



INVITATION FOR BID

PWC2627022

**FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336
MVA AT 65C**

**Date of Issue: Tuesday, October 20, 2026
Bid Opening Date: Tuesday, November 24, 2026
2:00 P.M.**

Direct all inquiries concerning this IFB to:

**Candice Kirtz
Director of Supply Chain
procurement@faypwc.com**

TABLE OF CONTENTS
FAYETTEVILLE PUBLIC WORKS COMMISSION
FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336 MVA AT 65C

ADVERTISEMENT FOR BID

INSTRUCTIONS TO BIDDERS

ABOUT PWC

OBJECTIVE OF THE REQUEST

IFB SCHEDULE

QUESTIONS

ECONOMIC IMPACT (EI) PROGRAM PARTICIPATION

REFERENCES

VENDOR REGISTRATION VIA ISUPPLIER

SUBMISSION INSTRUCTIONS

QUANTITIES AND PRICING

BID PRICE EVALUATION

EVALUATION AND AWARD

DELIVERY AND PAYMENT

ATTACHMENT A: TECHNICAL SPECIFICATIONS

ATTACHMENT B: BID PRICING FORM

ATTACHMENT C: CERTIFICATION OF PRIMARY PARTICIPANT

ATTACHMENT D: PWC SALE OF GOODS AGREEMENT

ATTACHMENT E: FORM OF EXCEPTIONS – SPECIFICATIONS

ATTACHMENT F: FORM OF EXCEPTIONS – SALE OF GOODS AGREEMENT

ATTACHMENT G: ECONOMIC IMPACT DISCLOSURE FORM

ATTACHMENT H: BID SUBMITTAL CHECKLIST

**ADVERTISEMENT FOR BID
FAYETTEVILLE PUBLIC WORKS COMMISSION
FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336 MVA AT 65C**

**Cumberland County
North Carolina**

Pursuant to N.C.G.S 143-129 and 133-3, sealed Bids are solicited and will be received at Fayetteville Public Works Commission, Administration Building, Conference Room 107, 955 Old Wilmington Road, Fayetteville, NC 28301, until **2:00 p.m., EST Tuesday, November 24, 2026**, for the **FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336 MVA AT 65C**.

Fayetteville Public Works Commission (PWC) is soliciting sealed bids for the purchase and delivery of four (4) 230/66 kV autotransformers, rated 201.6/268.8/336 MVA at 65°C. The autotransformers will support PWC's electrical transmission system, including the new POD 5 facility and the replacement of aging equipment. The replacements are intended to address equipment reliability concerns, maintain system capacity, and support continued safe and reliable electric service.

Bidders shall submit the completed Attachment B: Bid Pricing Form, required technical documentation under Attachment A, Attachment C, any applicable Forms of Exceptions (Attachments E and F), and acknowledgment of all issued addenda. Bidders are also requested to complete Attachment G: Economic Impact Disclosure Form for program reporting purposes. Unsolicited bid samples or descriptive literature may not be examined or tested, will not be used to determine responsiveness, and will not be deemed to vary any of the provisions of the IFB. Failure to comply with these requirements shall constitute sufficient cause to reject a bid without further consideration.

Questions regarding this bid must be submitted in writing to the attention of **Candice Kirtz**, at procurement@faypwc.com no later than **5:00 p.m., EST Tuesday, November 3, 2026**, in order to be considered for a response.

Mailed bids must be addressed to the Director of Supply Chain identified above, Fayetteville Public Works Commission, 955 Old Wilmington Road, Fayetteville, North Carolina 28301. The outside of the envelope must be marked **IFB: PWC2627022 FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336 MVA AT 65C** and shall indicate the name and address of the bidder. Late bids will not be considered.

Fayetteville Public Works Commission reserves the right to accept or reject any or all bids, to waive minor informalities or technicalities as permitted by law, to disregard nonconforming or nonresponsive bids, and to re-advertise for bids if deemed in the best interest of PWC. The bid tabulation and announcement of the apparent low bidder at the bid opening do not constitute a binding contract with PWC. No contract will be considered awarded until a formal written Agreement is executed by both PWC and the successful bidder. The award of a contract, if made, will be to the lowest responsive, responsible bidder whose qualifications indicate the award will be in the best interest of PWC.

FAYETTEVILLE PUBLIC WORKS COMMISSION
Candice Kirtz
Director of Supply Chain

**PWC2627022
FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336 MVA AT 65C**

INSTRUCTIONS TO BIDDERS
FAYETTEVILLE PUBLIC WORKS COMMISSION
FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336 MVA AT 65C

ABOUT PWC

For information about Fayetteville Public Works Commission (PWC), including its operations and services, visit PWC At a Glance <https://www.faypwc.com/pwc-at-a-glance/>

OBJECTIVE OF THE REQUEST

It is the intent of this bid invitation to obtain pricing for the subject project, in accordance with the material/technical specifications section of this Invitation for Bid (IFB). Bidders are requested to submit pricing using **Attachment B: Bid Pricing Form**.

IFB SCHEDULE

The following table shows the schedule of events to prepare your organization's response. The key deadlines and targeted dates for this process are as follows:

Action	Date/Time
Advertisement Date	Tuesday, October 20, 2026
Question Deadline	Tuesday, November 3, 2026, 5:00 p.m.
Addendum Deadline	Tuesday, November 10, 2026, 5:00 p.m.
Bid Opening	Tuesday, November 24, 2026, 2:00 p.m.
Target PWC Board of Commissioners Meeting	Wednesday, December 9, 2026
Target City Council Meeting	Monday, January 11, 2027
Anticipated Award /Sale of Goods Agreement	January 2027
Preferred Delivery (specifics in Attachment B)	February 2031, March 2031, April 2031

QUESTIONS

Written questions shall be e-mailed to procurement@faypwc.com by the date and time specified in the IFB schedule. Bidders will enter **"IFB PWC2627022 – Questions"** as the subject of the email.

Questions received by the question deadline identified in the IFB Schedule, PWC's responses, and any additional information deemed necessary by PWC will be posted as written addenda on the PWC website and incorporated into this IFB. No information, instruction, or advice provided orally or informally by any PWC personnel, whether made in response to a question or otherwise concerning this IFB, shall be considered authoritative or binding. Bidders shall rely only on the written material contained in an Addendum to this IFB.

Bidders are expressly prohibited from contacting any PWC official or employee associated with this IFB or project, except through the Director of Supply Chain and only in the manner described above.

ECONOMIC IMPACT (EI) PROGRAM PARTICIPATION

Fayetteville PWC supports fair and open competition in all procurement activities and encourages participation from qualified businesses of all sizes. For the purposes of PWC procurements, a qualified business is one that demonstrates the capacity, capability, and resources to perform in accordance with the specifications, terms, and conditions of the solicitation. PWC also recognizes the value that small and locally based suppliers bring to the community and to the efficiency of its operations.

While no specific business certification is required for award, bidders that are certified as a Disadvantaged Business Enterprise (DBE), Small Business Administration (SBA)-certified firm, or PWC Small Local Supplier (SLS) are encouraged to participate and, when applicable, to indicate that status on the Economic Impact Disclosure Form included in this solicitation.

REFERENCES

Bidders are encouraged to provide up to three (3) references demonstrating experience supplying the same or similar materials or equipment identified in this IFB. References should be from customers with comparable purchasing requirements and include the company name, contact name, telephone number, and email address.

PWC may contact the references provided or request additional references during evaluation to assess the bidder's experience, delivery performance, and ability to fulfill the requirements of this IFB. References are recommended but not required unless expressly stated otherwise in the IFB.

COMPANY NAME	CONTACT NAME	TELEPHONE NUMBER	EMAIL

VENDOR REGISTRATION VIA ISUPPLIER

- 1) Vendors awarded a contract with PWC must complete registration through the iSupplier Portal before a purchase order can be issued. Registration instructions are available at the link below.

<https://www.faypwc.com/isupplier-doing-business-with-pwc/>

SUBMISSION INSTRUCTIONS

- 1) Bids should be complete, clearly written, and responsive to all information requested in this IFB. Submissions should be straightforward and concise, demonstrating the bidder's ability to meet the stated requirements. Any proposed deviation, exception, clarification, or variation to the Material/Technical Specifications or the Sale of Goods Agreement must be clearly identified and submitted only on the applicable Form of Exceptions (**Attachment E** and/or **Attachment F**). Deviations, conditions, or bidder standard terms included elsewhere in the bid, including in cover letters, pricing notes, appendices, or other materials, shall not modify the requirements of this IFB and may render the bid nonresponsive.

Proposed exceptions to the Sale of Goods Agreement that materially alter or are inconsistent with the rights, obligations, risk allocation, remedies, indemnification, warranty, insurance, governing law, limitation of liability, delivery, payment, or other material terms of the Agreement may affect responsiveness, award eligibility, or contract execution. PWC reserves the right to request clarification of such exceptions and, if deemed in the best interest of PWC, negotiate their resolution. If the parties are unable to reach agreement on mutually acceptable terms, PWC may reject the bid, rescind an award, or proceed to the next lowest responsive, responsible bidder.

- 2) Unsolicited bid samples or descriptive literature may not be examined or tested, will not be used to determine responsiveness, and shall not modify any requirement of this IFB.
- 3) Bids may be withdrawn by the bidder only in writing and if receipt of such withdrawal is acknowledged by PWC prior to the time for the bid submittal deadline identified in the Advertisement for Bidders (or such later date included in an Addendum). Written withdrawal requests shall be submitted on the bidder's letterhead and signed by an official of the bidder duly authorized to make such request. Any withdrawal request made after the bid submittal deadline shall be allowed only if the price bid was based upon a mistake that constituted a substantial error, provided the bid was submitted in good faith, and then only pursuant to the terms of N.C.G.S. § 143-129.1.
- 4) Bids must be submitted in an envelope clearly marked with **"IFB: PWC2627022 FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336 MVA AT 65C"** along with the bidder's name and address. **Even if this envelope is placed inside a courier's envelope, the courier envelope itself must also be properly marked to ensure the bid can be identified without opening it.** This is critical for proper sorting and handling, as multiple bids are received daily for different Supply Chain Management personnel. Any bid received without proper labeling on the courier envelope will be returned to the sender and will not be considered for award. All bids must be delivered to the Fayetteville Public Works Commission, Administration Building, Procurement Department, at 955 Old Wilmington Road, Fayetteville, NC 28301, by the specified deadline. Late bids will not be considered.
- 5) Bids will be examined promptly after the due date, and an award will be made at the earliest possible date. Bids shall remain firm and valid for the period established under **QUANTITIES AND PRICING**. Following award approval and execution of the Sale of Goods Agreement, PWC will issue a purchase order to the successful bidder.
- 6) Bidders shall submit bids only on the Bid Pricing Forms provided herein, or exact copies thereof (**See Attachment B: Bid Pricing Form**). Failure to provide full and complete Bid Pricing Forms using the form provided herein will result in a bid being deemed non-responsive.

- 7) All bids must be signed by an authorized representative of the bidder. Bids containing material omissions, unauthorized alterations, conditional pricing, or other deviations from the IFB requirements may be deemed nonresponsive and rejected.
- 8) Do not submit alternate bids unless specifically called for.

QUANTITIES AND PRICING

- 1) All bidders shall include all costs associated with furnishing and delivering the goods specified in this IFB to the delivery location identified under **DELIVERY AND PAYMENT**, including materials, labor, overhead, profit, freight, handling, duties, tariffs, and other import-related charges, unless expressly authorized otherwise in this IFB.
- 2) Bid prices shall exclude applicable North Carolina sales and use tax. Sales and use tax shall not be included in unit prices, extended prices, or the Total Bid Price. Applicable sales and use tax will be added to the awarded bid price, as applicable, for purposes of establishing the total Sale of Goods Agreement amount.
- 3) Known tariffs, duties, and import-related charges effective as of the bid due date shall be included in the bid price. Pricing that excludes such costs or conditions their inclusion upon shipment date, import date, or future determination may be deemed nonresponsive.
- 4) The invoice submitted for payment shall not reflect any additional or separate charges, including fuel surcharges, tolls, or tariffs, except for applicable North Carolina sales and use tax, which shall be separately stated. PWC is not tax-exempt.
- 5) Bid prices shall remain firm and valid for a minimum of **ninety (90)** calendar days from the date of bid opening. This period allows PWC to evaluate bids, recommend an award, obtain required approvals from the PWC Board of Commissioners and Fayetteville City Council, and execute the Sale of Goods Agreement. Bids containing pricing that expires before the required validity period, or that is subject to adjustment during that period, shall be deemed nonresponsive and rejected.
- 6) Post-award price increases related to fuel surcharges, tolls, or tariffs are not permitted.
- 7) Bid prices shall remain firm throughout the initial Sale of Goods Agreement term unless this IFB expressly permits price adjustments. Any permitted adjustment must be based on the specified market index, adjustment interval, and applicable commodities identified in the IFB. Price adjustments shall not be permitted unless expressly provided for in the solicitation.
- 8) Bid prices shall remain firm through bid evaluation, award, and execution of the Sale of Goods Agreement. Any request for post-award price adjustment shall be limited to documented changes in published market indices applicable to major transformer commodities, including but not limited to copper, electrical steel, or other mutually approved industry indices.

- 9) Any proposed adjustment methodology shall be disclosed by the bidder in its bid submission and shall identify the applicable index, baseline date, adjustment frequency, eligible cost components, and calculation methodology. Adjustments shall be limited to the portion of the contract price directly attributable to the indexed commodity and shall not apply to labor, overhead, profit, freight, taxes, duties, tariffs, or other non-indexed costs unless expressly authorized by PWC.
- 10) Any approved adjustment shall be supported by documentation demonstrating the change in the referenced index from the established baseline and shall be subject to review and acceptance by PWC prior to payment. Failure to identify a requested adjustment methodology in the bid submission shall constitute the bidder's agreement that pricing shall remain firm for the duration of the Agreement.

BID PRICE EVALUATION

- 1) If required by the Bid Pricing Form, bidders shall provide a unit price and an extended price for each line item. The extended price shall be calculated by multiplying the bidder's unit price by the quantity identified in the IFB.
- 2) As part of the evaluation process, PWC will prepare a bid tabulation using the quantities identified in the IFB and the unit prices submitted by each bidder. PWC will verify the bidder's extended price for each line item by multiplying the bidder's submitted unit price by the applicable IFB quantity. PWC will not modify or adjust a bidder's submitted unit price.
- 3) Notwithstanding the foregoing, evaluation of bids for this procurement shall be performed in accordance with the Cost of Ownership methodology identified in the Technical Specifications and Attachment B.
- 4) The tabulated bid price is intended to ensure a consistent and equitable comparison of bids using the same quantities and pricing methodology for all bidders. The bidder's submitted unit price shall govern for each line item. In the event of a discrepancy between a bidder's submitted extended price, total bid price, bid opening announcement, or other bidder-calculated totals and the tabulated bid price calculated using the bidder's submitted unit prices and the IFB quantities, the tabulated bid price shall control for evaluation and award recommendation purposes.
- 5) Separate freight, handling, delivery, tariff, fuel surcharge, or similar charges are not permitted unless expressly authorized by this IFB. Bids that exclude required costs from submitted unit prices or condition pricing upon separate charges may be deemed nonresponsive and rejected.
- 6) Applicable North Carolina sales and use tax shall be excluded from the tabulated bid price and shall not be considered in determining the lowest responsive, responsible bidder or the recommended award amount.

EVALUATION AND AWARD

- 1) An award of a contract is subject to the approval by the Board of Commissioners of PWC and the Fayetteville City Council.

- 2) Following award approval, PWC will provide the Sale of Goods Agreement to the successful bidder for signature. The successful bidder shall execute and return the Agreement within thirty (30) calendar days of receipt. If the Agreement is not fully executed within thirty (30) calendar days, including situations involving proposed revisions, exceptions, or conditions that materially alter the terms of the IFB or Sale of Goods Agreement, PWC reserves the right, at its sole discretion, to rescind the award and proceed to the next lowest responsive, responsible bidder without further obligation to the initially selected bidder.
- 3) PWC reserves the right to inspect, at a reasonable time, the equipment, item, plant, or other facilities of a prospective Bidder prior to award, and during the Sale of Goods Agreement term, as PWC deems necessary to determine that such equipment, item, plant, or other facilities conform with the specifications/requirements and are adequate and suitable for the proper and effective performance of the Sale of Goods Agreement.
- 4) PWC reserves the right to request additional information from bidders to aid in the evaluation process. This information may include but is not limited to, financial statements, a reference list of contracts of similar size, etc.
- 5) Products offered shall be evaluated for compliance with the published Material Specifications, regardless of whether the manufacturer or product has been previously evaluated by PWC. Prior evaluation may inform PWC's technical review but shall not independently determine bid responsiveness or award eligibility.
- 6) PWC reserves the right to make a single award for all items or may award separate contracts to multiple bidders for various items to the lowest responsive, responsible bidder or bidders, taking into consideration product quality, performance to PWC, and conformity with the specifications in these bid documents. PWC may also consider, among other things, the Bidder's past performance conduct on other contracts, and other information as PWC deems necessary to assist in the evaluation of any bid.
- 7) A Sale of Goods Agreement will be executed in connection with this award. For one-time purchases, the Sale of Goods Agreement will cover the anticipated delivery timeframe required to fulfill the purchase. For purchases utilizing releases, the Sale of Goods Agreement will be awarded for an initial period of one (1) year, to begin on contract execution date, and may be extended for an additional one-year period, if the placement or delivery of the final releases extends beyond the initial term, upon mutual written agreement of both parties. The Sale of Goods Agreement will govern applicable pricing, delivery, and contractual terms for the applicable purchase type.
- 8) Pricing shall remain firm for the initial Sale of Goods Agreement term, except for adjustments expressly permitted under **QUANTITIES AND PRICING**. If the Agreement is extended, any price adjustment shall be subject to the terms established in the IFB and Sale of Goods Agreement and must be mutually agreed upon in writing before the extension becomes effective. No price adjustment shall be automatic.
- 9) The successful bidder shall not assign, transfer, or convey any part of the agreement, including rights or obligations, to a third party without obtaining prior written approval from PWC. This includes the assignment of payments that may become due under the agreement. Any unauthorized assignment may result in disqualification or termination of the agreement. Approved assignments do not relieve the successful bidder of their responsibilities under the terms of the agreement unless explicitly stated in writing by PWC.

- 10) The successful bidder must promptly notify PWC in writing of any legal actions, investigations, or issues arising during the agreement period that may impact their ability to perform their obligations under the agreement. Failure to provide timely notification may result in termination of the agreement. As outlined in **Attachment C: Certification of Primary Participant Regarding Debarment, Suspension, and Other Responsibility Matters**, the successful bidder must also certify that no such legal impediments exist at the time of bid submission. If circumstances change after submission or during the agreement period, the bidder is required to immediately inform PWC, providing full details of the situation.

DELIVERY AND PAYMENT

- 1) All goods shall be delivered F.O.B. Destination to the following PWC location:

POD	ITEM DESCRIPTION
5	217 Southland Drive, Fayetteville, NC 28311
3	6400 Cliffdale Road, Fayetteville, NC 28314
1	2842 Cumberland Road, Fayetteville, NC 28306
2	2274 Custer Avenue, Fayetteville, NC 28312

- 2) Deliveries shall be made between the hours of **9:00 a.m. and 3:00 p.m., Monday through Friday**, within the time frame specified on the Bid Pricing Form.
- 3) Payment for equipment, material, supplies, etc. purchased pursuant to this bid shall be made in accordance with the milestone payment allocation identified in Attachment B and the Sale of Goods Agreement, and the invoice received in the PWC Accounts Payable Office, P.O. Box 1089, Fayetteville, North Carolina 28302.

ATTACHMENT A

SPECIFICATION AND BID DOCUMENTS FOR 336MVA AT 65-degree AUTOTRANSFORMER FOR THE 230 TO 66 KV POINT-OF-DELIVERY

Technical Specifications

Scope

The work shall include furnishing all equipment and materials, as outlined in the Bid Schedule(s) and as specified herein.

This transformer will act as a step-up and step-down with a non-loaded tertiary winding and no LTC for a substation interconnecting to a transmission system.

General Requirements

All materials and equipment shall be new. These Specifications describe the type, size, and characteristics of the various materials and equipment required to be furnished. Strict adherence to these general Specifications is required to facilitate review and consideration of the Bid Proposal. Alternate proposals will be evaluated if deemed appropriate.

It is the intent of these Specifications that the transformer shall be complete and fully operable. Any details or materials not mentioned in the Specifications, but required for satisfactory operation, shall be furnished and installed by the Bidder.

Station power available at the Owner's substation will be 120/240 volts, 60 Hz, single-phase. The control DC voltage at the substation will be 125 volts. The equipment on the transformers shall coordinate with these voltages, as appropriate.

Special Conditions

1. Standards

All equipment and materials covered by these Specifications and all tests applied thereto shall, unless otherwise stated herein, be in accordance with the applicable provisions of the latest editions of the Standards of the ASTM, ANSI, AEIC, ASME, ASME IX, or AWS D1.1, NEMA, and IEEE.

