INVITATION FOR BIDS

GENERATOR PROJECT:
AGRICULTURE BUILDING, HEALTH DEPARTMENT, AND FUEL DEPOT

PENDER COUNTY GOVERNMENT

PENDER COUNTY GOVERNMENT COMPLEX
805 SOUTH WALKER STREET,
BURGAW, NC 28425

PROJECT SCOPE

The Project consists of electrical work for the installation of standby diesel generators, transfer switches, and associated electrical equipment, and circuitry to complete the detailed scope of work included in this submittal.

NOTICE TO BIDDERS

Pender County invites North Carolina Licensed Electrical Contractors to submit a single-prime Lump-Sum bid for the GENERATOR PROJECT: AGRICULTURE BUILDING, HEALTH DEPARTMENT, AND FUEL DEPOT located at 805 South Walker Street, Burgaw, North Carolina 28425. Sealed bids will be received at **Pender County Facilities & Fleet Services, 210 South Bennett Street, Burgaw, NC 28425 until 3:00 p.m. on Thursday, January 16, 2020.** This project will be bid and awarded in accordance with North Carolina G.S. 143-129. The Pender County point of contact for this proposal is:

Allen Vann, Assistant County Manager
Pender County Government
210 South Bennett Street
Burgaw, NC 28425
Phone: (910) 259-0225
Email: avann@pendercountync.gov

NOTE: This project does not require Bid, Performance, or Payment Bonds.

Contractors are hereby notified that they must have proper license under the State laws governing their respective trades and that North Carolina General Statute 87 will be observed in receiving and awarding contracts.

****Prospective bidders may attend a Pre-Bid meeting which will be held at the Pender County Government Administration Building, 805 South Walker Street, Burgaw on January 7, 2020 at 3:00 p.m. A tour of the facilities will take place to describe/elaborate the enclosed scope of work.**

****Prospective bidders may call or email Allen Vann, Assistant County Manager at the information listed above in order to receive a copy of the electronic bid package.**

****IT IS THE RESPONSIBILITY OF RESPECTIVE BIDDERS TO CHECK PENDER COUNTY'S WEBSITE (www.pendercountync.gov) FOR ADDENDA INFORMATION PRIOR TO SUBMITTING BIDS.**

Once submitted, no bid may be withdrawn after the opening of bids for a period of 45 days. The Owner reserves the right to reject any or all bids and waive informalities. Proposals shall be made only on the form provided herein with all blank spaces for bids properly filled in and all signatures properly executed.

Note on the outside of the sealed envelope:

Bid Proposal For:

Generator Project: Agriculture Building, Health Department, and Fuel Depot
January 16, 2020
Attn: Allen Vann
(Name of Contractor)
(License Number)

SELECTION PROCESS

The following is a general description of the process by which the contractor will be selected:

One complete copy of this proposal form must be received by Pender County in a sealed envelope by the date and time specified in the Notice to Bidders. The proposal must be signed and dated by an official who is authorized or has power of attorney to bind the Applicant. Unsigned or uncompleted proposals will not be considered.

Responses to this Invitation for Bids must be received by Pender County no later than the date and time specified. If hand delivered, ensure the proposal is delivered to the office of Pender County Government, Facilities & Fleet Services, 210 South Bennett Street, Burgaw, NC 28425. Delivery to any other location of the county government will not be considered delivered.

THIS IS NOT A CONTRACT OR AN OFFER TO CONTRACT. Contractors are cautioned that this is a request for quotation, not a request to contract, or an offer to contract, or an acceptance of any proposal or offer. Pender County reserves the unqualified right to reject any and/or all submittals when such rejection is deemed to be in its best interest. Additionally, only submitted written questions may be addressed in Addenda; verbal questions and responses are not official and do not change the requirements of this Invitation for Bids.

GENERAL CONDITIONS

GENERAL INSTRUCTIONS

It is understood and agreed that by submitting a bid the Contractor has examined the proposal documents, specifications, visited the site of the Work, and has satisfied themselves relative to the Work to be performed.

MATERIALS, EQUIPMENT AND EMPLOYEES

a. The contractor shall, unless otherwise specified, supply and pay for all labor, transportation, materials, tools, apparatus, lights, power, fuel, sanitary facilities and incidentals necessary for the completion of his work, and shall install, maintain and remove all equipment for the construction, and be responsible for the safe, proper and lawful construction, maintenance and use of same, and shall construct in the best and most workmanlike manner, a complete job and everything incidental thereto, as stated in the specifications, or reasonably implied therefrom, all in accordance with the contract documents.

b. All materials shall be new and of quality specified. Workmanship shall always be of a grade accepted as the best practice of the particular trade involved, and as stipulated in written standards of recognized organizations or institutes of the respective trades except as exceeded or qualified by the specifications.

c. No changes shall be made in the Work except upon written approval and change order of the Owner.

d. If at any time during the construction and completion of the work covered by these contract documents, the conduct of any workman of the various crafts be adjudged a nuisance to the Owner or if any workman be considered detrimental to the work, the Contractor shall order such parties removed immediately from grounds.

e. The contractor shall designate a foreman/superintendent who shall direct the work. An email address and cell number shall be provided upon receipt of notice to proceed.

CODES, PERMITS AND INSPECTIONS

a. The Contractor shall obtain the required permits, give all notice and comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work under this contract. If the Contractor observes that the drawings and specifications are at variance therewith, he shall promptly notify the Owner in writing. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, codes, rules and regulations, and without such notice to the Owner, he shall bear all cost arising therefrom.

b. All work under this contract shall conform to the 2018 North Carolina State Building Code and other state and national codes as are applicable.

SAFETY REQUIREMENTS

a. The Contractor shall be responsible for the entire site and the construction of the same and provide all the necessary protections as required by laws or ordinances governing such conditions and as required by the Owner. They shall be responsible for any damage to the Owner's property or that of others on the job, by themselves, their personnel or their subcontractors, and shall make good such damages. They shall be responsible for and pay for any claims against the Owner arising from such damages.

b. The Contractor shall adhere to the rules, regulations and interpretations of the North Carolina Department of labor relating to Occupational Safety and Health Standards for the Construction Industry (Title 29, Code of Federal Regulations, Part 1926 published in Volume 39, Number 122, Part 11, June 24, 1974 Federal Register), and revisions thereto as adopted by General Statutes of North Carolina 95-126 through 155.

c. The Contractor shall provide all necessary safety measures for the protection of all persons on the work, including the requirements of the A.G.C. Accident Prevention Manual in Construction as amended, and shall fully comply with all state laws or regulations and North Carolina State

Building Code requirements to prevent accident or injury to persons on or about the location of the work. They shall clearly mark or post signs warning of hazards existing and shall barricade excavations and similar hazards. They shall protect against damage or injury resulting from falling materials and shall maintain all protective devices and signs throughout the progress of the work.

d. The Contractor shall be responsible for moving all furniture, fixtures, and/or physical improvements required to complete the scope of work outlined.

e. The Contractor shall provide a port-o-john that is to be used by all individuals associated with the work outlined in this proposal. Under no circumstances shall indoor restroom facilities be used.

