INVITATION FOR BID

PWC2526026

TWO 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C

Date of Issue: September 16, 2025
Date of Opening: October 23, 2025
2:00 P.M.

Direct all inquiries concerning this IFB to:

JoAnn Bowman
Procurement Advisor
procurement@faypwc.com

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ADVERTISEMENT FOR BID
FAYETTEVILLE PUBLIC WORKS COMMISSION
TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C

Cumberland County
North Carolina

Pursuant to N.C.G.S 143-129, sealed Bids are solicited and will be received at Fayetteville Public Works Commission, Administration Building, Procurement Department/Conference Room 107, 955 Old Wilmington Road, Fayetteville, NC 28301, until **2:00 p.m., EST Thursday, October 23, 2025**, for the **PWC2526026 TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C.**

The Commission is requesting firm quotations for two (2) 230/66KV autotransformers 134.4/179.2/224 MVA at 65C as specified in this document, to support the operations of the Electric Support Services Department.

Enclosed are the Instructions to Bidders, Technical Specifications, and Bid Pricing Form. Bidders must submit the completed Bid Pricing Form, References, Attachment B – E, and any required addendum acknowledgments. Submissions must be made using the provided forms or exact copies thereof, as specified in the bid documents. 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 **JoAnn Bowman**, at procurement@faypwc.com no later than **5:00 p.m. EST, Thursday, October 2, 2025** in order to be considered for a response.

Mailed bids must be addressed to **JoAnn Bowman**, Procurement Advisor, Fayetteville Public Works Commission, 955 Old Wilmington Road, Fayetteville, North Carolina 28301. The outside of the envelope must be marked **IFB: PWC2526026 TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C** and shall indicate the name, and address of the bidder. Email bids to procurement@faypwc.com with the bid title and number in the subject line "**IFB: PWC2526026 TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C "**. 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 responsible, responsive bidder whose qualifications indicate the award will be in the best interest of PWC.

FAYETTEVILLE PUBLIC WORKS COMMISSION
Nikole Bohannon
Procurement Manager

INSTRUCTIONS TO BIDDERS
FAYETTEVILLE PUBLIC WORKS COMMISSION
TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C

SCOPE

PWC is seeking bids for the purchase of power transformers, with orders to be placed in 2025. The procurement includes the purchase of two (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C, which must be shipped by the manufacturer on or before December 15, 2027. Bids should reflect firm pricing based on an order placed within sixty (60) days from the bid date.

Bids must cover all associated costs, including delivery, unloading, handling, rigging, and placement of the transformers onto PWC's foundation pad or piling at designated substation sites within PWC's service area, which includes Fayetteville, North Carolina, and surrounding areas. PWC will specify the exact delivery site for each transformer at least thirty (30) days prior to the scheduled delivery date. PWC will ensure roadworthy access to the designated delivery sites.

OBJECTIVE OF THE REQUEST

It is the intent of this bid invitation to obtain pricing for **TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C** within the technical specifications section of this Invitation for Bid (IFB). You are requested to submit your bid on the enclosed 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	Responsibility	Date/Time
Submit Written Questions	Bidders	Thursday, October 2, 2025, 5:00 pm
Provide Response to Questions	PWC	Tuesday, October 7, 2025, 5:00 pm
Submit IFB	Bidders	Thursday, October 23, 2025, 2:00 pm
Target Commission Date	PWC	Wednesday, November 12, 2025
Target Council Date	PWC	Monday, December 8, 2025
Award /Sale of Goods Agreement	PWC	Wednesday, December 30, 2025
Preferred Delivery	Awarded Bidder	December 15, 2027

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 **PWC2526026** – Questions" as the subject of the email.

Questions received prior to the submission deadline date, the Procurement Advisor's response, and any additional information deemed necessary by PWC will be posted in the form of an addendum to the PWC website and shall become an Addendum to 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. Firms shall rely only on written material contained in an Addendum to this IFB.

Inquiries should be submitted no later than the date and time noted in the IFB schedule. Questions answered verbally will be followed up by written addenda as deemed necessary; oral interpretations shall have no effect.

REFERENCES

Bidders shall provide at least three (3) different references for which your company has supplied the exact model of equipment offered. PWC may contact these references to determine the commodity provided are substantially similar in scope to those requested in Attachment A and that the bidder's performance has been satisfactory. The information obtained shall be considered in the evaluation of the bid. If PWC is referenced, it cannot be counted towards your three (3) required references but may be included in addition to.

COMPANY NAME	CONTACT NAME	TELEPHONE NUMBER	EMAIL
Fayetteville Public Works Commission, if applicable			

VENDOR REGISTRATION VIA ISUPPLIER

1) All vendors interested in doing business with PWC must register as a vendor through the iSupplier Portal using the link below. The iSupplier self-service portal enables vendors to have real-time access to information regarding purchase orders, invoices, and payments through a secure environment. Attach a copy of your W9 to your online registration.

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

BID DEPOSIT

1) Each bid shall be accompanied by a cashier's check or certified check drawn on a bank insured by the Federal Deposit Insurance Corporation or Savings Association Insurance Fund. Checks shall be payable to Fayetteville Public Works Commission, Fayetteville, North Carolina, in an amount not less than five percent (5%) of the total bid as a guarantee that a Contract, if awarded, will be entered into. In lieu thereof, a bid bond may be submitted by the bidder.

2) Bid bond shall be conditioned that the surety will, upon demand, forthwith make payment to the Obligee upon said bond if the bidder fails to execute the Agreement in accordance with the bid bond, and that upon failure to forthwith make payment, the Surety shall pay to the Obligee an amount equal to double the amount of said bond.

3) Only one (1) bid bond is required, the amount of which shall be based on the total amount of the bid. The value for the bid bond shall be based on the bid schedule of the maximum total

amount.

SUBMISSION INSTRUCTIONS

1) Bids should be complete and carefully worded and should convey all the information requested in the IFB. Bids should be prepared simply and economically, providing a straightforward, concise description of the bidder's capabilities to satisfy the requirements of the IFB. Emphasis should be on completeness and clarity of content. If the bid includes any comment over and above the specific information requested in the IFB, the bidder should include this information as a separate appendix to its bid. Bids that include clarifications or modifications to any of the IFB's contractual requirements, or a bidder's standard terms and conditions, may be deemed non-responsive and not considered for award at PWC's discretion.

2) 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. PWC 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 responsible, responsive bidder whose qualifications indicate the award will be in the best interest of PWC.

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: PWC2526026 TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 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 Procurement Advisors. 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 must be held firm for PWC for a period of sixty (60) days after the bid due date. A purchase order will be issued to the awarded 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 official of the bidder. Bids may be rejected for any omission, alteration of form, additions not called for, conditional bid, or any irregularities of any kind.

8) Do not submit alternate bids unless specifically called for on the Bid Pricing Forms.

PRICING

1) All bidders are advised to include all costs incurred by the bidder in delivering the **TWO** (2) **230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C** in their bid submittal. The invoice submitted for payment shall not reflect any other costs (fuel surcharge, toll, etc.). PWC is not tax-exempt.

2) Bids for each transformer shall include the bidder's risk of delivery, unloading, handling, rigging, and placement of the transformer onto the PWC foundation pad or foundation piling at each site to a substation site located within the PWC's service area in and surrounding Fayetteville, North Carolina. PWC will designate the specific delivery site for each transformer at least thirty (30) days before the Manufacturer's scheduled delivery. PWC will provide reasonable roadworthy access to each site.

3) Price Adjustments: The Agreement shall contain a provision for price adjustment based on the U.S. Bureau of Labor Statistics, Producer Price Index by Industry: Electric Power and Specialty Transformer Manufacturing: Power and Distribution Transformers and shall provide, in part, that in the event of a change of +/- 5% prior to the purchase of the materials from the time of bidding, the price shall be adjusted accordingly. A website such as https://fred.stlouisfed.org/series/PCU3353113353111 shall be used to determine commodity values during the manufacturing process period.

EVALUATION AND AWARD

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

2) 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.

3) 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.

4) In evaluating the bids for the award of the Sale of Goods Agreement, PWC will consider, in addition to the prices quoted in the Bid, and other potential criteria, the following factors:

a) Lead times.
b) Adherence to the plans and technical specifications.
c) Suitability of materials.
d) Firm prices.
e) Additional extended warranty.
f) Standardization of equipment.
g) Long-range economy.
h) History of prior delivery performance.
i) No-Load and Load Loss Evaluation.
j) Accessibility of service facilities and personnel.
k) History of prior equipment and service personnel performance.
l) Ability and practicality to inspect the equipment in person prior to shipment and witness any testing.

5) Bids submitted shall be evaluated for "Equivalent First Cost" utilizing initial cost, transformer losses, and auxiliary losses. The formalization is as follows:

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

*Including possible escalation, if any.

For the purpose of evaluating transformer losses for award and determination of compliance of compliance after manufacturing and testing, the following shall apply for no-load, winding, and auxiliary losses:

No-load and winding losses will be evaluated using the quoted values provided by the Bidder.

Winding Losses will be evaluated using the quoted values provided by the Bidder.