Additionally, all schematic, wiring, and connection diagrams shall use the device symbols and reference designation letters defined in IEEE Std 315, Graphic Symbols for Electrical and Electronic Diagrams, Including Reference Designation Letters, so that drawing conventions are identical regardless of the originating OEM drafting standard. The control cabinet, including its construction, internal component arrangement, drawing package, wire identification convention, and testing requirements, shall comply with the governing Utility Standard DRDWCCAB01-0626-E3 included herein of this specification, as issued and maintained by Dynamic Ratings on behalf of the Owner, referenced further in Section 10.j.xi below.

- *IEEE standards for Power Transformers*
 - IEEE Std 1276™-2020 IEEE Guide for the Application of High-Temperature Insulation Materials in Liquid-Immersed Power Transformers

- IEEE Std 1538™-2000 (R2005), IEEE Guide for Determination of Maximum Winding Temperature Rise in Liquid-Filled Transformers
- IEEE Std 1538a™-2015, IEEE Guide for Determination of Maximum Winding-Temperature Rise in Liquid
- IEEE Std C57.12.00™-2021, IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
- IEEE Std C57.12.10™-2017, IEEE Standard Requirements for Liquid-Immersed Power Transformers
- IEEE Std C57.12.36™-2017, IEEE Standard Requirements for Liquid-Immersed Distribution Substation Transformers
- IEEE Std C57.12.37™-2015, IEEE Standard for the Electronic Reporting of Distribution Transformer Test Data
- IEEE Std C57.12.70™-2020, IEEE Standard for Standard Terminal Markings and Connections for Distribution and Power Transformers
- IEEE Std C57.12.90™-2021, IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
- IEEE Std C57.13™-2016, IEEE Standard Requirements for Instrument Transformers
- IEEE Std C57.13.1™-2017, IEEE Guide for Field Testing of Relaying Current Transformers
- IEEE Std C57.13.3™-2014, IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases
- IEEE Std C57.13.5™-2019, IEEE Standard for Performance and Test Requirements for Instrument Transformers of a Nominal System Voltage of 115 kV and Above
- IEEE Std C57.19.01™-2017, IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
- IEEE Std C57.19.04™-2018, IEEE Standard for Performance Characteristics and Dimensions for High Current Power Transformer Bushings with Rated Continuous Current in Excess of 5000 A in Bus Enclosures
- IEEE Std C57.19.100™-2012, IEEE Guide for Application of Power Apparatus Bushings
- IEEE Std C57.91™-2011, IEEE Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators
- IEEE Std C57.93™-2019, IEEE Guide for Installation and Maintenance of Liquid-Immersed Power Transformers
- IEEE Std C57.98™-2011, IEEE Guide for Transformer Impulse Tests
- IEEE Std C57.100™-2011, IEEE Standard Test Procedure for Thermal Evaluation of Insulation Systems for Liquid-Immersed Distribution and Power Transformers
- IEEE Std C57.106-2015, IEEE Guide for Acceptance and Maintenance of Insulating Mineral Oil in Electrical Equipment
- IEEE Std C57.109™-2018, IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration

- IEEE Std C57.119™-2018, IEEE Recommended Practice for Performing Temperature Rise Tests on Oil-Immersed Power Transformers at Loads Beyond Nameplate Ratings
- IEEE Std C57.120™-2017, IEEE Loss Evaluation Guide for Power Transformers and Reactors
- IEEE Std C57.131™-2012, IEEE Standard Requirements for Tap Changers
- IEEE Std C57.148™-2020, IEEE Standard for Control Cabinets for Power Transformers
- IEEE Std C57.149™-2012, IEEE Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers
- IEEE Std C57.150™-2012, IEEE Guide for the Transportation of Transformers and Reactors Rated 10 000 kVA or Higher
- IEEE Std C57.152™-2013, IEEE Guide for Diagnostic Field Testing of Fluid-Filled Power Transformers, Regulators, and Reactors
- IEEE Std C57.158™-2017, IEEE Guide for the Application of Tertiary and Stabilizing Windings in Power Transformers

NOTE: Where the term “Standards” is used in specifications, it shall be understood to refer to the above standards.

2. Drawings

a. Preliminary

Before proceeding with fabrication, the manufacturer shall submit to the Engineer, for approval, sufficient Drawings demonstrating that all parts conform to the requirements and intent of these Specifications. The Drawings shall include outline, control cabinet front view and layout, nameplate, applicable equipment nameplates, material list with manufacturer part numbers, and control schematics and wiring diagrams. Drawings shall be submitted electronically as AutoCAD “.dwg” drawings and in PDF format. Each drawing shall contain identifying information, such as but not limited to the customer and project name. Catalog cut sheets and details of instrument transformers, bushings, bushing terminal connectors, surge arresters, relays, and all accessories shall also be submitted for approval.

The Outline Drawing shall show dimensions of equipment, including bushings, bushing designations, radiators and cooling equipment, base, control cabinet, and all other important external features. Outline Drawings shall be to scale and include plan view and elevations from all four (4) sides. These Drawings shall show shipping weight, total weight, center of gravity, bushings, bushing catalog numbers, and ampere ratings, a description of top bushing terminals, and arrangement of all external accessory devices. Control schematic drawings shall clearly indicate power requirements for DC circuits and AC auxiliary power (amps/volts/watts).

Approval of Drawings shall not relieve the manufacturer of obligations to meet all requirements of the Specifications, or of responsibility for the correctness of the Drawings, or of responsibility to meet the original shipping promise, even if the customer is allowed two (2) weeks for approval.

The Engineer may require additional submittals of Shop Drawings if, in the opinion of the Engineer, such is required due to the extent of changes required on the previous submittal(s). If an extension of time is required due to a protracted drawing approval process, the price will remain as quoted for the quoted delivery.

Receipt of Approval Drawings by the Bidder constitutes authorization for manufacture based upon the corrections found thereon.

No changes shall be made in the final Drawings from the approved Approval Drawings. Any proposed changes from the approved drawings must go through the approval drawing process again, **with the changes clearly denoted**.

Following approval of drawings, the Bidder shall submit a complete set of "For Construction" drawings to the Engineer.

b. Final Drawings and Instruction Manuals

Bidder shall furnish five (5) hard copies of instruction manuals prior to the shipment of the equipment. One (1) copy shall be sent to the Engineer, and the other four (4) copies shall be sent to the Owner. Each instruction manual shall include a digital medium (such as a USB drive) containing the entire contents of the manual in PDF format. Final drawings are to be certified as "As-Built" and shall be provided in AutoCAD format in addition to PDF format.

Instruction manuals are to include, as a minimum, each of the following:

- Bidder's installation and maintenance instructions for transformer
- Manufacturer manuals for components, fittings, valves, controls, and accessories
- Outline and assembly drawings
- Control cabinet front view and layout drawing(s)
- Nameplate drawing(s)
- Material list drawing
- Schematic and wiring diagram drawings for all control and accessory items
- Details of bushing and bushing terminal connectors
- Diagram of bushing current transformers indicating connection, number of turns, polarity marking, ratio, accuracy class, and thermal rating factor
- Catalog cut sheets for instrument transformers, surge arresters, relays, and all control accessories
- Renewal parts catalog
- Certified test report

3. Shipping of Power Transformer

Delivery shall be made in 2031 or sooner, or the alternate proposed date.

The transformer shall be shipped to the substation site and installed on a concrete pad. **NOTE: Bidder shall be responsible for providing the crane and rigging to offload the transformer from the delivery truck onto the pad.** Before shipment, the Autotransformer shall be fully assembled to verify that all parts fit properly. Parts removed for shipment shall be marked to facilitate easy identification during reassembly.

Methods of packing and loading shall be such as to protect all parts from dampness, corrosion, breakage, or vibration injury that might reasonably be encountered in transportation, storage, and handling. Release for shipment is to be granted based upon the manufacturer's compliance with the following:

1. Fourteen (14) days' notification of tests shall be given so the Engineer may have a representative present to witness the tests.
2. Furnishing of the required number of copies of the Final Drawings and Instruction Books as called for in the Specifications.
3. Thirty (30) days' notification of the tentative shipping schedule shall be given, and forty-eight (48) hours' notification prior to delivery.
4. A three-direction impact recorder with GPS shall be installed to travel on the transformer for shipment and shall remain on the unit until it is unloaded unless the Bidder is relieved of this requirement by the Commission's Engineer. The impact recorder shall be read prior to unloading, at the rail siding prior to unloading if applicable, on the trailer prior to transportation to the site, and after arrival at the site.
5. The transformer will be shipped dry. The bushings and oil will be returned to the transformer once it is placed on the concrete pad.
6. Delivery shall be made to the substation site #1 located at:
Point of Delivery #1 Fayetteville
2842 Cumberland Road
Fayetteville, NC 28306
Daniel Vinson, cell (910) 309-2901
7. Delivery shall be made to the substation site #2 located at:
Point of Delivery #3 Fayetteville
6400 Cliffdale Road
Fayetteville, NC 28314
Danny Vinson, cell (910) 309-2901
8. Delivery shall be made to the substation site #3 located at:
Point of Delivery #2 Fayetteville
2274 Custer Avenue
Fayetteville, NC 28312
Danny Vinson, cell (910) 309-2901
9. Delivery shall be made to the substation site #4 located at:
Point of Delivery #5 Fayetteville
217 Southland Drive
Fayetteville, NC 28311
Danny Vinson, cell (910) 309-2901
10. The transformer is shipped without oil; it shall be shipped dry-air-filled and equipped with proper pipe connections for checking and filling under vacuum. The new oil shall be shipped by tanker with the unloading pump furnished. The unloading pump shall have been flushed free of undesirable contaminants with the same type of oil used for the transformer. The Bidder shall furnish all equipment, labor, and supervision required for filling, and the Bidder shall coordinate timing and arrangements. Bidder shall be responsible for the proper cleanup of any oil spilled during the filling operation. The following 8 points will address the Assembly and Oil Processing specification:

a. Assembly and Oil Processing of the Power Transformers

The purpose of this document is to provide the requirements for contractors to assemble and process large power transformers for Fayetteville PWC. This includes

maintenance, re-gasketing, and reprocessing of power transformers. These transformers are equipped with either a conservator-type oil preservation system or a nitrogen gas blanket system. The transformers are manufactured by various OEMs worldwide. The manufacturer will secure the following services for Assembly and Oil Processing of the power transformer, including Vacuum-Fill and Hot Oil Circulation. The oil processing rig will be self-contained with a power generator and the ability to perform all the following specifications:

b. Codes and Standards

All requirements, definitions, and tests, except as specifically covered in this Specification, shall be in accordance with the requirements of the applicable American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), Institute of Electrical and Electronic Engineers (IEEE), National Electronics Manufacturers Association (NEMA), National Fire Protection Association (NFPA), U.S. Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), and American Welding Society (AWS) standards of the latest issue in effect at the effective date of this document.

c. Scope

The successful bidder will be responsible for the complete assembly, vacuum processing, and oil filling of the transformers. High-vacuum degassing equipment, complete with a means to heat the insulating oil, is required to process and fill these transformers. The successful bidder will provide a detailed list of all equipment to be used. PWC reserves the right to inspect and approve the equipment.

d. Attached Documents

- i. Material Control Procedure for Oil-Filled Transformers
- ii. Transformer OEM documents listed in the detailed specification

Note: If the manufacturer's requirements differ from those listed in this document, PWC personnel shall be consulted for clarification.

e. Transformer Assembly Requirements

i. Manufacturer's Instructions

- (1) The transformer shall be assembled in accordance with the OEM instruction leaflets as listed in the detailed specification.
- (2) If required by the transformer OEM or PWC, a manufacturer's Representative will be present during all or part of the assembly and processing.

ii. General

- (1) Any time a transformer has an opening exposed to the atmosphere, a constant flow of dry air shall be maintained on the transformer, and the MATERIAL CONTROL PROCEDURE FOR OIL-FILLED TRANSFORMERS will be utilized. This procedure ensures that all tools and materials entering the transformer are accounted for before the entry is closed.
- (2) Ensure all temporary shipping braces, etc., have been removed.
- (3) Make a chronological list of problems experienced during assembly of the transformers. These problems should be explained in detail and forwarded to the responsible PWC representative.

- (4) Assemble the bushings, radiators, and all tank fittings. The radiators and bushings will be handled as prescribed by the manufacturer; in general, they should be lifted vertically during handling and installation. This work will require referring to the instruction manual and drawings provided by the manufacturer.
- (5) After the transformer has been assembled, the transformer shall be pressurized to 3 PSI for 24 hours before installing vacuum equipment. The ending pressure shall be within 10% of the pressure calculated by the following formula. $P_2 = P_1 \cdot T_2 / T_1$. The beginning/ending time, temperature, and pressure will be recorded and reported to PWC personnel. (P2 and P1 in psia or atm., T1 and T2 in °Kelvin -- °K = °C + 273). After the 24-hour pressure test, the gas dew point shall be measured and reported to the responsible PWC representative.
- (6) The transformer shall not be opened to the atmosphere when rain is threatening, or rain has begun. In addition, if the transformer has been opened and rain threatens, the transformer shall be sealed and pressurized until the rain threat is no longer present. Any time the main tank is exposed to the atmosphere, preparations shall be made to close any opening with minimal delay.
- (7) Radiators, oil piping, valves, and fittings shall be thoroughly cleaned and flushed with clean oil before being fitted to the transformer.

iii. Bushings

Bushings should be absolutely clean and dry when installed. A power factor test shall be performed on each bushing before it is installed. A visual inspection of the bushing oil level shall be made. Current-carrying connections shall be thoroughly cleaned and solidly bolted. Instructions for handling the high-voltage bushings should be included in the bushing crate. Mechanical load on the ends of the bushings shall not exceed design limits. The instruction manual will detail lifting instructions for a particular bushing.

iv. Conservator Tank

The inspection ports on the conservator shall be removed to facilitate the inspection of the Aircel. Inspect the mechanical float arm of the liquid level gauge. Care shall be taken that the float arm is not damaged while the Aircel is pressurized. The Aircel shall be pressure-tested at $\frac{3}{4}$ PSI for 4 hours to check for leaks prior to filling the conservator. During this 4-hour pressure test, the conservator tank shall be vented. The ending pressure shall be within 10% of the pressure calculated by the following formula: $P_2 = P_1 \cdot T_2 / T_1$ (P2 and P1 in psia or atm; T1 and T2 in degrees Kelvin). The beginning/ending time, temperature, and pressure shall be recorded and reported to the responsible PWC representative.

v. Radiators/Coolers

- (1) Check gasket seats on radiator/cooler and on the transformer.
- (2) Check radiator/cooler valves for open after the radiators are installed.

vi. Control and accessories

- (1) Install accessories and control equipment as required.
- (2) Check fans/pumps for correct number, type, and location in accordance with

the transformer outline drawing. If power is available, check pump rotation prior to installing the pump.

- (3) The oil level gauge, temperature gauges, and other accessories shall be assembled in accordance with the manufacturer's instructions. Check the operation of the oil level gauge in the main tank and/or the conservator before sealing the main tank and conservator.

vii. Conflicts

- (1) Any conflicts between the above instructions and the manufacturer's instructions shall be resolved by the responsible PWC representative prior to the task being performed.

viii. Internal Inspection

- (1) An internal inspection of the transformer shall be performed by PWC personnel after all assembly is complete.

f. Vacuum Processing 115 KV GSU and >115 KV Transformers

- i. High Vacuum equipment will be required to pull an adequate vacuum to process and dry transformers rated > 115 KV.
- ii. Pull vacuum to 2 mm (2,000 microns). Isolate the transformer from the vacuum pump and monitor the vacuum on the transformer tank. The vacuum leakage rate should not exceed 10 mm over 30 minutes. If leakage exceeds 10 mm in 30 minutes, correct and retest.

NOTE: Allow 5 minutes for stabilization before starting the 30-minute leak test.

- iii. Unless approved by the PWC representative, a minimum of 48 hours of vacuum time will be required to adequately process the transformer.
- iv. A cold trap to capture oil and water vapor, or an approved vacuum Dewpoint analyzer, is required. If a cold trap is used, the oil and water that is trapped shall be defrosted and measured every 8 hours.
- v. Hot oil vacuum-fill the transformer through the processing rig at 75° C. The Vacuum level change of less than 100 microns will be maintained during filling. Final fill, top-off, and bleeding per conservator tank filling procedure. Circulate four nameplate gallons through the transformer, adding inhibitor on the last pass.
- vi. The completion of the vacuum process will require the following conditions to be met:
 - (1) Maximum absolute vacuum of 250 microns as measured at the transformer.
 - (2) Maximum tank leak down rate of 200 microns/hour.
 - (3) Less than 1/8" rise in water column of vacuum pump exhaust.
 - (4) Maximum of 8 oz. of water measured during the cold trap defrost cycle for 3 consecutive defrost cycles, or dew point measured under vacuum is less than -55 °C.
 - (5) Approval of the responsible PWC representative.

g. Vacuum Processing Transformers 115 KV and Less

- i. High-vacuum equipment will be required to pull an adequate vacuum to process

and dry transformers.

- ii. Pull vacuum to 2 mm (2,000 microns). Isolate the transformer from the vacuum pump and monitor the vacuum in the transformer tank. The vacuum leakage rate should not exceed 10 mm over 30 minutes. If leakage exceeds 10 mm in 30 minutes, correct and retest.

NOTE: Allow 5 minutes for stabilization before starting the 30-minute leak test.

- iii. Maintain a vacuum to 2 mm or less and continue for 6 hours + 1 hour for every hour the tank is open.

NOTE: Ensure that all components are rated for full vacuum.

NOTE: Vacuum readings should be taken from the main tank.

h. Oil Filling

- i. The transformer shall be filled with oil in accordance with the transformer OEM leaflets that were provided with this specification:
- ii. The oil is to be provided by either the transformer OEM or the local operating company. In most cases, the oil will need to be ordered at least 7-10 days before the anticipated fill date. (Depending on supply, the oil can take much longer for delivery).
- iii. PWC will require an oil sample directly from the oil tankers for oil quality and dissolved gas acceptance tests. The samples shall be sent to the MVA Laboratory located in Canton, OH. Any **oil tankers used by the successful bidder shall be inspected by PWC personnel prior to the introduction of oil into the tanker.**
- iv. Prior to the commencement of oil filling, a dielectric test and dissipation factor test must be performed on the oil. The minimum acceptable dielectric strength is 30 kV using the D 877 method. The maximum acceptable dissipation factor is 0.05%.
- v. The oil shall be introduced into the transformer at 75°C (167°F) and at a rate not to exceed 40 gallons per minute. The main tank oil level shall not rise more than ½" per minute.
- vi. Positive pressure shall be maintained on the oil fill line.
- vii. Vacuum at the transformer tank shall be maintained at less than 2 mm during the oil filling.
- viii. The oil shall be filtered (0.5 micron or less) and processed in a high vacuum oil chamber prior to introduction into the transformer. This vacuum shall be capable of purifying the oil to achieve a total dissolved gas content of less than 1% and a water content of less than 10 ppm.
- ix. The oil filling operation shall be continuous once started, including final purge and conservator tank filling.
- x. The conservator tank shall be placed in normal operation immediately after filling is complete. Likewise, the nitrogen preservation system shall be placed in service immediately after filling is complete on gas-blanketed transformers. The gas space oxygen level shall be monitored and not exceed 2%. If the oxygen level exceeds 2%, the gas space shall be purged until the level falls below 2%.
- xi. An oil sample shall be taken from the transformer and will be tested for dissolved gas content of less than 1% and water content of less than 10 ppm. If these values

are not met, the transformer will be subject to being drained, vacuum processed, and refilled.

