LV Winding	
				9912252030			Single			Single	
Connections				H1 - H2			-			-	
				X1 - X2			-			-	
Tap	HV [kV]	Tap	LV [kV]	Cal	Ratio 1	Ratio 2	Ratio 3	Min. Lim	Max. Lim	FRANK™	Manual
1	281.467		13.2	21.323	*	*	*	21.217	21.430		
2	288.684		13.2	21.87	*	*	*	21.761	21.979		
3	295.901		13.2	22.417	*	*	*	22.305	22.529		
4	303.118		13.2	22.963	*	*	*	22.849	23.078		
5	310.335		13.2	23.510	*	*	*	23.393	23.628		
1	281467	Y	13200	21.323	*	*	*	21.217	21.430		
2	288684	Y	13200	21.87	*	*	*	21.761	21.979		
3	295901	Y	13200	22.417	*	*	*	22.305	22.529		
4	303118	Y	13200	22.963	*	*	*	22.849	23.078		
5	310335	Y	13200	23.510	*	*	*	23.393	23.628		

TurnsRatio Tests [H-T]

	Serial Number	HV Winding	TV Winding
	9912252030	Single	Single
Connections	**H1 - H2**	**-**	**-**
	X1 - X2	**-**	**-**

Tap	HV [kV]	Tap	TV [kV]	Cal	Ratio 1	Ratio 2	Ratio 3	Min. Lim	Max. Lim	FRANK™	Manual
1	281.467		13.2	21.323	*	*	*	21.217	21.430		
2	288.684		13.2	21.87	*	*	*	21.761	21.979		
3	295.901		13.2	22.417	*	*	*	22.305	22.529		
4	303.118		13.2	22.963	*	*	*	22.849	23.078		
5	310.335		13.2	23.510	*	*	*	23.393	23.628		

LVTTR Tests (H-L) [M7100 Serial: 999900000079]

#	Winding : Tap	HV [kV]	LV [kV]	Ratio [#]	Test V [V]	Phase	Ratio [#]	Δ [%]	Angle [°]	FRANK™	Manual
1	HV: 3	295.897	13.200	22.416	100.000	Phase A	22.484	0.301	0.0	Good	
						Phase B	*	*	*	Good	
						Phase C	*	*	*	Good	

LVTTR Tests (H-T) [M7100 Serial: 999900000079]

#	Winding : Tap	HV [kV]	LV [kV]	Ratio [#]	Test V [V]	Phase	Ratio [#]	Δ [%]	Angle [°]	FRANK™	Manual
1	HV: 3	295.897	13.200	22.416	100.000	Phase A	22.435	0.082	0.0	Good	
						Phase B	*	*	*	Good	
						Phase C	*	*	*	Good	

7000734_X3

Report Source **Three-winding Transformer**

Session Test Date 7/28/2023 9:06:38 AM

Nameplate - Three-winding Transformer

Company	US Army Corps of Eng	**Serial Number**	7000734
Location	Lower Monumental	**Special ID**	T1B
Division	CENWD	**Circuit Designation**	T1B
Manufacturer	Westinghouse Electric	**Configuration**	SINGLE
Year Manufactured	1968	**Tank Type**	N2 Blanket
Mfr Location		**Class**	FA
Winding Config [H-L]	Single-Single	**Coolant**	Oil
Winding Config [H-T]	Single-Single	**Oil Volume**	15539 UG
Winding Config [L-T]	Single-Single	**Weight**	591500 LB
Phases	Single	**BIL**	*
kV	288.68, 13.2	**VA Rating**	164, 218.6, *, *, MVA

Administration

Test Date	7/28/2023	**Test Time:**	9:06 AM	**Weather**	Sunny
Air Temperature	29.4°C	**Apparatus Temperature**	29.4°C	**Humidity**	43 %
Tester	C. Flores/P. Susin	**Work Order**		**Date Last Tested**	7/29/2019
Verified		**Test Set Type**		**Date Retested**	
Verification Date		**Set Top Serial #**		**Reason**	Routine
Last Sheet #		**Test Set Model**		**Travel Time**	
Purchase Order		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Nameplate Notes

---------- Test Session 1 ----------
H.V. BUSHING CONNECTED TO ARRESTOR STACK AND DISCONNECT.

---------- Test Session 10 ----------
Tests performed for benchmark purposes prior to regasketing evolution.

---------- Test Session 11 ----------
Unit was completely regasketed. Oil drained, bushings disconnected and lifted, Y2 bushing replaced, radiators removed and refinished, and tap changer linkage serviced, and gauges replaced/calibrated. 22 hr hot oil circulation was performed followed by a vacuum dryout evolution of 163 hrs which removed 244 oz water. Transformer was filled under vacuum with degassed, reprocessed oil.

---------- Test Session 17 ----------
Changed the name of neutral bushing to H2.

---------- Test Session 18 ----------
Changed the name of neutral bushing to H2.

Session Notes

Neutral Bushing C1 Test is High compared to nameplate. However, it has always been high compared to nameplate.

Arrester Nameplate

Location	Serial #	Manufacturer	Overall Catalog	Unit Catalog	Type	Rated kV	Order
LA-T	58865	General Electric	9L16GNP396	9L16GHD802A		142	1
LA-M	58865-2	General Electric	9L16GNP396	9L16GHD802A		142	1
LA-B	58865-3	General Electric	9L16GNP396	9L16GHD305		112	3

Bushing Nameplate

Designation	Serial #	Manufacturer	Type	C1 %PF	C1 Cap (pF)	C2 %PF	C2 Cap (pF)	Rated kV	Amps
H0	SN-H3			*	*	*	*	*	*
H1	SN-H1	Westinghouse Electric		0.414	437	*	12550	500	1600
H2	SN-H0	Westinghouse Electric	OS	0.58	244	*	*	23	1200
H3	SN-X3			*	*	*	*	*	*
H4	SN-Y3			*	*	*	*	*	*
N	HC-SN-1			*	*	*	*	*	*
S3	q			*	*	*	*	*	*
X1	None	Westinghouse Electric	MRJ	*	*	*	*	23	*
X2	None-6	Westinghouse Electric	MRJ	*	*	*	*	23	*
Y1	None-9	Westinghouse Electric	MRJ	*	*	*	*	25	*
Y2	None-10	Westinghouse Electric	MRJ	*	*	*	*	23	*

Bushing Additional Details -S3

Designation	S3	**Voltage**	Primary	**Serial #**	q		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H0

Designation	H0	**Voltage**	Primary	**Serial #**	SN-H3		
Catalog #	1-M-1408	**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**	264-0-500		
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H3

Designation	H3	**Voltage**	Primary	**Serial #**	SN-X3		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**	471C325		
Style		**Other**		**S.O. Number**	1-M-1408		
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -H4

Designation	H4	**Voltage**	Primary	**Serial #**	SN-Y3		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**	471C375		
Style		**Other**	GR. 2	**S.O. Number**	M8M-1408		
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -N

Designation	N	**Voltage**		**Serial #**	HC-SN-1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Overall Tests [M4100 Serial: 99500614]

Use Arrhenius TC: No

	Insulation	V [kV]	I [mA]	Loss [W]	PF*TCF [%]	TCF	Cap (pF)	FRANK™	Manual
1	CH+CHL	10.003	43.408	1.735	0.382	0.955	11514.242		
2	CH	10.003	15.175	0.665	0.418	0.955	4025.189	Deteriorated	Good
3	CHL (Measured)	10.002	28.221	1.089	0.369	0.955	7485.846	Good	
4	CHL	*	28.233	1.070	0.362	0.955	7489.053	Good	
5	CL+CLT	7.001	70.806	2.839	0.383	0.955	18781.637		
6	CL	7.001	70.113	2.828	0.385	0.955	18597.860	Good	
7	CLT (Measured)	7.001	0.692	0.007	0.099	0.955	183.534	Investigate	Good
8	CLT	*	0.693	0.011	0.152	0.955	183.776	Deteriorated	Good
9	CT+CHT	7.000	20.563	0.872	0.405	0.955	5454.348		
10	CT	7.000	11.061	0.531	0.458	0.955	2934.065	Deteriorated	Good
11	CHT (Measured)	7.000	9.500	0.340	0.342	0.955	2519.841	Good	
12	CHT	*	9.501	0.341	0.343	0.955	2520.283	Good	
13	CH+CL+CT	7.001	96.433	3.967	0.393	0.955	25579.276		

Winding without Attached Bushing Calculation

CH-C1	CH'	12.487	0.527	0.403	0.955	3312.242
CL-C1	CL'	70.113	2.828	0.385	0.955	18597.860
CT-C1	CT'	11.061	0.531	0.458	0.955	2934.065

FRANK™ Message	2 (Deteriorated) - The power factor results are high for this apparatus. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. For this apparatus, the low power factor limit is 0.1%, the degraded limit is 0.4%, and the high limit is 0.6%. 7 (Investigate) - The measured power factor is abnormally low for this type of apparatus. This may indicate a change in insulation health. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. 8 (Deteriorated) - The calculated watts losses are more than 30% different from the measured watts losses. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. 10 (Deteriorated) - The power factor results are high for this apparatus. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble.

Bushing Test (C1) [M4100 Serial: 99500614]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	10.003	1.636	0.077	1	0.468	0.414	433.940	437	Good	
H2	SN-H0	10.004	1.052	0.061	0.818	0.476	0.58	279.007	244	Investigate	

FRANK™ Message	2 (Investigate) - The C1 upper limit for a "G" rating is1% The C1 lower limit for a "G" rating is0.1% The C1 Capacitance is very high compared to Nameplate.