EQUAL OPPORTUNITY

a. The non-discrimination clause contained in Section 202 (Federal) Executive Order 11246, as amended by Executive Order 11375, relative to Equal Employment Opportunity for all persons without regard to race, color, religion, sex or national origin, and the implementing rules and regulations prescribed by the Secretary of Labor, are incorporated herein.

b. The Contractors agree not to discriminate against any employees or applicant for employment because of physical or mental handicap regarding any position for which the employees or applicant is qualified. The Contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices.

INSURANCE

The Contractor shall not commence work until they have obtained all insurance required, and such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on the subcontract until all similar insurance required of the subcontractor has been obtained.

The Contractor shall provide and maintain during the life of this contract Workmen's Compensation Insurance for all employees employed at the site of the project under their contract in compliance with North Carolina requirements.

The Contractor shall provide and maintain during the life of this contract such Public Liability and Property Damage Insurance as shall protect them and any subcontractor performing work covered by this contract, from claims for damage for personal injury, including accidental death, as well as from claims for property damages which may arise from operations under the contract, whether such operation be by the Contractor themselves or by any subcontractor, or by anyone directly or indirectly employed by either of them and the amounts of such insurance shall be as follows:
Public Liability Insurance in an amount not less than $1,000,000 for injuries, including accidental death, to any one person and subject to the same limit for each person, in amount not less than $500,000 on account of one accident; and Property Damage Insurance in an amount not less than $500,000.

The Contractor shall furnish such additional insurance as may be required by General Statutes of North Carolina, including motor vehicle insurance in amounts not less than statutory limits.

Each Certificate of Insurance shall bear the provision that the policy cannot be canceled, reduced in amount or coverage eliminated in less than fifteen (15) days after mailing written notice to the insured and/or the Owner of such alteration or cancellation, sent by registered mail.

The Contractor shall furnish the Owner with satisfactory proof of carriage of the insurance required before written approval is granted by the Owner.

INVOICES FOR PAYMENT

Partial Payment Requests may be submitted to the Owner's Project Manager (Allen Vann) on or about the 25th of each month of the project. All partial payment requests shall be accompanied by a County approved Schedule of Values reflecting the work completed in the preceding month. In addition, a copy of all materials invoices, and a Sales Tax Listing, and Sales Tax Affidavit shall be submitted with each request. Final payment will be made within fifteen (15) consecutive days after acceptance of the work and the submission both of notarized contractor's affidavit and copies of any remaining invoices which are to include the contract, account and job order numbers.

The contractor's affidavit shall state: "This is to certify that all costs of materials, equipment, labor, and all else entering into the accomplishment of this contract, including payrolls, have been paid in full."

Executed contract documents, insurance certifications and, upon completion and acceptance of the work, invoices and other information requested are to be sent to:

Allen Vann, Assistant County Manager
Pender County Government
210 South Bennett Street
Burgaw, NC 28425

It is imperative that contract documents, invoices, etc., be sent only to the above address in order to assure proper and timely delivery and handling.

CLEANING UP

a. The Contractor shall always keep the sites and surrounding area reasonably free from rubbish and shall remove debris from the site from time to time or when directed to do so by the Owner. Before final inspection and acceptance of the project, the Contractor shall thoroughly clean the site, and completely prepare the project and site for use by the Owner.

GUARANTEE

a. The contractor shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve (12) months following the final acceptance of the work and shall replace such defective materials or workmanship without cost to the owner.

b. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that piece of equipment or material. The contractor shall replace such defective equipment or materials, without cost to the owner, within the manufacturer's warranty period.

c. Additionally, the owner may bring an action for latent defects caused by the negligence of the contractor, which is hidden or not readily apparent to the owner at the time of beneficial occupancy or final acceptance, whichever occurred first, in accordance with applicable law.

CONTRACTOR-SUBCONTRACTOR RELATIONSHIPS

The Contractor agrees that the terms of these contract documents shall apply equally to a Subcontractor as to the Contractor, and that the subcontractor is bound by those terms as an employee of the Contractor.

SUPPLEMENTARY GENERAL CONDITIONS

TIME OF COMPLETION

The Contractor shall commence work to be performed under the Contract on a date to be specified in written order from the Owner and shall fully complete all work hereunder within **116** consecutive calendar days from the Notice to Proceed for the contract.

Tentative Schedule:

Notice to Proceed	February 4, 2020
Pre-Construction Meeting	February 18, 2020
Substantial Completion	May 29, 2020
Final Completion	June 19, 2020

If the Contractor is delayed at any time in the progress of his work by any act or negligence of the Owner, his employees or his separate contractor, by changes ordered in the work; by abnormal weather conditions; by any causes beyond the Contractor's control or by other causes deemed justifiable by Owner, then the contract time may be reasonably extended in a written order from the Owner upon written request from the contractor within ten days following the cause for delay.

PERFORMANCE AND PAYMENT BONDS

Not required.

EXHIBITS

- **Technical Specifications – Cheatham and Associates, P.A.**
- **Electrical Renovations Drawings – Cheatham and Associates, P.A.**
  - **E-001 NOTES, LEGENDS, LOADS, & LOCATION MAP**
  - **E-011 SITE PLAN**
  - **E-101 AGRICULTURE BUILDING**
  - **E-102 FUEL FACILITY DEMOLITION**
  - **E-103 FUEL FACILITY NEW WORK**
  - **E-104 HEALTH DEPARTMENT BUILDING**
  - **E-501 DETAILS**
  - **E-502 DETAILS**

TECHNICAL SPECIFICATIONS

26 00 00	**Electrical, Basics**
26 05 00	**Basic Materials and Methods**
26 05 19	**Conductors and Cables**
26 05 26	**Grounding and Bonding**
26 05 33	**Raceways and Boxes**
26 05 53	**Electrical Identification**
26 22 00	**Dry-Type Transformers (600V and less)**
26 27 26	**Wiring Devices**
26 28 16	**Enclosed Switches and Circuit Breakers**
26 32 13	**Engine Generators**
26 36 00	**Transfer Switches**

BID PROPOSAL

1) SIGNED AND SEALED BID PROPOSAL

PROPOSAL

For

Generator Project: Agriculture Building, Health Department, and Fuel Depot

The undersigned, as bidder, proposes and agrees if this proposal is accepted to contract with Pender County for the furnishing of all materials, equipment, and labor necessary to complete the construction of the work described in these documents in full and complete accordance with plans, specifications, and contract documents, and to the full and entire satisfaction of Pender County for the sum of:

BASE BID: _____ Dollars $_____

Respectively submitted this ____ day of_____2019.