Auxiliary Losses will be evaluated using the quoted values provided by the Bidder

The Cost of Losses will be evaluated using the following charge values:

	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

6) PWC reserves the right to change the no-load loss, winding loss, and auxiliary loss charge values given above insofar as these values are used to evaluate bids. Such changes might be necessary to reflect changed conditions and are not expected to be more than ±20% of the values shown above. If bid's total cost evaluations are within five percent (5%) of each other at total cost of ownership, PWC reserves the right to award to the lowest evaluated cost transformer. The no-load, winding, and auxiliary losses quoted by the Bidder are of the essence of the Agreement. Accordingly, the Agreement shall provide that should the Bidder neglect, refuse, or fail to meet the quoted losses provided, the Purchase Price shall be reduced by 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. PWC shall have the right to deduct

from and retain out of the portion of the monies then due and payable or which may become due and payable to the bidder such amount. In no event shall the adjustment factor under this provision result in a net price increase to PWC. If the funds due and to become due from PWC to the bidder is insufficient to pay in full any such amount, the bidder shall pay to the Commission the amount necessary to affect such payment in full upon demand therefore, provided, however, that PWC shall promptly notify the bidder in writing of the manner in which the amount retained, deducted, or claimed were computed.

7) The Sale of Goods Agreement will be awarded for a period of two (2) years to begin on or about December 30, 2025.

8) 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.

9) 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 F: 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) Delivery to be made F.O.B. Public Works Commission, **Point of Delivery # 1, 2842 Cumberland Road, Fayetteville, NC 28306,** and **Point of Delivery # 2, 6400 Cliffdale Road, 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. The successful bidder must provide 48-hour notice of all deliveries.

3) Coordinated shipment shall be made to reduce storage by PWC and to facilitate the accumulation of component parts. Partial shipments per transformer at scattered times will not be acceptable. In the event that delays occur, the successful bidder shall be responsible for all shipping demurrage, unless such delays are caused solely by PWC.

4) Receipt of "Approval Drawings" by the successful bidder constitutes an authorization for manufacture only, predicated upon the drawings and corrections found thereon. Tentative release for shipment is to be granted by either PWC or PWC's engineer, based upon the following:

a) Twenty-one (21) consecutive days prior to notification of tests so that PWC may have a representative present to witness the tests.
b) Furnishing of the requested number of copies of the final drawings as called for in the Sale

of Good Agreement.

c) Coordination of manufacturing and delivery with PWC's construction schedule as may be noted in the Sale of Good Agreement.
d) Thirty (30) days' notification of the tentative shipping schedule and 48 hours' notification prior to all deliveries.

5) Payment for equipment, material, supplies, etc. purchased pursuant to this bid shall be made by PWC in accordance with the milestone payment schedule as follows:

a) 15% upon approval of submitted of drawings
b) 30% upon receipt of copper and core steel at the factory
c) 30% upon shipment of transformer to owner
d) 20% after delivery to site, setting on pad, dressed, and tested
e) 5% retainage up to 60 days after delivery

Milestone Percentages, less retainage, to build transformer and after it is demonstrated that the equipment meets the technical specifications.

6) PWC will withhold five percent (5%) of each monthly payment as retainage. After fifty percent (50%) of the work is completed, PWC may consider waiving further retainage if the following conditions are met: (1) written consent is received from the surety; (2) satisfactory progress is being made on the project; and (3) any nonconforming work identified by the PWC engineer before fifty percent (50%) completion has been corrected by the Contractor and accepted by the PWC engineer. If retainage is reduced or waived, PWC reserves the right to reinstate retainage up to the five percent (5%) level if the Contractor's performance becomes unsatisfactory. Additionally, PWC may continue to withhold payment, even if the Contractor's work is satisfactory, to ensure a total retainage of two and one-half percent (2.5%) over the life of the project.

7) The address for submittal of all invoices is Fayetteville Public Works Commission, 955 Old Wilmington Road, Fayetteville, North Carolina 28301, Attention: Accounts Payable and Joel Valley.

8) The Agreement shall contain a liquidated damages provision with respect to damages due to delays which provides in part that in the event that the successful Bidder fails to deliver the power transformers within the agreed-upon delivery schedule, liquidated damages shall be assessed as follows:

a) First 90 Days: For the first ninety (90) calendar days following the agreed-upon delivery date, liquidated damages in the amount of $500 per calendar day shall be imposed for each day the delivery is delayed.

b) Beyond 90 Days: Beginning on the ninety-first (91st) calendar day and continuing until the delivery of the power transformers, liquidated damages in the amount of $750 per calendar day shall be imposed for each day the delivery is delayed.

These liquidated damages are intended to compensate PWC for the losses and inconvenience caused by the delay and are not intended as a penalty. The successful Bidder agrees that these amounts are reasonable estimates of the actual damages PWC will incur in the event of such delays.

TRANSITION ASSISTANCE

1) If a PWC Sale of Goods Agreement results from this solicitation, and said Agreement is not renewed at the end of the then current term or is terminated prior to its expiration for any reason, at the option of PWC, Bidder shall provide transition assistance to PWC for up to ____ [insert number - max of six months] months following termination or expiration of the Agreement to allow for the Services to continue without interruption or adverse effect, and to facilitate the orderly transfer of such Services to PWC or its designees. If PWC exercises this option, the Parties agree that such transition assistance shall be governed by the terms and conditions of the Agreement (notwithstanding this expiration or cancellation), except for those Agreement terms or conditions that do not reasonably apply to such transition assistance. PWC shall agree to pay the Bidder for any resources utilized in performing such transition assistance at the most current rates provided by the Bidder for performance of the Services or other resources utilized. Upon request of PWC, Bidder agrees to deliver an amendment to the Agreement in form and substance reasonably acceptable to the parties memorializing the extension of the term as contemplated above.

FAYETTEVILLE PUBLIC WORKS COMMISSION
TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C

ATTACHMENT A: TECHNICAL SPECIFICATIONS

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FAYETTEVILLE PUBLIC WORKS COMMISSION
TWO (2) 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C

TECHNICAL SPECIFICATIONS

1.0 Scope

1.1 Reference the IFB Instruction to Bidders Scope section.

2.0 Standards

2.1 All materials and equipment shall be new.

2.2 The Technical Specifications describe the type, size, and characteristics of the various materials and equipment required to be furnished. The Drawings indicate general arrangement, equipment location, and spacing.

2.3 Strict adherence to the Technical Specifications and Drawings is requested to facilitate checking and consideration of the Bid.

2.4 The transformer manufacturer must have a USA-located repair facility to bid on this project.

2.5 The transformers shall be manufactured in 24 countries to be considered in North America. (i.e., Canada, USA, Mexico).

2.6 Bid submittals shall include the following:

2.6.1 Catalog numbers, manufacturer, ratings, characteristics, types, sizes, etc., of all major removable materials and equipment included. A simple statement that all necessary materials and equipment will be provided is not satisfactory.

2.6.2 Performance data and evidence of short circuit testing for similar designs for the several items as outlined in the Detailed Specifications.

2.6.3 The Bidder shall state in its bid how the transformers will be shipped, namely, truck or rail; whether units shall be shipped oil-filled; or with gas pressure, and whether bushings will be installed or removed. The bushing shall be shipped upright.

2.6.4 Prices shall include the cost of delivery to the substation site and unloading onto the pad as per Instructions to Bidders.

2.6.5 These Technical Specifications are intended for the transformer to be complete and fully operable. Any details not mentioned in the Technical

Specifications but required for satisfactory operation shall be furnished and installed by the awarded Bidder including top-off oil.

2.6.6 Station power available at the PWC'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.

The transformer to be provided herein shall include a full five (5) year warranty on the complete transformer together with all parts. This warranty shall extend for five (5) years from the date of delivery.

2.7 All equipment and materials covered by the Technical Specifications and all tests applied to it, unless otherwise stated herein, by the applicable provisions of the latest editions of the Standards of the ASTM, ANSI, AEIC, IEEE, NEMA, NESC, and OSHA.

Where the term "Standards" is used in the Technical Specifications it shall be understood to refer to the above Standards. The following is a reference list of applicable documents:

IEEE C37.90.1 Surge Withstand (SWC) Tests
IEEE C57.12.00 Standard General Requirements for Liquid Immersed Power Transformers
IEEE C57.12.10 Standard Safety Requirements for Power Transformers
IEEE C57.12.70 Standard Terminal Markings and Connections for Distribution and Power Transformers
IEEE C57.12.80 Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90 Standard Test Code for Liquid Immersed Power Transformers
IEEE C57.19.00 General Requirements and Test Procedure for Outdoor Power Apparatus Bushings
IEEE C57.19.01 Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
IEEE C57.91 Guide for Loading Oil-Immersed Power Transformers
IEEE C57.98 Guide for Transformer Impulse Tests
IEEE C57.116 IEEE Guide for Transformers Directly Connected to Generators
IEEE C57.131 Standard Requirements for Load Tap Changers
IEEE C57.163 IEEE Guide for Establishing Power Transformer Capability while under Geomagnetic Disturbances
IEEE 693 IEEE Recommended Practices for Seismic Design of Substations
Doble TDRB-291 Power Factor Test-Data Reference Book
Doble - Doble Transformer Oil Purchase Specification (TOPS)
EPRI 1015077 Guidance for Planned Replacement of Large Power Transformers at Nuclear Power Plants
NEMA TR1 Audible Sound Levels for Transformers
IEEE C57.32 Requiremen3ts, Terminology, and Test Procedure for Neutral Grounding Devices

IEC 60076-5 Power Transformer Ability to Withstand Short Circuit

3.0 Drawings

3.1 Preliminary

Before proceeding with fabrication, the manufacturer shall submit for approval sufficient Drawings to demonstrate that all parts conform to the requirements and intent of the Technical Specifications. The Drawings shall include four (4) copies each of Outline, Nameplate, Detail, Control, Elementary, and Control Wiring Drawings. All Drawings submitted shall be a minimum of a "D" (24" x 36") size print. Submittal of Drawings smaller than "D" size will be immediately returned stamped "not approved" and proper size Drawing will have to be submitted. All Drawings shall be dimensioned in feet and inches; metric measurements alone will not be acceptable. However, dual dimensioning in feet and inches and centimeters will be acceptable. Approval Drawings shall be submitted directly to: Fayetteville PWC, 1094 Commission Drive, Fayetteville, North Carolina 28301, and Attention: Joel C. Valley.