Bushing Test (C2) [M4100 Serial: 99500614]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	2.000	45.674	1.984	1	0.434	*	12115.293	12550	Good	
H2	SN-H0	0.500	3.777	0.240	1	0.635	*	1001.909	*	Good	

Bushing Test (C1+C2) [M4100 Serial: 99500614]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	2.000	47.314	2.052		0.434		12550.228		Good	
H2	SN-H0	0.499	4.836	0.294		0.498		1282.660		Good	

Bushing Test (C1 (Inv)) [M4100 Serial: 99500614]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	2.000	1.637	0.069		0.422		434.247		Good	
H2	SN-H0	0.499	1.061	0.052		0.398		281.512		Good	

Bushing Test ((C1+C2) - (C1+C2)) [M4100 Serial: 99500614]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	*	-0.003	0.008		0.469		-0.995			
H2	SN-H0	*	-0.007	0.006		0.613		-1.744			

Bushing Test (C1 - C1 (Inv)) [M4100 Serial: 99500614]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	*	-0.001	0.007		0.046		-0.307			
H2	SN-H0	*	-0.009	0.010		0.078		-2.505			

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Primary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			10	10.000	311.701 mΩ	377.309 mΩ	372.309 mΩ	1.343

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Secondary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			10	9.997	1.154 mΩ	1.396 mΩ	3.771 mΩ	-62.969

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Tertiary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			20	19.991	1.162 mΩ	1.407 mΩ	8.103 mΩ	-82.634

Custom Diagnostic [M4100 Serial: 99500614]

	Test Mode	Connection	V [kV]	I [mA]	Loss [W]	% PF Meas.	Cap./Ind.	Manual
X1 Isophase 1B & 2B	GND RB	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.004	38.302	3.998	1.044	10159.32 pF	Good
X2 Isophase 1C & 2C	GND RB	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.002	34.004	4.174	1.227	9019.27 pF	Good
Y1 Isophase 3B & 4B	GND RB	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.002	28.735	4.502	1.567	7621.26 pF	Good
Y2 Isophase 3C & 4C	GND RB	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.002	35.129	3.159	0.899	9317.87 pF	Good

Surge Arrester Tests

Location	Test Mode	V [kV]	I [mA]	Loss [W]	FRANK™	Manual
LA-B	GAR RB	*	*	*		
LA-M	UST RB	*	*	*		
LA-T	GAR RB	*	*	*		

Excitation Current & Loss [M4100 Serial: 99500614]

Ref. To 10kV: Yes Components: Yes

	Manufacturer	Type	Steps	Rated kV	Step kV	Step % Change	Oil Volume
DETC-1	W	Manual	5	288.68	12.500	2.500	*

		H1 H2			H2 H1			H H				
Winding : Tap	Test kV	mA	Watts	X	mA	Watts	X	mA	Watts	X	FRANK™	Manual
HV: 3	2	63.052	188.987	L	*	*		*	*			

Winding : Tap	Connections	I_L [mA]	I_R [mA]	I_C [mA]	PF [%]	θ [deg]
HV: 3	H1 H2	50.972	18.899	-9.138	29.973	-72.558
HV: 3	H2 H1	*	*	*	*	*
HV: 3	H H	*	*	*	*	*

TurnsRatio Tests [H-L]

	Serial Number	HV Winding	LV Winding
	9912252030	Single	Single
Connections	H1 - H2	-	-
	X1 - X2	-	-

Tap	HV [kV]	Tap	LV [kV]	Cal	Ratio 1	Ratio 2	Ratio 3	Min. Lim	Max. Lim	FRANK™	Manual
1	281.467		13.2	21.323	*	*	*	21.217	21.430		
2	288.684		13.2	21.87	*	*	*	21.761	21.979		
3	295.901		13.2	22.417	*	*	*	22.305	22.529		
4	303.118		13.2	22.963	*	*	*	22.849	23.078		
5	310.335		13.2	23.510	*	*	*	23.393	23.628		

TurnsRatio Tests [H-T]

	Serial Number	HV Winding	TV Winding
	9912252030	Single	Single
Connections	**H1 - H2**	**-**	**-**
	X1 - X2	**-**	**-**

Tap	HV [kV]	Tap	TV [kV]	Cal	Ratio 1	Ratio 2	Ratio 3	Min. Lim	Max. Lim	FRANK™	Manual
1	281.467		13.2	21.323	*	*	*	21.217	21.430		
2	288.684		13.2	21.87	*	*	*	21.761	21.979		
3	295.901		13.2	22.417	*	*	*	22.305	22.529		
4	303.118		13.2	22.963	*	*	*	22.849	23.078		
5	310.335		13.2	23.510	*	*	*	23.393	23.628		

LVTTR Tests (H-L) [M7100 Serial: 999900000079]

#	Winding : Tap	HV [kV]	LV [kV]	Ratio [#]	Test V [V]	Phase	Ratio [#]	Δ [%]	Angle [°]	FRANK™	Manual
1	HV: 3	295.897	13.200	22.416	100.000	Phase A	22.470	0.238	0.0	Good	
						Phase B	*	*	*	Good	
						Phase C	*	*	*	Good	

LVTTR Tests (H-T) [M7100 Serial: 999900000079]

#	Winding : Tap	HV [kV]	LV [kV]	Ratio [#]	Test V [V]	Phase	Ratio [#]	Δ [%]	Angle [°]	FRANK™	Manual
1	HV: 3	295.897	13.200	22.416	100.000	Phase A	22.427	0.049	0.0	Good	
						Phase B	*	*	*	Good	
						Phase C	*	*	*	Good	

7000943_X3

Report Source **Three-winding Transformer**

Session Test Date 7/28/2023 8:14:50 AM

Nameplate - Three-winding Transformer

Company	US Army Corps of Eng	**Serial Number**	7000943
Location	Lower Monumental	**Special ID**	T1C
Division	CENWD	**Circuit Designation**	T1C
Manufacturer	Westinghouse Electric	**Configuration**	SINGLE
Year Manufactured	1968	**Tank Type**	N2 Blanket
Mfr Location		**Class**	FA
Winding Config [H-L]	Single-Single	**Coolant**	Oil
Winding Config [H-T]	Single-Single	**Oil Volume**	15539 UG
Winding Config [L-T]	Single-Single	**Weight**	591500 LB
Phases	Single	**BIL**	*
kV	288.68, 13.2	**VA Rating**	164, 218.6, *, *, MVA

Administration

Test Date	7/28/2023	**Test Time:**	8:14 AM	**Weather**	Sunny
Air Temperature	26.7°C	**Apparatus Temperature**	26.7°C	**Humidity**	48 %
Tester	P Susin	**Work Order**		**Date Last Tested**	7/29/2020
Verified		**Test Set Type**		**Date Retested**	
Verification Date		**Set Top Serial #**		**Reason**	Routine
Last Sheet #		**Test Set Model**		**Travel Time**	
Purchase Order		**Ins. Book #**		**Duration**	
Copies		**Sheet #**		**Crew Size**	

Nameplate Notes

---------- Test Session 1 ----------
HV BUSHING CONNECTED TO ARRESTORS AND DISCONNECT SWITCH.

---------- Test Session 2 ----------
RETEST OF UNIT WITH HV CONNECITON OPEN.

---------- Test Session 11 ----------
Tests performed for benchmark purposes prior to regasketing evolution.

---------- Test Session 12 ----------
Unit was completely regasketed. Oil drained, bushings disconnected and lifted, radiators removed and refinished, and tap changer linkage serviced, and gauges replaced/calibrated. 22 hr hot oil circulation was performed followed by a vacuum dryout evolution of 282 hrs which removed 485 oz water. Transformer was filled under vacuum with degassed, reprocessed oil.

Arrester Nameplate

Location	Serial #	Manufacturer	Overall Catalog	Unit Catalog	Type	Rated kV	Order
LA-T	58870	General Electric	9L16GNP396	9L16GHD802A		142	1
LA-M	58870-2	General Electric	9L16GNP396	9L16GHD802A		142	1
LA-B	58870-3	General Electric	9L16GNP396	9L16GHD305		112	3

Bushing Nameplate

Designation	Serial #	Manufacturer	Type	C1 %PF	C1 Cap (pF)	C2 %PF	C2 Cap (pF)	Rated kV	Amps
H1	SN-H1	Westinghouse Electric	O	0.432	445	*	11530	500	1600
H2	SN-H0	Westinghouse Electric	OS	0.78	271	*	*	25	1200
H3	SN-H3			*	*	*	*	*	*
HC2	None			*	*	*	*	*	*
N	HC-SN-1			*	*	*	*	*	*
X1	None	Westinghouse Electric	MRJ	*	*	*	*	23	*
X2	None-6	Westinghouse Electric	MRJ	*	*	*	*	25	*
Y1	None-9	Westinghouse Electric	MRJ	*	*	*	*	25	*
Y2	None-10	Westinghouse Electric	MRJ	*	*	*	*	23	*

Bushing Additional Details -H3

Designation	H3	**Voltage**	Primary	**Serial #**	SN-H3		
Catalog #		**Amps**	*	**BIL**	1550 kV	**Tap**	
Class		**Year**		**Drawing**	264-D-500		
Style		**Other**		**S.O. Number**			
		Physical Dimensions					
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
		Flange Dimensions					
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -X2

Designation	X2	**Voltage**	Secondary	**Serial #**	None-6		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**	1967	**Drawing**	471C325		
Style		**Other**		**S.O. Number**			
		Physical Dimensions					
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
		Flange Dimensions					
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -Y1

Designation	Y1	**Voltage**	Tertiary	**Serial #**	None-9		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**	1967	**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -Y2

Designation	Y2	**Voltage**	Tertiary	**Serial #**	None-10		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**	1967	**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -N

Designation	N	**Voltage**		**Serial #**	HC-SN-1		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Bushing Additional Details -HC2