_____

(Name of firm or corporation making bid)

Federal ID#:_____

Attest: By: _____

_____ Title: _____

_____

_____ Address: _____

Title

_____

_____

(Corporate Seal)

ELECTRICAL NOTES

1. ELECTRICAL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND REQUIREMENTS OF THE LOCAL AUTHORITY HAVING JURISDICTION.
2. PERMITS FOR ELECTRICAL WORK SHALL BE OBTAINED BY AND PAID BY THE ELECTRICAL CONTRACTOR. THE ELECTRICAL CONTRACTOR SHALL PAY FOR ANY ADDITIONAL FEES FOR INSPECTIONS, TESTS, AND OTHER SERVICES AS REQUIRED FOR THE COMPLETION OF THE WORK.
3. THE ELECTRICAL CONTRACTOR AND ANY OF HIS SUBCONTRACTORS SHALL VISIT THE PROJECT SITE TO WITNESS EXISTING CONDITIONS AND BECOME FAMILIAR WITH THE SCOPE OF THE WORK REQUIRED PRIOR TO SUBMITTING PROPOSALS. WORK REQUIRED BY EXISTING JOB CONDITIONS NOT INDICATED ON DRAWINGS SHALL BE INCLUDED IN THE BID.
4. THE DRAWINGS AND SPECIFICATIONS ARE INTENDED TO RESULT IN THE PRODUCTION OF A COMPLETE AND FUNCTIONAL ELECTRICAL SYSTEM. THE ELECTRICAL CONTRACTOR SHALL PROVIDE ALL MATERIAL, LABOR, EQUIPMENT, AND OTHER SERVICES AS NECESSARY TO COMPLETE THE WORK.
5. DISCREPANCIES IN THE DRAWINGS AND SPECIFICATIONS THAT WILL AFFECT THE WORK SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER, AND/OR OWNER PRIOR TO SUBMITTING PROPOSALS.
6. UNLESS NOTED OTHERWISE, ALL MATERIALS AND EQUIPMENT SHALL BE NEW AND INCLUDE A 3RD PARTY LABEL (I.E.: UL, CSA, ETL, ETC.) LISTING APPROVAL FOR ITS INSTALLED APPLICATION.
7. PENETRATIONS OF FIRE-RATED WALLS, FLOORS, CEILINGS, AND PARTITIONS SHALL BE FIRE STOPPED IN ACCORDANCE WITH REQUIREMENTS OF THE STATE BUILDING CODE. COORDINATE WORK TO INSURE THAT FIRE STOPPING IS COMPLETED.
8. PENETRATIONS OF SMOKE PARTITIONS SHALL BE SEALED IN ACCORDANCE WITH REQUIREMENTS OF THE STATE BUILDING CODE. COORDINATE WORK TO INSURE THAT SMOKE PARTITION SEALING IS COMPLETED.
9. PENETRATIONS OF EXTERIOR BUILDING WALLS, FLOORS, OR ROOFS SHALL BE SEALED WATERTIGHT. INTERIORS OF RACEWAY PENETRATIONS THROUGH EXTERIOR WALLS SHALL BE SEALED WITH NON-HARDENING ELECTRICAL PUTTY.
10. CUTTING AND PATCHING TO INSTALL DEVICES AND EQUIPMENT SHALL BE PERFORMED WITH FINISHES RESTORED TO THEIR ORIGINAL CONDITION. SUCH WORK SHALL BE COMPLETED TO A DEGREE THAT IS ACCEPTABLE TO THE ENGINEER, AND/OR OWNER..
11. VERIFY PROPER SIZING OF OVERLOAD DEVICES IN STARTERS BASED ON EQUIPMENT NAMEPLATE DATA.
12. WHERE WORKING IN EXISTING BUILDINGS, FACILITIES, OR STRUCTURES; PROTECT AND MAINTAIN IN OPERATION EXISTING LIFE SAFETY SYSTEMS, PUBLIC ADDRESS SYSTEMS, ELECTRICAL SYSTEMS, ETC. IF SHUTDOWNS ARE REQUIRED, NOTIFY THE ENGINEER, AND OWNER FOR COORDINATION WELL IN ADVANCE OF ANY SYSTEM SHUTDOWN. WHERE AN OUTAGE OF EXTENDED DURATION IS NOT ACCEPTABLE TO THE OWNER, PROVIDE TEMPORARY CONNECTIONS AS REQUIRED TO MAINTAIN SERVICE.
13. WHERE WORKING IN EXISTING BUILDINGS, FACILITIES, OR STRUCTURES; WORK MAY BE REQUIRED TO BE PERFORMED WHILE REMAINING OCCUPIED BY OWNER STAFF. WORK SHALL BE COORDINATED WITH THE OWNER TO MINIMIZE DISRUPTION TO THE OWNER.
14. WHERE WORKING IN EXISTING BUILDINGS, FACILITIES, OR STRUCTURES; EXISTING ABANDONED CIRCUITS USED TO CONNECT NEW LOADS IN THE SAME AREA SHALL BE CLEARLY IDENTIFIED ON AS-BUILT MARK-UP DRAWINGS WITH REGARD TO PANEL-CIRCUIT AND CIRCUITRY ROUTING CONFIGURATION.
15. ABANDONED CIRCUITRY (RACEWAY & CONDUCTORS) SHALL BE REMOVED IN ITS ENTIRETY FROM ITS SOURCE. ABANDONED LOW VOLTAGE CABLING SHALL BE REMOVED IN ITS ENTIRETY UNLESS OTHERWISE NOTED.
16. LOAD CIRCUITS SHALL BE INSTALLED AS INDICATED ON THE DRAWINGS. CIRCUITRY REVISIONS WILL NOT BE ACCEPTED UNLESS APPROVED IN WRITING BY THE ENGINEER.