- xii. A power factor test (Doble) shall be performed on the transformer 24 hours after oil fill is complete. The results shall be evaluated and approved by PWC personnel. A power factor of less than 0.5% is required. If the power factor is greater than 0.5%, the transformer will be subject to being drained, vacuum processed, and refilled.
- xiii. The transformer shall be inspected for oil leaks 48 hours after the oil filling is complete. Any leaks found at this time shall be repaired **without delay**.
- xiv. The nitrogen cylinder shall be inspected 48 hours after the oil fill is complete. If the cylinder pressure is below 400 PSI, the transformer gas space shall be leak tested, and the cylinder shall be replaced.
- xv. *Transformer Oil Inhibitor*
 - (1) Transformers must be filled with new Type II Mineral Oil that meets ASTM D-3487-2016, a naphthenic oil. Inhibited oils are insulating oils, which have been supplemented with either 2,6 di-tert-butylphenol or 2,6 di-tert-butyl-p-cresol or any other specified and acceptable oxidation inhibitor. If an additive other than 2,6 di-tert-butylphenol or 2,6 di-tert-butyl-p-cresol is used, appropriate limit values for oxidation stability tests (those for Type II oils) shall be used. Oils with any detectable amounts of passivator will be assessed using the oxidation stability limits for Type II oils. All oil supplied for Type II insulating transformer mineral oil shall contain an antioxidant inhibitor. The manufacturer may supply 0.3% wt. DBPC or 0.3% wt. DBP inhibitor. Installation of the inhibitor shall be in accordance with the newest version of IEEE C57.106.
 - (2) Installation of inhibitor shall be in accordance with the newest version of IEEE C57.106.
 - (3) All oil and inhibitor shall be furnished and installed by the manufacturer with associated PCB certification

i. Manufacturer's Field Representative(s)

The manufacturer shall provide, and include as a part of his Proposal, all the costs associated with furnishing the services of a Field Service Engineer as required for final assembly and acceptance testing. The duties of the Field Service Engineer shall include supervising the installation of Bidder-provided component parts that are removed for shipment, including, but not limited to, bushings, radiators, and surge arresters. The oil will be shipped separately, and the transformer will be filled on site. Bidder shall also be responsible for supplying all labor and equipment required to vacuum-fill the transformer. He shall supervise the installation of all control and auxiliary wiring. Field Service Engineer shall perform field acceptance tests after assembly as called for in the "Tests" section (7.0) of this specification. The Bidder must also furnish all labor and equipment required to perform the field assembly and testing work. Field Service Engineer shall clean and repair or paint any surfaces that were soiled, discolored, or otherwise damaged by abrasion since leaving the factory. The Field Service Engineer shall certify when the transformer is ready to be energized.

j. Transformer

- i. Type and Rating

The transformer shall be three-phase, 60-Hz, suitable for outdoor service at an altitude of less than 1 kilometer (3300 feet) above sea level. The windings shall be insulated and connected as follows:

Winding	Voltage (kV)	Connection	BIL (kV)
High Voltage	230/132.790	Wye	825
Low Voltage	66/38.106	Wye	350
Tertiary	13.8	Delta	110
H0X0	24.9	Ground	150

The high voltage shall be in phase with the low voltage and have a Delta-connected tertiary winding considered buried. The tertiary power rating is considered 35% of the HV and LV power ratings and will be brought out and externally accessible for testing purposes only. The transformer will be operated with the H0 and X0 bushings solidly grounded to copper. All windings shall be copper.

The Transformers shall be oil-immersed for continuous self-cooled/forced air-cooled operation ONAN/ONAF/ONAF with two (2) stages of fan cooling and shall be furnished completely with oil. Fans shall be included with the transformer; operating voltage for fans shall be 240 volts, single-phase. Transformer ratings, when loaded in accordance with ANSI C57.91 (latest edition) "IEEE Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators", shall be as follows:

Class	Rise (°C)	Rating (kVA)
ONAN	55/65	180,000/201,600
ONAF1	55/65	240,000/268,800
ONAF2	55/65	300,000/336,000

The tertiary "Y" copper winding capacity **shall be 35%** of "H" and "X" windings MVA rating.

The transformers shall be capable of carrying rated current continuously at 5% above rated secondary voltage without exceeding an average winding temperature rise of 65°C above a 40°C maximum ambient and 30°C average ambient over 24 hours.

The transformer shall be a 65°C construction where the winding temperature rise by resistance will not exceed 65°C; hottest-spot winding temperature rise will not exceed 80°C; suitable for loading in accordance with ANSI C57.91 (latest edition) "IEEE Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators".

The transformer shall have five (5) full-capacity, high-voltage taps at rated kVA and shall be provided as follows:

HV Taps Rating (volts)
218,500
224,250
230,000
235,750
241,500

A weatherproof, hand-operated tap-changing mechanism shall be provided, suitable for de-energized operation, with one external handle that may be operated from the transformer base level and a provision for locking in any position. An external indicator shall clearly display the tap position.

Core shall be of cruciform or circular shape. Round, oval, and elliptically shaped cores are not acceptable.

High-voltage, low-voltage, and tertiary windings (as applicable) shall use a continuous-disc or helical copper winding design exclusively. Pancake and layer (or "barrel") type windings are not acceptable.

The windings shall be properly braced and blocked so the coils will withstand short-circuit forces caused by short circuits on the secondary terminals.

All windings shall be wound with copper conductors. On coils requiring multiple conductors per turn, allowance of multiple conductors per turn of rectangular magnet wire, to minimize losses and hot-spot temperatures and to produce a more compact winding with improved short-circuit performance. Continuously Transposed Copper CTC cable is a suitable design, such as parallel winding and the tertiary winding, but is not required in all multiple conductor turns.

Photographs of the high-voltage and low-voltage sides of the core and coil assembly, indicating blocking, bracing, and dressing out of leads, shall be submitted for approval prior to tanking.

- ii. All transformer windings shall be copper (99.99%) Oxygen-Free Copper (OFC) with circular coil design and circular core and shall be suitably clamped and harnessed with mechanical means at the top and bottom to prevent shifting under short circuit conditions as specified in the standard IEEE C57.12.00, newest edition. Electrical Conductivity: Must meet (100%) the International Annealed Copper Standard (IACS) to ensure low resistance and minimal heat generation. Using copper grades C10100, UNS C10200 TU1, temper O state meeting ASTM B5-22 and B152M-24. The paper covered with rectangular copper wire is to be an oxygen-free copper rod and shall be extruded or drawn by a mold. Transformer winding leads shall be connected to porcelain apparatus bushings using cable connections or bare copper bars with flexible links.

All core steel shall comply with ASTM A876-17e1 for High-Permeability, low-loss grain-oriented electrical steel (GOES), tested at 17 kG (1.7 T). Provide low-loss grain-oriented electrical steel suitable for power transformer applications, consistent with the applicable IEEE C57.12.00 requirements. Transformer core and windings shall be suitably harnessed in the tank to prevent movement during faults, shipping, or installation. The installed core and coil assembly shall receive a vapor-phase drying process to minimize moisture content.

The bid proposal shall describe the type of core and winding construction, including clamping design. All design standards applied will be disclosed.

- iii. Insulation:

Solid insulation ASTM D1305-16, within the windings and clamping structure, shall be of suitable cellulosic or aramid material and shall comply with current applicable industry standards for dielectric integrity, short circuit, thermal requirements, loss of life, and emergency loading. Solid insulation within the windings and clamping structure shall be of a high-density transformer-board manufactured in accordance

with ASTM D4063-99 (2022). Type 1 transformer boards will be produced using an electrical-grade pulp specified by the transformer-board manufacturer. Transformer-board to be produced using unbleached kraft pulp, with key properties and testing methods clearly specified, with values for nitrogen content of acceptable thermally upgraded papers shall be between 1 and 4 percent when measured in accordance with ASTM D982.

Conductors shall be insulated with insulating paper, 12HTCC or 22HTCC Crepe paper, or flat paper, thermally stabilized using the INSULDUR™ system. Solid insulation paper used to insulate the conductor between layers in the coil shall be thermally upgraded kraft paper made from 100% electrical grade (E-grade) unbleached sulfate (kraft) wood pulp, as defined by IEEE C57.100, a cellulose-based paper that has been chemically modified to reduce the rate at which the paper decomposes. Values for nitrogen content of acceptable thermally upgraded papers shall be between 1 and 4 percent when measured in accordance with ASTM D982. Paper is to be supplied by a paper manufacturer with a proven record of at least 15 years of supplying this material for this application to the oil-filled transformer industry.

iv. Case and Cover

The tank shall be designed and braced for full vacuum and suitable for filling with oil under a vacuum of 28 inches of mercury, in the field.

Lifting lugs on the tank capable of lifting the entire transformer completely assembled, lifting eyes on the cover, and provisions for jacking. Location of jack bosses shall be a minimum of thirteen inches (13") above the transformer base line and capable of supporting the entire weight of the transformer completely assembled.

Stainless steel Type 304 nameplate in accordance with IEEE 12.57.00, located on the main tank near the control cabinet. Voltage and current ratings, temperature rise, insulation levels (BIL), manufacturer details, serial numbers, and date of manufacture shall be given on such nameplate.

The stainless-steel Type 304 diagram instruction plate shall be stainless steel. Turn progression and accuracy class of bushing current transformers shall be shown on the nameplate.

The containment case shall not leak oil. Welded joints and seams shall be employed whenever practicable. No welds will be made on the vertical corners of the tank. Welds will not be greater than 2' from the vertical edge of the transformer.

The main transformer cover shall be welded. Gasketed joints for manhole covers, bushings, and other bolted attachments shall be sealed with a durable, reusable gasket material (ordinary cork or corkprene is not approved) and shall be designed to permit reassembly to ensure oil-tightness. Mechanical stops shall be provided to prevent crushing (controlled compression).

Transformer base design shall be suitable for skidding the transformer in a direction parallel to either centerline of the tank and shall be capable of supporting the transformer on two pier foundations. The bottom of the transformer tank shall not bear on the concrete pad in the finished installation. The bottom shall be primed and painted as described above. Flat-bottom transformers shall be furnished with supporting spacer beams. The dimensions and locations of these beams shall be

shown in the manufacturer's drawings.

All conduits provided on the exterior of the transformer case shall be rigid steel. A Flexible Metal Conduit (FMC) where the external coating is non-conductive and UV-inhibited. The FMC can be used on gauges, devices, and existing and entering all control cabinets, but shall not exceed 24 inches in continuous length. PVC or EMT is not acceptable.

All surfaces of the case and covers, both exterior and interior, shall be thoroughly cleaned by means of shotblasting or by any other equally effective method. Primer coats of exterior paint and exterior paint topcoat shall comply with applicable standards for painting of substation transformers and meet the stipulations of the EEL finishing requirements.

The top of the transformer main tank and the top of the LTC compartment (if applicable) shall have a non-skid surface.

The exterior surface of all mounting hardware shall be stainless steel bolts and washers with silicon bronze nuts. No exposed cadmium-plated or zinc chromate-plated parts will be allowed.

The transformer tank shall be furnished with supported 4" x 1/4" copper bus bars from the top of the tank to a location 12" above the base of the tank on both diagonal corners to connect high-and low-voltage surge arresters and the H0 and X0 neutral bushings. The copper shall be tinned at all connection points, and the copper bar shall be painted with ANSI Gray 70 paint. Support points shall be spaced at a maximum of 4 feet from the tank base to the top surface. Arrester leads shall be 4/0 AWG copper or 1/4" x 2" copper bar minimum, and the neutral bushing lead shall be 1000 MCM copper or equivalent minimum. All leads shall be connected to the main 1/4" x 4" bars with NEMA 2-hole or 4-hole drilling. One (1) spare NEMA 4-hole drilling shall be provided on each copper bar for connection to the station ground system.

v. Impedance

The percent impedance voltage at the self-cooled rating, as measured at the rated-voltage connection, shall be in accordance with the latest revision of IEEE Std. C57.12.10, and tolerance shall be as specified in the latest revision of IEEE Std. C57.12.00. This transformer's impedance at the base rating of 201.6MVA shall be approximately nine percent (9%) at 65°C. This transformer's impedance at the base rating of 180.0 MVA shall be approximately 8.0 to 8.4% at 55°C.

vi. Sound Level

The transformer shall be so designed that the average sound level will not exceed the values given in the latest revision of NEMA TR-1 when measured at the factory in accordance with the conditions outlined in the latest revision of IEEE Std. C57.12.00.

The sound level at the 120-MVA self-cooled rating shall not exceed 72 dBA when factory-tested in accordance with the procedure stated in NEMA TR1-9.04.

vii. Bushings and Terminals

The transformer shall be provided with transformer-type bushings constructed of high-strength wet-process porcelain and be clearly labeled externally. All bushings shall be light gray, ANSI No. 70, condenser type, and have provisions for a power

factor C1 testing port. High-voltage bushings shall be oil-filled, dimensionally interchangeable between transformers, and equipped with corona mitigation, in accordance with the latest revisions of ANSI Standard C76. The high voltage bushings shall be 1,200-Amp bottom lead type, and the low voltage bushings shall be 4,000-Amp bottom lead connected.

Type of Contaminated Environment: Medium

Minimum creepage distance shall be based on the type of contaminated environment stated above and as described in the latest revision of IEEE Std C57.19.100.

Bushings shall be rated to meet or exceed the electrical insulation characteristics given in the latest revision of Table 1 of IEEE Std C57.19.01.

Bushings shall be provided as follows:

Location	Voltage-Class (kV)	Amperes	Connection
H1, H2, H3	245	1200	Bottom
X1, X2, X3	72.5	4000	Bottom
H0X0	27	1200	Bottom
Y (Tertiary)	27	1200	Bottom

The neutral and tertiary bushings shall be furnished with a NEMA 4-hole spade-type terminal for connection with 750 MCM copper to the 1/4" x 4" copper neutral bus extending from the terminal to a tank ground pad for direct connection to the station ground system. Tertiary winding leads shall be brought to the exterior of the transformer for testing purposes, not for load carrying.

All primary and secondary bushings shall be provided with copper-threaded studs sized in accordance with their respective current ratings. Each bushing stud shall be provided with a NEMA 4-hole flat spade terminal connector. High- and low-voltage terminal studs and flat spade terminal connectors shall have silver-plated contact surfaces.

The bushings shall be spaced to comply with or exceed the minimum phase-to-phase and phase-to-ground external clearances between live parts in accordance with IEEE C57.12.10, the newest edition.

viii. Auxiliary Cooling

Cooling equipment shall be furnished in accordance with ANSI standards for transformer self-cooled and forced-cooled ratings of ONAN/ONAF/ONAF.

Galvanized cooling radiators shall be mounted independently of one another on the transformer and individually removable from the transformer tank. Radiators shall be designed and braced to withstand all vibration and operating forces.

Radiator mounting flanges on the transformer tank shall each be equipped with valves to permit the removal or replacement of an individual cooling radiator without loss of either oil or gas above oil in the transformer tank.

Auxiliary cooling equipment shall consist of hot-dipped galvanized radiators, hot-dipped galvanized fans, and painted pumps with ANSI 70 Gray enamel, and shall

be located on the side of the tank in either Segment 2 or Segment 3, as identified by IEEE C57.12.10. Placement of radiators shall not obstruct the operator's view of any indicating dial or gauge located within Segment 1 of the transformer.

All cooling radiators shall be hot-dipped, galvanized, and mounted either in Segment 2 or Segment 3 as identified by IEEE C57.12.10, and as described in subparagraph 8.4.1 of these Technical Specifications. Final location of the radiators on the tank wall shall be subject to the approval of the Commission or the Commission's Engineer.

Each cooling radiator shall be equipped with a filling valve at the top and a drain valve at the bottom. All cooling fans shall be equipped with automatic controls to operate all cooling stages based on sensing of transformer winding temperature. Each fan shall be driven by an enclosed waterproof induction motor rated 240 volts AC, single-phase, 60-Hertz. Each motor shall be equipped with thermal overload protection. Each fan shall be dynamically balanced for vibration-free operation.

All cooling fans (and/or pumps) shall be controlled by the Dynamic Rating E3-7200 transformer monitor to operate all cooling stages based on sensing of transformer winding and oil temperatures. Each fan (and/or pump) shall be driven by an enclosed, waterproof induction motor rated at 240 volts AC, single-phase, and 60 hertz. Each motor shall be equipped with thermal overload protection. Each fan (and/or pump) shall be dynamically balanced for vibration-free operation. All fan guards shall be stainless steel or hot-dipped galvanized and shall meet OSHA safety standards.

Automatic control of all electrically powered cooling systems shall be accomplished by the closure of contacts within the transformer monitor. Recommendations for set points for turning cooling fans on and off, alarming, and tripping shall be supplied by the manufacturer.

The cooling systems shall provide a control switch to transfer the cooling operation from automatic to manual control. All cooling system controls shall be enclosed in the transformer control cabinet, complete with all conduit and inner wiring to the fan. This function may be provided by the transformer monitoring system in lieu of a separate relay if so equipped.

ix. **Current Transformers**

The power transformers shall be equipped with bushing-type current transformers mounted inside the main case on terminals H1, H2, H3, H0X0, X1, X2, X3, and tertiary with leads brought to identified terminal shorting blocks in a control cabinet.

Bushing-type current transformers shall have standard taps and be furnished in accordance with the latest revision of Table 5 of IEEE Std C57.12.10-newest edition, as follows:

Location	Ampere Ratio	Quantity EA/Bushing	Total	Revenue Metering Class	Relay Accuracy Class	Thermal Rating
H1, H2, H3	1200:5	2	6	0.3B-1.8	C800	2.0
X1, X2, X3	3000:5	2	6	0.3B-1.8	C800	2.0
H0X0	1200:5	1	1	0.3B-1.8	C400	2.0
Tertiary	1200:5	1	1	0.3B-1.8	C200	2.0

If the current transformers are mounted in a removable current transformer adapter,

the current transformer shall be shipped in the main transformer mounted in the adapter. The current transformer secondary leads shall be permanently connected to the terminal blocks in the control cabinet. No splicing of secondary current transformer leads shall be required after delivery to the Owner. A CT metal diagram instruction plate shall be provided. Turns progression, accuracy class, and thermal rating factor of bushing current transformers shall be shown on the nameplate.

x. Surge Arresters

Surge arresters shall be transformer-mounted on the high- and low-voltage sides of each phase. These shall be rated:

System Voltage, L-L (kV)	Ur, Duty Cycle (kV)	Uc, MCOV (kV)
230	180	144
69	72	57

Surge arresters shall be polymer-housed, IEC line-discharge class 3 (station class), light gray, ANSI No. 70. The surge arresters shall comply with the latest revision of ANSI Standard C62.11. Only metal oxide arresters are acceptable.

The surge arresters shall be located with relation to one another and the bushings to comply with, or exceed, minimum phase-to-phase and phase-to-ground clearances between live parts in accordance with ANSI Std C57-12.00-newest edition Table 11.

Lightning Arrester Mounting. Tank-mounted lightning arrester brackets shall be provided as follows: three removable brackets for mounting the specified station-class arresters near each high-voltage bushing. Three brackets for mounting the specified low-side arresters near each low-voltage bushing.

Support brackets, conductors, and connectors for the transformer grounding system. The copper shall be tinned at all connection points, and the copper bar shall be painted with ANSI Gray 70 paint when not a connection point. The surge arresters shall be provided with 4-hole NEMA pad connectors to the bushing terminals. Ground conductors equivalent at minimum to 4/0 copper or 1/4" x 2" copper bus shall also be furnished and carried from the arrester bases to the transformer ground buses (looped configuration).

xi. Control Cabinet

The control cabinet, including its construction, internal component arrangement, drawing package, wire identification convention, and testing requirements, shall comply with the governing Utility Standard for Power Transformer Control Cabinet Design (DRDWCCAB02-0626) incorporated herein of this specification, as issued and maintained by Dynamic Ratings on behalf of the Owner. The intent of that standard, and of this Section, is to ensure that every control cabinet furnished under this Specification, regardless of the transformer manufacturer, presents an identical physical appearance, an identical documentation structure, and an identical operating philosophy to the Owner's operations and maintenance personnel. A qualified technician shall be able to approach any transformer furnished under this Specification, open the control cabinet, and immediately understand the cabinet organization without first consulting the project drawings.

Dynamic Ratings shall be identified as the preferred supplier for the control cabinet, transformer monitor, and DGA monitoring equipment to promote consistency of design, integration, commissioning, and long-term support across the complete monitoring and control system. Equivalent systems will be considered provided they comply with all specifications and functional requirements detailed herein.

Scope of Supply:

- The control cabinet shall be: DRDWCCAB02-0626.
- The monitor shall be: E3-7200, or approved equivalent.
- The DGA shall be: Vaisala OPT100, or approved equivalent.

No tripping relays shall be mounted on a swinging panel. All tripping relays shall have covers.

xii. Transformer Monitoring System

A microprocessor-based transformer monitoring system shall be installed and programmed on the transformer. The monitor shall be factory-programmed by the monitor manufacturer in accordance with the design and functionality of the transformer control system and shall be bench-tested for proper I/O operation. Self-checking functions shall be included. Specific requirements are as follows:

- (1) Front-panel visualization. The transformer monitoring system shall be capable of displaying measured values, calculated values, I/O statuses, device status, and configuration parameters on a front-panel, backlit, full-graphical display with adjustable font. The display shall have a full numeric keypad, four quick-access function keys, and eight programmable "hot keys" for instant access to the user's favorite screens. The eight programmable keys shall be preconfigured as follows, and a label shall be provided accordingly:
 - New Alarms
 - Active alarms
 - DGA
 - BHM
 - PDM
 - Harmonics
 - Temperature detail
 - Motor Currents
- (2) Functions provided. The transformer monitoring system shall monitor and report the following functions: top oil temperature, hot spot temperature on HV and LV windings, load, transformer insulation aging, transformer gas pressure, main tank liquid level, warnings and alarms with dry contact output, monitoring of fans and/or pumps, fan exercise, LTC contact wear, LTC tap position, tap counter for total as well as individual tap counts, tap changer motor energy and LTC/Top Oil differential temperature with alarms, event recording, and remote access of data. The transformer monitoring system shall directly measure and calculate the energy consumed by the OLTC drive motor during each tap change and record the result in Joules. Historical trending and configurable high- and low-Joule alarms shall be provided to assess OLTC mechanical

condition and performance. The transformer monitoring system shall provide automatic cooling control based on top oil temperature, winding hot spot temperature, and transformer thermal model calculations. Cooling stages shall be automatically initiated upon reaching the first applicable control criterion and shall include configurable hysteresis to prevent excessive cycling. The transformer monitor shall provide automatic bank-swapping for the cooling bank to equalize fan and pump runtime, reducing uneven wear and extending the cooling system's life. Cooling groups shall be alternated on a user-defined schedule or by digital input, with the monitor automatically reassigning cooling stages, setpoints, and operating modes while maintaining uninterrupted transformer cooling performance.