Designation	HC2	**Voltage**	Primary	**Serial #**	None		
Catalog #		**Amps**	*	**BIL**	*	**Tap**	
Class		**Year**		**Drawing**			
Style		**Other**		**S.O. Number**			
			Physical Dimensions				
Creep Distance	*	**Overall Length**	*	**Inner Seal Dia.**	*	**Eff. Gnd Sleeve**	*
Total Weight	*	**Recess Depth**	*	**Outer Seal Dia.**	*	**Slot Size**	*
Units							
			Flange Dimensions				
To Bottom	*	**# Bolts**	*	**Max. Diameters**		**Draw Lead**	
To Top	*	**Bolt Size**	*	**Below Flange**	*	**Tube ID**	*
		Circle Diameter	*	**Above Flange**	*	**To Pin**	*

Overall Tests [M7100 Serial: 999900000079]

Use Arrhenius TC: No

	Insulation	V [kV]	I [mA]	Loss [W]	PF*TCF [%]	TCF	Cap (pF)	FRANK™	Manual
1	CH+CHL	10.003	43.277	1.827	0.409	0.969	11479.615		
2	CH	10.002	15.165	0.828	0.529	0.969	4022.565	Deteriorated	
3	CHL (Measured)	10.003	28.110	1.002	0.345	0.969	7456.328	Deteriorated	Good
4	CHL	*	28.112	0.999	0.344	0.969	7457.050	Good	
5	CL+CLT	10.001	65.414	2.828	0.419	0.969	17351.655		
6	CL	10.000	64.766	2.819	0.422	0.969	17179.768	Deteriorated	Good
7	CLT (Measured)	10.001	0.649	0.007	0.109	0.969	172.179	Deteriorated	Good
8	CLT	*	0.648	0.009	0.132	0.969	171.888	Good	
9	CT+CHT	10.002	20.782	0.902	0.421	0.969	5512.682		
10	CT	10.001	11.152	0.561	0.487	0.969	2958.152	Deteriorated	Good
11	CHT (Measured)	10.002	9.631	0.341	0.343	0.969	2554.651	Deteriorated	Good
12	CHT	*	9.630	0.341	0.343	0.969	2554.530	Good	
13	CH+CL+CT	10.002	91.191	4.752	0.505	0.969	24189.095		
Winding without Attached Bushing Calculation									
CH-C1	CH'		12.389	0.660	0.516	0.969	3286.298		
CL-C1	CL'		64.766	2.819	0.422	0.969	17179.768		
CT-C1	CT'		11.152	0.561	0.487	0.969	2958.152		

FRANK™ Message	2 (Deteriorated) - The power factor results are high for this apparatus. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. For this apparatus, the low power factor limit is 0.1%, the degraded limit is 0.4%, and the high limit is 0.6%. The relative humidity is between 45% and 70%, which may cause some increases in measured watts and power factor. If higher than expected results are obtained, clean and dry all porcelain surfaces before retesting, using heat if necessary. 3 (Deteriorated) - Power factor results are acceptable compared to the limits. The capacitance has increased by more than 10% since the first test. The capacitance is comparable to the previous test. This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. 6 (Deteriorated) - The power factor results are high for this apparatus. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. 7 (Deteriorated) - Power factor results are acceptable compared to the limits. The capacitance has increased by more than 10% since the first test. The capacitance is comparable to the previous test. This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. 10 (Deteriorated) - The power factor results are high for this apparatus. All results are comparable to previous & initial test results. Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble. 11 (Deteriorated) - Power factor results are acceptable compared to the limits. The capacitance has increased by more than 10% since the first test. The capacitance is comparable to the previous test. This may indicate that the prior measurement was performed in error, or the test circuit included an unexpected capacitance Repeat the test to confirm, first checking all test connections and test set, including all test leads. Clean and dry surfaces of insulators to eliminate surface issues as a factor. Contact your supervisor or Doble.

Bushing Test (C1) [M7100 Serial: 999900000079]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	10.004	1.677	0.083	1.041	0.517	0.432	444.716	445	Investigate	Deteriorated
H2	SN-H0	10.005	1.099	0.085	0.867	0.667	0.78	291.552	271	Deteriorated	Good

FRANK™ Message

1 (Investigate) - The C1 upper limit for a "G" rating is0.5%

The C1 lower limit for a "G" rating is0.1%

The C1 Power Factor has decreased since initial test.

The C1 Power Factor is high compared to limit.

2 (Deteriorated) - The C1 upper limit for a "G" rating is1%

The C1 lower limit for a "G" rating is0.1%

The C1 Capacitance is high compared to Nameplate.

Bushing Test (C2) [M7100 Serial: 999900000079]

Use Arrhenius TC: No

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	2.002	41.421	1.719	1	0.415	*	10987.322	11530	Good	
H2	SN-H0	0.500	3.619	0.378	1	1.044	*	959.869	*	Deteriorated	Good

FRANK™ Message

2 (Deteriorated) - The C2 upper limit for a "G" rating is1%

The C2 lower limit for a "G" rating is0.1%

The C2 Power Factor is high compared to limit.

Bushing Test (C1+C2) [M7100 Serial: 999900000079]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	1.997	40.428	51.062		13.054		10645.639		Investigate	
H2	SN-H0	0.499	4.719	0.463		0.851		1251.615		Good	

FRANK™ Message

1 (Investigate) - The C1 plus the C2 capacitance should equal the (C1+C2) capacitance measured here. This is the same as the C1 test except that a GST-Ground circuit is used instead of a GST-Guard.

Bushing Test (C1 (Inv)) [M7100 Serial: 999900000079]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	1.995	1.621	1.138		7.327		428.832		Investigate	
H2	SN-H0	0.499	1.100	0.084		0.666		291.732		Good	

FRANK™ Message	1 (Investigate) - The capacitances measured with the C1 and the inverted C1 tests should be equal. If not, it may indicate a bad connection near one end of the insulation tested which behaves differently depending on the voltage applied. Make sure your own tesr connections were good.The capacitances measured with the C1 and the inverted C1 tests should be equal. If not, it may indicate a bad connection near one end of the insulation tested which behaves differently depending on the voltage applied. Make sure your own tesr connections were good.

Bushing Test ((C1+C2) - (C1+C2)) [M7100 Serial: 999900000079]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	*	2.670	-49.260		-12.123		786.398			
H2	SN-H0	*	-0.001	-0.001		0.860		-0.194			

Bushing Test (C1 - C1 (Inv)) [M7100 Serial: 999900000079]

ID	Serial #	V [kV]	I [mA]	Loss [W]	TCF	PF*TCF [%]	NP %PF	Cap (pF)	NP Cap	FRANK™	Manual
H1	SN-H1	*	0.056	-1.054		-6.810		15.884			
H2	SN-H0	*	-0.001	0.000		0.001		-0.180			

Hot Collar Tests

				Standard			Legacy (GST, optional)				
ID	Serial #	Test Mode	Skirt #	V [kV]	I [mA]	Loss [W]	V [kV]	I [mA]	Loss [W]	FRANK™	Manual
N	HC-SN-1	GND RB	3	*	*	*	*	*	*		

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Primary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			10	10.052	309.535 mΩ	378.671 mΩ	374.174 mΩ	1.202

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Secondary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			20	19.998	1.170 mΩ	1.431 mΩ	*	*

Winding Resistance [M7100 Serial: 999900000079]

Winding Material	Temperature Rise
Copper	65°C

Tertiary

Winding : Tap	Phase	IEEE	Plot	Requested Current	Measured Current	Measured Resistance	Corrected Resistance	Benchmark Resistance	Percentage Deviation
HV: 3	A			20	19.992	1.159 mΩ	1.418 mΩ	*	*

Custom Diagnostic [M7100 Serial: 999900000079]

	Test Mode	Connection	V [kV]	I [mA]	Loss [W]	% PF Meas.	Cap./Ind.	Manual
X1 Isophase 1C & 2C	Energize HV1 Measure MG	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.002	33.999	4.139	1.218	9017.94 pF	Good
X2 Isophase 1A & 2A	Energize HV1 Measure MG	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.002	35.427	14.890	4.209	9389.29 pF	Deteriorated
Y1 Isophase 3C & 4C	Energize HV1 Measure MG	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.002	35.122	3.132	0.892	9316.10 pF	Good
Y2 Isopahse 3A & 4A	Energize HV1 Measure MG	Ref. to 10kV, Line Freq. Modulation, 60 Hz	10.003	32.203	3.959	1.230	8541.68 pF	Good

Surge Arrester Tests

Location	Test Mode	V [kV]	I [mA]	Loss [W]	FRANK™	Manual
LA-B	GAR RB	*	*	*		
LA-M	UST RB	*	*	*		
LA-T	GAR RB	*	*	*		

TurnsRatio Tests [H-L]

				Serial Number			HV Winding			LV Winding	
				9912252030			Single			Single	
Connections				H1 - H2			-			-	
				X1 - X2			-			-	
Tap	HV [kV]	Tap	LV [kV]	Cal	Ratio 1	Ratio 2	Ratio 3	Min. Lim	Max. Lim	FRANK™	Manual
1	281.467		13.2	21.323	*	*	*	21.217	21.430		
2	288.684		13.2	21.87	*	*	*	21.761	21.979		
3	295.901		13.2	22.417	*	*	*	22.305	22.529		
4	303.118		13.2	22.963	*	*	*	22.849	23.078		
5	310.335		13.2	23.510	*	*	*	23.393	23.628		

FRANK™ Message	1 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. TTR results are considered acceptable if the measured value is within 0.5% of the calculated value. Anything outside this range is cause for further investigation. 2 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. 3 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. 4 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. 5 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. 6 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. 7 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. 8 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. 9 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue. 10 (Unrated) - Continue tests on remaining phases. Inability to complete tests on other phases at this test voltage may indicate an issue.