The Outline Drawing shall show the dimensions of the equipment including bushings, radiators and cooling equipment, base, and all other important external features. These Drawings shall show weights, bushing catalog numbers, ampere ratings, and descriptions of top bushing terminals and arrangement of all external accessory devices, as well as the complete transformer rating.

Approval of Drawings shall not be held to relieve the Bidder of obligations to meet all requirements of the Technical Specifications, of responsibility for the correctness of the Drawings, or of responsibility to meet the original shipping promise based on the PWC's Engineer being allowed two weeks for approval.

Receipt of Approval Drawings by the Bidder constitutes authorization for manufacture only, based upon the corrections found thereon. The PWC's Engineer reserves the right to request resubmittal of Drawings as deemed appropriate before authorizing manufacture.

3.2 Final Drawings

Contingent upon Approval Drawing review, and product manufacture, the Bidder shall issue final documentation for the transformer as follows:

3.2.1 One (1) complete set of all Drawings, revised to "as-built" status, released on paper media.

3.2.2 Two (2) complete sets of all Drawings, revised to "as-built" status, released on two (2) separate USB drives with PDF and AutoCad files.

3.2.3 Four (4) copies of applicable instruction books, including one (1) print each of all Drawings representing physical and electric details as furnished per paragraph 3.1.

3.2.4 Two (2) copies of certified test reports corresponding to functional performance measurements after final assembly.

3.2.5 All Drawings are to be certified correct and supplied within a reasonable length of time prior to shipment of the equipment. Each set of Drawings and documentation shall include the following information:

3.2.5.1 Outline and Assembly Drawings showing size and location of major components and all principal dimensions.

3.2.5.2 Control cabinet front view.

3.2.5.3 Details of bushing and bushing terminal connectors.

3.2.5.4 Diagram of bushing current transformers, connection, number of turns, polarity marking, ratios, and bushing orientation.

3.2.5.5 Current transformer performance characteristic curves and data for all relay accuracy CTs.

3.2.5.6 Details of the control housing.

3.2.5.7 Panel connection diagram showing the exact connection for all components furnished.

3.2.5.8 AC and DC elementary circuit diagrams for all relay and control equipment furnished.

3.2.5.9 Wiring control and schematic diagrams.

3.2.5.10 Instruction books, including LTC operations manual(s), if so equipped.

3.2.5.11 Renewal parts catalog.

3.2.5.12 Two (2) copies of certified test reports.

4.0 Shipping of Power Transformer

Delivery shall be made in 2027 or the alternate proposed date accepted by PWC.

4.1 Each transformer shall be shipped to Point of Delivery #1 Fayetteville, 2842 Cumberland Road, Fayetteville, NC 28306, and Point of Delivery #3 Fayetteville, 6400

Cliffdale Road, Fayetteville, NC 28312. The Manufacturer shall furnish an adequate capacity crane for unloading, handling, rigging, and placement of the transformer onto the PWC's foundation.

4.2 Before shipment, the transformer shall be completely assembled to determine if all parts fit properly. Parts removed for shipment shall be marked to permit easy identification when reassembling. Assembly of any parts removed for shipment will be performed by the manufacturer's field labor or a hired contractor by the manufacturer and to be under the supervision of the manufacturer's field service engineer.

4.3 Method of packing and loading shall ensure protection of all parts from dampness, corrosion, breakage, or vibration injury that might be encountered in transportation, storage, and handling.

4.4 Release for shipment is to be granted by either PWC or the PWC's Engineer based upon the manufacturer's compliance with the following:

4.4.1 Fourteen (14) consecutive days before notification of tests, so PWC may have a representative present to witness the tests.

4.4.2 Furnishing of the requisite number of copies of the Final Drawings and Instruction Books as called for in the Specifications.

4.4.3 Thirty (30) days' notification of tentative shipping schedule and forty-eight (48) hours' notification before delivery.

4.5 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 PWC's Engineer. The impact recorder shall be read before unloading, at the rail siding before unloading if applicable, on the trailer before transportation to the site, and after arrival at the site.

4.6 The transformer shall be shipped dry-air-filled only, with all oil and bushings removed for transport. Bushings and oil shall be reinstalled after the transformer is placed on the concrete pad at the designated substation site.

4.7 The transformer shall be equipped with proper pipe connections for checking and filling under vacuum. The oil shall be shipped by tanker with the unloading facility (pump) furnished. The unloading facility shall have been flushed free of undesirable contaminants by flushing with the same type of oil provided for the transformer.

4.8 The Manufacturer/Bidder shall furnish all equipment, labor, and supervision required for filling, and shall coordinate timing and arrangements with PWC. The Manufacturer/Bidder shall also be responsible for the proper cleanup of any oil spilled during the filling operation.

4.9 All work associated with assembly, vacuum processing, and oil filling of the transformer shall be performed in accordance with the requirements set forth in the Assembly and Oil Processing Specification section of these Technical Specifications, which includes requirements for vacuum fill, hot oil circulation, and compliance with ANSI, IEEE, ASTM, NEMA, NFPA, EPA, OSHA, and AWS standards.

5.0 Transformer Assembly Requirements

5.1 Manufacturer's Instructions

5.1.1 The transformer shall be assembled in accordance with the OEM instruction leaflets as listed in the technical specification.

5.1.2 If required by the transformer OEM or PWC, a Manufacturer's Representative shall be present during all or part of the assembly and processing.

5.2 General

5.2.1 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 that enter the transformer are accounted for prior to the entry being closed.

5.2.2 Ensure all temporary shipping braces, etc., have been removed.

5.2.3 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.

5.2.4 Assemble the bushings, radiators, and all tank fittings. The radiators and bushings will be handled as prescribed by the manufacturer, but in general, they should be lifted in a vertical position during handling and installation. This work will require referring to the instruction manual and drawings provided by the manufacturer.

5.2.5 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. P2 = P1*T2/T1. 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 dewpoint shall be tested and reported to the responsible PWC representative.

5.2.6 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 that the main tank is exposed to the atmosphere, preparations shall be made to close any opening with a minimum delay.

5.2.7 Radiators, oil piping, valves, and fittings shall be thoroughly cleaned and flushed with clean oil before being fitted to the transformer.

5.3 Bushings

5.3.1 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.

5.4 Conservator Tank

5.4.1 The inspection ports on the conservator shall be removed to facilitate the inspection of the aircell. Inspect the mechanical float arm of the liquid level gauge. Care shall be taken that the float arm is not damaged while the aircell is pressurized. The aircell shall be pressure tested with ¾ 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: P2 = P1*T2/T1 (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.

5.5 Radiators / Coolers

5.5.1 Check gasket seats on radiator/cooler and on the transformer.

5.5.2 Check radiator/cooler valves for open after the radiators are installed.

5.6 Control and Accessories

5.6.1 Install accessories and control equipment as required.

5.6.2 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.

5.6.3 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.

5.7 Conflicts

5.7.1 Any conflicts between the above instructions and the manufacturer's instructions shall be resolved by the responsible PWC representative before the task being performed.

5.8 Internal Inspection

5.8.1 An internal inspection of the transformer shall be performed by PWC personnel after all assembly is complete.

6.0 Vacuum Processing 115 KV GSU and >115 KV Transformers

6.1 High Vacuum equipment will be required to pull an adequate vacuum to process and dry transformers rated > 115 KV.

6.2 Pull vacuum to 2 mm (2,000 microns). Isolate the transformer from the vacuum pump and monitor the vacuum on the transformer tank. Vacuum leakage rate should not exceed 10 mm in 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.

6.3 Unless approved by the PWC representative, a minimum of 48 hours of vacuum time will be required to adequately process the transformer.

6.4 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.

6.5 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 gallon passes through the transformer and add inhibitor on the last pass.

6.6 The completion of the vacuum process will require the following conditions to be met:

6.6.1 Maximum absolute vacuum of 250 microns as measured at the transformer.

6.6.2 Maximum tank leak down rate of 200 microns/hour.

6.6.3 Less than 1/8” rise in water column of vacuum pump exhaust.

6.6.4 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.

6.6.5 Approval of the responsible PWC representative.

7.0 Vacuum Processing Transformers 115 KV and Less

7.1 High-vacuum equipment will be required to pull an adequate vacuum to process and dry transformers.

7.2 Pull vacuum to 2 mm (2,000 microns). Isolate the transformer from the vacuum pump and monitor the vacuum in the transformer tank. Vacuum leakage rate should not exceed 10 mm in 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.

7.3 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.

8.0 Oil Filling

8.1 The transformer shall be filled with oil in accordance with the transformer OEM leaflets that were provided with this specification:

8.2 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 a minimum of 7-10 days prior to the anticipated fill date. (Depending on supply, the oil can take much longer for delivery)

8.3 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 that are used by the successful bidder shall be inspected by PWC personnel prior to oil being introduced into the tanker.

8.4 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%

8.5 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.

8.6 Positive pressure shall be maintained on the oil fill line.

8.7 Vacuum at the transformer tank shall be maintained at less than 2 mm during the oil fill.

8.8 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 such that the oil's total dissolved gas content is less than 1% and the water content is less than 10 ppm.