The monitoring system shall continuously measure fan and pump motor current and provide alarming for under-current, over-current, failed contactors, and cooling system degradation.

- (3) DGA Monitor Integration: The transformer monitor shall be able to communicate with the DGA monitor, read and store all applicable gas values and alarms, display values and alarms on its integrated web pages, and provide the following analytics: Duval's triangles, Duval's pentagons, IEEE ratio, Rogers Ratio, IEC Ratio, Dorenburg, IEEE key gas, IEEE condition, CO₂/CO ratio, Method NEI, Method X1, X2, X3 dependent on DGA model. The transformer monitor shall also be able to consolidate and transmit DGA data and alarms via user-selectable protocols, including Modbus, DNP3, or IEC61850, to the user's SCADA RTU. The user-selectable protocols will be available via the web interface.
- (4) Programming capability. The transformer monitoring system shall be capable of implementing a wide variety of logic and control functions using the tools available in the Programming Language. Logic shall have the ability to use math functions, comparison functions, and Boolean logic functions.
- (5) DNP3 or NTP synchronized, time-stamped events. The transformer monitoring system shall store up to one year (52 weeks) of events, with synchronized timestamps. An internal real-time clock shall be used for time-stamping when a SCADA master time-sync signal is unavailable.
- (6) Sequential Event Recorder. A chronological report shall be provided by the transformer monitoring system to help determine the order and cause of events and assist in troubleshooting. The last 52 weeks of events, alarms, and analog values shall be recorded.
- (7) Metering. The transformer monitoring system shall include metering capabilities for real-time current, voltage, power, and energy quantities, as well as phase and peak-demand current values, for all AC current and voltage inputs.
- (8) Transformer Thermal Monitor. The system shall incorporate a transformer thermal monitor in accordance with the latest edition of IEEE C57.91. The model shall include the capability to enter both known transformer thermal constants and default constants. Three (3) loss-of-insulation-life values shall be provided, including loss-of-life per day, total loss-of-life, and insulation aging factor. The monitor shall be able to provide predictive smart-activated cooling.
- (9) Harmonics Analysis: The monitoring system should provide harmonic analysis

with the following parameters: total fault count, maximum fault current, total harmonic distortion, and the ratio of even and odd harmonics.

- (10) Through-Fault Event Monitor. The system shall provide the capability to report fault current level, duration of up to 3 seconds or 10 times rated current, and date/time for overcurrent events that exceed a preprogrammed threshold via the bushing CTs installed on the LV windings. Through-fault monitoring shall provide accumulated through-fault levels, the number of through-faults, the total fault count, the maximum fault current, and the total consumed through-fault capacity of the transformer (based on the IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration, section 4.3.2 of the C57.109, *Newest edition*).
- (11) Event Record. The transformer monitoring system shall store up to 15 cycles of raw data with 16-sample/cycle resolution.
- (12) Voltage Inputs. Voltage inputs shall accept 0–150 Vac.
- (13) Current Inputs. Current inputs shall accept 0–10mA and utilize an intrinsically safe clamp-on 1000:1 interfacing CT on a bushing CT secondary.

Fiber-optic Ethernet communications port to communicate with the substation RTU via DNP3.
- (14) DNP3. The transformer monitoring system shall be capable of operating as a DNP3 Level 2 Slave, via serial or LAN/WAN. All control points within the transformer monitor shall be available as DNP3 control points using latch-on/latch-off pulse-on/pulse-off, or trip/close control functions.
- (15) IEC 61850 Ethernet Communications. The device shall provide IEC 61850-compliant communications. The IEC 61850 capability shall include GOOSE messaging and defined logical node data points.
- (16) PC Software. The transformer monitor shall be compatible with PC software for programming control settings and logic functions and for retrieving event data. The PC software shall be supplied as part of the transformer monitor.
- (17) Operating Temperature. The transformer monitor shall have an operating temperature range of –40° to +80°C and a power supply input of the applicable DC control voltage.
- (18) Specification Compliance. The transformer monitoring system front panel shall meet NEMA 12/IP54. The programmable automation controller shall be type-tested to sections of the C37.90, IEC 60255, IEC 60068, and IEC 61000 standards.
- (19) Warranty. The complete monitoring system, including the control cabinet, transformer monitor, DGA system, communications infrastructure, and associated components, shall be covered by a single 10-year warranty provided by the supplier. Split warranties from multiple vendors are not acceptable. Warranty coverage shall include all hardware, software, integration, and communication functionality.

xiii. Pressure Relief

A pressure relief valve with visual indication shall be provided on the transformer to detect excessive positive pressure rise in the transformer tank. The pressure relief alarm point contact shall be wired to the transformer monitor.

A transformer pressure relief device shall be provided to release at no more than 10 psi. Stainless steel or aluminum piping shall be provided to direct oil released through the pressure relief device to the base of the tank.

The pressure relief device shall be Qualitrol XPRD with alarm contacts and 8" stainless steel or aluminum discharge pipe or approved equal.

xiv. Rapid Pressure Rise Relay

A Qualitrol 900 oil fault pressure relay located at eye level, flange connected on the side of the transformer tank to allow testing without having to take the unit out of service, and the output shall be interconnected to the station "Lock-out relay". A seal-in relay (QUALITROL 909-300 or equivalent) for latching an alarm or trip signal is required.

xv. Winding Temperature Relay

A winding temperature relay shall be provided on the transformer to detect over-temperature. The relay shall have four (4) sets of contacts and be wired to the transformer monitor for remote alarm and remote initiation of a transformer lockout relay. Contacts supplied for alarms and lockout initiation shall be dry and normally open.

The four-element winding temperature relay shall incorporate an indicating dial to display the transformer's winding temperature.

The winding temperature device shall be Qualitrol or an approved equal.

xvi. Oil Level Relay

An oil level relay shall be provided on the transformer to detect low oil. The relay shall have two (2) sets of contacts and be wired to the transformer monitor for remote alarm and remote initiation of a transformer lockout relay. Contacts supplied for alarms and lockout initiation shall be dry and normally open.

The two-element liquid level relay shall incorporate an indicating dial to display the liquid level of the transformer.

The winding temperature device shall be Qualitrol or an approved equal.

xvii. Windings, Oil, and Ambient Temperatures

Resistance temperature detectors (RTD) shall be provided for the detection of the hottest spot winding temperature, transformer main tank top oil temperature, and ambient temperature.

RTDs shall be three (3)- wire-style units. The outputs shall be wired to the transformer monitor RTD inputs for remote alarm, remote initiation of a transformer lockout relay, and fan control.

xviii. Undervoltage Relays

Undervoltage relays shall be provided to monitor AC and DC circuits. Each stage of fans shall be individually monitored, as shall the DC trip circuit(s) on the load side of the breakers. Alarm contacts shall be supplied and wired out to the inputs of the transformer monitor.

xix. Conservator Oil Preservation System (COPS)

Oil preservation shall be by a conservator system, consisting of an externally

mounted conservator (expansion) tank. A system of piping and valves for oil expansion from the main tank to the conservator, including control and monitoring equipment required to safeguard and protect the equipment.

The oil level in the expansion tank shall be designed to maintain positive pressure on the main transformer tank, including bushing pockets, turrets, and/or adapters. The expansion tank shall be of sufficient capacity to operate through an ambient temperature range of -40°C to +85°C without causing the low-level alarm contacts at the lower limit and without exceeding the recommended full oil level at the upper limit. The conservator system shall be designed to prevent direct contact between the oil and the atmosphere. This shall be accomplished by an air cell in the expansion tank, which shall vent air to the atmosphere through a dehydrating breather.

The air cell shall be made of nitrile rubber or an equivalent material and shall neither affect nor be affected by contact with hot oil. Neoprene rubber and similar materials are not acceptable. The dehydrating breather must be located so that it can be conveniently accessed from the transformer pad and can be maintained without removing the transformer from service.

A low oil level gauge shall be mounted on the conservator tank and designed so that rupture of the air cell does not prevent the operation of the oil level indicator or cause the low oil level alarm to fail. A section of removable pipe or stainless-steel braided flexible hose, with isolation valves, shall be furnished between the transformer tank and the conservator tank. All piping and valves shall be capable of withstanding a full vacuum.

The design of the conservatory system shall be such that thermal siphoning of oil between the transformer tank and the conservator shall not occur due to density changes.

The transformer shall be equipped with a Buchholz relay equipped with contacts for alarming and provisions for testing. A gas sampling valve (mounted within 70 inches of the base) shall be provided to pull gas samples from the gas relay. Provisions shall be made to apply full vacuum or equalize pressure/vacuum to the expansion tank when oil filling is required. Vent valves and piping located on the transformer cover shall be located to avoid tripping hazards and guarded to prevent damage.

xx. Wiring

The control cabinet wiring package shall comply with the governing Utility Standard for Autotransformer Control Cabinet Design (DRDWCCAB02-0626) incorporated herein of this specification, as issued and maintained by Dynamic Ratings on behalf of the Owner.

xxi. Trip Contacts

Sudden pressure and transformer monitor trip contacts, as specified herein, shall be brought to a single terminal block for ease of customer connections. Transformer monitor relay health alarm, communication alarm, and any spare output contacts shall also be brought to the same or adjacent terminal block.

xxii. Terminal Blocks and Molded Case Circuit Breakers

The control cabinet terminal blocks and molded case circuit breakers shall comply with the governing Utility Standard for Autotransformer Control Cabinet Design

(DRDWCCAB02-0626) incorporated herein of this specification, as issued and maintained by Dynamic Ratings on behalf of the Owner.

xxiii. Transformer Oil Inhibitor

All oil supplied for Type II insulating transformers shall contain an antioxidant oil inhibitor. The manufacturer may supply 0.3% wt. DBPC or 0.3% wt. DBP inhibitor. Installation of the inhibitor shall be in accordance with the newest edition of IEEE C57.106.

xxiv. The Transformer Core Ground

The core ground strap is to be made accessible, provided on the cover or on the tank sidewall near the cover. Tests for core grounds are to be performed after tanking and just prior to leaving the factory using a 1000-volt Megger. Resistance measurements are to be included in a certified test report and reported to the Engineer prior to shipment. The core ground pocket bushing with the protective cover shall be accessible from the ground. Core ground shall be protected from unintentional contact with the core in multiple locations.

Fall-Arrest System – provide DBI SALA 8516691 Portable Fall Arrest System or equivalent and 8517565 Carrying/Storage bag. The manufacturer will weld a bare steel plate DBI SALA Model 8517412 or equivalent and then paint it to match the transformer ANSI 70 Gray.

<http://www.aikencolon.com/dbi-sala-8516691-advanced-portable-fall-arrest-post-system#3>

k. Tests

- i. The transformer shall receive standard commercial tests in accordance with ANSI Standards. The Bidder shall furnish evidence of short circuit testing on similar units having the same basic ratings and designs. Short-circuit tests shall comply with the appropriate ANSI regulations.
- ii. The transformer shall receive standard ANSI impulse tests, including full-wave and chopped waves on each high-voltage line terminal and on each low-voltage line terminal. Copies of oscillography's and a formal report will be submitted as a record of the tests.
- iii. The transformer shall receive a Sweep Frequency Response Analysis (SFRA) during factory testing on the neutral taps. This test shall be repeated during site testing. Results shall be compared, and a report shall be provided with an explanation for any differences in results.
- iv. Perform Partial Discharge testing, making measurements per IEEE standards C57.12.00, Table 17 & C57.12.90, section 10.8, which describes induced testing requirements and procedures, by evaluating partial discharge measurements as criteria for pass/fail.
- v. In addition to the Standard ANSI tests, the transformer shall be corona tested at the full induced-test voltage level. RIV testing: equipment and general method used will be in accordance with IEEE C57.12.90 Annex A. IEEE Transactions PAS 86 No. 12, December 1967, "Tests for Damaging Corona on Oil-Insulated Power Transformers". Second, the corona test shall be made after all other insulation tests are completed. The RIV readings shall not exceed one hundred (100) microvolts for the following test procedure:
 - (1) The corona tests shall be made as follows: one with the cooling oil-circulation pumps shut down and one with all pumps running. Only one (1) corona test will be required where no pumps are required for cooling.
- vi. For each test, RIV readings at one hundred seventy percent (170%) of rated maximum voltage to the transformer terminal shall be recorded for at least five (5) seconds, after which the test voltage should be reduced to one hundred fifty percent (150%) of rated maximum voltage and held for one (1) hour. Should the corona RIV reading increase in the last twenty (20) minutes of the test, the test time shall be extended beyond one (1) hour to allow time for the RIV readings to stabilize or decrease. If the RIV readings continue to increase, the test shall be considered to indicate a transformer failure. A further investigation shall be made to determine the problem and to correct it.
- vii. Corona shall be monitored continuously throughout the test and recorded every five (5) minutes. This shall be included in the certified test reports. A frequency of 120 Hertz is recommended for each test.
- viii. All impedances between windings shall be shown on the test reports.
- ix. The Bidder may substitute some manufacturers' standard tests in lieu of those specified, but any deviation from IEEE standard tests must be in the exception pages. However, the basic quotation must include all tests specified.
- x. The Engineer reserves the option of having a representative present to inspect the core and coils prior to tanking and to witness any or all tests.

- xi. Without limiting in any way any obligation of the Bidder under this agreement, the Bidder shall demonstrate to the satisfaction of the Engineer that the transformer proposed to be furnished under this Specification shall have sufficient mechanical strength to withstand without failure all fault currents. The Bidder shall demonstrate that the transformers meet this requirement by one of the following methods:
- (1) Certified test data showing that a transformer with a core and coil in a similar design and construction and similar with respect to MVA capacity, kV ratings, BIL, impedance, and voltage taps have been tested without failure for short-circuit strength. The Bidder will provide the Engineer with a description of the test code under which the transformer was tested for short-circuit strength.
 - (2) A history of successful experience with transformers of identical or similar ratings, design, and construction. The Bidder shall list all transformers in service with cores and coils that are essentially identical in design, construction, and manufacture to the transformer covered by this specification, and provide information on the date of installation, location, and any failures. Where such transformers have not been built, or the cumulative service record is less than 20 transformer years, a list of transformers in service that represents the closest approximation to the transformer covered by this Specification shall be submitted. The information submitted shall be representative of the manufacturer's total experience with the design of the transformer it proposes to furnish, and shall include the dates of installation or shipping, the ratings of the transformers, and any failures and their causes, if any, that have been experienced.
 - (3) The Bidder shall submit with his Proposal a complete listing of all full-size transformers of his manufacture of similar ratings which have been short-circuited tested. The list shall include all full-size units tested, whether they were developed tests or tests of customer units. Complete ratings shall be given of each unit, and each shall be noted as to whether copper or aluminum windings were used for comparison with that winding material offered on this bid. In the case of units tested for or by the ultimate customer, an indication shall be given on each unit as to whether the test was successful or unsuccessful, and if tested more than once, each subsequent test shall be so listed, and appropriate comments shall be given as to design changes made, if any.
 - (4) If the Bidder has no such test data available, they shall so state in the Proposal.
- xii. **The transformer shall be tested for the following:**

(1) **Factory Tests**

- (a) The transformer shall receive at the factory those tests identified in IEEE Standard C57.12.00, latest revision section on "Routine Tests". All tests are to be performed at 60 hertz.
- (b) The transformer shall be designed and built to meet the short-circuit design requirements of IEEE C57.12.00, latest revision, and the Short-circuit test code of IEEE C57.12.90, latest revision.
- (c) PWC shall be notified five (5) weeks in advance so that its representative can witness the following factory routine tests (FAT) without causing any delays in factory schedules when located in North America; add an additional 3-weeks for non-NAFTA countries:
 - (i) Performance Tests

1. Winding resistance measurements
2. The ratio on all taps
3. Polarity and Phase relation tests
4. No-load losses and excitation current at 100% and 110% rated voltage
5. Impedance voltage and load loss
6. Operation tests of all devices
7. Control (auxiliary) and cooling consumption losses
8. Zero-phase sequence impedance voltage and load loss
9. Temperature rise
10. Dissolved gas in oil analysis (before the start of all tests and after the completion of all tests)
11. Audible sound level
12. The transformer shall receive a full-spectrum Sweep Frequency Response Analysis (SFRA) during factory testing on the neutral taps. This test shall be repeated during field testing. Results shall be compared, and a report shall be provided with an explanation for any differences in results.

(2) **Dielectric Tests**

- (a) Winding insulation resistance
- (b) Core insulation resistance
- (c) Insulation power factor and capacitance
- (d) Low-frequency test on auxiliary devices and control, and current transformer circuits
- (e) Lightning impulse
- (f) Low-frequency
- (g) Partial discharge tests

(3) **Mechanical Tests**

- (a) Pressure
- (b) Leak (fully assembled, with radiators installed, and a conservative tank)
- (c) The certified test report shall include impedance values as follows: Z1%, X1/R1, Z0%, and X0/R0 (and specify MVA base of these values).

(4) **Field Tests/Checks**

- (a) All tests as called for by the latest revision of ANSI/NETA Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems shall be performed. For reference, applicable portions of ANSI/NETA ATS-2009 have been included in Appendix 5.
- (b) In addition, a Sweep Frequency Response Analysis shall be performed. The

technicians performing the tests will need to be NETA certified. This will need to be performed even if the manufacturer has to hire a testing contractor.

(c) Any tests listed that are not included in the bidder's proposal shall be so noted in the list of exceptions to the specifications.

(d) In addition, the manufacturer shall provide certification for all design and other tests listed in Table 18 of ANSI C57.12.00, including verification that the design has passed Short Circuit Criteria per ANSI C57.12.00 and C57.12.90.