TurnsRatio Tests [H-T]

				Serial Number			**HV Winding**			**TV Winding**	
			9912252030				Single			Single	
Connections				**H1 - H2**			**-**			**-**	
				X1 - X2			**-**			**-**	
Tap	**HV [kV]**	**Tap**	**TV [kV]**	**Cal**	**Ratio 1**	**Ratio 2**	**Ratio 3**	**Min. Lim**	**Max. Lim**	**FRANK™**	**Manual**
1	281.467		13.2	21.323	*	*	*	21.217	21.430		
2	288.684		13.2	21.87	*	*	*	21.761	21.979		
3	295.901		13.2	22.417	*	*	*	22.305	22.529		
4	303.118		13.2	22.963	*	*	*	22.849	23.078		
5	310.335		13.2	23.510	*	*	*	23.393	23.628		

LVTTR Tests (H-L) [M7100 Serial: 999900000079]

#	Winding : Tap	HV [kV]	LV [kV]	Ratio [#]	Test V [V]	Phase	Ratio [#]	Δ [%]	Angle [°]	FRANK™	Manual
1	HV: 3	295.897	13.200	22.416	100.000	Phase A	22.478	0.274	0.0	Good	
						Phase B	*	*	*	Good	
						Phase C	*	*	*	Good	

LVTTR Tests (H-T) [M7100 Serial: 999900000079]

#	Winding : Tap	HV [kV]	LV [kV]	Ratio [#]	Test V [V]	Phase	Ratio [#]	Δ [%]	Angle [°]	FRANK™	Manual
1	HV: 3	295.897	13.200	22.416	100.000	Phase A	22.430	0.059	0.0	Good	
						Phase B	*	*	*	Good	
						Phase C	*	*	*	Good	

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TRANSFORMER SHIPMENT, HAULING AND SITE ASSEMBLY

PART 1 GENERAL

1.1 GENERAL INFORMATION

This Section, in conjunction with Sections 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2), 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1), and 01 11 01.00 28, SUPPLEMENTARY REQUIREMENTS, covers the contractor's responsibilities for shipment of the transformers for delivery f.o.b. destination the Little Goose Lock & Dam storage yard, hauling, off-loading and placement, site assembly, oil-filling, field testing, and provisions for long-term storage and provision of Erecting Engineer services.

1.2 DESCRIPTION OF WORK

Deliver the transformers to the Little Goose storage yard per the required delivery schedule as included in Clause 52.211-8, "TIME OF DELIVERY", and perform the following site work on each transformer:

a. Perform on-car inspections and testing (as required).

b. Perform transformer cleaning.

c. Off-load and coordinate movement of the transformer and locate the transformer on the mounting pad in position.

d. Off-load the accessory crates at the location directed by the COR.

e. Perform transformer reassembly, vacuum treatment, oil-filling and processing, all required field tests, and final transformer cleaning and touch-up painting.

f. Provide manufacturer's Erecting Engineer services for witnessing all site movement and work performed, as required in paragraph, "ERECTING ENGINEER SERVICES".

1.3 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D923	(2015; R 2023) Standard Practices for Sampling Electrical Insulating Liquids
ASTM D1933	(2003; R 2017) Standard Specification for Nitrogen Gas as an Electrical Insulating Material
ASTM D3283	(1998; Reapproved 2020) Standard Specification for Air as an Electrical

	Insulating Material
ASTM D3487	(2024) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.13	(2016) Standard Requirements for Instrument Transformers
IEEE C57.93	(2019) Guide for Installation and Maintenance of Liquid-Immersed Power Transformers
IEEE C57.149	(2012) Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers
IEEE C57.152	(2013) Guide for Diagnostic Field Testing of Fluid-Filled Power Transformers, Regulators, and Reactors

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

1. Delivery/Shipping Plan; G, AO

Submit for approval a transformer movement plan detailing movement of the transformers to the *Little Goose* storage yard not later than 60 calendar days prior to shipment of the transformer (see paragraph "TRANSFORMER MOVEMENT PLAN").

2. Transformer Site Assembly Procedure; G, HDC

Submit for approval a transformer site assembly procedure and schedule detailing the reassembly of the transformers, vacuum treatment, heated oil-filling, final field testing and durations not later than 60 calendar days prior to delivery of the transformer (see paragraph "Transformer Site Assembly Procedure").

3. Field Supervisor Experience; G, HDC

Submit for approval the field supervisor experience qualifications a minimum of 60 calendar days prior to the performance of site work, if the proposed field supervisor is different than that included with the proposal documents. (see paragraph "Field Supervisor Experience").

4. Erecting Engineer's Qualifications; G, HDC

Submit for approval the manufacturer's Erecting Engineer's qualifications not later than 60 calendar days prior to delivery

of the transformer (see paragraph "Erecting Engineer's Qualifications").

5. Site Assembly Contractor Experience List; G, HDC

Submit for approval the site assembly contractor's experience list not later than 60 calendar days prior to delivery of the transformer (see paragraph "Site Assembly Contractor Experience").

SD-03 Product Data

Submit for approval descriptive data of the following no later than 90 calendar days prior to transformer shipment, to demonstrate fully that all items will conform to the requirements and intent of the specifications.

1. Insulating Oil Oxidation Inhibitor; G, HDC

2. Dry-Air; G, HDC

3. Nitrogen; G, HDC

4. Grounding Conductors; G, HDC

5. Valve Locks; G, HDC

6. Impact Recorders; G, HDC

SD-06 Test Reports

1. Delivery Transformer Oil Test Report; G, HDC

Submit for approval a transformer oil field test report, showing that the transformer oil meets the requirements of ASTM D3487, Table I, Type II, with an oxidation inhibitor content of between 0.25 and 0.30 percent by mass, not later than 15 working days following taking of the oil samples (see paragraph "Transformer Oil for Processing").

2. Transformer Field Test Report; G, HDC

Submit for approval a transformer field test report for each transformer no later than 7 calendar days following completion of the field tests (see paragraph "Electrical Tests").

3. Oil-Filled Transformer Oil Test Report; G, HDC

Submit for approval a transformer oil test report for each transformer after the final transformer oil-filling process has been completed, showing that the transformer oil meets the requirements of TABLE 1, TRANSFORMER INSULATING OIL TEST REQUIREMENTS, included at the end of this section, not later than 15 working days following taking of the oil samples (see paragraph "Oil Tests").

SD-07 Certificates

Shipping bills and Notices; G, AO

Submit a list of articles shipped with descriptive data within 7 calendar days of the shipment for each transformer (see paragraph "Packaging and Marking for Shipment").

SD-08 Manufacturer's Instructions

1. Training Outline; G, AO

Submit for approval a training outline covering the material to be used for performance of the on-site training session, including a schedule, not later than 60 calendar days prior to completion of the transformer field tests (see paragraph "CONTRACTOR-FURNISHED TRAINING OF GOVERNMENT PERSONNEL").

2. Site Delivery Inspection Procedure And Schedule; G, HDC

SD-09 Manufacturer's Field Reports

1. Impact Recorder Summary Report; G, AO

Submit for approval the impact recorder summary report for each transformer, including a copy of the digital impact recorder log and photos of any impacts greater than 3.0g on any axis for the analog impact recorder trace, within 24 hours after delivery of the transformer (see paragraph "Site Delivery Inspection Procedure and Schedule")

2. Site Delivery Inspection Report; G, AO

Submit for approval the site delivery inspection report for each transformer within 48 hours following completion of the site delivery inspection for the transformer (see paragraph "Site Delivery Inspection Report")

3. Tools and parts control checklist; G, AO

Submit for approval a copy of the tools and parts control checklist at the end of every working shift for each transformer. (see paragraph "Tools and Parts Control").

1.5 FIELD SUPERVISOR EXPERIENCE AND RESPONSIBILITIES

1.5.1 Field Supervisor Experience

The field supervisor must have been engaged in the field (site) movement, reassembly, oil-filling and testing of similar power transformers as specified herein, based upon performance of this work at a minimum of five projects within the previous ten years. Submit for approval the field supervisor experience, which includes a listing of projects performed, scope of the work, and a contact name and phone number. The field supervisor and erecting engineer may be the same person, provided the qualifications for both are met.

1.5.2 Responsibilities

One full-time employee of the contractor must be available at the worksite anytime other contractor or subcontractor personnel are working on the site, to supervise and direct the work specified herein, who is fluent in the spoken and written English language. The supervisor must be present

at the Little Goose Lock & Dam "Storage Yard" during all site work including transformer site movements, reassembly, oil-filling and testing, and be responsible for following OSHA safe clearance procedures and the Government's Safe Clearance procedures. The supervisor must keep all as-built drawings current and provide copies upon completion of the work. The field supervisor must be responsible for the performance, oversight and correctness of all site work identified in these specifications, including the following:

a. Compliance with all safety, health and reporting requirements of these specifications, including Safe Clearance procedures, accident prevention, environmental protection, activity hazard analysis, fall protection, and confined space entry.

b. Preparation of all required submittals and documentation.

c. Securing an inventory of all materials entering the transformers to ensure no unintended foreign objects remain in the tank.

1.6 SITE ASSEMBLY CONTRACTOR EXPERIENCE

Submit for approval a site assembly contractor experience list, if the transformer site assembly contractor is other than the transformer manufacturer, documenting that the proposed contractor has been engaged in the site assembly and oil filling of generator step-up transformers, rated greater than or equal to 500 kV and 75 MVA single-phase for the last five (5) or more years.

1.7 ERECTING ENGINEER SERVICES

1.7.1 General

Provide a transformer manufacturer’s erecting engineer on the site of the work continually during the progress of each transformer delivery, movement, assembly, oil-filling and testing, who is fluent in the spoken and written English language. The erecting engineer and field supervisor may be the same person, provided the qualifications for both are met.

1.7.2 Erecting Engineer's Qualifications

Provide an erecting engineer who is a permanent employee of the transformer manufacturing facility, or a factory certified representative thereof, who has been engaged in the witnessing of field (site) assembly and installation of similar power transformers, as specified herein, for a minimum of five years, and has performed this work on a minimum of 20 transformers. Erecting engineer must also have experience with 500 kV rated transformers. Submit for approval the Erecting Engineer’s Qualifications, consisting of a listing of this required experience, including a verifying contact, name and phone number for three facilities at which this work was performed. The Erecting Engineer has the authority to make decisions on behalf of the transformer manufacturer.