8.9 The oil filling operation shall be continuous once started, including final purge and conservator tank filling.

8.10 The conservator 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 is less than 2%.

8.11 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.

8.12 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.

8.13 The transformer shall be inspected for oil leaks 48 hours after the oil fill is complete. Any leaks found at this time shall be repaired without delay.

8.14 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.

9.0 Manufacturer's Field Representative

The Manufacturer shall provide, and include as part of its Bid, all costs associated with furnishing the services of a Field Service Engineer (FSE) as required for final assembly and acceptance testing.

The duties of the FSE shall include supervising the installation of Manufacturer-provided component parts removed for shipment, including but not limited to bushings, radiators, and surge arresters. The oil will be shipped separately, and the transformer shall be vacuum-filled on site. The Manufacturer shall provide all labor and equipment necessary for vacuum fill, final assembly, and field testing.

The FSE shall supervise the installation of all control and auxiliary wiring. Once re-assembled, the transformer shall be field tested by the FSE as specified in Section 5.0 - 7.0 of these Technical Specifications. The Manufacturer shall also provide all labor and equipment needed to perform the field testing.

The FSE shall clean and repair or paint any surfaces that were soiled, discolored, or otherwise damaged by abrasion since leaving the factory. The FSE shall certify when the transformer is ready to be energized.

10. Transformer

10.1 Type and Rating

The transformer shall be three-phase, 60 Hertz, suitable for outdoor service at an altitude less than one 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. Tertiary winding leads shall be brought to the exterior of the transformer for testing purposes, not for load carrying. The transformer will be operated with the H0 and X0 bushings tied solidly to the copper ground. All windings shall be copper.

Transformer 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 complete 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 (ºC)	Rating (kVA)
ONAN	55/65	120,000/134,400
ONAF1	55/65	160,000/179,200
ONAF2	55/65	200,000/224,000

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 have provision for locking in any position. An external indicator shall clearly display the tap position.

Core shall be of cruciform, or circular, shape. Obround, 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 circuits 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 suitable design, such as; parallel winding and the tertiary winding but is not required in all multiple conductors turns.

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

10.2 All transformer windings shall be copper 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. The paper covered 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 be low-loss grain-oriented electrical steels that come from the following approved companies: AK Steel - USA, USS-POSCO USA, and ThyssenKrupp Steel – Germany. 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 shall describe the type of core and winding construction, including clamping design.

10.3 Insulation

Solid insulation ASTM D1305-16, within the windings and clamping structure shall be of a 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 Weidmann USA and/or ABB Pucaro transformer-board manufactured in accordance with ASTM D4063-99. The transformer board will be produced using an electrical-grade pulp specified by the transformer-board manufacturer. Transformer-board to be produced using unbleached softwood Weidmann USA Kraft pulp, with key properties and testing methods clearly specified by the transformer-board manufacturer.

Conductors shall be insulated with Weidmann USA 12HCC or 22HCC Crepe paper or M-250 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 as defined by IEEE C57.100 as cellulose-based paper which 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 D-982. Paper is to be supplied by a paper

manufacturer from the United States or Canada with a proven record of no less than 15 years supplying this material for this application to be oil-filled, transformer industry.

10.4 Case and Cover

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 ANSI Standards, located on the main tank near the control cabinet.

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 and reusable gasket material (ordinary cork or corkprene is not approved) and shall be designed so as to permit their being made oil-tight in reassembly. 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 shot-blasting or by any other equally effective method. Primer coats of

exterior paint and exterior paint top coat shall comply with applicable standards for painting of substation transformers and meet the stipulations of the EEI 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 at 4 feet maximum spacing 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.

10.5 Impedance

The percent impedance voltage at the self-cooled rating as measured on 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 134.4MVA shall be approximately nine percent (9%) at 65°C. This transformer's impedance at the base rating of 120.0 MVA shall be approximately eight-point-four percent (8.4%) at 55°C.

10.6 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. C57.12.90.

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.

10.7 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 and dimensionally interchangeable between transformers and have corona mitigation, according to 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 (kV)	Amperes	Connection
H1, H2, H3	230	1200	Bottom
X1, X2, X3	69	4000	Bottom
H0X0	24.9	1200	Bottom
Y (Tertiary)	15	1200	Bottom

The neutral and tertiary bushings shall be furnished with a NEMA 4-hole spade-type terminal for connection with 1000 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, minimum phase-to-phase and phase-to-ground external clearances between live parts in accordance with IEEE C57.12.10-newest edition.

Trench is not an acceptable bushing supplier.

10.8 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, including USA-manufactured radiators, USA-manufactured fans, and pumps, 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, manufactured in the USA by Menks or Trantech, and mounted either in Segment 1 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 fill valve at the top and a drain valve at the bottom of the unit. All cooling fans shall be equipped with automatic control to provide the operation of all cooling stages, based on the 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 USA-manufactured and utilize the Dynamic Rating E3-7200 transformer monitor to provide the operation of all cooling stages based on the sensing of transformer winding and oil temperatures. Each fan (and/or pump) shall be driven by an enclosed waterproof induction motor rated 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 for the transfer of 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.

10.9 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	C800/400	2.0
X1, X2, X3	2000:5	2	6	0.3B-1.8	C800/400	2.0
H0X0	1200:5	1	1	0.3B-1.8	C400/200	2.0
Tertiary	1200:5	1	1	0.3B-1.8	C200/100	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.

10.10 Surge Arresters

Surge arresters shall be transformer-mounted for the high and low voltage sides on 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 tank-mounted 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, conductor, and connectors for the transformer grounding system. The copper shall be tinned at all connection points and the copper bar shall be paint with ANSI Gray 70 paint. 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).

10.11 Control Cabinet

The control cabinet will be provided by Dynamic Ratings, located in Sussex, Wisconsin. The manufacturer will work on all control cabinet approval drawings through Dynamic Ratings. Dynamic Ratings will provide a customized monitoring schematic to interface properly with the transformer manufacturer's control system drawings. A NEMA 4X, weatherproof, painted, and stainless-steel Type 304 control cabinet shall be furnished enclosing control circuits, signal circuits, protective relays, individual transformer alarm indicators, and a suitable 240/120-volt, 60 Hertz thermostatically controlled heater with double-pole terminal circuit breaker. All control conductors shall be tinned copper. All control wires into the control cabinet shall terminate on clearly marked and properly identified terminal blocks. All wires shall be identified by showing the other end they came from and the landing designation. A swing-out panel shall be provided to mount a DYNAMIC RATINGS E3-7200 transformer monitor user interface unit.

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

The weatherproof control panel shall be centrally located near the bottom of the tank at a location to be approved by the Owner or Dynamic Ratings. The Control Cabinet shall be shock and vibration-isolated from the main tank. The cabinet door shall be completely weatherproof and shall have a handle with a triple latching mechanism, hinged on the left side. The handle/latch mechanism shall be furnished with padlocking provisions. Bolted door covers will not be acceptable. Doors shall have provisions for blocking in the open position. Breathers for the control cabinet shall be silica-gel type. The window shall be UV-protected safety glass.

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 tempered glass window in the front door of the cabinet.

The control cabinet heater shall be equipped with guards and thermostatically controlled so that the guard temperature cannot exceed 120°F. The 240-volt electric terminals of the heater shall also be covered.

All cabinets attached to the transformer shall be solidly grounded to the transformer case.

10.12 Transformer Monitoring System

A microprocessor-based transformer monitoring system shall be installed and programmed on the transformer. The monitor shall be factory programmed at Dynamic Ratings per 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:

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 numerical keypad, four quick access function keys, and eight programmable “hot keys” to allow instant access to the user's favorite screens. The eight programmable keys shall be preconfigured as follows, and a label shall be provided accordingly:

0- New Alarms
1- Active alarms
2- DGA
3- BHM
4- PDM
5- Harmonics
6- Temperature detail
7- Motor Currents

Functions provided. The transformer monitoring system shall monitor and report the following functions: top oil temperature, hot spot temperature on LV windings, load, transformer insulation aging, overload capability, transformer gas pressure, main tank liquid level, warnings and alarms with dry contact output, through fault current measuring, monitoring of fans, exercise and rotation of fans, event recording, and remote access of data.

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.

IRIG-B synchronized, time-stamped events. 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 if a SCADA master time sync signal is not available.

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.

Metering. The transformer monitoring system shall include metering capabilities for real-time current, voltage, power, and energy quantities, as well as phase demand and peak demand current values, for all AC currents and voltage inputs.

Transformer Thermal Monitor. The system shall incorporate a transformer thermal monitor based on IEEE C57.91, the newest edition. The model shall include a capability for entering known transformer thermal constants as well as 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.

DGA Monitor Integration. The Dynamic Ratings E3 transformer monitor shall be able to communicate to the Vaisala OPT100 DGA monitor through ethernet cabling or fiber ethernet, read and store all applicable gas values and alarms, display values and alarms on E3-7200 integrated web pages and provide the following analytics: Duvals triangles, Duvals 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 the DGA data and alarms via user-selectable protocols of either Modbus, DNP3, or IEC61850 to the users' SCADA RTU. The monitor shall also provide a bubble evolution alarm and a moisture-in-paper analyzer. **The Bidder will purchase the commissioning and testing services for Dynamic Ratings and Vaisala-installed equipment. Along with onsite field training for PWC substation employees.**

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.

Through-Fault Event Monitor. The system shall provide for the capability of reporting fault current level, duration of a maximum 3 seconds or for 10 times rated current, and date/time for overcurrent events which exceed a preprogrammed threshold via the bushing CTs installed on the LV windings. Through-fault monitoring shall provide accumulated through-fault levels, a number of through-faults, total fault count, 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).