I. Transformer Bid Evaluation

i. Transformer bids shall be evaluated for "Equivalent First Cost of Ownership" utilizing initial cost and transformer losses. The formula is as follows:

(1) "Cost of Ownership" = (Unit Cost*) + (Factor A x No-Load Losses) + (Factor B x Winding Losses) + (Factor C x Auxiliary Losses)

(2) The Cost of Losses will be evaluated using the following Factor amounts:

Unit	Factor	ONAN Base Rating
No-Load Loss	A	\$5,200 per kW
Winding Loss	B	\$1,800 per kW
Auxiliary Losses	C	\$1,000 per kW

b. The No-Load and Winding Losses quoted by the Bidder are of the essence of the Contract. Should the Bidder fail to meet the quoted losses, the Owner shall have the right to deduct from and retain out of such monies which may be then due or which may become due and payable to the Bidder the sum equal to the difference in quoted loss values and the actual loss values as verified by the certified test reports provided after manufacture computed in dollars utilizing the No-Load Loss and Winding Loss values listed above as liquidated damages and not as a penalty. In no event shall the adjustment factor under this provision result in a net price increase to the Owner. If the amount due and to become due from the Owner to the Bidder is insufficient to pay in full any such liquidated damages, the Bidder shall pay to the Owner the amount necessary to effect such payment in full, provided, however, that the Owner shall promptly notify the Bidder in writing of the manner in which the amount retained, deducted, or claimed as liquidated damages was computed.

m. Warranty

- i. The Bidder shall guarantee his materials and workmanship against defect due to faulty materials or faulty workmanship, or negligence for a period as outlined below, following final acceptance of the work. He shall make good any defective materials or workmanship, and any damage resulting therefrom, during the warranty period, at no cost to the Owner.
- ii. Each class of equipment shall carry a full five (5) year warranty against defects. Unless otherwise stated in previous specifications.
- iii. Materialmen will purchase the commissioning and testing services for Dynamic Ratings and Vaisala equipment installed along with their 10-year warranty on these two pieces of equipment provided by DR.

n. DGA Specification

- i. The online DGA must, at a minimum, measure the following parameters in the transformer oil:
 - (1) Hydrogen
 - (2) Methane (CH₄)
 - (3) Ethane (C₂H₆)
 - (4) Ethylene (C₂H₄)
 - (5) Acetylene (C₂H₂)
 - (6) Carbon monoxide (CO)
 - (7) Carbon dioxide (CO₂)
 - (8) Moisture
- ii. Construction of the DGA is such that no plastic components are in contact with transformer oil.
- iii. All measurement components must be hermetically sealed to prevent leakage of transformer oil or gases. Oil Temperature Range: -40 to +120 °C
- iv. Measured DGA gases must not be vented to the atmosphere.
- v. The online DGA shall not require any regular factory calibration or consumable gases during its service lifetime.
- vi. The online DGA must have an autocalibration capability, which must be made without the use of any calibration gases or other consumables.
- vii. The measurement cycle shall not take longer than 2 hours in regular operations.
- viii. The measurement system of carbon gases must be optical and based on Non-Dispersive Infrared (NDIR) technology.
- ix. The receiver of the NDIR measurement system must not contain any mechanical parts, such as microphones or mechanical chopper wheels or rotating filters.
- x. The NDIR measurement system must have the ability to define its maximum IR transmission and compensate for any decrease in light source intensity.
- xi. No external pumps shall be needed to ensure the flow of oil into the DGA.
- xii. Gases shall be extracted from the transformer oil using the vacuum extraction method.
- xiii. Use of membranes for gas separation from oil shall not be acceptable.
- xiv. The online DGA must have an integrated data logging capability for data storage up to 10 years. The online monitoring system shall be able to provide alarms based on single index increments.
- xv. The online system can be connected to SCADA using known protocols such as Modbus, DNP3, or IEC61850. It must support RS232, RS485, fiber-optic serial, fiber-optic Ethernet, 4G, Ethernet carriers, and include 3 x LED Indicators (Power, Service, Alarm) and Alarm relay contacts.
- xvi. The online monitoring system shall be able to:

- (1) Provide PD output in a single line energy trend, which can be trended together with Load, H2 production, and all relevant indexes for diagnostic correlations;
 - (2) Initiate a DGA sample based on PD readings
- xvii. Installation should be able to be performed without an outage if required.
- xviii. With regard to specific Dissolved Gas Analysis, the monitoring system shall have a user interface that provides the following Dissolved Gas Analysis:
- (1) DGA Graph Trending
 - (2) DGA Instantaneous Values
 - (3) DGA Scheduling
 - (4) DGA Online Monitor Alarm Management
 - (5) Cross Data Trending
 - (6) Data Export to User device
- xix. The supplier shall be capable of providing a team of transformer experts to support and enhance the customer experience, providing monitor support and technical transformer service. Costs for these services will be agreed with the customer in advance, on a per-project or per-transformer basis.
- xx. The supplier should also be able to support OEM Design for specification review and acceptance tests and provide training across all aspects of transformer operational life.
- xxi. The online DGA enclosure must be rated to IP66. Enclosure to be constructed of 304 SS stainless steel that is white powder-coated.
- (1) The enclosure shall be further protected with a rain shield lip covering the swing door.
- xxii. A factory calibration test report for the online DGA must be included during the delivery.
- xxiii. The unit shall be capable of tolerating vacuum and overpressure.
- xxiv. The DGA must have an automatic recovery after a power outage without any user intervention
- xxv. Sensor Specifications:

For Hydrogen		
Measurement range (in oil)	:	5 to 5000 ppm
Accuracy (in oil temp. range - 20 ... +60 °C)	:	15% of reading or 25 ppm (whichever is greater)
Repeatability	:	10% of reading or 15 ppm (whichever is greater)
Typical long-term stability	:	3 % of reading/year
Cross-Sensitivity to Other Gases	:	< 2 % (CO ₂ , C ₂ H ₂ , C ₂ H ₄ , CO)
Sensor	:	Catalytic Solid-State Sensor
For Methane (CH₄)		
Measurement Range	:	20 - 50 000 ppm

Accuracy	:	10 ppm or 10 % of reading
Repeatability	:	10 ppm or 5 % of reading
For Ethane (C2H6)		
Measurement Range	:	0 - 10 000 ppm
Accuracy	:	10 ppm or 10 % of reading
Repeatability	:	10 ppm or 5 % of the average of 5 readings
For Ethylene (C2H4)		
Measurement Range	:	5 - 90 000 ppm
Accuracy	:	10 ppm or 10 % of reading
Repeatability	:	10 ppm or 5 % of reading
For Acetylene (C2H2)		
Measurement Range	:	2 - 5 000 ppm
Accuracy	:	2 ppm or 5 % of reading
Repeatability	:	1 ppm or 10 % of reading
For Carbon monoxide (CO)		
Measurement Range	:	25 - 20 000 ppm
Accuracy	:	10 ppm or 10 % of reading
Repeatability	:	10 ppm or 5 % of reading
For Carbon dioxide (CO2)		
Measurement Range	:	0 ... 10 000 ppm
Accuracy	:	10 ppm or 10 % of reading
Repeatability	:	10 ppm or 5 % of reading
For Moisture		
Measurement Range	:	5 to 95 %RS / Water Activity 0 to 1/ non-condensing
Accuracy (including non-linearity, hysteresis, and repeatability)	:	±2 ppm or ±10% of reading
Sensor	:	Capacitive Polymer
Calibration	:	Lowest calibration point <2%RH Certificate supplied.

xxvi. The online DGA must be able to operate in the following environment

Operating humidity range	:	5 to 95%RH, non-condensing
Operating Temperature Range	:	-40 to +55 °C

xxvii. The manufacturer's test report for Ingress Protection reports must be submitted with the proposal.

xxviii. The online DGA must have the following communications output options

- (1) RS-485, which supports Modbus RTU and DNP3 Ethernet
- (2) TCP/IP, which supports Modbus TCP/IP, DNP3, and HTTP
- (3) includes 3 x LED Indicators (Power, Service, Alarm) and Alarm relay contacts
- (4) support RS232, RS485, Fiber optic, Fiber-optic Ethernet, 4G cellular, Ethernet carriers

xxix. No additional software other than a Browser shall be required for commissioning and data interpretation. All advanced diagnostic charts (Duval's Triangle, Bushing Polar Plot, Trends...) should be visible without installing any desktop software or

server, but just using a Browser (IE10, Chrome, Firefox). The Overall Dashboard must display, on a single page, the gas levels, temperatures (top oil, environmental, tap changer, and LTC differential, if equipped), and load values.

- xxx. The Web browser-based user interface shall contain the following information from the DGA
 - (1) All measured parameters in graph format
 - (2) All measured parameters in tabular format showing the most recent measured values, 1-day average values, 1-day rate of change, and 30-day rate of change
- xxxi. The user must be able to download this data in comma-separated values (.csv) format directly from the web browser
- xxxii. The user must be able to start and stop the measurement of the online DGA using the web browser interface.
- xxxiii. The user must be able to configure the relays directly from the web browser.
- xxxiv. Declaration of Conformity or Certificate for EMC & safety type tests according to IEC standards must be provided.
- xxxv. Operating power of the unit shall be 60 hertz single-phase 120-240 AC voltage. Other operating voltages allowed are 125 volts DC.

Utility Standard for Autotransformer Control Cabinet Design

DRDWCCAB01-0626-E3 **E3-7200 Monitor Platform Variant**

Document Type	Utility Control Cabinet Standard
Document Number	DRDWCCAB01-0626-E3
Parent Standard	DRDWCCAB01-0626
Monitor Platform	Dynamic Ratings E3-7200
Typical Application	Large power transformers and autotransformers, such as the 120 MVA autotransformer class, where the project specification calls for the E3-7200 monitor with integrated DGA
Equipment Scope	Large power transformer control cabinets
Primary Objective	Safety, consistency, maintainability, and restoration speed
Revision Status	R3
Prepared For	Utility transformer engineering, operations, maintenance, and procurement teams

Purpose

The purpose of this standard is to establish a uniform design philosophy and construction standard for all power transformer control cabinets supplied to the Utility. This standard requires consistent physical appearance, drawing package structure, component arrangement, wiring methodology, identification method, and testing approach regardless of transformer manufacturer. This variant of the standard applies where the project specification calls for the Dynamic Ratings E3-7200 transformer monitor, and carries forward the same design philosophy, drawing package structure, zoning, wiring, and testing requirements, with the specific adjustments identified in this document.

The Utility considers standardization to be a significant contributor to personnel safety, reduced outage duration, improved maintainability, reduced training requirements, improved documentation quality, and lower lifecycle cost.

Scope

- This standard applies to control cabinets furnished with large power transformers.
- This standard applies to new transformer procurement and may be applied to retrofit or replacement cabinets where practical.
- This standard applies to cabinet layout, documentation, wiring, device identification, terminal blocks, testing, and deliverables.
- The requirements in this standard are intended to supplement transformer purchase specifications and project-specific data sheets.
- Where this standard conflicts with project-specific utility requirements, the project-specific requirements shall govern only when specifically approved by the Utility.

Objectives

- Improve personnel safety when personnel open and access transformer control cabinets.

- Reduce restoration time by providing consistent layouts and predictable troubleshooting paths.
- Standardized maintenance practices across the transformer fleet.
- Reduce technician training burden by using repeatable cabinet architecture.
- Standardize spare parts and common replacement components wherever practical.
- Improve drawing quality, revision control, and document usability.
- Simplify factory acceptance testing, commissioning, troubleshooting, and long-term maintenance.
- Reduce lifecycle costs through consistent design, documentation, and spare parts practices.

Applicable Standards and References

- IEEE C57 Series, including applicable transformer control cabinet guidance.
- IEEE C37 Series, where applicable to control, relaying, and switching devices.
- ANSI device function numbers and standard device identification practices.
- NFPA 70, National Electrical Code, where applicable.
- UL 508A, Industrial Control Panels, where applicable.
- NEMA 250, Enclosures for Electrical Equipment, where applicable.
- IEEE Std 315, Graphic Symbols for Electrical and Electronic Diagrams, Including Reference Designation Letters. All schematic, wiring, and connection diagrams shall use the device symbols and reference designation letters defined in this standard so that drawing conventions are identical regardless of the originating OEM drafting standard.
- Project-specific transformer purchase specification and utility standards.

Requirements not specifically addressed in this document shall be governed by the applicable IEEE C57 control cabinet guidance, the project specification, and approved Utility engineering direction.

Design Philosophy

A qualified technician shall be able to approach any transformer in the Utility fleet, open the control cabinet, and immediately understand the basic cabinet organization without first studying the drawing package. The cabinet shall be arranged in consistent zones so that control, monitoring, cooling, terminal, and circuit protection equipment are in predictable areas on every transformer.

- Optional equipment shall not alter the overall cabinet architecture.
- Designated zones shall remain designated for their intended purpose even when the associated feature is not supplied.
- Unused zones shall remain blank or reserved and shall not be repurposed without written Utility approval.

- Cabinet design shall prioritize touch-safe access, consistent operating interface location, and serviceability.
- The drawing package shall mirror the physical cabinet arrangement and control logic sequence.
- The OEM shall not optimize an individual cabinet at the expense of fleet standardization.

Document Control and Drawing Package Requirements

Each transformer shall be supplied with a complete drawing package organized in the standardized sequence defined below. The sequence shall be maintained for all projects, regardless of transformer size, cooling configuration, OLTC arrangement, or paralleling requirements.

Section	Drawing Section	Required Content
1	Table of Contents	Complete drawing index with section and page references.
2	Bill of Materials	All major purchased and fabricated components.
3	Component List	Device tags, descriptions, manufacturers, model numbers, and location references.
4	Main Supply and Control Power	AC and DC supply circuits, protection, distribution, and control power logic.
5	Cooling Control Logic	Fan, pump, cooler group, temperature, current monitoring, and loss of cooling logic.
6	OLTC Control Logic, if applicable	Raise, lower, automatic, manual, local, remote, blocking, and status circuits.
7	Paralleling Logic, if applicable	Master, follower, circulating current, blocking, and permissive logic.
8	Transformer Monitor Drawings	Dynamic Ratings E3-7200 wiring, I/O, communications, DGA integration, sensors, and monitoring circuits.
9	Device Drawings	Vendor device details, alarm contacts, wiring references, and configuration details.
10	Terminal Strip Drawings	All control, alarm, SCADA, CT, VT, power, and spare terminals.
11	Cable Schedule	Cable number, origin, destination, conductor count, shield handling, and spare conductors.
12	Field Wiring	Customer and field interface wiring, conduit entries, and termination references.
13	Spare Terminal Identification	Reserved terminals and intended future use, where known.

- Drawing sections shall not be renumbered or reordered to match OEM preference.
- If a function is not used, the section shall remain in the drawing package and be marked Not Applicable.
- All drawings shall include sheet number, section number, drawing title, revision, project number, and transformer identifier.
- Drawings shall be provided in native CAD format and searchable PDF format.

- As-built drawing packages shall be submitted after FAT and after resolution of all documented changes.

Control Cabinet Construction Requirements

- The cabinet shall be suitable for outdoor substation service and shall meet the NEMA rating required by the project specification.
- The exterior enclosure shall be fabricated of weatherproof, painted ANSI 61 Light Gray Stainless Steel construction, and shall be fitted with a three-point latching mechanism hinged on the left side, consistent with the standard cabinet orientation defined throughout this Standard.
- If required, the exterior access door shall be fitted with a viewing window constructed of UV-protected safety glass. The window shall be located and sized so that, with the exterior door closed, an observer can see the installed target relays, the alarm status indicating lamps, and the face of the transformer monitor interface unit without opening the cabinet. This requirement supports rapid visual status assessment by operations personnel without requiring direct access to energized equipment.
- The cabinet shall include external access doors and internal swing frames or swing panels.
- All hinged doors and swing frames shall include mechanical means to hold the door or panel in the open position during service.
- All doors, panels, and swing frames shall be bonded to the cabinet ground system using flexible bonding conductors.
- The cabinet shall include anti-condensation heaters controlled by a thermostat or approved control method.
- The control cabinet heater shall be equipped with guards and thermostatically controlled so that the guard temperature cannot exceed 120°F. The heater's 240-volt electrical terminals shall also be covered.
- A SEL 2725#NG4B with conformal coating 4-port Ethernet switch with one FX-LC fiber to be installed in the main cabinet, and all Ethernet runs must go to this network switch.
- Where a Vaisala OPT100 or approved equivalent DGA monitor is integrated with the E3-7200 transformer monitor, a dedicated port on the network switch shall be reserved for DGA communications, or a switch with sufficient spare port capacity shall be provided so that DGA integration does not consume the last available spare port.
- The cabinet shall include a door-operated light or approved internal lighting arrangement.
- The cabinet shall include an internal document pocket sized for the approved drawing package, unless drawings are supplied through an approved digital method only.
- The cabinet shall include utility-approved provisions for field cable entry and sealing.
- The cabinet shall include a ground bus with clear field connection provisions.

- Terminal blocks for CT leads shall be shorting-type, and each CT shall be connected to a separate six-point terminal block. All the secondary leads of the current transformers shall be extended to shorting-type terminal blocks (Marathon 1506SC, GE EB-27, or equivalent) in the control cabinet. CT wiring shall be No. 10 AWG minimum and be terminated with insulated ring lugs.
- A dead-front control panel in the control cabinet shall contain the necessary switches, circuit breakers, relays, indicating lamps, etc. Target relays or indicating lamps shall be visible through a UV-protected glass window in the front door of the cabinet.
- Molded-type terminal blocks rated 600 volts and 30 amperes, for all external control connections, shall be provided. Terminal blocks with self-contained pressure-type connectors are not acceptable.
- Marathon 1600 DJ series of Buchanan or equivalent Type HD or XHD terminal blocks shall be provided furnished with white marking strips for identification of terminal wires for all connections except current transformers. The terminals shall be identified with legible permanent markings.
- Marathon 1600 SC series terminal blocks or equivalent shall be provided for current transformer leads with at least three shorting screws per terminal block. A separate short-circuit-type terminal block shall be provided for each set of current transformer leads. A States terminal block is not an acceptable substitution.
- One three-pole terminal block sized for #6 to #2/0 AWG wire for Commission's single-phase, three-wire, 120/240 volt; control power leads shall be furnished.
- A minimum of fifteen percent (15%) spare (but not less than 12 points) terminal points shall be provided in the control cabinet. These terminal points shall be furnished with all screws and lock washers.
- Circuit breakers shall be ABB or Square D Industrial series (non-residential) and Philips/Straight-slotted silicon bronze screws on each terminal, or approved equivalent.
- Under-Voltage relay for all phases of cooling power.
- No tripping relays shall be mounted on a swinging panel. All tripping relays shall have covers.
- Three (3) 1200:5 multi-ratio current transformers of C800 relaying accuracy on each high-voltage phase bushing with leads brought down to shorting terminal blocks in the control cabinet.
- One (1) 2000:5 current transformer of C400 relaying accuracy on the neutral low-side bushing, with leads brought down to shorting terminal blocks in the control cabinet.
- Six (6) 2000:5 multi-ratio current transformers of C800 relay accuracy with an RF of 2.0 on each low-voltage phase bushing with leads brought down to shorting terminal blocks in the control cabinet.

Standard Cabinet Zoning and Component Layout

For consistency, left and right shall be defined as viewed by a person standing in front of the

cabinet looking into the open cabinet.

1. Cabinet Zoning Diagram

- a. The following diagram defines the standard cabinet zones. The exact cabinet dimensions may vary by transformer, but the relative equipment zones shall remain consistent.

FRONT VIEW WITH EXTERNAL DOORS OPEN			
Left Swing Frame	Center Opening	Right Swing Frame	Back Panel Behind Swing Frames
Zone L1 Voltage control devices OLTC local controls Paralleling controls Reserved area if not applicable	Zone C1 Access space Swing frame clearance No permanent components unless approved	Zone R1 Dynamic Ratings E3-7200 transformer monitors Local monitoring interface Monitor status indication	Zone B1 Cooling control equipment Cooling contactors Auxiliary relays Power supplies as approved
Back of Right Swing Frame: Zone R2, general control circuit breakers mounted on DIN rail. Breakers are accessible only after opening the swing frame.			CT Terminations: Zone B2, Marathon 1506SC ring tongue style CT terminal blocks mounted on back panel.
Bottom Zone: Field cable entry, grounding, terminal strip access, wire duct routing, and spare terminal allocation. Conduit and cable entry shall not obstruct service access.			

2. Zoning Requirements

Requirement Area	Requirement	Verification Method
Left Swing Frame	Voltage control and paralleling devices shall be mounted on the left swing frame. If voltage control, OLTC, or parallel is not supplied, the assigned area shall remain reserved.	Drawing review and visual inspection
Right Swing Frame	The Dynamic Ratings E3-7200 transformer monitor shall be mounted on the right swing frame in a consistent operator viewing location. The right swing frame zone shall be sized to accommodate the E3-7200 door-mounted HMI and bezel; swing frame width and depth shall be verified against the E3-7200 outline drawing prior to fabrication.	Drawing review and visual inspection
Back Panel	Cooling control equipment, cooling contactors, auxiliary cooling relays, and cooling power devices shall be mounted on the back panel.	Drawing review and visual inspection
Back of Right Swing Frame	General control circuit breakers shall be mounted on DIN rail on the back of the right swing frame and shall only be accessible after opening the swing frame.	Visual inspection
CT Terminations	CT terminations shall use Marathon 1506SC ring tongue style terminal blocks mounted on	BOM review and visual inspection

	the back panel.	
Optional Features	Optional features shall not cause relocation of other standard components or standard zones.	Drawing review
Clearance	Swing frames shall provide sufficient clearance for wire routing, wire bend radius, and safe service access.	Drawing review and visual inspection

Wiring Requirements

- All internal wiring shall be neatly routed in wire duct or approved wire management systems with removable covers.
- Initial wire duct fill shall not exceed 50 percent so that future additions can be accommodated without rerouting the cabinet.
- Control wiring shall be stranded copper and shall meet the voltage and temperature ratings required by the project specification.
- All power wiring shall be made with #12 AWG stranded tinned copper wire or larger sized wire. The primary insulation jacket of all wiring shall be 600-volt, 105°C, water-, oil-, and flame-resistant. Control wiring shall be 45- or 65-mil stranded cable, not smaller than #14 AWG tinned copper wire, with the exception of wiring to alarm auxiliary relays and indicator lights, which may be smaller in size. SIS control wire is recommended. All current transformer leads are to be #10 AWG-stranded tinned copper.
- Power wiring shall be sized as required following the National Electrical Code.
- All connections for wiring shall be made using silicon bronze, split-type lock-washers.
- All wires shall be identified at each end with legible permanent labels. Wire identification shall show both placement and where it came from.
- Wiring connections between fixed and hinged sections shall be a minimum of 41-stranded wire.
- Seven-stranded control wire is not acceptable.
- All terminal connections for conductor sizes #10 AWG in size and smaller shall be made with pre-insulated, full-ring tongue, crimp-type lugs. Lugs shall be AMP, Inc., "Pre-Insulated Diamond-Grip" (PIDG) with nylon or PVC sleeves or approved equivalent. Spade-type terminals or slip-on connectors are not acceptable.
- All terminal connections for conductor sizes #2 AWG through #9 AWG shall be made with Burndy Insulug Type YAEV or approved equivalent.
- All terminal connections for conductor sizes larger than #2 AWG shall be made with two-hole, long-barrel, double-indent, crimp-type lugs: Burndy Hylug Type YA or approved equivalent. (Single-hole lugs may be used only where necessary).
- Grommets shall be provided for all openings in metal barriers used for wiring.
- Uninsulated exposed conductor or terminal lugs shall not extend beyond the sides of the terminal block or its insulating barriers.
- All leads for multi-ratio current transformers shall be wired to terminal blocks in the control cabinet. If junction boxes are required in the wiring between the current transformer and the control cabinet, terminal blocks shall be used for wiring connections. In-line-type

disconnecting terminals such as American Petroleum Institute (API). No. 32488 or Burndy No. YZ10 will not be acceptable.