1.7.3 Responsibilities

The transformer manufacturer's Erecting Engineer is responsible for the transformers, and for the oversight and correctness of instructions given during their reassembly, including the following:

a. Witness and guide off-loading and loading of the transformers at

each transloading location (transferring a shipment from one mode of transportation to another) during shipment, and off-loading from the transport trucks at the Little Goose Lock & Dam "Storage Yard".

b. Witness and guide movement of the transformers to its final long-term storage location, and coordinate placement on the mounting pads with the Corps COR representative.

c. Witness and guide the reassembly of the transformers, including the oil filling process.

d. Witness, guide or perform all transformer inspections and tests for each transformer.

e. After completion of all transformer site work, conduct training for Government personnel, per the requirements of paragraph "CONTRACTOR-FURNISHED TRAINING OF GOVERNMENT PERSONNEL".

1.7.4 Reporting

Maintain a record of all data taken during site assembly and installation, including inspection activities, instructions provided, test results, recommendations and observations for each transformer, and provide this information to the Field Supervisor for inclusion in the daily reports.

PART 2 PRODUCTS

2.1 DRY-AIR

Submit for approval the descriptive data for the proposed Dry-air for use onsite in conformance with the following paragraphs.

2.1.1 Dry-Air in Cylinders

Dry-air provided in cylinders that meets the requirements of ASTM D3283, Type I, with the composition and properties as follows:

a. Oxygen, volume: 19.5% to 23.5%

b. Carbon monoxide, max. volume: 0.0020%

c. Carbon dioxide, max. volume: 0.10%

d. Nitrogen: predominantly balance

e. Dew point, max.: -58 Degrees Celsius

2.1.2 Air Compressor Dryer

Dry-air supplied by an oil-less compressor must include the following, as a minimum:

a. Desiccant system on the output of the compressor for removal of dirt, water, oil and uncondensed moisture from compressed air lines.

b. Maintain a maximum -40 degrees Fahrenheit dew point, while achieving a 0% compressed air humidity.

c. Coalescer that removes oil and sub-micron particles down to 0.01

microns.

d. Filter that provides removal of water and contaminants down to 5 microns.

e. Provides a filtration capacity up to 30 CFM @ 175 psi.

f. Replaceable or regenerative desiccant system which provides indication of silica gel saturation.

2.2 NITROGEN

If transformers with nitrogen oil preservation systems were provided, submit for approval the descriptive data for the nitrogen proposed for use during the transformer reassembly process, and for establishing the nitrogen blanket headspace after the vacuum oil-filling process for the transformers. Provide nitrogen that meets the requirements of ASTM D1933, Type III in cylinders that fit the applicable nitrogen regulator cabinet.

2.3 GROUNDING CONDUCTORS

Provide bare No. 6 AWG, Class A stranded conductors for grounding of each transformer's bushings to the tank, and from the tank to the existing project chain link fence grounding clamp. Ground conductors are to meet the requirements of SECTION 26 05 19.00 26, paragraph "Ground Conductors". Submit for approval the descriptive data for the grounding

2.4 VALVE LOCKS

Provide locks for locking each valve on each transformer as listed in paragraph "VALVES" in SECTIONS 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2), and 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1), coordinated with the size of the valve lock hasps. All locks are to be keyed the same, with two keys provided for each transformer. Submit for approval the descriptive data for the valve locks proposed for use in locking the hasps of all valves.

2.5 IMPACT RECORDERS

Provide a 3-axis analog impact recorder for each transformer shipped, and for transportation within North America also provide a digital impact recorder with GPS satellite tracking for each transformer. that meet the following:

a. Solar powered with battery backup with sufficient life to supply power to the recorder for the entire duration of the shipment, or replaceable batteries.

b. Programmable to recorder and transmit impacts greater than 1.0g

c. Provides reports every 30 minutes.

d. Includes a shield to protect the recorder.

e. Capable of real-time data that is Internet viewable

PART 3 EXECUTION

3.1 PROTECTION OF MATERIAL AND WORK

At all times prior to delivery and during the assembly and testing process, all materials, supplies, and equipment of every description including property which may be Government-owned and all work performed must be protected and preserved. If, as determined, material, equipment, supplies, and work performed are not adequately protected, such property may be protected by the Government and the cost thereof may be charged to the contractor or deducted from any payment due. All machinery, materials, and articles in a complete or incomplete state for which progress payment has been made prior to delivery must be adequately protected from loss and from corrosion and all other forms of damage. The contractor must also be responsible for, and make good for, any damages due through their fault or negligence occurring during assembly and testing of the equipment at the Little Goose Lock & Dam "Storage Yard".

3.2 TRANSFORMER SHIPMENT PREPARATION

3.2.1 General

Supply units of shipping dimensions and weight that allow for transport from the point of manufacture to the Little Goose Lock & Dam "Storage Yard", including any beams or cribbing required to distribute loading during shipment. Color any internal shipping blocking or bracing that is to be removed from the transformers at its destination a bright yellow, and specifically address these components and their removal during the reassembly process in the transformer site assembly procedure. Any material to be returned to the vendor after transformer shipment must be returned at the contractor's expense, and include identification of material ownership and the shipping address. Materials not so marked will be disposed of at the Government's discretion.

3.2.2 Packaging and Marking for Shipment

a. Prepare and load all material and articles for each shipment in such manner as to protect them from damage during transit, and include the following at a minimum:

(1) Protect all bushings left installed on the transformers during shipment using covers fabricated of either wood or metal, securely fastened.

(2) Protect the control cabinets, and all valves located within 48 inches of the base of the transformer tanks, using covers fabricated of either wood or metal, and securely fastened.

(3) For each transformer, wrap the entire transformer with a marine/industrial shrink film of 7-mil thickness, with provisions made for the following:

(a) Access to any transformer tank tie-down locations required during shipment.

(b) Exposure of the impact recorder's solar cells if applicable.

(c) Access to any testing terminals which require access

during shipment.

(d) Access to the shipment dry-air gas cylinder regulator and gauges.

b. Each transformer and accessories must not be shipped until after the inspections by Government personnel have been performed with all noted deficiencies corrected (unless inspection of the equipment has been waived in writing), factory acceptance tests have been completed and the test reports approved, and the Delivery/Shipping Plan has been reviewed and approved with either an Action Code A or B.

c. Prepare all transformer accessories removed for shipment, including spare parts, in crates with integral skids and lifting means for a fork lift. Package and wrap all accessories within the crates so that they are water resistant. Identify each shipping crate with a unique number which corresponds to an overall packing list for each transformer, and a crate contents packing list which is securely affixed within a see-through weatherproof envelope, and includes the following:

1. Manufacturer

2. Contract number

3. Each spare part or accessory identified so that it can be easily matched with the transformer, its entry on the packing list, and with the transformer layout drawing.

4. Clearly identify the hardware included for installation of each accessory device, and fasten the hardware securely to the device if possible.

d. Identify all crates containing equipment that should be stored indoors, including electronic devices, bushings, gaskets and spare parts, with 2-inch high lettering indicating "STORE INDOORS". Identify items that are required to be shipped and stored in a particular arrangement with 2-inch high lettering indicating "THIS SIDE UP".

e. Submit for approval the shipping bills and notices as soon as each shipment is made, which includes a description of the article furnished, the item number of the contract schedule to which the article applies, the shipping weight of each item, the number of pieces, the total weight, and, if shipped by railroad, the car number.

3.3 SHIPPING

3.3.1 Preparation for Shipment

Deliver each transformer with the oil drained from the tanks. Purge each tank with dry air meeting the requirements of paragraph "DRY-AIR", and install a dry air cylinder and pressure regulator set to at least 2.5 psi during shipment, including gauges to indicate both the transformer tank pressure and the cylinder pressure. Attach a shipping marker with the regulator equipment showing the regulator setting, bottle pressure, tank dew point measurements, and date each tank was sealed for each transformer. Prior to shipment, perform a transformer tank pressure test on each transformer in the shipping configuration, maintained for a

minimum of 24 hours, to verify that there are no leaks and there is no appreciable reduction in bottle pressure. If part of the shipment is by rail, then ship the transformer on rail cars equipped with hydraulic draft gear and hydraulic snubbing devices.

3.3.2 Impact Recorders

Mount the impact recorders on each transformer's tank reinforcing channels, covered with a shield. Calibrate the digital impact recorder to record and transmit impact data greater than 1.0g, and provide timed on-line reports every 30 minutes during transformer movement. Provide the Government with the login and password information necessary for website access prior to shipment. Provide the impact recorder serial number and corresponding transformer serial number information for the device.

3.3.3 Shipment

Prepare each transformer and ancillary equipment for shipment from the manufacturing facility to the Little Goose Lock & Dam "Storage Yard", after completion of factory testing and each transformer have been released for shipment by the COR. Perform the following at all transformer transloading operations and include with the site delivery inspection report:

a. Inspection and logging of each transformer tank dry air shipping pressure.

b. Inspection for any signs of transformer movement or shipping damage.

c. Take photos of each transformer and transloading movement operations.

3.3.4 Hauling

The dimensions and weight (without oil) of the largest piece being transported must not exceed that allowed for truck transport and for movement to the Little Goose Lock & Dam "Storage Yard". In the event the shipping dimensions or weight of the largest piece exceed those allowed for truck transport or at the project, the transformers must be designed and manufactured such that its weight and dimension can be safely reduced in the field to that allowed for transport. Any limitations affecting transportation must not become the basis for claims or damages, or for extension of time for completion of work.