Event Record. The transformer monitoring system shall store up to 15 cycles of raw data with 16-sample/cycle resolution.

Voltage Inputs. Voltage inputs shall accept 0–150 Vac.

Current Inputs. Current inputs shall accept 0–10mA and utilize an intrinsically safe clamp on a 1000:1 interfacing CT on a bushing CT secondary.

Fiber-optic Ethernet communications port to communicate with the substation RTU via DNP3.

DNP3. The transformer monitoring system shall be capable of operating as a DNP3 Slave Level 2, either 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.

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.

PC Software. The transformer monitor shall include compatibility with a PC software program for use in programming control settings and logic functions, and retrieving event data. The PC software shall be supplied as part of the transformer monitor.

Operating Temperature. The transformer monitor shall have an operating temperature range of – 40° to +80°C and a power supply input of applicable DC control voltage.

Specification Compliance. The transformer monitoring system front panel shall meet NEMA 12/IP54. The programmable automation controller shall be type tested to sections of C37.90, IEC 60255, IEC 60068, and IEC 61000 standards.

Warranty. The transformer monitoring system shall have a minimum 10-year warranty.

The transformer monitoring system shall be a combination of Dynamic Rating E3-7200 with Vaisala OPT100 or approved equal.

The Dynamic Rating E3-7200 monitor shall be wired in accordance with the Input/Output Schedule included in the Appendix. Bidder will purchase the commissioning and testing services for the Dynamic Ratings and Vaisala-installed equipment. Along with onsite field training for PWC substation employees.

The transformer monitoring system above, as supplied by Dynamic Ratings, Inc., shall include the Dynamic Ratings 10-year Warranty package, to be purchased by the transformer manufacturer with the hardware, and shall include the following:

10.12.1 Commissioning in the substation, within 10 years from the date of shipment.

10.12.2 Product warranty is 10 years from the date of shipment from Dynamic Ratings.

10.12.3 Ten-year labor warranty on all DR-supplied equipment

10.12.4 Free firmware updates for 10 years from shipment from Dynamic Ratings (date of warranty expiry is hard-coded into the equipment by Dynamic Ratings at the time of shipment).

10.12.5 Diagnostic support for any requirements during the first 10 years of product usage

10.13 Pressure Relief

A pressure relief valve with visual indication shall be provided on the transformer for the detection of an excessive positive increase in transformer tank pressure. 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.

10.14 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". Seal in relay (QUALITROL 909-300) for latching alarm or trip signal is required.

10.15 Winding Temperature Relay

A winding temperature relay shall be provided on the transformer for the detection of 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 initiation of lockout shall be dry and normally open.

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

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

10.16 Oil Level Relay

An oil level relay shall be provided on the transformer for the detection of 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 initiation of lockout 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.

10.17 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 control of fans.

10.18 Undervoltage Relays

Undervoltage relays shall be provided to monitor AC and DC circuits. Each stage of fans shall be individually monitored as well as 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.

10.19 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 -40ºC to +85ºC 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 means of an air cell used in the expansion tank, which shall vent air to the atmosphere through a dehydrating breather.

The air cell shall be nitrile rubber or equivalent material and shall not 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 such that the rupture of the air cell shall not prevent the operation of the oil level indicator or cause the low oil level alarm to fail to operate. A section of removable pipe or stainless steel

braided flexible hose and 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 for the application of full vacuum or equalization of 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.

10.20 Wiring

The primary insulation jacket of all wiring shall be 600-volt, 105° C, water, oil, and flame-resistant. All power wiring shall be made with #12 AWG or larger stranded tinned copper wire. All current transformer leads are to be #12 AWG stranded tinned copper or larger in size. All voltage transformer wiring shall be made with #12 AWG or larger stranded tinned copper wire. All control wiring shall be flexible SIS type, minimum 41 stranded, and not smaller in size than 12 AWG tinned copper wire, with the exception that wiring to alarm auxiliary relays and indicating lights may be smaller in size. CT wiring shall be No. 10 AWG minimum and be terminated with insulated ring lugs.

All wires into the control cabinet shall be enclosed in conduit. All conductors into the control cabinet shall terminate on clearly marked and properly identified terminal blocks.

10.20.1 Power wiring shall be sized in accordance with the National Electrical Code.

10.20.2 All connections for wiring shall use silicon bronze, split-type lock washers.

10.20.3 All wires shall be identified at each end with legible permanent labels.

10.20.4 Wiring connections between fixed and hinged sections shall be SIS flexible type, minimum 41-stranded wire.

10.20.5 All terminal connections for conductor sizes #10 AWG in size and smaller shall be made with the non-insulated full-ring tongue, crimp-type lugs. Lugs shall be AMP, Inc. "Solistrand Diamond-Grip" or approved equivalent. Spade-type terminals or slip-on connectors are not acceptable.

10.20.6 All terminal connections for conductor sizes #2 AWG through #8 AWG

shall be made with Burndy HYLUG Type YAV-L, or approved equivalent.

10.20.7 All terminal connections for conductor sizes larger than #2 AWG shall be made with a 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.)

10.20.8 Grommets shall be provided for all openings in metal barriers used for wiring.

10.20.9 Uninsulated exposed conductor or terminal lug shall not extend beyond the sides of the terminal block or its insulating barriers.

10.20.10 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 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.

10.20.11 Bushing current transformer grounds: jumpers must be from the sixth pole of the shorting terminal block on the manufacturer's side directly to the ground bar. Jumpers between shorting terminal blocks are not acceptable unless jumpers are strictly between terminal blocks grouped together. An example of a grouping would be H1-H2-H3.

10.20.12 If accidental short-circuiting of certain wires can result in a malfunction of equipment, these wires shall not be terminated on adjacent terminal block points.

10.20.13 No more than two wires per terminal point are permissible.

10.20.14 All conduits mounted on the transformer shall be rigid steel unless otherwise specified.

10.21 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.

10.22 Terminal Blocks and Molded Case Circuit Breakers

All terminal points shall be furnished with screws.

Marathon 1500 STD series or equivalent terminal blocks shall be provided, furnished with white marking strips for identification of terminal wires for all connections except current transformers and control power.

A minimum of 15 percent spare (but no less than 12 points) terminal points shall be provided in the control cabinet.

Marathon 1600 SC series terminal blocks 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.

Marathon Catalog No. 1423123 power terminal blocks shall be provided for the landing of Owner's AC control power leads.

Marathon Catalog No. 1422123 power terminal block shall be provided for the landing of the Owner's DC voltage control power leads.

Molded case circuit breakers shall be used for interruption and protection of low-voltage circuits.

10.23 Transformer Oil Inhibitor

All oil is to be Type II insulating transformer oil supplied shall have an antioxidant oil inhibitor added. 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.

10.24 The Transformer Core Ground

The core ground strap is to be made accessible, provided on the cover, or 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. Resistances measured 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.

10.25 Fall-Arrest System – provide DBI SALA 8516691 Portable Fall Arrest System and 8517565 Carrying/Storage bag. The manufacturer will weld a bare steel plate DBI SALA Model 8517412, 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

11.0 **Tests**

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 appropriate ANSI regulations.

The transformer shall receive standard ANSI impulse tests, including full-wave and chopped wave on each high-voltage line terminal and on each low-voltage line terminal. Copies of oscillograms and a formal report will be submitted as a record of the tests.

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.

Perform Partial Discharge testing, making measurements per IEEE standards C57.12.00, Table 17 & C57.12.90, section 10.8 describes induced testing requirements and procedures, by evaluation of partial discharge measurements as criteria for pass/fail.

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:

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.

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.

Corona shall be monitored continuously throughout the test and recorded every five (5) minutes. This shall be made a part of the certified test reports. A frequency of 120 Hertz is recommended for each test.

All impedances between windings shall be shown on the test reports.

The Bidder may offer in his quotation deductions for substitution of manufacturers' standard tests in lieu of those specified. <u>However, the basic quotation must include all tests specified.</u>

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.

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:

11.0.1 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 has been tested without failure for short-circuit strength. A description of the test code under which the transformer was tested for short-circuit strength will be provided by the Bidder to the Engineer.

11.0.2 A history of successful experience with transformers of identical or similar ratings, design, and construction. The Bidder shall list all transformers in service with core 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 failures, if any. 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 represent the closest approximation to the transformer covered by this Specification shall be submitted. The information submitted shall be representative of the total experience of the manufacturer with the design of the transformer it proposes to furnish, and include the dates of installation or shipping, the ratings of the transformers, and the failures and causes of failure, if any have been experienced.

11.0.3 The Bidder shall submit with his Bid a complete listing of <u>all</u> 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.

11.0.4 If the Bidder has no such test data available, he shall so state on the Bid.

The transformer shall be tested for the following:

<u>Factory Tests</u>

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.

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.

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:

Performance Tests

- Winding resistance measurements
- The ratio on all taps
- Polarity and Phase relation tests
- No-load losses and excitation current at 100% and 110% rated voltage
- Impedance voltage and load loss
- Operation tests of all devices
- Control (auxiliary) and cooling consumption losses
- Zero-phase sequence impedance voltage and load loss
- Temperature rise
- Dissolved gas in oil analysis (before the start of all tests and after the completion of all tests)
- Audible sound level
- 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.