- If accidental short-circuiting of certain wires can result in malfunction of equipment, these wires shall not be terminated on adjacent terminal block points.
- Two (2) wires per terminal point maximum are permissible with the opposite lay of the terminal lug.
- Unless a more stringent project-specific requirement governs, current transformer secondary wiring shall be #10 AWG minimum and terminated with insulated ring-tongue lugs; general power wiring shall be #12 AWG minimum stranded, tinned copper; and general control wiring shall be SIS-type, 65-mil insulated, stranded cable, #14 AWG minimum.
- Conductors crossing between fixed panels and any hinged section of the cabinet, including the swing frames, shall be a minimum of 41-strand flexible cable, routed and supported to withstand repeated flexing through the full range of door and swing frame travel without conductor fatigue.
- All terminal connections for conductors #10 AWG and smaller shall be made using pre-insulated, full-ring tongue, crimp-type lugs with nylon insulating sleeves, sized and rated for the conductor and terminal point being served.
- Ferrules shall be used on stranded control wiring except where ring tongue terminals are required.
- Ring tongue terminations shall be used where specified for CT circuits or other Utility-approved applications.
- No more than two conductors shall be landed on a single terminal point unless the terminal is specifically rated and approved for additional conductors.
- Wiring shall be routed to maintain separation between AC power, DC control, CT, VT, communications, and low-level signal wiring where practical.
- Wire colors shall be standardized by voltage or function. The final color schedule shall be submitted with the drawing package for Utility approval.

Wire Numbering and Identification Convention

Every wire shall be identified at both ends. The wire identifier shall indicate the source and destination devices so that the wiring can be traced without relying solely on sequential wire numbers. Wire markers shall be heat-shrink type and installed so that the text is readable without rotation or upside-down orientation.

1. Standard Wire Identifier Format

Unless otherwise approved by the Utility, wire identifiers shall use the following format:

SOURCE DEVICE / SOURCE TERMINAL - DESTINATION DEVICE / DESTINATION TERMINAL - CIRCUIT OR SEQUENCE

Example format:

E3/DO1 - K1/A1 - 001

This format identifies that the wire originates at the E3-7200 transformer monitor digital output 1, terminates at relay K1 terminal A1, and is assigned sequence 001 for the associated circuit.

Element	Definition	Required Format	Example
Source Device	Device where the conductor originates.	Approved device tag or ANSI reference.	E3, 63, 49, 84, K1, TB1
Source Terminal	Specific terminal on originating device.	Terminal number or terminal designation.	DO1, A1, 13, 14, X1
Destination Device	Device where the conductor terminates.	Approved device tag or terminal block tag.	K1, TB2, 52X, SCADA
Destination Terminal	Specific destination terminal.	Terminal number or designation.	A2, 14, 21, TB2-07
Circuit or Sequence	Unique suffixes are used to avoid duplicate IDs.	Three-digit numeric sequence unless otherwise approved.	001, 002, 003

2. Wire Identification Rules

- The same wire identifier shall appear on both ends of the same conductor.
- Both ends of each wire shall identify the opposite end through the source and destination format.
- Wire markers shall be heat-shrink style and permanently applied.
- Wire marker text orientation shall be selected based on the side of the component where the wire lands so that the marker can be read without inversion.
- Wire identifiers shown on physical wires shall match the schematic, connection diagram, terminal strip drawing, and cable schedule.
- Field wiring and internal wiring shall use the same identification philosophy, unless a project-specific field cable numbering system is approved.
- Spare conductors shall be labeled with cable number, conductor number, and spare designation.
- Shield drain wires shall be identified and terminated according to the approved grounding and shielding practice.

3. Example Wire Identifiers

Circuit Example	Wire Identifier	Meaning	Drawing Cross Reference
Cooling stage output	E3/DO1-KF1/A1-001	E3-7200 output to fan contactor relay coil.	Cooling Control Logic
Alarm contact to terminal strip	63/13-TB3/01-002	Pressure relay alarm contact to terminal block.	Device Drawing and Terminal Strip
Trip contact to terminal strip	86/14-TB4/05-003	Lockout relay contact to customer terminal.	Trip and Alarm Interface
OLTC raise command	84R/13-TB5/10-004	OLTC raise relay contact to terminal strip.	OLTC Control Logic
CT secondary wire	CT1/X1-TBCT1/01-005	CT secondary leads to dedicated CT terminal block.	CT Terminal Strip

Component Identification and Labeling

- All component designations on drawings and physical labels shall comply with ANSI device identification conventions where applicable.
- Each device shall have a unique tag that appears consistently on all drawings, BOMs, component lists, labels, and test records.
- Engraved phenolic or equivalent durable labels shall be provided for devices, terminal strips, circuit breakers, relays, switches, monitors, and major subassemblies.
- Labels shall use standardized naming, font, size, color, and placement throughout the cabinet.
- Labels shall remain visible after wiring and wire duct covers are installed.
- Temporary or handwritten labels shall not be acceptable for final delivery.

Terminal Blocks and Field Wiring Interfaces

- Terminal strips shall be grouped by function, including AC power, DC control, alarms, trips, SCADA status, analog signals, communications, CT circuits, VT circuits, and spares.
- Terminal strip numbering shall be standardized and shown consistently on schematics, terminal strip drawings, and field wiring drawings.
- A minimum of 20 percent spare terminals shall be provided in each major terminal group unless otherwise approved by the Utility.
- CT circuits shall use Marathon 1506SC ring tongue style terminal blocks or approved Utility equivalent.
- CT circuits shall be physically segregated from general control wiring and shall be clearly identified.
- Terminal strip drawings shall show internal side wiring, field side wiring, jumpers, shields, spare terminals, and destination references.
- Each spare terminal shall be labeled and included in the spare terminal identification section of the drawing package.

Spare Capacity and Future Expansion

Requirement Area	Requirement	Verification Method
Panel Space	Provide minimum 20 percent usable spare panel space in each cabinet zone where practical.	Drawing review and visual inspection
DIN Rail	Provide minimum 20 percent spare DIN rail space for future approved devices.	Drawing review and visual inspection
Wire Duct	Provide wiring duct capacity that initial fill does not exceed 50 percent.	Visual inspection
I/O Capacity	Provide minimum 20 percent spare monitor or control I/O where practical and supported by the supplied equipment.	BOM review and I/O list review
Terminal Capacity	Provide minimum 20 percent spare	Terminal strip review

	terminals for each terminal group.	
Drawing Space	Drawing packages shall show reserved space, unused I/O, spare terminals, and spare conductors.	Drawing review

Alarm, Trip, and Status Philosophy

- Alarm, trip, and status circuits shall be clearly separated on drawings and terminal strips.
- Each alarm point shall identify source device, contact type, normal state, terminal destination, and whether the signal is monitored by the transformer monitor, SCADA, or both.
- Trip circuits shall be clearly identified and segregated from general alarm circuits.
- Where both alarm and trip contacts are available, the intended use of each contact shall be shown on the device drawing and terminal strip drawing.
- Alarm naming shall be standardized so the same condition uses the same description across all transformer cabinets.
- The alarm list shall be included in the drawing package or supplied as an approved supplemental document.
- The same alarm philosophy shall be applied regardless of transformer manufacturer.

Factory Acceptance Test Requirements

The OEM or cabinet supplier shall perform a documented Factory Acceptance Test prior to shipment. The FAT shall verify compliance with the approved drawings, this standard, and project-specific requirements. All exceptions, deviations, failed tests, and open punch list items shall be documented and resolved or formally accepted by the Utility prior to shipment.

1. FAT Checklist

No.	Inspection or Test Item	Acceptance Criteria	Result	Comments / Initials
1	Drawing package review	Latest approved drawing revision is available at FAT.	Pass / Fail / N/A	
2	Cabinet nameplate and project identification	Cabinet identification matches project documents and transformer identification.	Pass / Fail / N/A	
3	Physical zoning verification	Left swing frame, right swing frame, back panel, CT terminal, and breaker zones match this standard.	Pass / Fail / N/A	
4	Touch-safe swing frame verification	Swing frames provide barrier against accidental contact with energized components during normal access.	Pass / Fail / N/A	
5	E3-7200 monitor location	Dynamic Ratings E3-7200 is mounted on right swing frame in approved location.	Pass / Fail / N/A	
6	Voltage control and paralleling location	Voltage control and paralleling equipment is mounted on left swing frame or zone is reserved.	Pass / Fail / N/A	
7	Cooling equipment	Cooling contactors and cooling	Pass / Fail /	

	location	controls are mounted on the back panel.	N/A	
8	Control breaker location	General control breakers are mounted on DIN rail on back of right swing frame.	Pass / Fail / N/A	
9	CT terminal block verification	CT terminations use Marathon 1506SC ring tongue style terminal blocks or approved equivalent.	Pass / Fail / N/A	
10	Grounding and bonding	Cabinet, doors, swing frames, and panels are bonded to ground system.	Pass / Fail / N/A	
11	Wire routing inspection	Wiring is neatly routed in wire duct with removable covers and does not obstruct access.	Pass / Fail / N/A	
12	Wire duct fill inspection	Initial wire duct fill does not exceed 50 percent.	Pass / Fail / N/A	
13	Wire marker inspection	All wires are marked at both ends with approved heat shrink markers.	Pass / Fail / N/A	
14	Wire marker orientation	Wire markers are readable without rotating upside down.	Pass / Fail / N/A	
15	Wire numbering verification	Wire IDs match schematic, terminal drawings, and cable schedule.	Pass / Fail / N/A	
16	Terminal strip verification	Terminal numbers, jumpers, field side, internal side, and spare terminals match drawings.	Pass / Fail / N/A	
17	Spare capacity verification	20 percent spare terminal, DIN rail, panel space, and I/O requirements are met where applicable.	Pass / Fail / N/A	
18	Point to point wiring check	Continuity verified for each internal wire and field interface point.	Pass / Fail / N/A	
19	Insulation and separation review	Power, control, CT, VT, communications, and low level circuits are separated where practical.	Pass / Fail / N/A	
20	Control power verification	Main supply and control power circuits operate as shown on drawings.	Pass / Fail / N/A	
21	Cooling logic functional test	Cooling stage operation, permissive, alarms, and status points operate as specified.	Pass / Fail / N/A	
22	OLTC logic test, if applicable	Raise, lower, local, remote, manual, automatic, and blocking functions operate as specified.	Pass / Fail / N/A	
23	Paralleling logic test, if applicable	Paralleling permissive, mode selection, blocking, and status points operate as specified.	Pass / Fail / N/A	
24	Transformer monitor I/O test	E3-7200 inputs, outputs, communications, DGA	Pass / Fail / N/A	

		interface, sensors, and alarms operate as specified.		
25	DGA monitor integration test	Vaisala OPT100 or approved equivalent DGA monitor communicates with the E3-7200; gas values, alarms, and moisture readings are displayed and logged correctly.	Pass / Fail / N/A	
26	Alarm and trip output test	Alarm, trip, and status outputs operate and terminate as shown on drawings.	Pass / Fail / N/A	
27	Heater, lighting, and receptacle test	Cabinet heater, thermostat, light, and receptacle operate as specified.	Pass / Fail / N/A	
28	Label verification	Device labels, terminal labels, warning labels, and cabinet labels are installed and match drawings.	Pass / Fail / N/A	
29	Document holder and cabinet layout drawing	Laminated layout drawing and document storage provisions are installed where required.	Pass / Fail / N/A	
30	QR code verification	QR code is installed and links to approved documentation location where required.	Pass / Fail / N/A	
31	Punch list review	All deficiencies are documented, assigned, and resolved or accepted before shipment.	Pass / Fail / N/A	

Required Deliverables

- Approved drawing package in native CAD format.
- Approved drawing package in searchable PDF format.
- As-built drawing package after FAT and after resolution of punch list items.
- Bill of materials with manufacturer and model number for each major component.
- Component list with device tag, description, location, manufacturer, model number, and drawing reference.
- Terminal strip drawings and cable schedule.
- Wire color schedule and wire numbering convention documentation.
- Alarm list and I/O list.
- FAT checklist and signed FAT report.
- Final punch list and closeout record.
- Spare parts list.
- Operation and maintenance manuals for major devices.
- Cabinet layout drawing is suitable for mounting inside the cabinet door.

- QR code or approved digital access method linking to the latest approved documentation package, if required by the Utility.

Deviations and Exceptions

- Any deviation from this standard shall be submitted in writing to the Utility for review and approval prior to fabrication.
- Deviation requests shall identify the affected section, proposed alternate approach, reason for deviation, and impact on safety, maintenance, spare parts, drawings, and future standardization.
- Approval of a deviation on one transformer shall not establish approval for future transformers.
- Unapproved deviations discovered during FAT shall be recorded as punch list items or nonconformances.

Appendices

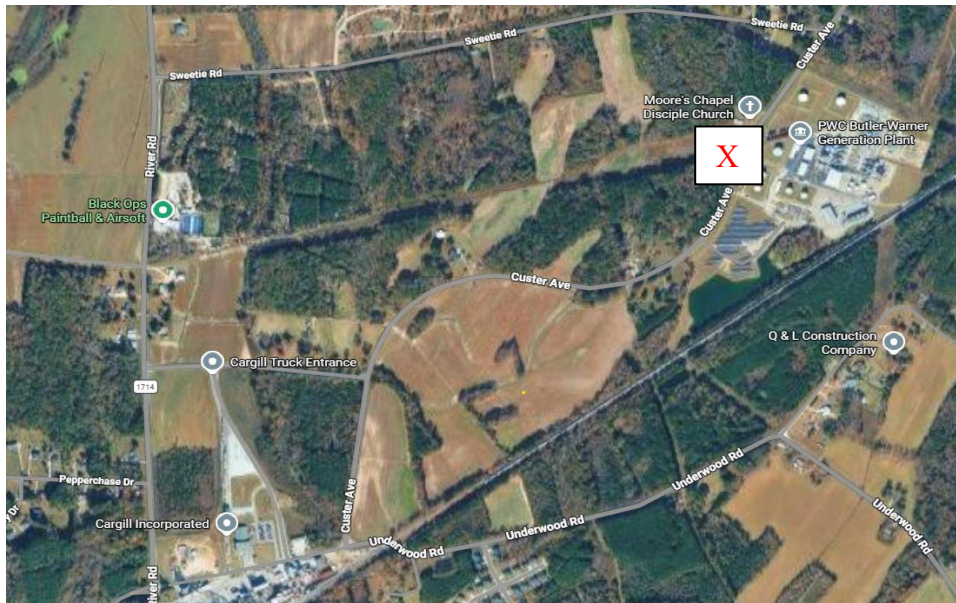
Appendix A: Standard Cabinet Zone Summary

Zone	Location	Primary Equipment	Notes
L1	Left swing frame	Voltage control, OLTC controls, paralleling controls	Reserved if not applicable.
R1	Right swing frame	Dynamic Ratings E3-7200 transformer monitor	Standard operator interface location. Where DGA integration is supplied, the Vaisala OPT100 or approved equivalent DGA monitor shall be mounted by manufacturer instructions and communicate to the E3-7200 via Ethernet.
R2	Back of right swing frame	General control circuit breakers on DIN rail	Accessible only when swing frame is opened.
B1	Back panel	Cooling controls, contactors, auxiliary relays	Visible after swing frames are opened.
B2	Back panel	CT terminations using Marathon 1506SC terminal blocks	Dedicated CT termination zone.
BTM	Bottom zone	Field cable entry, grounding, wire routing	Shall not obstruct maintenance access.

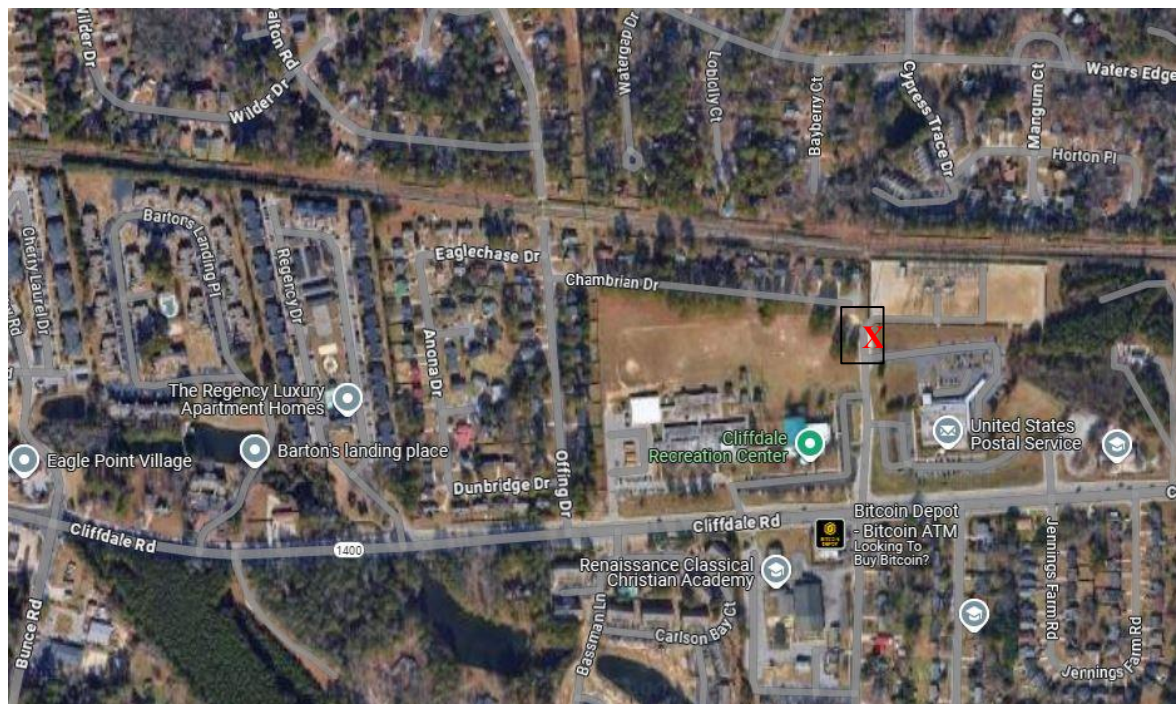
Appendix B: FAT Signoff Sheet

Role	Name	Signature	Date
OEM Test Lead			
Utility Engineering Representative			
Utility Operations Representative			
Quality Representative			
Project Manager			

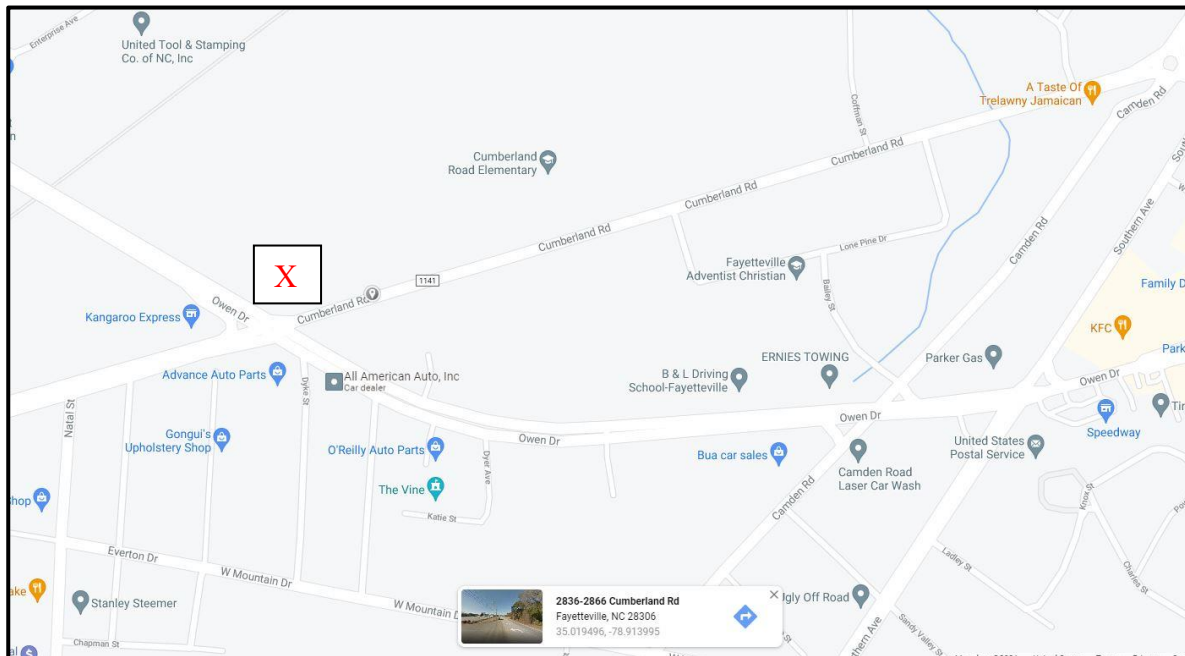
Appendix C: Area Map for Point of Delivery #2 at 2274 Custer Avenue, Fayetteville, NC 28312



Appendix D: POD3 Waters Edge at 6400 Cliffdale Road, Fayetteville, NC 28314



Appendix E: Area Map for Point of Delivery #1 at 2842 Cumberland Road, Fayetteville, NC