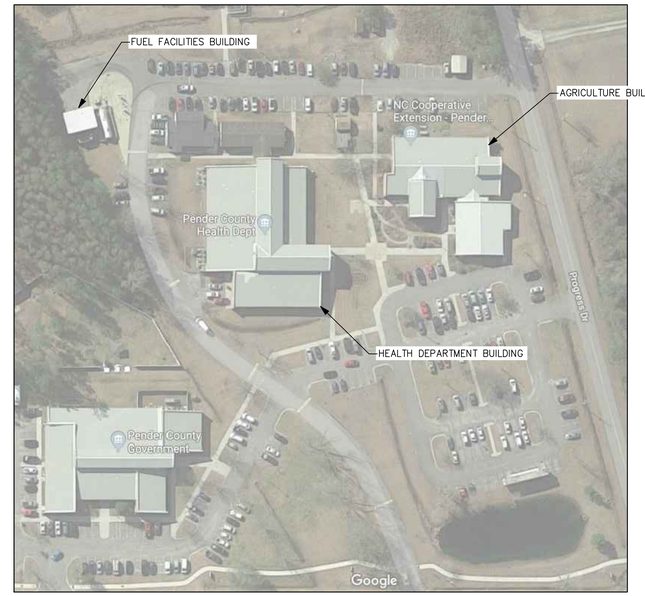
ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AIC	AMPS INTERRUPTING CAPABILITY
ATS	AUTOMATIC TRANSFER SWITCH
BKR	BREAKER
C	CONDUIT
C/B	CIRCUIT BREAKER
CKT	CIRCUIT
CMU	CONCRETE MASONARY UNIT
CU	COPPER
DTSS	DOUBLE THROW SAFETY SWITCH
DWG	DRAWING
EC	ELECTRICAL CONTRACTOR
EXIST.	EXISTING
G	EQUIPMENT GROUND
GEC	GROUNDING ELECTRODE CONDUCTOR
GFCI	GROUND FAULT CIRCUIT INTERRUPTERT
HTR	HEATER
K	KILO (THOUSAND)
MCB	MAIN CIRCUIT BREAKER
MDP	MAIN DISTRIBUTION PANEL
MFR	MANUFACTURER
MLO	MAIN LUG ONLY
MTS	MANUAL TRANSFER SWITCH
N	NEUTRAL
N/A	NOT APPLICABLE
NEC	NATIONAL ELECTRICAL CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOC.
NTS	NOT TO SCALE
P	PHASE OR POLE
PH	PHASE
PNL	PANEL
PVC	POLYVINYL CHLORIDE
REC	RECEPTACLE
RECPT	RECEPTACLE
REQ.	REQUIRED
SYS	SYSTEM
S/N	SOLID NEUTRAL
TYP	TYPICAL
UL	UNDERWRITERS LABORATORY
UNO	UNLESS NOTED OTHERWISE
UON	UNLESS OTHERWISE NOTED
V	VOLTS
VA	VOLT-AMPS
W	WATTS
W	WIRE
W/	WITH
WP	WEATHERPROOF
XFMR	TRANSFORMER

ELECTRICAL DRAWING LIST

E-001	NOTES, LEGENDS, LOCATION MAP
E-011	ELECTRICAL SITE PLAN
E-101	AGRICULTURE BUILDING RENOVATIONS
E-102	FUEL FACILITY DEMOLITION
E-103	FUEL FACILITY CONSTRUCTION
E-104	HEALTH DEPARTMENT BUILDING
E-501	DETAILS
E-502	DETAILS

LOAD SUMMARY AG BUILDING	EXISTING DMDP SERVICE		EXISTING MDP SERVICE		COMBINED SERVICE	
12 Month Recorded Peak Demand (kW)	76.0	kW	23.0	kW	99.0	kW
25% Additional Load (NEC 220.87)	19.0		5.8		24.8	
Total (kW)	95.0	kW	28.8	kW	123.8	kW
Estimated Power Factor	85%		85%		85%	
kVA	111.8	kVA	33.8	kVA	145.6	kVA
Additional Connected Load (kVA)	0.0	kVA	0.0	kVA	0.0	kVA
Total Load (kVA)	111.8	kVA	33.8	kVA	145.6	kVA
Service Voltage					480	Volts
Amps @ Service Voltage					175.1	Amps



A E-001 LOCATION MAP
SCALE: N/A

MISC. ELECTRICAL SYMBOL LEGEND

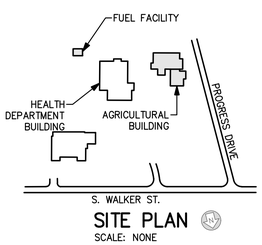
	ENCLOSED CIRCUIT BREAKER, NEMA 1 (UNO), AMPERAGE AS INDICATED OR BASED ON SUPPLY CIRCUIT RATING.
	DOUBLE THROW SAFETY SWITCH , HEAVY-DUTY, FUSED. NEMA 1 INSIDE, NEMA 3R OUTSIDE (UNO), AMPERAGE AS INDICATED OR BASED ON SUPPLY CIRCUIT BREAKER RATING.
	PANELBOARD
T	TRANSFORMER, DRY TYPE, RATINGS INDICATED, NEMA 3R (PAINTED STAINLESS STEEL) ENCLOSURE (UNO). PROVIDE 18" HIGH CONCRETE HOUSE KEEPING PAD.
	GROUND ROD, 3/4" X 10' COPPER CLAD. WHERE TWO RODS ARE INDICATED, SPACE A MINIMUM OF 20' APART.

HOMERUN DESIGNATION, #12 CONDUCTORS UNLESS NOTED OTHERWISE.
EQUIPMENT GROUND CONDUCTOR
PHASE CONDUCTOR
NEUTRAL CONDUCTOR

A E-505
LETTER INDICATES ELEVATION OR DETAIL; NUMBER INDICATES PLAN OR SECTION
SHEET NUMBER WHERE PLAN, SECTION, ELEVATION OR DETAIL IS DRAWN

RECEPTACLE LEGEND

SYMBOL	NEMA	VOLTS	DESCRIPTION
BLK HTR	5-20R	120V 1P 2W	POWER FOR GENERATOR BLOCK HEATER
W/G	5-20R	120V 1P 2W	DUPLEX GFCI, MTD 18" AFG UNO; LISTED WEATHER-RESISTANT TYPE; PROVIDE CAST ALUMINUM WEATHERPROOF IN-USE COVER WITH CAST ALUMINUM FD WEATHERPROOF BOX
BATT CHG	5-20R	120V 1P 2W	POWER FOR GENERATOR BATTERY CHARGER, BATTERY HEATER, & WINDING HEATER