Dielectric Tests

- Winding insulation resistance
- Core insulation resistance
- Insulation power factor and capacitance
- Low-frequency test on auxiliary devices and control, and current transformer circuits
- Lightning impulse
- Low-frequency
- Partial discharge tests

Mechanical Tests

- Pressure
- Leak (fully assembled, with radiators installed, and a conservative tank)

The certified test report shall include impedance values as follows: Z1%, X1/R1, Z0%, and X0/R0 (and specify MVA base of these values).

Field Tests/Checks

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.

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.

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

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.

12. Transformer Bid Evaluation

12.1 Reference the IFB Instruction to Bidders Evaluation and Award section.

13. Warranty

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 such defective materials or workmanship and any damage resulting therefrom during the warranty period without any cost to the Owner.

Each class of equipment shall carry a full five (5) year warranty against defects. Unless otherwise stated in previous specifications.

Bidder will purchase the commissioning and testing services for Dynamic Ratings and Vaisala installed equipmenalong with their 10-year warranty on these two pieces of equipment provided by DR.

DGA Specification

1. The online DGA must, at a minimum, measure the following parameters in the transformer oil
   - Hydrogen
   - Methane (CH4)
   - Ethane (C2H6)
   - Ethylene (C2H4)
   - Acetylene (C2H2)
   - Carbon monoxide (CO)
   - Carbon dioxide (CO2)
   - Moisture

2. Construction of the DGA is such that no plastic components are in contact with transformer oil.

3. All measurement components must be hermetically sealed to prevent leakage of transformer oil or gases. Oil Temperature Range: -40 to +120 °C

4. Measured DGA gases must not be vented to the atmosphere.

5. The online DGA shall not require any regular factory calibration or consumable gases during its service lifetime.

6. The online DGA must have an autocalibration capability, which must be made without the use of any calibration gases or other consumables.

7. The measurement cycle shall not take longer than 2 hours in regular operations.

8. The measurement system of carbon gases must be optical and based on Non-Dispersive Infrared (NDIR) technology.

9. The receiver of the NDIR measurement system must not contain any mechanical parts, such as microphones or mechanical chopper wheels or rotating filters.

10. The NDIR measurement system must have the ability to define its maximum IR transmission and compensate for any decrease in light source intensity.

11. No external pumps shall be needed to ensure the flow of oil into the DGA.

12. Gases shall be extracted from the transformer oil using the vacuum extraction method.

13. Use of membranes for gas separation from oil shall not be acceptable.

14. 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.

15. 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.

    The online monitoring system shall be able to:

    - 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;
    - Initiate a DGA sample based on PD readings

16. Installation should be able to be performed without an outage if required.

17. With regards to specific Dissolved Gas Analysis, the monitoring system shall have a user interface that provides the following Dissolved Gas Analysis:

    - DGA Graph Trending
    - DGA Instantaneous Values
    - DGA Scheduling
    - DGA Online Monitor Alarm Management
    - Cross Data Trending

- Data Export to User device

18. 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 based on a per-project or transformer basis.

19. 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.

20. The online DGA enclosure must be rated to IP66. Enclosure to be constructed of 304 SS stainless steel that is white powder-coated.

    - The enclosure shall be further protected with a rain shield lip covering swing door.

21. A factory calibration test report for the online DGA must be included during the delivery.

22. The unit shall be capable of tolerating vacuum and overpressure.

23. The DGA must have an automatic recovery after a power outage without any user intervention

24. 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_2H_2, C_2H_4, CO)
Sensor	:	Catalytic Solid-State Sensor

For Methane (CH_4)

Measurement Range	:	20 - 50 000 ppm
Accuracy	:	10 ppm or 10 % of reading
Repeatability	:	10 ppm or 5 % of reading

For Ethane (C_2H_6)

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 (C_2H_4)

Measurement Range	:	5 - 90 000 ppm
Accuracy	:	10 ppm or 10 % of reading
Repeatability	:	10 ppm or 5 % of reading

For Acetylene (C_2H_2)

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.

25. 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

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

26. The online DGA must have the following communications output options
    - RS-485, which supports Modbus RTU and DNP3 Ethernet
    - TCP/IP, which supports Modbus TCP/IP, DNP3, and HTTP
    - include 3 x LED Indicators (Power, Service, Alarm) and Alarm relay contacts
    - support RS232, RS485, Fiber optic, Fiber-optic Ethernet, 4G cellular, Ethernet carriers

27. 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.

28. The Web browser-based user interface shall contain the following information from the DGA
    - All measured parameters in graph format
    - 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

29. The user must be able to download this data in comma-separated values (.csv) format directly from the web browser

30. The user must be able to start and stop the measurement of the online DGA using the web browser interface.

31. The user must be able to configure the relays directly from the web browser.

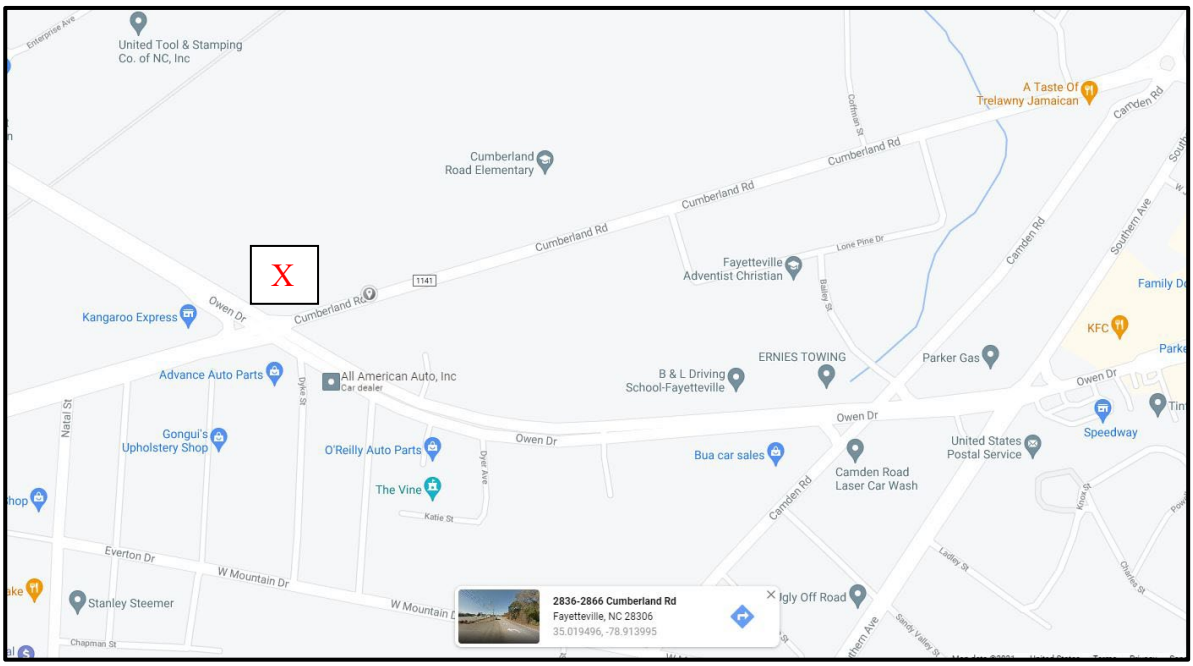
32. Declaration of Conformity or Certificate for EMC & safety type tests according to IEC standards must be provided.

33. Operating power of the unit shall be 60 hertz single-phase 120-240 AC voltage. Other operating voltages allowed are 125 volts DC.