3.4 TRANSFORMER DELIVERY/SHIPPING PLAN

The Contractor is responsible for the loading, delivering and offloading of all finished products. Government personnel will not assist the Contractor in the offloading process. Delivery of each transformer is to be made to the Little Goose Lock & Dam "Storage Yard". Refer to contract drawings for location of delivery. Government approval of the movement plan does not constitute approval by railroad or transportation authorities. Submit for approval Delivery/Shipping Plan drawings, approved with either an Action Code A or B prior to transformer shipment, to include the following as a minimum.

a. The method and means of transformer lifting and movement from the manufacturing facility to the Little Goose Lock & Dam "Storage Yard",

including all transloading locations. Transloading locations must be identified and scheduled for inspections during these occurrences. Provide descriptions of methods of delivering each transformer, including details for support during shipment to prevent distortion, damage to paint system or other structural members. Include the orientation and location of each transformer on the delivery vehicles prior to shipment for Government approval.

b. Drawings or detailed maps showing the intended route to be taken by the transporters to the Little Goose Lock & Dam "Storage Yard".

c. Wheel, axle, outrigger, and track loads of each transport truck, as applicable, and their locations along the route. Axle loading and road loading limitations must be coordinated with the applicable state and county Departments of Transportation.

d. The method and means of off-loading and handling of each transformer at the Little Goose Lock & Dam "Storage Yard", including equipment, crane operations, loading plans for equipment, and intended route while on Government property at the Little Goose Lock & Dam "Storage Yard".

e. Store material above ground on platforms, skids, or other supports. Protect material from dirt, oil, and other foreign matter. Protect material so that water is not permitted to collect and pool. Employ handling methods that do not result in damage to components during fabrication, assembly, loading, shipment, and unloading of components. Replace damaged material with new material or repair using a procedure approved by the Engineer of Record. Shipping of each transformer is to be at the Contractor's expense. Arrange each transformer on the delivery vehicles such that no damage occurs during shipping.

3.5 SITE DELIVERY INSPECTIONS

3.5.1 Site Delivery Inspection Procedure and Schedule

Submit for approval a transformer site delivery inspection procedure and schedule, which contain a step-by-step activity listing and a schedule that defines critical path activities and activity dependencies. Include in the procedure the persons on each shift responsible for superintendence and safe clearance, and the activities which are hazardous, affect plant operation, or require participation by Government personnel.

3.5.2 Sample Site Delivery Inspection Procedure

The following outline is based on the expected site delivery inspection and shipping procedure, and is intended to show the scope of the required work. The actual step-by-step procedure submitted must be applicable to the transformer actually furnished, and list methods of repair and/or retesting if unacceptable results of the inspections are obtained.

a. Perform an on-car or transporter external inspection of each transformer and associated equipment for shipping damage, including signs of movement and loose or damaged tie rods. Provide photographs of any noted rail or transporter shipping damage, and included in the Site Delivery Inspection Report.

b. Record each transformer tank and bottle gas pressures at the

shipping regulator gauges. Maintain positive pressure on each tank. If a tank pressure is found other than positive, contact the transformer manufacturer to determine the necessity for field dry-out procedures, per the requirements of IEEE C57.93, paragraph 5.8.2, high-vacuum drying, Method 2 with hot oil circulation.

c. Perform a dew point check on each transformer and determine the insulation moisture content, per the methods of IEEE C57.93, Annex C, paragraph C.2.1.1. Moisture content, in terms of temperature, pressure, and dew point should essentially be the same as when the respective transformer was shipped. If the moisture content is greater than 0.5 percent of the dry weight of insulation, perform field dry-out procedures per the requirements of IEEE C57.93, paragraph 5.8.2, high-vacuum drying, Method 2 with hot oil circulation. If it becomes necessary to dry-out any part of the transformer, the contractor must perform all such operations as required at no additional cost to the Government.

d. For each transformer, inspect the impact recorders before removal for tight securement, in position as loaded, protective cover intact, seals in position, and whether the area the device is secured to is intact, loose, or deformed. Any exceptions to the shipment observed must be brought to the attention of the COR. Remove the impact recorder mounting provisions. Inspect the analog impact recorder charts, and the digital GPS data files, in the presence of the COR for any indication of excessive impacts during shipment. Inform the transformer manufacturer of any impacts greater than 3.0g on any axis, and perform inspections and tests as required, below. For each transformer, submit for approval an Impact Recorder Summary Report.

e. The contractor must be responsible for acceptance of all delivered materials and equipment, the condition, and completeness as compared to the manufacturer's shipping packing list.

f. Perform an SFRA test of each transformer in its shipping configuration, as specified in Sections 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1), and 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2), as defined in paragraph "Sweep Frequency Response Analysis Tests" and paragraph "FIELD TESTS", below, and compare to the factory SFRA tests as performed with each transformer in its shipping configuration. Wavetrace comparisons are expected to match closely, with little differences between matched scans. Wavetrace comparisons that do not match closely must be explained to the satisfaction of the COR, and may be grounds for transformer rejection, requiring an internal inspection of the transformer by the contractor to determine the cause of the deviations, or requiring the transformer to be sent back to the manufacturing facility for repair at no expense to the Government.

g. If shipping damage is suspected or impacts greater than 3.0g on any axis was recorded on the impact recorders and/or charts for any transformer, perform an internal inspection of that transformer to check for internal damage such as loose coils, broken lead supports, dislodged end insulation, frayed lead insulation, core grounds, or loose nuts or bolts. During this internal inspection, follow the requirements of paragraph, "REQUIREMENTS FOR PERFORMANCE OF WORK WITHIN THE TRANSFORMER TANK" and include the inspection results, with photos and manufacturer repair and test recommendations, in the transformer's site delivery inspection report. Reseal the transformer

after the internal inspection has been completed, perform vacuum treatment, and repressurize the transformer to 2.5 psi with dry-air. Maintain positive pressure during transportation of the transformer to the project, off-loading, and until such time that the tank is opened during assembly. Perform an additional dew point check 24 hours after reseal of the transformer.

3.5.3 Site Delivery Inspection Report

Submit for approval a Site Delivery Inspection Report after completion of the transformer site delivery inspections for each transformer, based upon the approved procedural outline. The Government will not accept delivery of any transformer until a Government review of the report verifies no damage to the transformer has occurred during shipping. The site delivery inspection report must include, but not necessarily be limited to, the following for each transformer:

a. Records of inspections performed and photos taken for all transloading operations.

b. Record of the tank pressure, cylinder pressure and dew point, including the procedure for diagnosis and correction in the event of loss of positive gas pressure during shipment.

c. Visual inspection log, including photographs of any shipping damage and any evidence of transformer movement during shipment, and the proposed method of repair.

d. Results of internal inspection, if required, including photographs of any shipping damage and the proposed method of repair including any recommended tests.

e. Sweep Frequency Response Analysis test results.

3.6 TRANSFORMER CLEANING

Perform heated water pressure washing and cleaning of each transformer prior to moving to the long-term storage location, if determined necessary by the COR. This cleaning process may be performed on the transport truck, at a location approved by the COR. Avoid the ingress of moisture into any electrical cabinets during the cleaning process. Any cleaning agent used during this process must be biodegradable, and subject to the approval of the COR.

3.7 SITE MOVEMENT AND ASSEMBLY

3.7.1 Transformer Movement and Site Placement

Off-load and move each transformer at the Little Goose Lock & Dam "Storage Yard" as indicated below:

a. Offload the accessory crates at the staging location, as indicated. Notify the COR of any crates which require indoor storage, and coordinate their storage for future access.

b. Off-load each transformer to its long-term storage location, locating the transformer on the concrete pad in a containment vault in the position as indicated by the Government representative.

c. After placement on the concrete pad in a containment vault, perform transformer reassembly, vacuum processing, oil-filling, all required field tests, and final transformer cleaning and touch-up painting.

d. Provide manufacturer's Erecting Engineer services for witnessing all site movement and work performed, as required in paragraph, "ERECTING ENGINEER SERVICES".

3.7.2 Transformer Site Assembly Procedure

The contractor is responsible for the complete reassembly of each transformer, operational verification of all transformer components, vacuum processing, oil-filling and performance of the final field tests as required in paragraph "FIELD TESTS". For each transformer type, submit for approval a transformer site assembly procedure which includes a step-by-step activity listing and a proposed time line for each specific task, with references to the transformer manufacturer's instructions, as follows. Include any activities which are hazardous, affect plant operation, or require participation by Government personnel.

a. Torque all bolted connections to the manufacturer's recommendations, and indicated with a permanent marker on every connection that the torquing process has been performed.

b. Perform an internal inspection of each transformer during the assembly process, by visual inspection through the manhole and bushing covers, for evidence of shifting components during transportation, condition of high-voltage lead insulation for evidence of abrasion, and verification that no tools or hardware were inadvertently left inside the tank after the manufacturing process. Any discovered anomalies must immediately be brought to the attention of the COR. Take photos of the inside of the transformer during this inspection process, and include in the field test report.

c. Hand-clean each bushing and inspect for damage prior to its installation. Perform pre-installation insulation power factor and capacitance tests on each bushing which includes a test tap and a hot collar test on the LV bushings and compare to nameplate values, including the spare bushings being provided. Install the bushings on the transformers in the same phase locations as installed at the manufacturing facility for performance of the factory acceptance tests.

d. Remove any interior shipping braces. Install and connect the bushings, radiators, low-voltage bushing housings and accessory devices removed for shipment. Install new gaskets at gasketed connections for the re-installation of components removed for shipping purposes. Thoroughly clean all gasketed grooves and mating surfaces prior to installation of the new gasket, and apply a high-temperature lubricant designed for transformer gasket applications to the gasket during installation. Do not use Vaseline as a lubricant. Inspect each gasket during installation to assure no damage exists, and the gasket is properly sized to provide approximately 25% compression for filling of the groove when installed, and not oversized causing the gasket to be compressed out of the groove and pinched between the mating surfaces.

e. Do not install the cooling fans, they must be turned over to the Government in their shipping crates must not be installed on the

transformer and must be turned over to the Government in their shipping crates for storage after they have been thoroughly inspected for shipping damage or missing parts.

f. Pressure test each assembled transformer.

f. Perform a vacuum leak test on each completely assembled transformer, per the requirements of IEEE C57.93, paragraph 5.7.4, and these specifications.

g. Perform vacuum treatment and hot oil-fill each transformer under vacuum to the normal operating level per the requirements of paragraph "TRANSFORMER OIL-FILLING AND PROCESSING", and the manufacturer's recommendations (whichever is more stringent). Provide a listing of all equipment to be used during the filling process.

h. Perform routine accuracy tests on all bushing current transformers for each transformer in accordance with IEEE C57.13, paragraph 6.11. After completion of the tests, verify that all the shorting screws on the bushing current transformer terminal blocks within the control cabinet are installed, and the current transformer are shorted to ground.

i. Perform an inspection of each transformer and verify the correct installation of the transformer ancillary equipment and devices after reassembly.

j. Verify the tightness of all valve stem packing glands on each transformer.

k. Completely clean each transformer after completion of the reassembly process, including the insulator sheds on the bushings, and perform touch-up painting.