SITE PLAN
SCALE: NONE

REVISION	
DATE	DESCRIPTION

PENDER COUNTY GOVERNMENT GENERATORS
ELECTRICAL RENOVATIONS
NOTES, LEGENDS, LOADS, & LOCATION MAP
BURGAW, NORTH CAROLINA

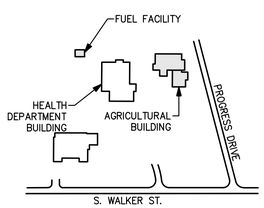
CHEATHAM AND ASSOCIATES, P.A.
CONSULTING ENGINEERS
3412 ENTERPRISE DRIVE
WILMINGTON, NORTH CAROLINA 28405
PH: (910)452-4210 FAX: (910)452-4211
E-MAIL: INFO@CHEATHAMPA.COM
NC LICENSE #C-1072
WWW.CHEATHAMPA.COM

NORTH CAROLINA PROFESSIONAL SEAL 17895 ENGINEER MARK A. CIARROCCA
12/6/2019

DESIGNED BY	K. FORTIER
DRAWN BY	K. FORTIER
CHECKED BY	M. CIARROCCA
JOB NUMBER	19064
SHEET	E-001
DATE	NOVEMBER 18, 2019

1 E-011 ELECTRICAL SITE PLAN
SCALE: 1" = 40'-0"

GRAPHIC SCALE: 1"=40'
0 10 20 40 80



SITE PLAN
SCALE: NONE

REVISION	
DATE	DESCRIPTION

PENDER COUNTY GOVERNMENT GENERATORS

ELECTRICAL RENOVATIONS
SITE PLAN
BURGAW, NORTH CAROLINA

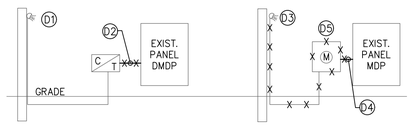
CHEATHAM AND ASSOCIATES, P.A.
CONSULTING ENGINEERS
3412 ENTERPRISE DRIVE
WILMINGTON, NORTH CAROLINA 28405
PH: (910)452-4210 FAX: (910)452-4211
E-MAIL: INFO@CHEATHAMPA.COM
NC LICENSE #C-1073
WWW.CHEATHAMPA.COM

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 17693 MARK A. CIARROCCA 18 DEC 2019

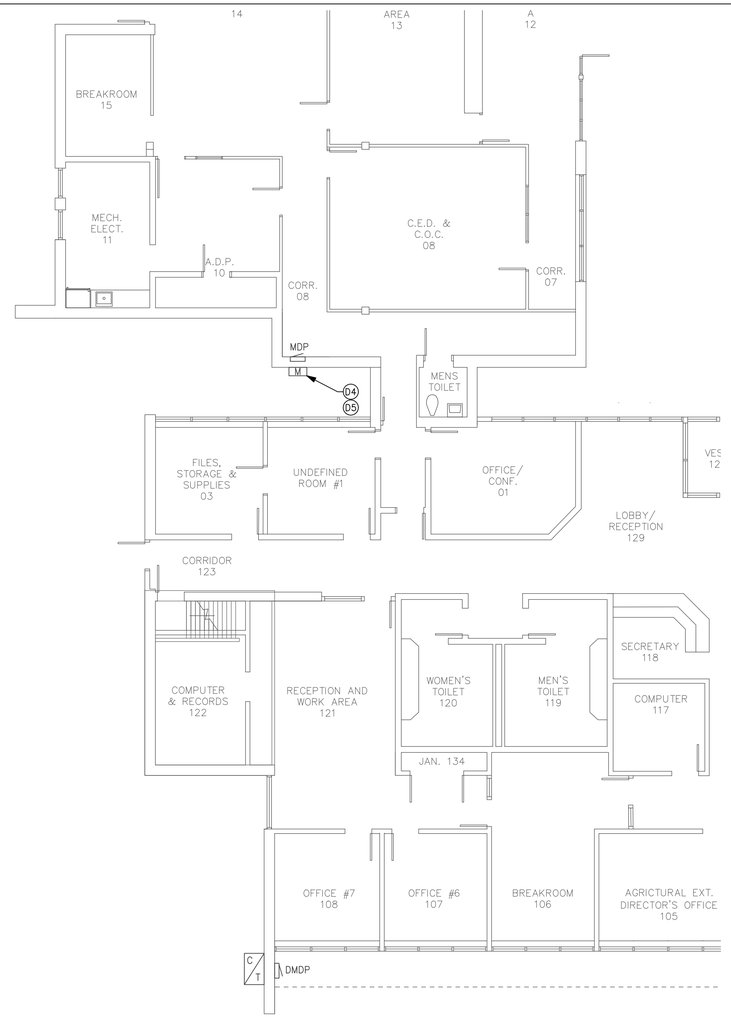
DESIGNED BY	K. FORTIER
DRAWN BY	K. FORTIER
CHECKED BY	M. CIARROCCA
JOB NUMBER	19064
SHEET	E-011
DATE	NOVEMBER 18, 2019

KEYED NOTES (DEMOLITION WORK):

1. (D1) EXISTING UTLITY POLE MOUNTED TRANSFORMER 480/277V,3PH,4W TO REMAIN.
2. (D2) REMOVE EXISTING 3 1/2"C,3#500KCMIL,#500KCM N.
3. (D3) COORDINATE REMOVAL OF EXISTING UTILITY SERVICE WITH DUKE.
4. (D4) EXISTING 2 1/2"C TO REMAIN, REMOVE EXISTING 3#4/0,#4/0 N.
5. (D5) REMOVE EXISTING METER BASE. COORDINATE WITH DUKE ENERGY FOR SERVICE REMOVAL.