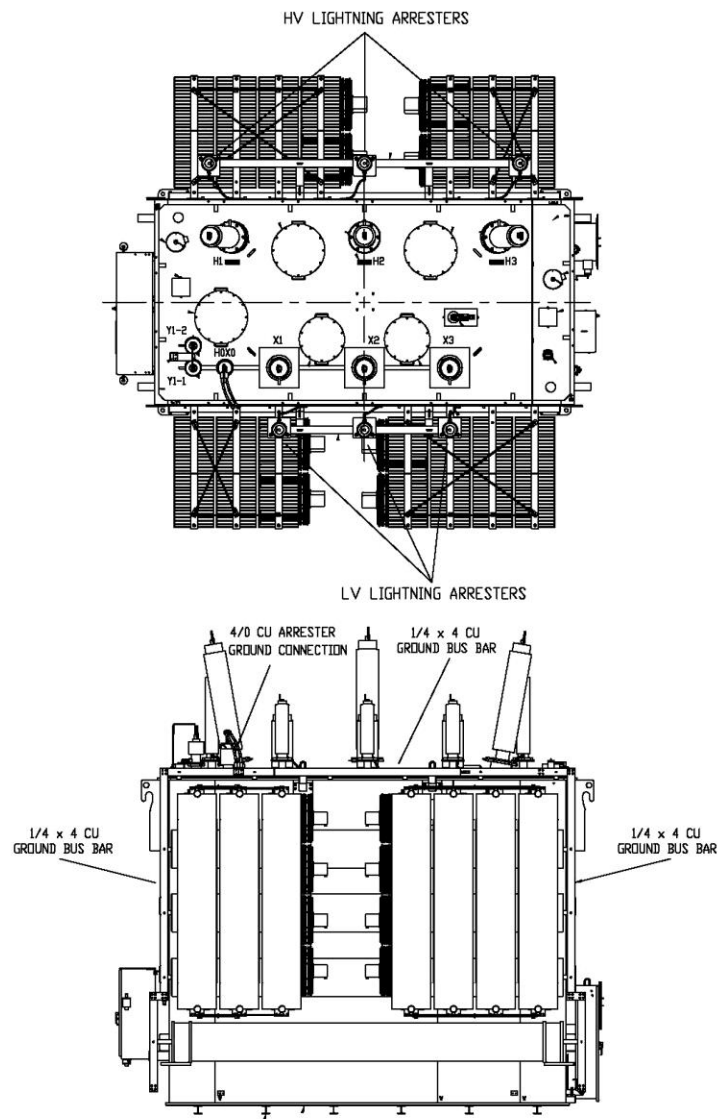


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Appendix F: POD5 at 217 Southland Drive, Fayetteville, NC 28311

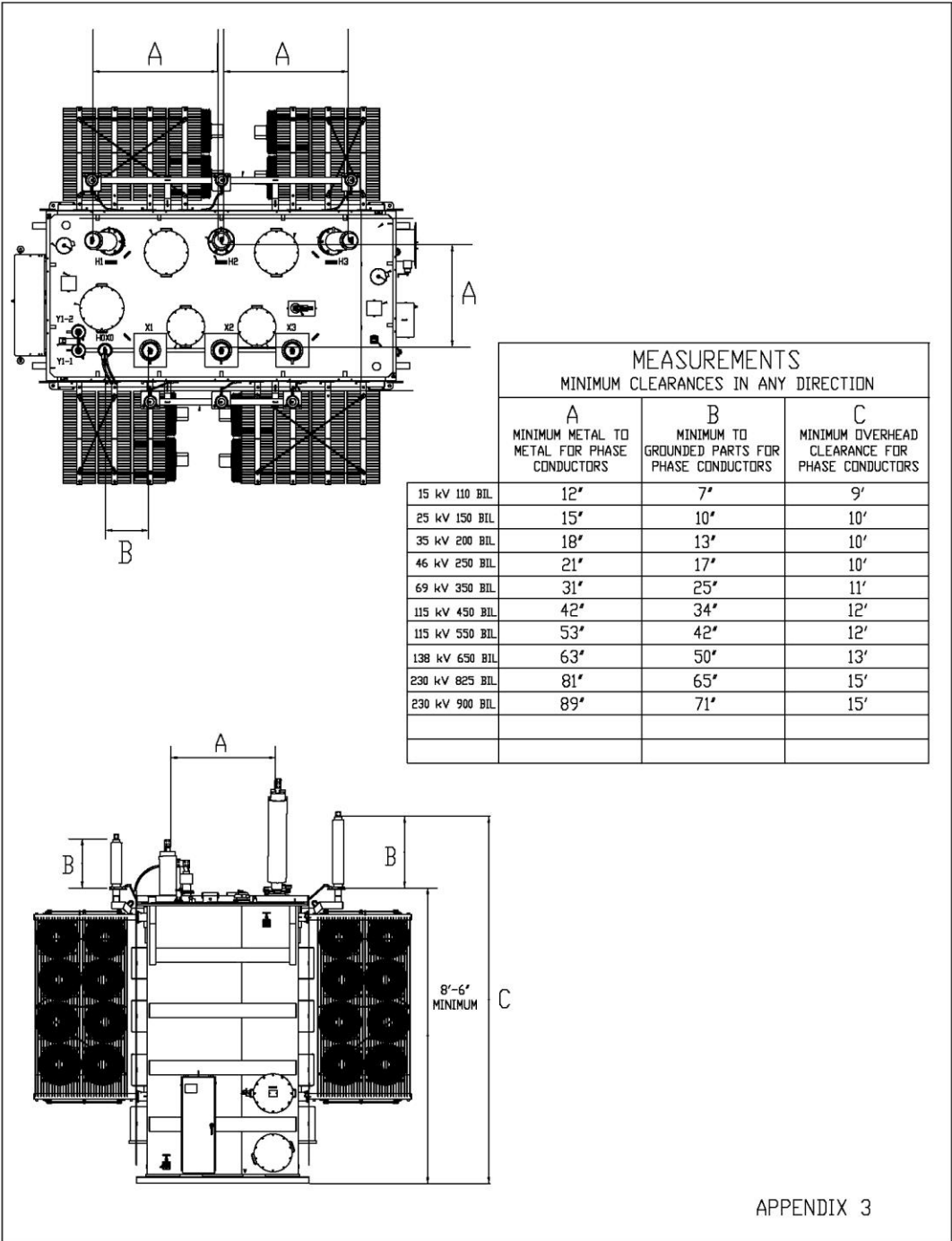


Appendix G

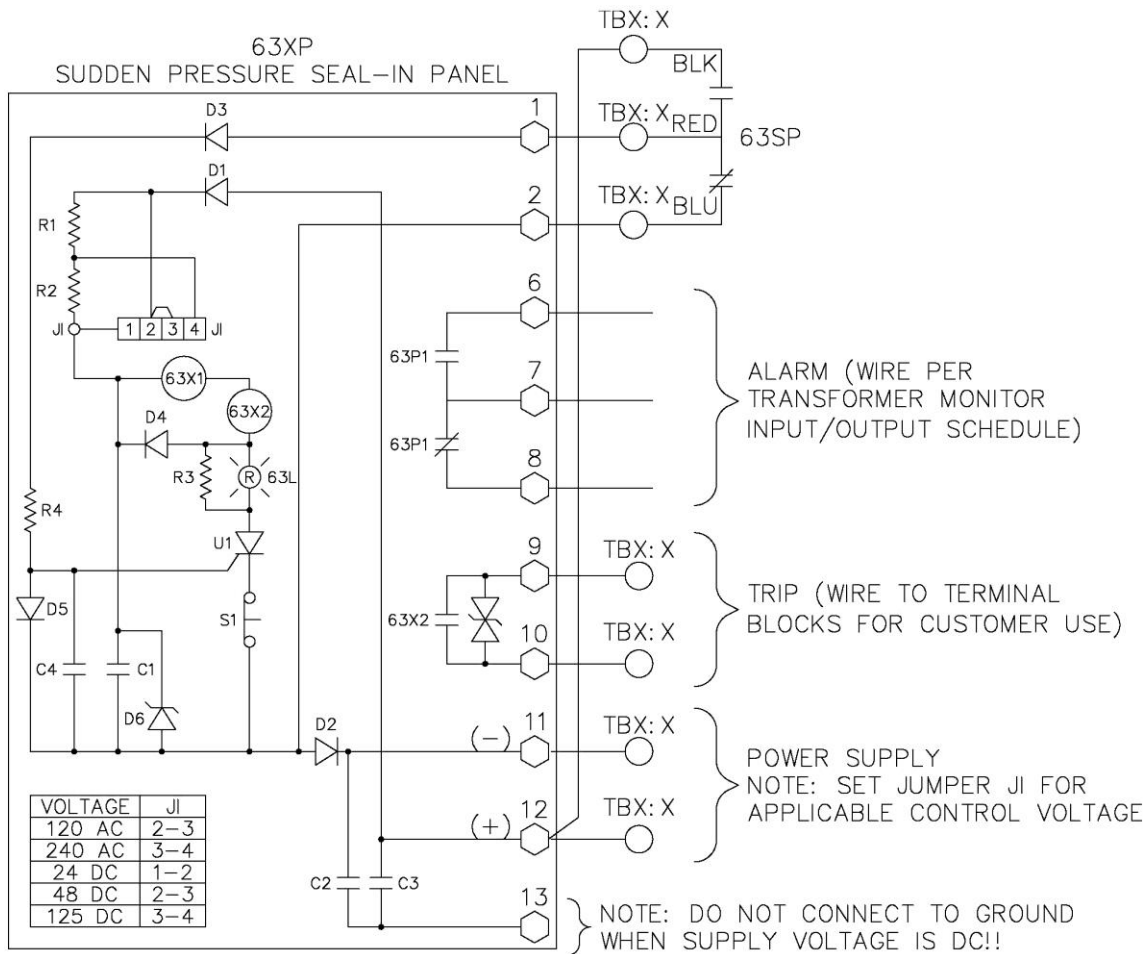


APPENDIX 2

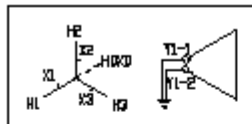
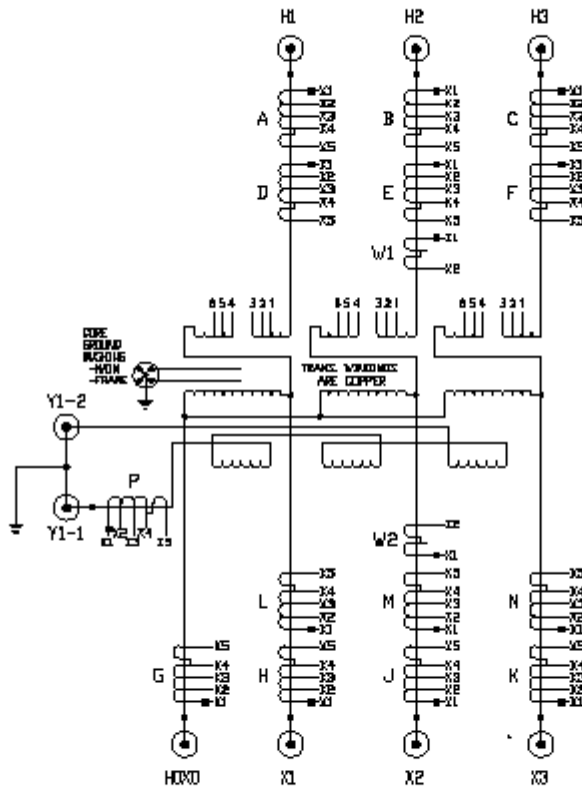
Appendix H



Appendix I: 63XP Sudden Pressure Seal-in Circuit



Appendix J



CURRENT RATIO	CURRENT RATIO	CURRENT RATIO	SEC. TAP
50:5	100:5	800:5	X2-X3
100:5	200:5	400:5	X1-X2
150:5	300:5	1200:5	X1-X3
200:5	400:5	500:5	X4-X5
250:5	500:5	300:5	X3-X4
300:5	600:5	1100:5	X2-X4
400:5	800:5	1500:5	X1-X4
450:5	900:5	800:5	X3-X5
500:5	1000:5	1600:5	X2-X5
600:5	1200:5	2000:5	X1-X5

APPENDIX 1

ATTACHMENT B: BID PRICING FORM

Bid Pricing Instructions:

Bidders shall provide a firm unit price for each transformer identified below. Each unit price shall include the complete transformer and all equipment, materials, accessories, engineering, drawings, factory testing, field testing, warranties, delivery, unloading, crane and rigging services, placement on the designated foundation or cribbing, field assembly, oil processing and filling, commissioning support, manufacturer field-service personnel, and all other requirements of the Technical Specifications.

Prices shall be F.O.B. Destination and shall include freight, handling, duties, tariffs, and all other costs necessary to furnish and deliver each complete and fully operable transformer. Applicable North Carolina sales and use tax shall not be included in the unit prices or Total Base Bid and shall be stated separately for informational purposes.

The bidder's submitted unit price for each transformer shall govern. Pricing for required equipment, materials, services, testing, warranties, or support shall not be separated from the applicable transformer unit price unless specifically requested as informational pricing on this form.

Pricing shall remain firm for the bid validity period established under **QUANTITIES AND PRICING** and shall not be conditioned upon shipment date, import date, regulatory change, exchange rate fluctuation, or any other post-bid variable.

Bidder Information:

Company Name: _____

Company Address: _____

City/State/Zip: _____

Primary Contact Phone Number: _____ Email Address: _____

Manufacturer Information:

Manufacturer: _____

Type / Model: _____

Manufacturing Facility Location: _____

Nearest Repair Facility Location: _____

Manufacturer Experience:

Percent Failure of Last 100 Power Transformers at Factory Testing: _____ %

Percent Failure of Last 100 Power Transformers After Installation in Field: _____ %

Company Name: _____

Business Classification:

PWC SLS: ☐ Yes ☐ No NCDOA SBE: ☐ Yes ☐ No

PWC SDBE: ☐ Yes ☐ No NCDOT DBE: ☐ Yes ☐ No SBA Certified: ☐ Yes ☐ No

Certification:

Printed Name: _____ Title: _____

Authorized Signature: _____ Date: _____

Furnish And Deliver:

SCHEDULE	ITEM DESCRIPTION	UNIT PRICE
1	One complete 230/66 kV Autotransformer, 201.6/268.8/336 MVA at 65 C, for Point of Delivery #5 - Southland Drive. Preferred shipment: February 2031 or sooner.	\$
2	One complete 230/66 kV Autotransformer, 201.6/268.8/336 MVA at 65 C, for Point of Delivery #3 - Cliffdale Road. Preferred shipment: March 2031 or sooner.	\$
3	One complete 230/66 kV Autotransformer, 201.6/268.8/336 MVA at 65 C, for Point of Delivery #1 - Cumberland Road. Preferred shipment: March 2031 or sooner.	\$
4	One complete 230/66 kV Autotransformer, 201.6/268.8/336 MVA at 65 C, for Point of Delivery #2 - Custer Avenue. Preferred shipment: April 2031 or sooner.	\$

TOTAL BASE BID ITEMS 1-4 (Excluding Sales and Use Tax) \$ _____

Applicable NC Sales and Use Tax (Informational Only) \$ _____

Applicable Tax Rate _____ %

PWC2627022

FOUR 230/66KV AUTOTRANSFORMER 201.6/268.8/336 MVA AT 65C

Company Name: _____

Milestone Payment Allocation:

The following milestone payment percentages shall apply to the unit price of each transformer. The milestone percentages are payment allocations only and shall not be added to the unit prices or Total Base Bid.

PAYMENT MILESTONE	%
Approval of submitted drawings	15%
Receipt of copper and core steel at factory	30%
Shipment of transformer to PWC	30%
Delivery to site, placement, dressing, assembly, and testing	20%
Retainage, payable up to 60 days after delivery	5%
TOTAL PAYMENT ALLOCATION	100%

Guaranteed Loss and Evaluation Data:

The guaranteed values below shall apply to all four transformers and will be used by PWC in the Equivalent First Cost of Ownership evaluation. These values are not additional prices.

Maximum guaranteed no-load kW losses, 100% voltage, 75°C, 180 MVA	kW	kW
Maximum guaranteed load kW losses, not total losses, at 180 MVA	kW	kW
Maximum guaranteed total kW losses, at 180 MVA, 75°C	kW	kW
Auxiliary kW losses, first-stage cooling	kW	kW
Auxiliary kW losses, second-stage cooling	kW	kW
Impedance		%

1. All transformers in all bid schedules shall conform to these losses.
2. These levels will be considered in evaluating the bids.
3. No-load and total losses are to be guaranteed per ANSI or IEEE standards.

PWC Evaluation Formula: Evaluated Cost of Ownership per Transformer = (Unit Price) + (Factor A × No-Load Losses) + (Factor B × Winding Losses) + (Factor C × Auxiliary Losses)*

*Any escalation included in the evaluated Unit Cost shall be determined in accordance with the price-adjustment provisions of the IFB and the bidder's accepted adjustment methodology.

PWC will calculate the evaluated Cost of Ownership in accordance with the Technical Specifications. The resulting amount is for bid evaluation purposes only and will not replace the Total Base Bid or become the Agreement amount.

Company Name: _____

Delivery Commitment:

ITEM	DELIVERY LOCATION	APPROVAL DRAWINGS, WEEKS ARO	FINAL DRAWINGS, WEEKS ARO	DELIVERY, WEEKS ARO
1	POD #5 – Southland Drive			
2	POD #3 – Cliffdale Road			
3	POD #1 – Cumberland Road			
4	POD #2 – Custer Avenue			

ARO: After Receipt of Order (Purchase Order)

Field-Service Rate Information:

This information is provided for contract administration purposes and shall not be considered in bid evaluation.

FIELD-SERVICE INFORMATION	BIDDER RESPONSE
Field Service Engineer days included per transformer	days
Daily rate for PWC-authorized additional days	\$ /day
Daily credit for included but unused days	\$ /day

Included field-service days and related travel and living expenses shall be included in each line-item price. Additional-day pricing shall apply only when authorized in writing by PWC and shall not be included in the Total Base Bid.

Tariff Disclosure Section:

- Are any tariffs included in the Bid Price?
☐Yes ☐No
- If yes, complete the table below for each tariff-impacted line item or component included in this bid:

LINE ITEM / COMPONENT	COUNTRY OF ORIGIN	BASE COST INCLUDED IN BID	TARIFF % APPLIED	TARIFF COST INCLUDED

Company Name: _____

3. Percentage of total bid price attributable to tariffs: _____ %

4. Total tariff cost included in this bid: \$ _____

Addendum Acknowledgment Section:

The Bidder has received, acknowledged, and used the following addenda in completing the Bid.
(Initial and Date as appropriate).

Addendum No. 1	Date _____
Addendum No. 2	Date _____
Addendum No. 3	Date _____
Addendum No. 4	Date _____
Addendum No. 5	Date _____
Addendum No. 6	Date _____
Addendum No. 7	Date _____

**ATTACHMENT C: CERTIFICATION OF PRIMARY PARTICIPANT REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS**

The Primary Participant, _____ (major third-party contractor), certifies to the best of its knowledge and belief, that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
2. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (2) of this certification; and
4. Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

(If the primary participant is unable to certify to any of the statements in this certification, the participant shall attach an explanation to this certification.)

THE PRIMARY PARTICIPANT _____ CERTIFIES
OR AFFIRMS THE TRUTHFULNESS AND ACCURACY OF THE CONTENTS OF THE
STATEMENTS SUBMITTED ON OR WITH THIS CERTIFICATION AND UNDERSTANDS THAT
THE PROVISIONS OF 31 U.S.C. SECTIONS 3801 ET. SEQ. ARE APPLICABLE THERETO.

Signature

Title

Printed Name

Date

SALE OF GOODS AGREEMENT

This Sale of Goods Agreement ("Agreement") is made by and between the City of Fayetteville (the "City"), by and through the Fayetteville Public Works Commission ("PWC"), a North Carolina public authority, and [insert seller's full legal name] ("Seller"), a [identify the legal entity and State in which formation was accomplished] (each of PWC and Seller is a "Party" and both are collectively the "Parties") as of the date of execution last written below (the "Effective Date"). In consideration of the mutual covenants and agreements contained herein, and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, The Parties agree as follows:

1. Sale of Goods. Seller shall sell to PWC and PWC shall purchase from Seller the following [Identify the goods specifically] (the "Goods"). PWC may issue a purchase order for the Goods that specifies any additional applicable terms and conditions set forth for the purchase (a "Purchase Order"), but such Purchase Order is subject to the terms of this Agreement. In the event of a conflict between the provisions of this Agreement and the provisions of any Contract Documents, attachment, exhibit or Purchase Order made pursuant to this Agreement, the terms of this Agreement shall govern.