34. Reference acceptable model be TOTUS G5 TTM (single Tank) or equivalent.

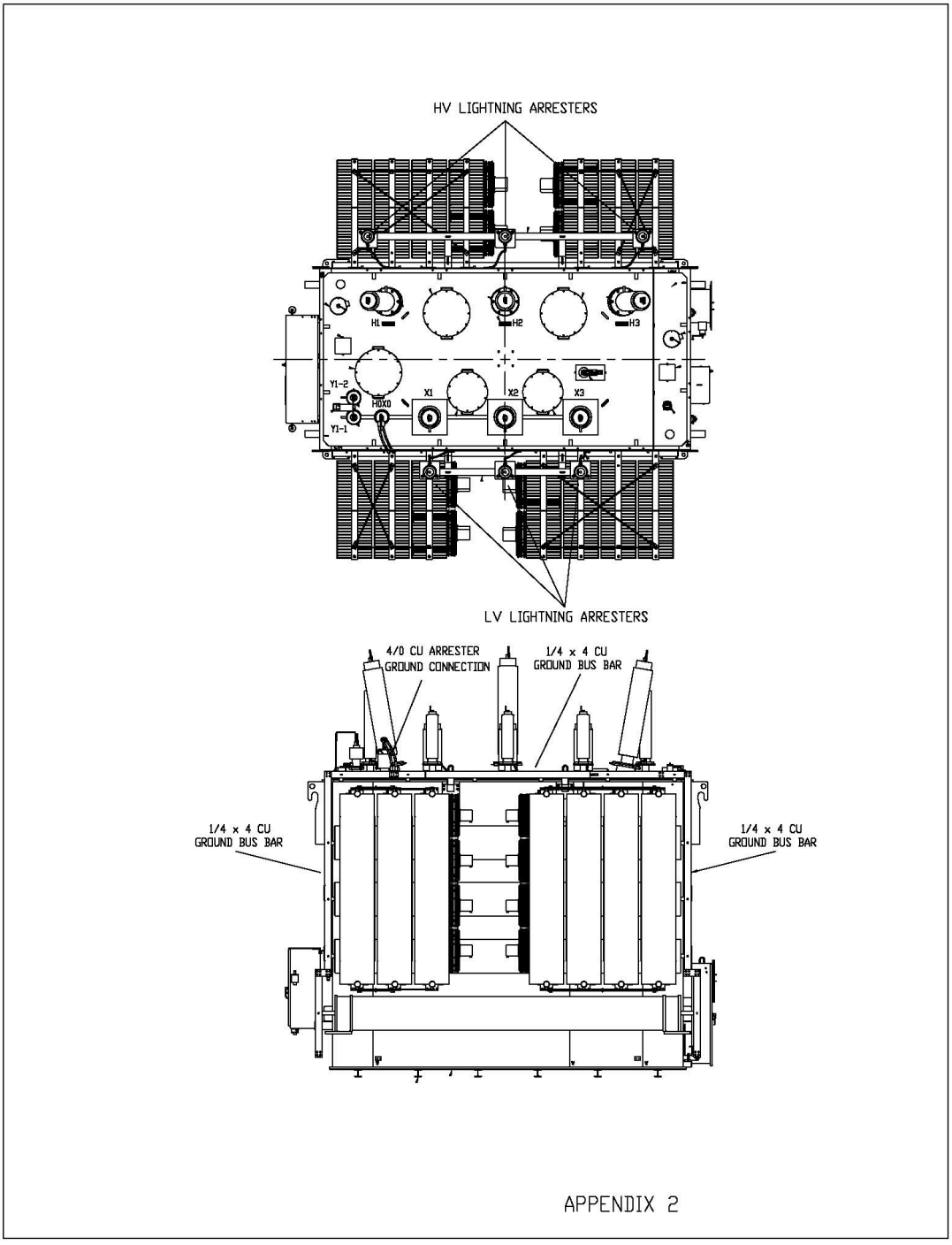
Appendix 1

Area Map for Point of Delivery #1 at 2842 Cumberland Road, Fayetteville, NC 28306

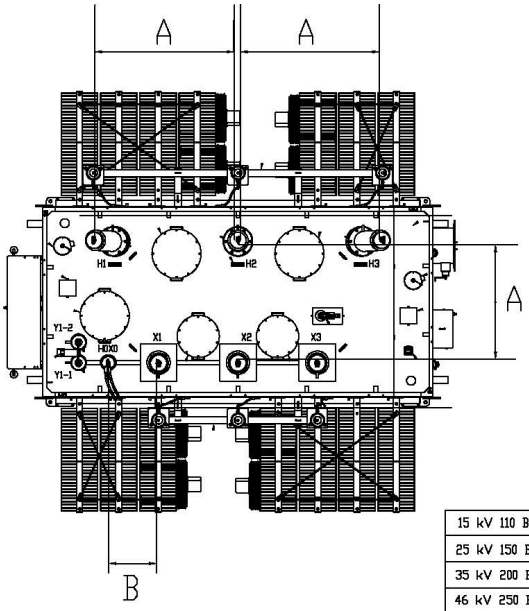


POD3 Waters Edge at 6400 Cliffdale Road

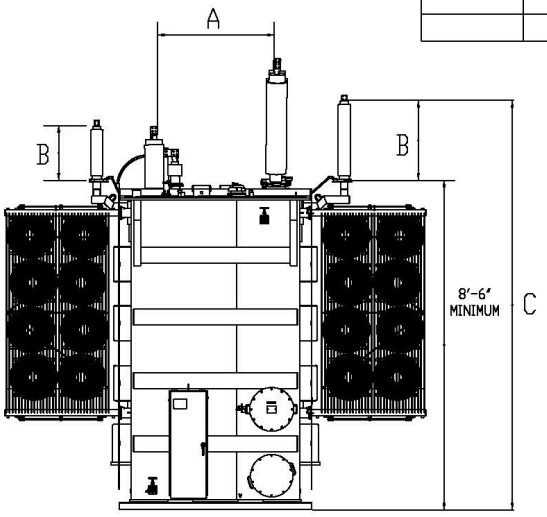
Appendix 2


HV LIGHTNING ARRESTERS
H1
H2
H3
Y1-2
Y1-1
HOXO
X1
X2
X3
LV LIGHTNING ARRESTERS
4/0 CU ARRESTER GROUND CONNECTION
1/4 x 4 CU GROUND BUS BAR
1/4 x 4 CU GROUND BUS BAR
1/4 x 4 CU GROUND BUS BAR
APPENDIX 2

Appendix 3



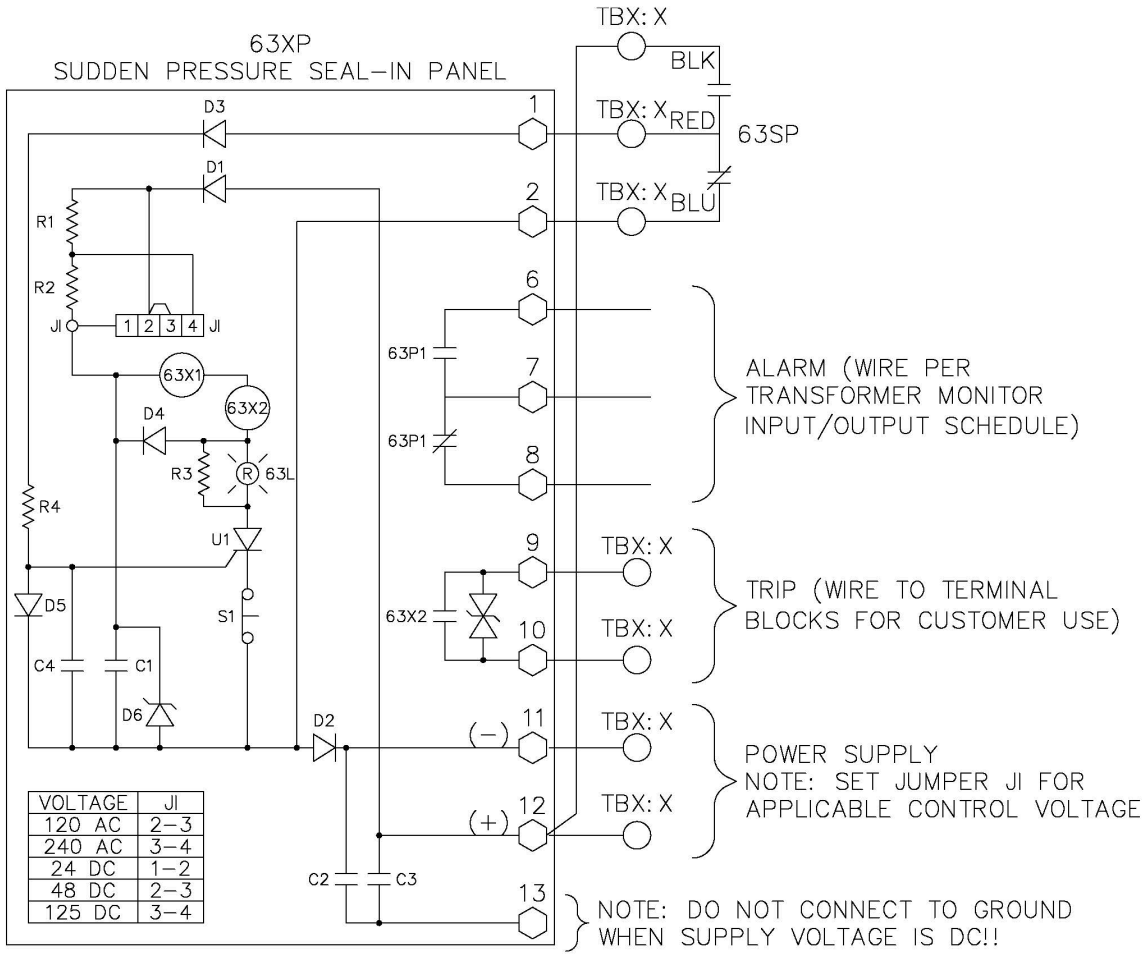
	MEASUREMENTS MINIMUM CLEARANCES IN ANY DIRECTION		
	A MINIMUM METAL TO METAL FOR PHASE CONDUCTORS	B MINIMUM TO GROUNDED PARTS FOR PHASE CONDUCTORS	C MINIMUM OVERHEAD CLEARANCE FOR PHASE CONDUCTORS
15 kV 110 BIL	12″	7″	9′
25 kV 150 BIL	15″	10″	10′
35 kV 200 BIL	18″	13″	10′
46 kV 250 BIL	21″	17″	10′
69 kV 350 BIL	31″	25″	11′
115 kV 450 BIL	42″	34″	12′
115 kV 550 BIL	53″	42″	12′
138 kV 650 BIL	63″	50″	13′
230 kV 825 BIL	81″	65″	15′
230 kV 900 BIL	89″	71″	15′



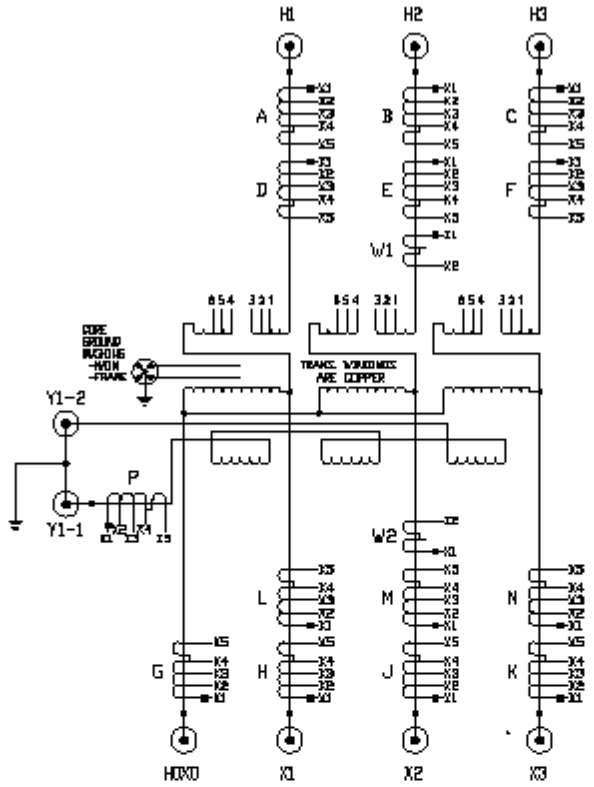
APPENDIX 3

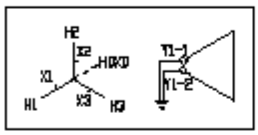
Appendix 4

63XP Sudden Pressure Seal-in Circuit



Appendix 5





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 SCHEDULE NO. 1

Bidder Information:

Name of Company _____

Address _____

Phone Number _____

Email Address _____

NAICS _____

Is the company an N.C. Certified HUB or DBE _____

Printed Name _____

Title _____

Signature _____

Date _____

The bidder declares that it has examined the Technical Specifications for the work and the Invitation for Bid and the Agreement relative thereto, read all special provisions furnished prior to the opening of the bids, and satisfied himself relative to the work to be performed.