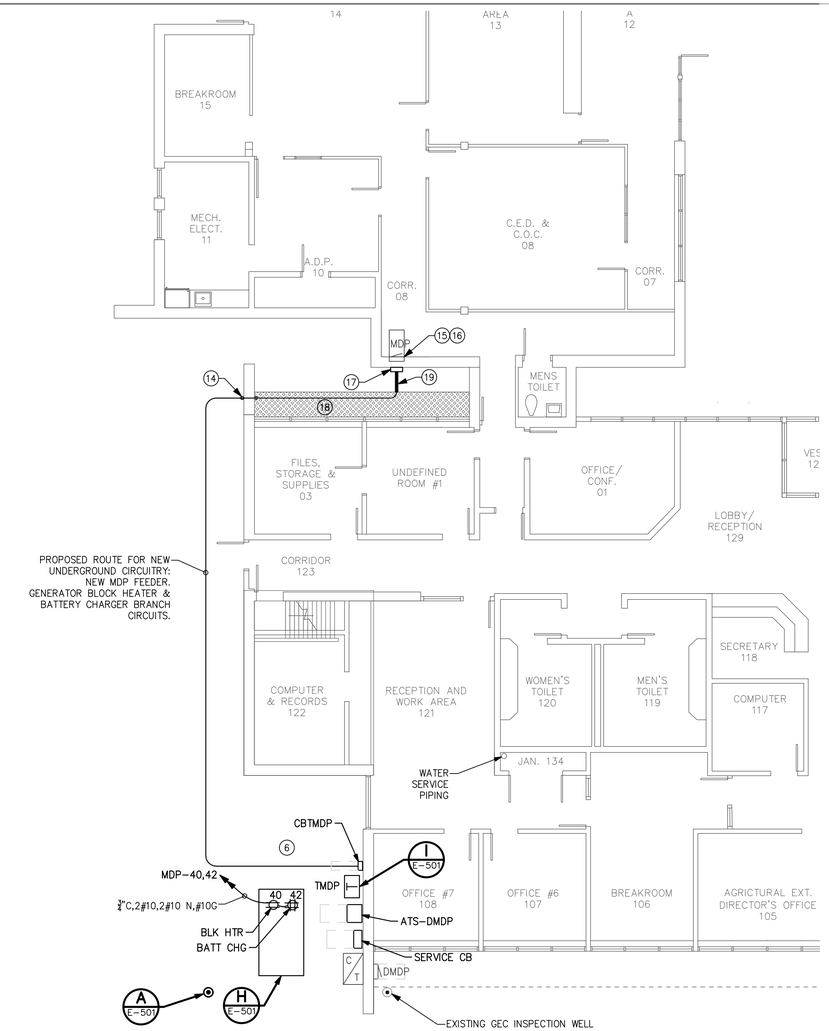


C / E-101 ELECTRICAL DEMOLITION RISER – AGRICULTURE BUILDING
SCALE: N/A



1 / E-101 ELECTRICAL DEMOLITION PLAN – AGRICULTURE BUILDING
SCALE: 1/8" = 1'-0"

PLAN NORTH TRUE NORTH GRAPHIC SCALE: 1/8"=1'-0" 0 2 4 8 16

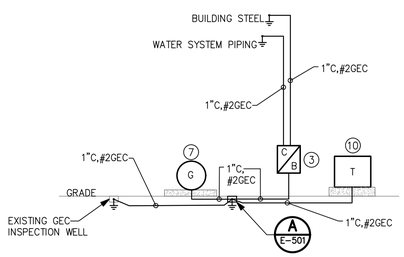


2 / E-101 ELECTRICAL NEW WORK PLAN – AGRICULTURE BUILDING
SCALE: 1/8" = 1'-0"

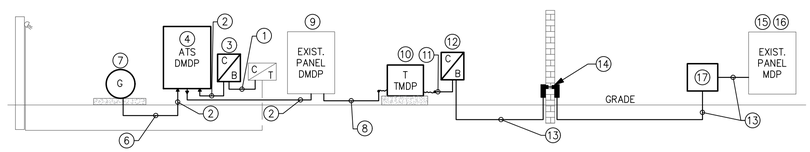
PLAN NORTH TRUE NORTH GRAPHIC SCALE: 1/8"=1'-0" 0 2 4 8 16

KEYED NOTES (NEW WORK):

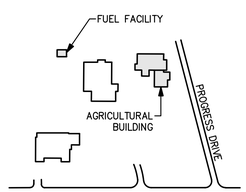
1. 2 2 1/2"C,3#250KCM,#250KCMIL N.
2. 2 1/2"C,3#250KCM,#250KCMIL N,#4G.
3. ENCLOSED CIRCUIT BREAKER (SERVICE) 600V, 3P, S/N, 250A, ULSE, 25KAIC, NEMA-3R.
4. AUTOMATIC TRANSFER SWITCH (ATS-DMDP). 600V, 4P, 260A, NEMA-3R.
5. 3/4"C,2#14,#14G (STOP/START CIRCUIT).
6. REMOVE EXISTING TREE. LEVEL GRADE AFTER TREE REMOVAL AND TRENCHING FOR UNDERGROUND CIRCUITRY.
7. GENERATOR: 150KW, 480/277V, 3PH, 4W, 250A BREAKER.
8. 1 1/2"C,3#2,#8G.
9. PROVIDE CIRCUIT BREAKER 3P, 100A, 25KAIC, IN AVAILABLE SPACE FOR NEW TRANSFORMER FEEDER. EXISTING PANEL MANUFACTURED BY CUTLER HAMMER (TYPE PRL1A).
10. TRANSFORMER (TMDP) 75KVA, 480V, 3PH TO 208/120V, 3PH, 4W, NEMA-3R PROVIDE 18" CONCRETE HOUSEKEEPING PAD.
11. 2 2 1/2"C,3#4/0,#4/0 N,#2G.
12. ENCLOSED CIRCUIT BREAKER (CBTMDP) 240V, 3P, 225A, S/N, 10KAIC, NEMA-3R.
13. 2 2 1/2"C,3#4/0,#4/0 N,#4G.
14. LB CONDUIT BODY (TYPICAL). PENETRATE EXISTING BRICK WALL FOR FEEDER INSTALLATION THEN SEAL.
15. ISOLATE THE NEUTRAL CONDUCTOR SYSTEM FROM THE EQUIPMENT GROUNDING SYSTEM IN EXISTING PANELS MDP AND DMDP.
16. PROVIDE (2) 1P/20A CIRCUIT BREAKERS FOR BATTERY CHARGER & BLOCK HEATER IN SPACES 40 & 42, EXISTING PANEL IS MANUFACTURED BY SQ-D (NQOD TYPE).
17. 16"X16"X6" PULLBOX, NEMA 3R.
18. EXISTING CONCRETE PAVERS. REMOVE FOR RACEWAY INSTALLATION & RE-INSTALL WHEN COMPLETED.
19. CUT & PATCH EXISTING CONCRETE TO ACCOMMODATE UNDERGROUND CIRCUITRY INSTALLATION.