3.8 REQUIREMENTS FOR PERFORMANCE OF WORK WITHIN THE TRANSFORMER TANK

3.8.1 General

Perform the following on each transformer when working within, or around an opening of, the transformer tanks:

a. Thoroughly clean and vacuum the top of the transformer prior to the removal of any tank man-hole covers, to minimize the possibility of contaminants entering the tank.

b. Monitor the temperature and relative humidity around the transformer during the performance of work. Do not open the tank if the measured relative humidity is greater than 80%, or if there are signs of external condensation on the tank surfaces.

c. Continuously purge the tank with dry air through the lower filter valve, utilizing a dry-air compressor delivering that meets the requirements of paragraph "Dry-Air" any time a transformer tank internals are exposed to the atmosphere.

d. Purge the tank with dry air until analysis of the gas in the transformer indicates at least 19.5 percent oxygen, prior to personnel entry.

e. Provide disposable coverall personal protective equipment suit for all personnel entering the transformer tank. Maintain a logbook of all items entering and leaving the transformer tank to assure nothing has inadvertently been left inside (See paragraph "Tools and Parts Control and Accountability Procedure").

f. Cover all openings into the transformer tank whenever possible to prevent any falling objects from entering the tank.

g. Re-seal the tank at the end of each working day, and pressurize with 2.5 psi of dry-air that meets the requirements of paragraph "DRY-AIR".

3.8.2 Tools and Parts Control and Accountability

A tool and parts control and accountability program is necessary for each transformer to ensure that foreign objects are not left within the transformer tank during internal inspections and transformer reassembly work. Personnel must remove all personal items from their person prior to entering the transformer tank. Log all tools and parts taken into the transformer tank, or which are used within the transformer tank, and any personal items which must remain with the contractor personnel when working within the tank, onto a Tools and Parts Control Checklist. At the end of each shift, and prior to resealing of the transformer tank, account for all tools and parts identified on the checklist, and inspect the interior of the transformer tank for any loose tools or parts. To maintain control of the tools entering the transformer tank, all personal transportable tools will be checked out of a controlled space, such as a tool bin, and checked back during each shift. The contractor Field Supervisor is responsible for assuring that inventoried tools for each craftsperson are accounted and signed for, and logged on the Tools and Parts Control Checklist during each shift. To control parts entering the transformer tank, the Quality Control manager must inventory and issue the parts during each shift. At the end of each shift, a count will be made of the installed parts to ensure that the quantity checked out matches what was installed. Provide a copy of the Tools and Parts Control Checklist to the COR at the end of each shift for work being performed within each transformer tank, or when the transformer tank is open, and discrepancies in tools or parts must be brought to the attention of the COR.

3.9 TRANSFORMER DRY-OUT

It is not anticipated that it will be necessary to dry-out the transformers; however, if gas pressure has been lost during shipment or shipping damage is suspected on any transformer, then dry-out may be necessary. If the moisture content is greater than 0.5 percent of the dry weight of insulation, perform field dry-out procedures per the requirements of IEEE C57.93, paragraph 5.8.2, high-vacuum drying, Method 2 with hot oil circulation. If it becomes necessary to dry-out any part of the transformer, the contractor must perform all such operations as required at no additional cost to the Government

3.10 TRANSFORMER OIL-FILLING AND PROCESSING

Provide all oil handling and high-vacuum processing equipment for filling of each transformer per the requirements of IEEE C57.93, paragraph 5.7, or the manufacturer's recommendations, whichever is more stringent. Include the transformer oil-filling and processing procedure in the transformer

site assembly procedure. No Government provided power source will be available to the contractor for this equipment.

3.10.1 Oil Containment

Utilize one-piece spill containment berms under the oil tanker trucks, vacuum processing trailers, and generator, sized to completely surround the equipment, for all oil-handling operations. Provide berms that are manufactured from a reinforced geomembrane of a minimum 30 mil thickness, chemically resistant to transformer oil, with supported collapsible walls. During the oil handling operations, all hose joints which are located outside of the spill containment berms must have interlocking connections, be wrapped with an absorbent material, with 5-gallon buckets located beneath the joint to help avoid oil spills. Submit for approval an oil spill plan and provide the necessary equipment to contain an oil spill.

3.10.2 Tank Pressure Test

Perform a transformer tank pressure test after each transformer has been fully assembled, but prior to oil-filling. Verify that all bolted connections have been torque-checked for the correct tightness prior to performing the test, and perform testing at a gauge pressure of 4 psi for a minimum of 8 hours. The tank must hold pressure during the test duration without leakage, and any leaks detected resolved prior to proceeding to vacuum treatment.

3.10.3 Vacuum Leak Test

Perform a transformer tank vacuum leak test after each transformer has been fully assembled, but prior to oil-filling. Ensure that all devices which are not suitable for vacuum have been valved off prior to testing. A vacuum level of 0.25 Torr must be achieved, and during the initial 30 minutes of the test the maximum allowable pressure rise must not exceed 0.15 Torr. If more than 0.15 Torr of vacuum is lost during the first 30 minutes, or if the rate of loss of vacuum increases over an hour, determine the source of the vacuum leak and take the necessary corrective actions, and re-perform the vacuum leak test until the maximum allowable pressure rise has been achieved.

3.10.4 Vacuum Treatment

On each transformer, after an acceptable leak rate has been achieved, perform vacuum treatment by holding a maximum vacuum of 0.25 Torr for a duration per the manufacturer's recommendations, but must be a minimum of 24 hours. If a vacuum of 0.25 Torr cannot be achieved, check all bolted fittings for tightness, and explain to the satisfaction of the COR. During this period, hot oil at a temperature between 60 - 65 degrees Celsius may be introduced to aid in heating the windings for moisture removal, then drained to allow for moisture removal using vacuum.

3.10.5 Transformer Oil for Processing

Provide insulating transformer oil which meets requirements Sections 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2), and 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1), paragraph "INSULATING OIL" for each transformer. Prior to filling, take oil samples from each oil tank and test per the requirements of paragraph "Oil Tests". Provide any temporary oil storage facilities required for handling and processing the transformer oil.

3.10.6 Vacuum Filling

For each transformer, after vacuum treatment, handle the oil from the tanker trucks to each transformer via a high-vacuum purifier. Vacuum-fill the transformer with hot oil, at a temperature between 60 - 65 degrees Celsius, circulating a minimum of two full volume passes of hot oil after completion of the vacuum filling process to aid in moisture removal. Fill the transformer in a continuous operation to the correct oil level based upon the oil temperature, per the manufacturer's recommendations. Establish the nitrogen blanket if supplying transformers with a nitrogen oil preservation system per the manufacturer's recommendations.

3.11 TOUCH-UP PAINTING

For each transformer, thoroughly clean any abrasions to the transformer paint, and touch-up paint any damaged areas with one coat of primer and one finish coat of paint. Clean all finished surfaces to receive primer on which the factory coating has deteriorated or been damaged by means of solvents, degreasers, light sanding or polishing with 240 grit aluminum oxide paper or cloth moistened with kerosene, or other approved means which removes all grease, paint markings, dirt, rust, and other foreign substances. Protect adjacent surfaces and equipment from overspray or paint splatter during the touch-up painting operations. The use of wet or dry cloths or paper must be approved by the COR on an individual basis. Primer paint and finish coats must be as specified in Sections 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2) and 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1), paragraph "FACTORY CLEANING AND PAINTING".

3.12 FIELD TESTS

3.12.1 Device Functional Tests

After reassembly of each transformer, all devices and wiring connections removed for shipment must be functionally tested to verify proper operation. The functionality of the cooling fan circuits must be verified by voltage check.