2. Contract Documents. "Contract Documents" means, collectively, the following documents that were either made available to Seller by PWC during the bid solicitation process (including Drawings) or executed by the Parties, or both, which are all incorporated by reference herein:

- a. This Agreement
- b. Notice to Prospective Bidders
- c. Definitions
- d. Instructions to Bidders
- e. General Conditions
- f. Materialman's Proposal
- g. Bid Bond
- h. Technical Specifications
- i. Purchase Order(s)
- j. Addenda

3. Delivery of Goods. Seller shall deliver the Goods [EITHER: "on or before _____" OR "as specified in the Contract Documents or an applicable Purchase Order issued by PWC" OR "as otherwise agreed in writing by the Parties"] (the "Delivery Date"). Timely delivery of the Goods is of the essence. If Seller fails to deliver the Goods on or before the Delivery Date, PWC may, without any liability to Seller, terminate this Agreement immediately by providing written notice to Seller. Unless otherwise specified in an applicable Purchase Order or the Contract Documents, excluding this Agreement, all Goods shall be delivered to PWC's Warehouse at 955 Old Wilmington Road, Fayetteville, North Carolina 28301 (the "Delivery Point") during PWC's normal business hours. Delivery shall be made FOB Delivery Point.

4. Title and Risk of Loss. Title of the Goods passes to PWC upon delivery of the Goods to the Delivery Point. Seller bears all risk of loss or damage to the Goods until delivery of the Goods to the Delivery Point.

5. Packaging. Seller shall properly pack, mark, and ship the Goods as instructed by PWC and otherwise in accordance with applicable law and industry standards and shall provide PWC with all shipment documentation showing the quantity of pieces in shipment, the number of cartons or containers in shipment, Seller's name, the airway bill or bill of lading number, and the state of origin.

6. Inspection and Rejection of Nonconforming Goods. PWC has the right to inspect the Goods on or after the Delivery Date. PWC, at its sole option, may inspect all or a sample of the Goods, and may reject all or any portion of the Goods if it determines the Goods are nonconforming or defective. If PWC rejects any portion of the Goods, PWC has the right, effective upon written notice to Seller, to: (a) terminate this Agreement in its entirety and require Seller to remove the Goods in a commercially reasonable time period or pay the full cost and expense to have the rejected Goods returned to Seller; or (b) reject the Goods and require replacement of the rejected Goods at Seller's sole expense. If PWC requires replacement of the Goods, Seller shall, at its sole expense and in the lesser of ninety (90) days or the number of days between any applicable Purchase Order of PWC and the Delivery Date, replace the nonconforming Goods and pay for all related expenses, including, but not limited to, transportation charges for the return of the defective goods and the delivery of replacement Goods. Any inspection or other action by PWC under this Section shall not reduce or otherwise affect Seller's obligations under this Agreement, including Seller's warranties, and PWC shall have the right to conduct further inspections after Seller has carried out its remedial actions.

7. Price. PWC shall purchase the Goods from Seller in the total amount of \$_____ ("Price"). The Price includes all packaging, transportation costs to the Delivery Location, insurance, fees, and applicable taxes, including, but not limited to, all sales, use, or excise taxes. No increase in the Price is effective, whether due to increased material, labor, transportation costs or otherwise, without the prior written consent of PWC.

8. Billing and Payment. Seller shall invoice PWC within thirty (30) days after the completion of the delivery of the Goods. PWC shall pay the undisputed portion of the invoice within forty-five (45) calendar days after PWC's receipt of the invoice. All payments from PWC to Seller shall be transferred electronically to Seller's designated financial institution, and Seller shall, prior to delivery of its invoice to PWC, supply the name of Seller's financial institution, routing number, and account number on the form available from PWC and provide to PWC a completed and signed IRS Form W-9. Seller has the right to impose a late payment charge of one percent (1%) per month for amounts unpaid by PWC by the date due.

Seller shall comply with all of the following requirements so that PWC may recover the full amount of sales and use tax under North Carolina law permitted under the law:

- a. Furnish PWC documentary evidence showing the material used, sales tax paid, and County paid (County of sale). The documentary evidence shall include Seller's certified statement showing total purchases of materials from each separate vendor and total sales taxes charged to PWC and paid by Seller. The documentary evidence shall also include Seller's certified statement as to the amount paid by PWC for sales tax on the Goods. A certified form is required even if no sales tax was paid for the pay request period. Materials used from Seller's warehouse stock shall be shown in a certified statement at warehouse stock prices and amount of County of Use Tax charged to PWC and paid by Seller;

- b. Seller shall furnish to PWC invoices or copies of invoices for all materials purchased for said work within pay request period, and such invoices shall state the amount of North Carolina Sales Tax, if any, paid for the Goods. Seller shall also furnish to PWC invoices identifying the amount paid for the sales and use tax on Services that are subject to such taxation under North Carolina law; and
- c. Seller shall not include any tax paid on supplies, tools, and equipment that Seller uses to perform its obligations under this Agreement.

9. Warranties. Seller warrants to PWC that for a period of twenty-four (24) months from the Delivery Date, all Goods will: (a) be free from any defects in workmanship, material and design; (b) conform to applicable specifications, drawings, designs, samples and other requirements set forth in the Contract Documents or as specified by PWC and agreed to by Seller; (c) be fit for their intended purpose and operate as intended; (d) be free and clear of all liens, security interests, or other encumbrances; and (e) not infringe or misappropriate any third party's patent or other intellectual property rights. These warranties survive any delivery, inspection, acceptance or payment of or for the Goods by PWC. These warranties are cumulative and in addition to any other warranty provided by law or equity. Any applicable statute of limitations runs from the date of PWC's discovery of the noncompliance of the Goods with the foregoing warranties. If PWC gives Seller notice of noncompliance with this Section 9, Seller shall, at its own cost and expense, within thirty (30) days replace or repair the defective or nonconforming Goods and pay for all related expenses, including, but not limited to, transportation charges for the return of the defective or nonconforming goods to Seller and the delivery of repaired or replacement Goods to PWC.

10. Termination. Notwithstanding any other or additional remedies that may be provided under this Agreement, PWC may terminate this Agreement with immediate effect upon written notice to the Seller, either before or after the acceptance of the Goods, if: (a) Seller repudiates, or threatens to repudiate, any of its obligations under this Agreement; (b) Seller is in breach of, or threatens to breach, any representation, warranty, or covenant of Seller under this Agreement and either the breach cannot be cured or, if the breach can be cured, it is not cured by Seller within a commercially reasonable period of time under the circumstances, in no case exceeding seven (7) days following Seller's receipt of Notice of such breach; (c) Seller fails to, or threatens to fail to, timely deliver Goods conforming to the requirements of, and otherwise in accordance with, the terms and conditions of this Agreement; or (d) Seller becomes insolvent, files a petition for bankruptcy, or commences or has commenced against it proceedings relating to bankruptcy, receivership, reorganization, or assignment for the benefit of creditors. PWC shall be obligated to pay Seller only for work performed and reasonable expenses incurred until delivery of the notice of termination.

11. Insurance. During the term of this Agreement and for a period of three (3) years after the date of this Agreement, Seller shall, at its own expense, maintain and carry insurance in full force and effect that includes, but is not limited to, commercial general liability (including product liability) with limits no less than \$1,000,000 for each occurrence and \$3,000,000 in the aggregate and umbrella liability in a sum no less than \$5,000,000, which insurance shall be placed with insurance companies authorized to do business in the State of North Carolina and rated A minus VII or better by the current edition of Best's Key Rating Guide or otherwise approved in writing by PWC. Prior to delivering any Goods, Seller shall deliver to PWC certificates of insurance confirming each such coverage, and Seller shall direct its insurers to provide annually to PWC certificates confirming each such coverage during the coverage period. PWC shall be named as an additional insured in the insurance policy. Seller shall not

reduce or allow the required insurance coverages to lapse without PWC's prior written approval. All policies for insurance must be endorsed to contain a provision giving PWC a thirty (30) calendar day prior written notice by certified mail of any cancellation of that policy or material reduction in coverage. Should a notice of cancellation be issued for non-payment of premiums or any part thereof, or should Seller fail to provide and maintain certificates as set forth herein, PWC shall have the right, but not the obligation, to pay such premium to the insurance company or to obtain such coverage and to deduct such payment from any sums that may be due or become due to Seller, or to seek reimbursement for said payments from Seller. Any such sums paid by PWC shall be due and payable immediately by Seller upon notice from PWC. The insurance provisions of this Agreement shall not be construed as a limitation on Seller's responsibilities and liabilities pursuant to the terms and conditions of this Agreement.

12. Indemnification. Seller shall indemnify, defend, and hold harmless PWC and its Commissioners, officers, employees, agents, and representatives (collectively, "Indemnitees") from and against all claims, actions, liabilities, damages, losses, costs, and expenses (including, without limitation, injury to or death of any persons and damage to property, economic and consequential damages and attorneys' fees) asserted by one or more third parties against one or more of the Indemnitees arising out of negligent or willful acts, violations of law, infringement of any patent, trademark, trade secret, copyright, or other intellectual property right of a third party, or omissions or breach of the obligations set forth in this Agreement by Seller or any of its employees, agents, representatives, and subcontractors. Seller's obligation to indemnify, defend, and hold harmless the Indemnitees shall survive the termination of this Agreement and shall include the duty to pay for the reasonable attorney's fees and costs associated with defending the Indemnitee(s) by the legal counsel of each Indemnitee's choice.

13. Notices. Any notice which either Party is required or desires to give the other shall be deemed sufficiently given if, in writing, it is delivered personally, or sent by certified U.S. mail, return-receipt requested, postage prepaid, to the addresses listed hereinbelow, or such other address as either Party shall give to the other Party by written notice in accordance herewith. Any notice given herein by personal delivery shall be deemed delivered when received. Any properly addressed notice given herein by certified mail shall be deemed delivered on the third Business Day after the same is deposited in an official United States Post Office, postage prepaid, or if sooner upon the date when the return receipt therefor is signed, or refusal to accept the mailing by the addressee is noted thereon by the postal authorities.

To PWC:

Fayetteville Public Works Commission
Attn: Timothy Bryant, CEO/General Manager
PO Box 1089
Fayetteville, NC 28302

To Seller:

[INSERT MAILING ADDRESS]

14. Compliance. Seller hereby acknowledges that "E-Verify" is the federal E-Verify program operated by the US Department of Homeland Security and other federal agencies which is used to verify the work authorization of newly hired employees pursuant to federal law and in accordance with Article 2, Chapter 64 of the North Carolina General Statutes. Seller further acknowledges that all employers, as defined by Article 2, Chapter 64 of the North Carolina General Statutes, must use E-Verify and after hiring an employee to work in the United

States, shall verify the work authorization of the employee through E-Verify in accordance with NCGS §64-26(a). Seller hereby pledges, attests, and warrants through execution of this Agreement that Seller complies with the requirements of Article 2, Chapter 64 of the North Carolina General Statutes and further pledges, attests, and warrants that all subcontractors currently employed by or subsequently hired by Seller to provide services for PWC shall comply with all E-Verify requirements. Failure to comply with the above requirements shall be considered a breach of this Agreement. Seller hereby further acknowledges that the execution and delivery of this Agreement constitutes Seller's certification to PWC and to the North Carolina State Treasurer that, as of the Effective Date, Seller is not listed on (a) the Final Divestment List created and maintained by the North Carolina Department of State Treasurer pursuant to the Iran Divestment Act of 2015, Chapter 147, Article 6E of the General Statutes of North Carolina (the "Iran Divestment Act"); or (b) the list of companies that the North Carolina State Treasurer determines to be engaged in a boycott of Israel in accordance with Article 6G of Chapter 147 of the General Statutes of North Carolina. Seller represents and warrants to Commission that Seller, and all persons and entities owning (directly or indirectly) an ownership interest in it: (i) are not, and will not become, a person or entity with whom a party is restricted from doing business with under regulations of the Office of Foreign Asset Control ("OFAC") of the Department of the Treasury (including, but not limited to, those named on OFAC's Specially Designated and Blocked Persons list) or under any statute, executive order (including, but not limited to, the September 24, 2001, Executive Order 13224 Blocking Property and Prohibiting Transactions with Persons Who Commit, Threaten to Commit, or Support Terrorism), or other governmental action; and (ii) are not knowingly engaged in, and will not knowingly engage in, any dealings or transactions or be otherwise associated with such persons or entities described in clause (i) above. Seller also shall at all times during the term of this Agreement comply with Executive Order 11246, including but not limited to the Equal Opportunity Clause requirements set forth in 41 C.F.R. § 60-1.4. Seller shall abide by the requirements of 41 CFR 60-300.5(a) and 60-741.5(a) prohibiting discrimination against qualified individuals on the basis of protected veteran status or disability and requiring affirmative action by covered prime contractors and subcontractors to employ and advance in employment qualified protected veterans and individuals with disabilities.

15. Cumulative Remedies. All rights and remedies provided in this Agreement are cumulative and not exclusive, and the exercise by either Party of any right or remedy does not preclude the exercise of any other rights or remedies that may now or subsequently be available at law or in equity.

16. Miscellaneous Provisions. Seller is and shall remain an independent contractor. Nothing contained in this Agreement shall be deemed or construed to create the relationship of principal and agent or of partnership or of joint venture or of any association whatsoever between the Parties. No breach or non-performance of any term of this Agreement shall be deemed to be waived by either Party unless said breach or non-performance is waived in writing and signed by the Parties. No waiver of any breach or non-performance under this Agreement shall be deemed to constitute a waiver of any subsequent breach or non-performance, and for any such breach or non-performance each Party shall be entitled to such remedies as provided by law. No consent or waiver by a Party shall be effective unless it is in writing and then only to the extent specifically stated. The invalidity, illegality, or un-enforceability of any portion or provision of this Agreement shall in no way affect the validity, legality, and/or enforceability of any other portion or provision of this Agreement. Any invalid, illegal, or unenforceable provision of this Agreement shall be deemed severed from this Agreement, and the balance of the Agreement shall be construed and enforced the same as if the Agreement had not contained

any portion or provision which was invalid, illegal, or unenforceable; provided, however, severability shall not prevent this entire Agreement from being void in the event any portion or provision of this Agreement that is of the essence of this Agreement shall be void. This is the entire agreement of the Parties on the subject matter hereof, and all prior negotiations, representations, proposals, letters, agreements, understandings, or other communications between the Parties, whether written or oral, are hereby merged into the Agreement and superseded by this Agreement. This Agreement shall not be modified unless such modifications are evidenced in writing, signed by both Parties. Nothing herein shall be construed to give any right or benefits hereunder to anyone other than the Parties. This Agreement shall be governed by the laws of the State of North Carolina without the application of the laws of any other state. The exclusive venue for all mediations and litigation and any other legal proceedings regarding this Agreement shall be the State and Federal Courts serving Cumberland County, North Carolina, and Seller consents to personal jurisdiction in such courts. Seller irrevocably waives, to the fullest extent permitted by law, any objection that it may now or hereafter have to the laying of the venue of any such suit, action or proceeding in any such court serving Cumberland County or that any such suit, action or proceeding brought in any such court serving Cumberland County has been brought in an inconvenient forum. This Agreement may be executed in counterparts with the same effect as if the signatures to each counterpart were upon a single instrument, and all such counterparts together shall be deemed an original of this Agreement. For purposes of this Agreement, a facsimile copy or scanned copy or photocopy of a party's signature shall be sufficient to bind such party. This Agreement shall be subject to execution by electronic means in accordance with Article 40 of Chapter 66 of the North Carolina General Statutes. The titles of the paragraphs throughout this Agreement are for convenience only and the words contained therein shall in no way be held to explain, modify, amplify, or aid in the interpretation, construction, or meaning of the provisions of this instrument.

17. Assignment. Seller shall not assign, transfer, or convey any part of the Agreement, including rights or obligations, to a third party without obtaining the prior written approval of PWC in its discretion. The prohibition on assignment includes an assignment of payments that may become due under the Agreement. Any unauthorized assignment shall be deemed to be a material breach of this Agreement. An approved assignment shall not relieve Seller of its responsibilities under the terms hereof unless explicitly stated in writing by PWC.

18. Conflicts. Except with PWC's knowledge and prior written consent, Seller shall not engage in any activity or accept any employment, interest or contribution that would reasonably appear to compromise Seller's professional judgment with respect to the Goods. Seller shall disclose to PWC any business or personal relationship with any Commissioner, officer, director, manager, or supervisor of PWC.

IN WITNESS WHEREOF, the Parties have executed this Agreement by their duly authorized representatives as of the Effective Date.

Fayetteville Public Works Commission

[INSERT SELLER'S FULL LEGAL NAME]

By: _____
Timothy Bryant, CEO/General Manager

By: _____
_____, _____
(Printed Name) (Title)

Date: _____

Date: _____

This instrument has been preaudited in the manner required by the Local Government Budget and Fiscal Control Act (N.C. Gen. Stat. § 159-1 et seq.).

By: _____
Rhonda Graham, Chief Financial Officer

Approved as to form:

Legal Dept.

SAMPLE

ATTACHMENT E: FORM OF EXCEPTIONS – SPECIFICATIONS

COMPANY NAME: _____ **MANUFACTURER:** _____

INSTRUCTIONS: Bidders shall identify each proposed exception or deviation from the Material/Technical Specifications by the applicable section, item, or paragraph reference and provide a detailed explanation of the proposed variation. The omission of exceptions shall be interpreted as the bidder's confirmation of full compliance with the Material/Technical Specifications.

SECTION / PARAGRAPH REFERENCE	EXCEPTION/VARIATION

PWC will evaluate any proposed exceptions or variations to the Material/Technical Specifications in determining bid responsiveness and award eligibility. Material exceptions or variations will not be accepted and may result in the bid being deemed nonresponsive.

ATTACHMENT F: FORM OF EXCEPTIONS – SALE OF GOODS AGREEMENT

COMPANY NAME: _____ **MANUFACTURER:** _____

INSTRUCTIONS: Bidders shall identify each proposed exception to the Sale of Goods Agreement by the applicable section or paragraph reference and provide a detailed explanation of the proposed exception or requested revision. The omission of exceptions shall be interpreted as the bidder's confirmation of full compliance with the Sale of Goods Agreement.

SECTION AND PARAGRAPH REFERENCE	EXCEPTION/VARIATION

Proposed exceptions to the Sale of Goods Agreement that materially alter or are inconsistent with the rights, obligations, risk allocation, remedies, indemnification, warranty, insurance, governing law, limitation of liability, delivery, payment, or other material terms of the Agreement may affect bid responsiveness, award eligibility, or contract execution. PWC reserves the right to request clarification of proposed exceptions and, if deemed in PWC's best interest and permitted by applicable law, negotiate their resolution. If the parties are unable to reach agreement on mutually acceptable terms, PWC may reject the bid, rescind an award, or proceed to the next lowest responsive, responsible bidder.

ATTACHMENT G: ECONOMIC IMPACT DISCLOSURE FORM

Company Name: _____
Address & Phone: _____
Name: _____
Pay Application # _____

Please provide the names of any local suppliers or subcontractors anticipated to be used on this project. For purposes of this requirement, "local" refers to firms located within the Fayetteville Metropolitan Statistical Area (MSA), which includes Cumberland, Hoke, and Harnett Counties. Bidders are requested to complete and submit this form with the bid for program reporting purposes. The successful bidder shall provide updated information with applicable subsequent pay applications.

Firm Name	Local	Construction Trade or Supplies	Payment Amount
<i>Ex. ABC Company</i>	<i>Local – MSA</i>	<i>Hauling</i>	<i>\$25,000.00</i>

Signature

_____, _____
Printed Name Title

Date

Company Name: _____

ATTACHMENT H: BID SUBMITTAL CHECKLIST

Bidders should use this checklist to verify that all required bid documents and supporting information are included. The requirements below identify which submissions are mandatory for bid responsiveness, necessary for technical evaluation, conditional upon proposed exceptions, or requested for informational and reporting purposes.

Item	Bid Submission Requirement	Requirement / Evaluation Treatment
1	Properly Marked Sealed Bid	Required. Submit the bid by the specified deadline in accordance with the Submission Instructions. Late bids will not be considered.
2	Attachment A: Technical Specifications and Supporting Documentation	Required for technical evaluation. Manufacturer technical datasheets and supporting documentation sufficient to demonstrate compliance. Documentation of transformer service history and short-circuit testing experience. Factory Test Certifications Failure to provide sufficient information to establish compliance may result in rejection.
3	Attachment B: Bid Pricing Form	Required for responsiveness. Complete and submit the form, including required pricing, bidder information, tariff disclosures, signature, and addendum acknowledgment.
4	Attachment C: Debarment and Responsibility Certification	Required when applicable. Submit the completed certification or explanation when required by the IFB.
5	Attachment E: Form of Exceptions – Specifications	Conditional. Submit with the bid if proposing any exceptions or deviations from the specifications.
6	Attachment F: Form of Exceptions – Sale of Goods Agreement	Conditional. Submit with the bid if proposing any exceptions to the Agreement.
7	Attachment G: Economic Impact Disclosure Form	Requested for program reporting. Used to collect supplier participation information and support Economic Impact reporting. Not used to determine bid responsiveness or award eligibility.
8	References	Recommended/Conditional. Up to three references demonstrating experience supplying similar materials or equipment. Required only when expressly stated in the IFB.