B / E-101 GROUNDING SYSTEM RISER – AGRICULTURE BUILDING
SCALE: N/A



A / E-101 ELECTRICAL NEW WORK RISER – AGRICULTURE BUILDING
SCALE: N/A



SITE PLAN
SCALE: NONE

REVISION	
DATE	DESCRIPTION

PENDER COUNTY GOVERNMENT GENERATORS

ELECTRICAL RENOVATIONS
AGRICULTURE BUILDING
BURGAW, NORTH CAROLINA

CHEATHAM AND ASSOCIATES, P.A.
CONSULTING ENGINEERS
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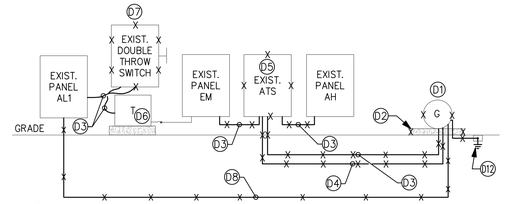
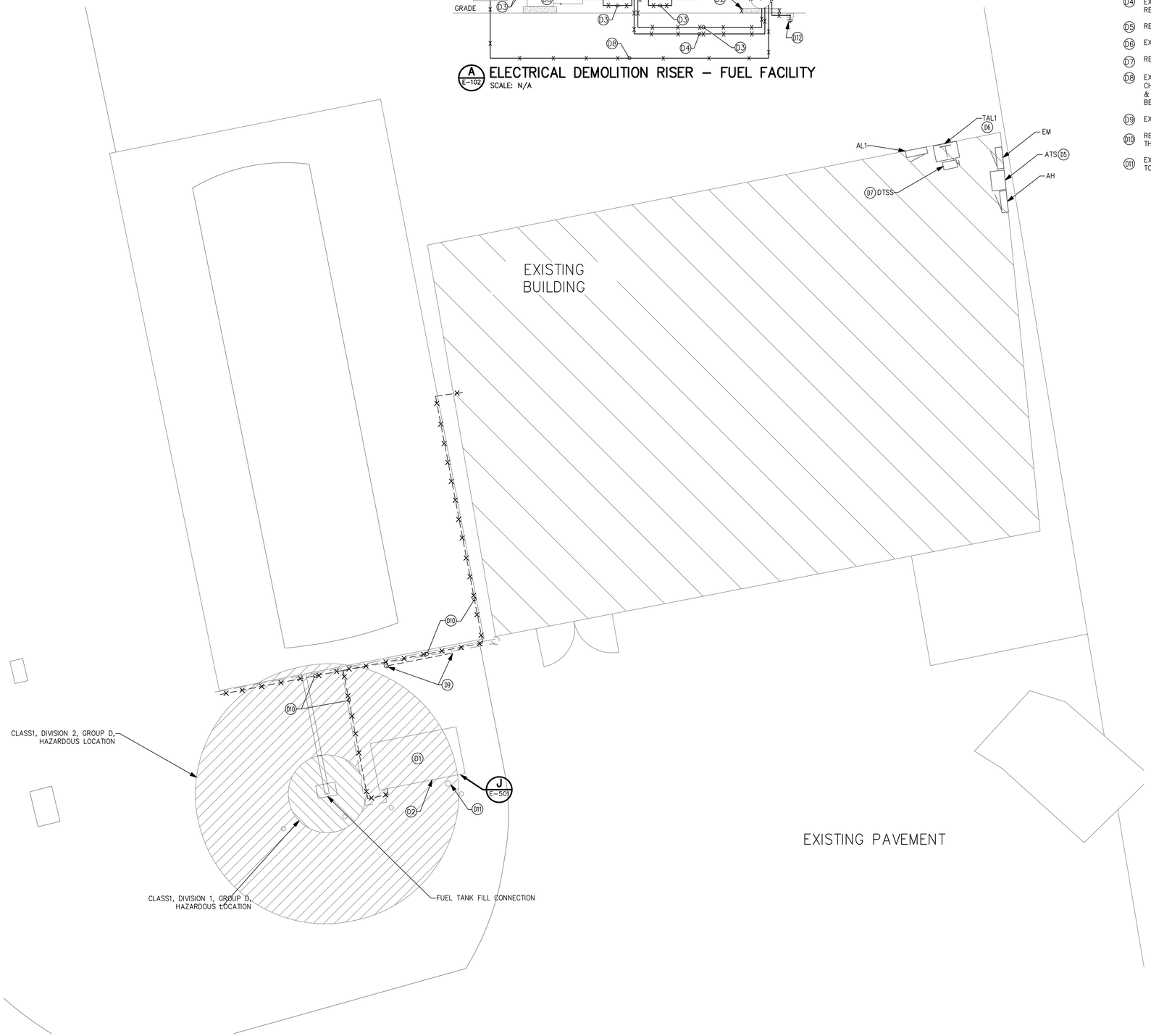
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 17993 18 DEC 2019 MARK A. CIARROCCA

DESIGNED BY	K. FORTIER
DRAWN BY	K. FORTIER
CHECKED BY	M. CIARROCCA
JOB NUMBER	19064
SHEET	E-101
DATE	NOVEMBER 18, 2019



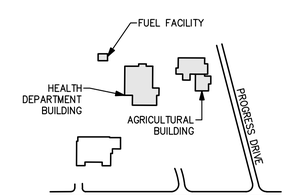
A E-102 ELECTRICAL DEMOLITION RISER – FUEL FACILITY
SCALE: N/A



1 E-102 ELECTRICAL DEMOLITION PLAN – FUELING FACILITY
SCALE: 1/4" = 1'-0"

PLAN NORTH TRUE NORTH

GRAPHIC SCALE: 1/4"=1'-0"
0 1 2 4 8



SITE PLAN
SCALE: NONE

KEYED NOTES (DEMOLITION WORK):

D1 REMOVE EXISTING 20KW GENERATOR.

D2 REMOVE EXISTING PAD. PATCH &REPAIR CONCRETE TO MATCH EXISTING. SEE DETAIL.

D3 REMOVE EXISTING 1"C 3#6,#10G FEEDER.

D4 EXISTING ¾"C, 2#14,#14G (STOP/START CIRCUIT) TO BE REMOVED.

D5 REMOVE EXISTING ATS.

D6 EXISTING 30 KVA TRANSFORMER TO REMAIN.

D7 REMOVE EXISTING DOUBLE THROW SAFETY SWITCH (100A).

D8 EXISTING ¾"C, 2#12,2#12N,#12G (BLOCK HEATER & BATTERY CHARGER CIRCUITS), CONNECTED AT PANEL AL1 BREAKERS #10 & 12 TO BE REMOVED BACK TO PANEL. CIRCUIT BREAKERS TO BE REUSED IN NEW WORK PHASE.

D9 EXISTING NATURAL GAS SERVICE / VALVE TO REMAIN.

D10 REMOVE EXISTING ABANDONED NATURAL GAS LINES BACK TO THE SERVICE SHUT-OFF VALVE. CAP AT VALVE..

D11 EXISTING GROUND ROD TO REMAIN. REMOVE EXISTING #6 GEC TO THE EXISTING GENERATOR.