The bidder proposes and agrees that if the following schedule or schedules of this bid are accepted, it will contract with the Fayetteville Public Works Commission, in the form of a the Agreement specified, to furnish all necessary materials and equipment, except materials and equipment specified to be furnished by the Commission, complete and in accordance with the Plans, Specifications, and the Agreement, to the full and entire satisfaction of the Commission, with a definite understanding that no money will be allowed for extra work except as set forth in the Agreement, and as cited on Change Order Forms.

Furnish And Deliver:

Item #	QTY.	UOM	DESCRIPTION	UNIT PRICE	EXTENDED PRICE
1	2	E.A.	Two 230/66KV AUTOTRANSFORMER 134.4/179.2/224 MVA AT 65C	$	$

Milestone Payment Schedule:

15% upon approval of the submitted drawings	1	$
30% upon receipt of copper and core steel at the factory	2	$
30% upon shipment of the transformer to the owner	3	$
20% after delivery to the site, setting on pad, dressed, and tested	4	$
5% retainage up to 60 days after delivery	5	$

ATTACHMENT C: MAXIMUM GUARANTEED LOSSES

SCHEDULES 1[(l)]

Maximum guaranteed no-load kW losses, 100% voltage, 75°C, 50 MVA(3)	kW	kW
Maximum guaranteed load kW losses, (not total losses) at 120MVA(3)	kW	kW
Maximum guaranteed Total kW losses, at 120MVA, 75°C(3)	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 and values.
(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.

Delivery (Weeks)*

Bid Schedule No. 1

Approval Drawings**	
Final Drawings**	
Delivery ***	

The following information is supplied regarding the materials and equipment on which this bid is based:

Manufacturer:

Manufacturer of LTC: _____

Type or Model: _____

Location or Manufacturing Facility: _____

Nearest Repair Facility: _____

Percent of Failure of last 100 power transformers at the factory testing: _____

Percent of Failure of last 100 power transformers after installed in field: _____

Other Utilities Purchasing Recent Units of the Same Design:

_____

_____

_____

_____

_____

_____

_____

ATTACHMENT D: FORMS OF EXCEPTIONS – SALE OF GOOD AGREEMENT

BIDDER: _____

MANUFACTURER: _____

INSTRUCTIONS: The following is a list of exceptions to the Sale of Good Agreement pertaining to the furnishing of the subject materials. Bidders shall identify each exception by page and paragraph number on this form. The omission of exceptions implies complete compliance with the Sale of Good Agreement.

PAGE NO. AND PARAGRAPH	EXCEPTION/VARIATION

If, in submitting this bid, the bidder has made any exceptions to bid documents, the bidder understands that PWC will evaluate the effect of such exceptions in determining the award of the agreement.

ATTACHMENT E: FORMS OF EXCEPTIONS – TECHNICAL SPECIFICATIONS

BIDDER: _____

MANUFACTURER: _____

INSTRUCTIONS: The following is a list of exceptions to the Technical Specifications pertaining to the furnishing of the subject materials. Bidders shall identify each exception by page and paragraph number on this form. The omission of exceptions implies complete compliance with the Specification.

PAGE NO. AND PARAGRAPH	EXCEPTION/VARIATION

If, in submitting this bid, the bidder has made any exceptions to bid documents, the bidder understands that PWC will evaluate the effect of such exceptions in determining the award of the agreement.

ATTACHMENT F: 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 or 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

PWC at a Glance

PWC
Fayetteville's
HOMETOWN UTILITY

Customers

- In operation since 1905
- Provides Electric, Water & Wastewater Services
- Total Customers: 121,886
- Number of Services: 274,101
  - Electric: 83,537
  - Water: 92,453
  - Wastewater: 92,100
  - Irrigation: 6,011
- Customers with 2+ services: 75%
- Annual Customer Turnover: 20-25%

Customer Service

- Annual Customer Contacts: 495,136
- Average Monthly Calls: 32,363
- Annual Bills Generated: 1.4 Million
- Customer Incentive Programs: 13
- Annual Water Leak Notifications: 20,363 (17.2 million gal)

Employees

- Number of Employees: 651
- Average Tenure of Employees: 10 years
- Average Age: 45
- Annual Turnover: 9.0%*
- Annual Hours Worked: 1.2 Million

*non retirement

Facilities

- Butler-Warner Generation Plant (268 MW)
  - Electric Service Area: 147 Sq. miles
- P.O. Hoffer Water Treatment Facility (39.5 MGD)
- Glenville Lake Water Treatment Facility (18.0 MGD)
  - Drinking Water Service Area: 116 Sq. miles
- Cross Creek Water Reclamation Facility (25 MGD)
- Rockfish Creek Water Reclamation Facility (21 MGD)
  - Wastewater Service Area: 109 Sq. miles

Electric Operations

- Purchase Wholesale Power from Duke Energy
- Only NC municipal system to own/operate a generation plant (Dispatched for use by Duke Energy)
- Generation Capacity: 268 MW
- Solar Generation: 1 MW
- Battery Storage: 2 MW
- Annual MWH Sold: 1.9 million
- System Peak: 499 MW (Feb. 9, 2015)
- Reliability Rate: 99.99%
- Electric Distribution Substations: 32
- Distribution Lines: 1,360 miles
- Transmission Lines: 123 miles
- Streetlights/Area Lights: 37,853

Water/Wastewater Operations

- Population Served: 225,000
- Drinking Water Treated: 10.7 Billion Gallons/Year
- 100% Compliant for all EPA Drinking Water Standards
- Daily Water Treatment Capacity: 57.5 MG/Day
- Daily Wastewater Treatment Capacity: 46 MG/Day
- Water/Wastewater Infrastructure: 2,825 miles
- Hydrants: 8,616
- Sanitary Sewer Lift Stations: 78
- Manholes: 34,002

Financial

- FY24 Annual Operating Budget: $428.8 Million
- Total Assets: $1.62 Billion
- Bond Rating: Aa2(Moody's), AA (Standard & Poor), AA (Fitch)
- Operations & Maintenance Expense per Customer: $505 ($557 National Median)
- Annual Cash Contributions to the City of Fayetteville in Lieu of Taxes: $12.2 Million
- Annual Streetlight Services: $3.9 Million
- Annual Annexation Construction Costs: $4.8 Million
- Total Annual Contributions to the City of Fayetteville: $25.4 Million

Visit www.faypwc.com to learn more about PWC

(As of May, 2024)

ATTACHMENT H: PWC SALE OF GOOD AGREEMENT

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.

Provider 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 Provider's certified statement showing total purchases of materials from each separate vendor and total sales taxes charged to PWC and paid by Provider. The documentary evidence shall also include Provider'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 Provider'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 Provider;

b. Provider 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. Provider 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. Provider shall not include any tax paid on supplies, tools, and equipment that Provider 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: _____	By: _____
Timothy Bryant, CEO/General Manager	_____, _____
	(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.

ATTACHMENT I: BID SUBMITTAL CHECKLIST

To ensure your bid is considered for evaluation and potential award, the following forms and required information must be submitted in full. Each item on this checklist must be completed and provided with your bid response. Failure to submit any required documentation or information may result in disqualification. Please carefully review the checklist to confirm all required materials are included before submitting your bid.

- ☐ 1. Properly Marked Sealed Bid (Submission Instructions paragraph 4)
- ☐ 2. References (provided on page 5)
- ☐ 3. 5% Bid Deposit (provided on page 5)
- ☐ 4. Descriptive Literature, if applicable (Attachment A)
- ☐ 5. Attachment B Company Information (completed and signed)
- ☐ 6. Attachment B Unit Price, Extended Price, and Milestone Payment Information (provided)
- ☐ 7. Attachment C Maximum Guaranteed Losses and Manufacturer Information (completed)
- ☐ 8. Attachment D and E, if applicable
- ☐ 9. Attachment F (completed and signed) or Explanation (provided)
- ☐ 10. Addendum 1, if applicable (acknowledged and signed)
- ☐ 11. Addendum 2, if applicable (acknowledged and signed)
- ☐ 12. Addendum 3, if applicable (acknowledged and signed)
- ☐ 13. Addendum 4, if applicable (acknowledged and signed)