3.12.2 Electrical Tests

Perform the electrical tests on each transformer in accordance with the applicable requirements of IEEE C57.152 and the approved transformer site assembly procedure, after each transformer has been filled with oil, the bushings installed, and assembly of each transformer is complete. A copy of each transformer's factory acceptance test report must be on-hand during performance of the field tests, and test result comparisons made to verify an acceptable transformer condition after reassembly and oil-filling each transformer. Any deviations between the factory and field test results must be brought to the attention of the COR for determination of acceptance. Submit for approval the Transformer Field Test Report for each transformer after completion of the tests. Electronic data test results for the tests listed below must be provided in standard Doble file formats, as applicable, for uploading into the Doble online database and comparison to factory and future tests performed by Government personnel. The witnessing representatives of the contractor and the COR must sign the reports of all witnessed tests. Perform the following electrical tests on each transformer prior to final acceptance by the Government:

a. Transformer Turns Ratio test (TTR) on each tap (IEEE C57.152, paragraph 7.2.10)

b. Exciting Current (IEEE C57.152, paragraph 7.2.11)

c. Winding insulation resistance of each winding to ground and between windings (IEEE C57.152, paragraph 7.2.13)

d. Winding resistance of each winding (IEEE C57.152, paragraph 7.2.7)

e. Polarization Index (IEEE C57.152, paragraph 7.2.13.4)

f. Power Factor test and excitation current of each transformer winding (IEEE C57.152, paragraph 7.2.14)

g. Power Factor Test of each transformer bushing (IEEE C57.152, paragraph 7.3.3)

h. If providing a core type transformer, core insulation resistance (IEEE C57.152, paragraph 7.2.6.2), for both core-to-frame and frame-to-ground.

i. Leakage Reactance Measurement Tests, per the requirements of IEEE C57.152, paragraph 7.2.12. Perform leakage reactance measurement tests between the high-voltage winding and each low-voltage winding, and between the two low-voltage windings (H-X, H-Y, X-Y, and H-X/Y), using the same model test equipment and methods as used in the manufacturing facility. The leakage reactance test results must not deviate more than 0.5 percentage points as compared to the factory test reports. Deviations in excess of 0.5 percentage points must be explained to the satisfaction of the COR, and may be grounds for requiring an internal inspection of the transformer by the contractor, at no expense to the Government, to determine the cause.

j. Sweep Frequency Response Analysis Test. Perform a sweep frequency response analysis (SFRA) test per the requirements of IEEE C57.149, using the same equipment and methods as used during the transformer factory acceptance testing. Include the proposed SFRA test equipment, setup, and test procedure in the field test procedures submittal. Compare the SFRA test results with the factory acceptance test "baseline" results, to determine the integrity of the core and winding structure after shipment from the manufacturing facility. Load the SFRA data obtained during the factory acceptance testing into the test equipment software to facilitate Wavetrace comparisons. Wavetrace comparisons are expected to match closely, with little differences between matched scans. Wavetrace comparisons that do not match closely must be explained to the satisfaction of the COR, and may be grounds for transformer rejection, requiring an internal inspection of the transformer by the contractor to determine the cause of the deviations, or requiring the transformer to be sent back to the manufacturing facility for repair at no expense to the Government.

3.12.3 Oil Tests

Perform testing on the supplied transformer oil per the requirements of TRANSFORMER INSULATING OIL TEST REQUIREMENTS, included with these specification, and obtain oil samples per the requirements of ASTM D923.

a. New oil certification, as delivered. Provide a copy of the transformer oil certification tests from the transformer oil supplier upon delivery, and prior to filling of each transformer. If the oxidation inhibitor content is below 0.25 percent by mass, the inhibitor content must be increased during the oil-filling process by the addition of a liquid concentrated oxidation inhibitor for insulating oil. Submit for approval the proposed Insulating Oil Oxidation Inhibitor, including the calculations for the amount of additive required to bring the overall oxidation inhibitor content to 0.30 percent by mass.

b. Delivery sample. Obtain an oil sample from each oil-filled compartment from each tanker truck upon arrival to the site, and send out for testing. Submit for approval a Delivery Transformer Oil Test Report. Any nonconformance with the required oil characteristics must be remedied during field processing, at no cost to the Government, by a process submitted for approval.

c. Post oil-filling samples. After transformer oil filling and processing on each transformer has been completed, obtain samples of the insulating oil from the transformer and send to two independent laboratories for analysis. Submit for approval an Oil-Filled Transformer Oil Test Report, which includes the identity of samples and results of analyses.

3.13 GROUNDING CONNECTIONS FOR LONG TERM STORAGE

After each transformer has been reassembled, oil-filled, and tested, all bushing terminals must be connected together using a #6 AWG ground conductor, as specified in 26 05 19.00 26 INSULATED WIRE AND CABLE, paragraph "Ground Conductors" and then connected to one of the tank grounding pads. The stud-to-flat bronze terminal connectors, must be installed on the high-voltage and neutral bushings for the purposes of connecting the grounding conductors during long-term storage. During installation of the terminal connectors, the bushing terminal threads must be coated with an approved conductive joint compound. Crimped fittings and connecting hardware must be provided for all grounding conductor connections, sized for the attachment to each transformer bushing terminal and tank ground pad.

3.14 NITROGEN GAS CYLINDER(S)

If providing transformers with a nitrogen preservation system, provide nitrogen gas in cylinder(s) that meets the requirements of paragraph NITROGEN to replace the existing nitrogen gas cylinders for each transformer.

3.15 CONTRACTOR-FURNISHED TRAINING OF GOVERNMENT PERSONNEL

3.15.1 Training General Requirements

Conduct a training course at the Little Goose Lock & Dam "Storage Yard" in the theory, operation, and maintenance of the power transformer within three weeks after performance of all transformer field tests have been completed. Coordinate the date the training is to be performed with the COR. The course must include the theory of operation of the transformer control circuits and the manufacturer’s recommended preventive maintenance. Record audio and visual of the training session and provide three digital copies for future use by the Government. The course must be

of 8 hours minimum duration for approximately 10 Government personnel.

3.15.2 Sample Training Outline

Course material must include the use of the site specific Operations and Maintenance Manual, and particular attention must be paid to the special accessories listed in paragraph “Transformer Mounted Accessories” of Sections 48 19 23.04 26 CLASS II GSU POWER TRANSFORMER (T2), and 48 19 23.08 26 CLASS II GSU POWER TRANSFORMER (T1). Submit for approval a training outline of the material to be covered, including a proposed schedule. Prepare the training course using Microsoft PowerPoint, and include an electronic copy and bound hard copy of the training material to be left with Project personnel for future reference. The training outline must include the following material:

a. Name and contact information for the contractor, and special equipment manufacturer representatives performing the training.

b. Summary technical data for two transformer types provided, including manufacturer location.

c. Overview of the structure of the O&M manual, the manufacturer's drawings, and the factory test data.

d. Thorough review of the transformer outline drawings, including the locations and descriptions of the ancillary equipment.

e. Photographs of the transformer manufacturing process, and configuration of the core and coils within the transformer tank.

f. Description of the manufacturer's recommended maintenance and inspection procedures for the transformer equipment, and the associated intervals.

g. Description of the recommended maintenance testing, and the associated intervals.

h. Overview of the fall arrest system.

i. Overview of the transformer spare parts, including any special storage and maintenance recommendations.

-- End of Section --

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TABLE 1 - TRANSFORMER INSULATING OIL TEST REQUIREMENTS					
OIL TEST	STANDARD	NEW OIL CERTIFICATION (AS DELIVERED)	DELIVERY SAMPLE (TAKEN FROM EACH TANKER)	POST-FILLING SAMPLES & COMMISSIONING SAMPLES	
				≥ 69 & < 230 kV	≥ 230 kV
PHYSICAL TESTS					
Analine Point	ASTM D611	≥ 63 °C			
Color	ASTM D1500	≤ 0.5	≤ 0.5	≤ 1.0	≤ 0.5
Flash point	ASTM D924	≥ 145 °C	≥ 145 °C		
Interfacial tension	ASTM D971	≥ 40 mN/m	≥ 40 mN/m	≥ 38 mN/m	≥ 38 mN/m
Pour point	ASTM D97	≤ -40 °C			
Specific gravity	ASTM D1298	≤ 0.91 (at 15 °C)	≤ 0.91 (at 15 °C)		
Viscosity	ASTM D445	≤ 3.0 mm^2/s (at 100 °C) ≤ 12.0 mm2/s (at 40 °C) ≤ 76.0 mm2/s (at 0 °C)			
Visual examination	ASTM D1524	Bright and clear	Bright and clear	Bright and clear	Bright and clear
ELECTRICAL TESTS					
Dielectric breakdown voltage	ASTM D1816	≥ 20 kV (1 mm gap) ≥ 35 kV (2 mm gap)	≥ 20 kV (1 mm gap) ≥ 35 kV (2 mm gap)	≥ 30 kV (1 mm gap) ≥ 55 kV (2 mm gap)	≥ 35 kV (1 mm gap) ≥ 60 kV (2 mm gap)
Gassing tendency	ASTM D2300	≤ 30 µL/min			
Dissipation factor	ASTM D924	≤ 0.05% (at 25 °C) ≤ 0.30% (at 100 °C)	≤ 0.05% (at 25 °C) ≤ 0.30% (at 100 °C)	≤ 0.05% (at 25 °C) ≤ 0.40% (at 100 °C)	≤ 0.05% (at 25 °C) ≤ 0.30% (at 100 °C)
CHEMICAL TESTS					
Oxidation stability, 72 hour	ASTM D2440	≤ 0.1 % (sludge mass) ≤ 0.3 mg KOH/g (acid)			
Oxidation stability, 164 hour	ASTM D2440	≤ 0.2 % (sludge mass) ≤ 0.4 mg KOH/g (acid)			
Oxidation stability by pressure vessel	ASTM D2112		≥ 195 minutes		
Oxidation inhibitor	ASTM D2668	≤ 0.30 %	Between 0.25 - 0.30 %	Between 0.25 - 0.30 % (Post-filling only)	Between 0.25 - 0.30 % (Post-filling only)
Corrosive sulfur	ASTM D1275	Noncorrosive	Noncorrosive		
Water content	ASTM D1533	≤ 35 ppm	≤ 35 ppm	≤ 10 ppm	≤ 10 ppm
Neutralization number	ASTM D974	≤ 0.03 mg KOH/g	≤ 0.03 mg KOH/g	≤ 0.03 mg KOH/g	≤ 0.03 mg KOH/g
Furanic compounds	ASTM D5837	≤ 25 µg/L	≤ 25 µg/L	Used as baseline	Used as baseline
PCB content	ASTM D4059	Not detectable	Not detectable		
Dissolved gas-in-oil analysis	ASTM D3612			Used as baseline	Used as baseline
Dissolved metal-in-oil analysis (*For forced-oil cooled trans.*)	ASTM D7151			Used as baseline	Used as baseline

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