REVISION	
DATE	DESCRIPTION

PENDER COUNTY GOVERNMENT GENERATORS
ELECTRICAL RENOVATIONS
FUELING FACILITY DEMOLITION
BURGAW, NORTH CAROLINA

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CONSULTING ENGINEERS
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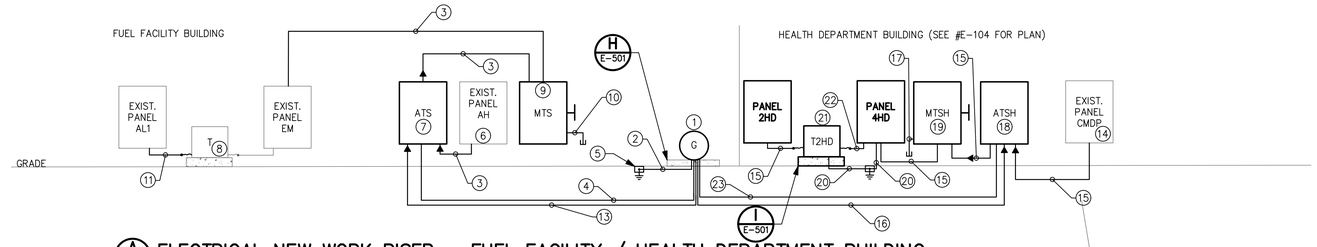
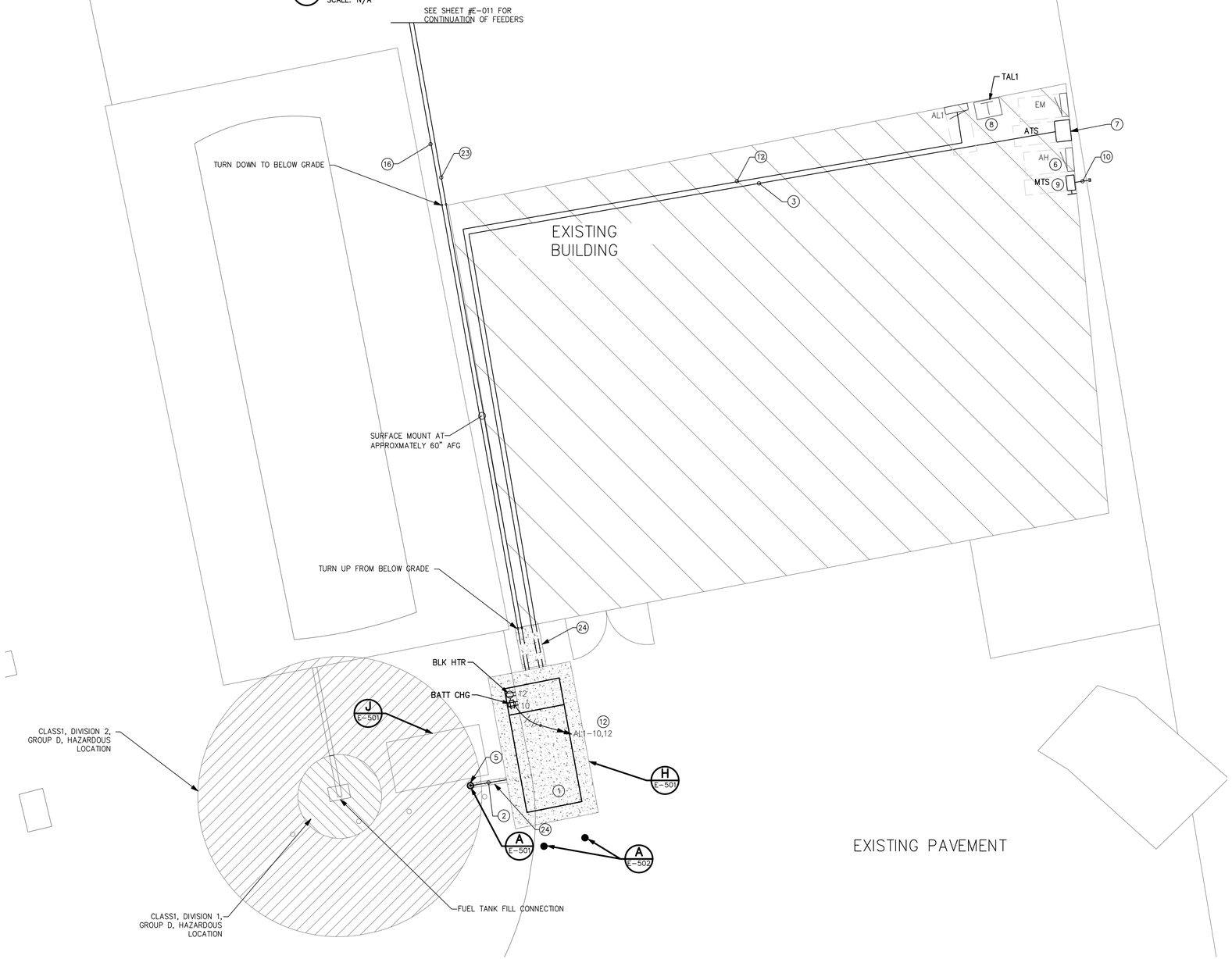
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 19064 MARK A. CIARROCCA

DESIGNED BY	K. FORTIER
DRAWN BY	K. FORTIER
CHECKED BY	M. CIARROCCA
JOB NUMBER	19064
SHEET	E-102
DATE	NOVEMBER 18, 2019



A E-103 ELECTRICAL NEW WORK RISER – FUEL FACILITY / HEALTH DEPARTMENT BUILDING

SCALE: N/A



1 E-103 ELECTRICAL NEW WORK PLAN – FUELING FACILITY

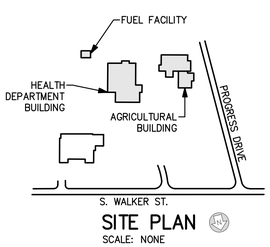
SCALE: 1/4" = 1'-0"

PLAN NORTH TRUE NORTH

GRAPHIC SCALE: 1/4"=1'-0"
0 1 2 4 8

KEYED NOTES (NEW WORK):

1. NEW GENERATOR 100KW. 480/277V,3PH,4W. PROVIDE (1) 60/2P & (1) 100A/2P CIRCUIT BREAKER.
2. 3/4"C,#4GEC. EXOTHERMIC WELD TO THE EXISTING GROUND ROD.
3. 1"C,3#6,#6N,#10G.
4. 3/4"C,2#14,#14G (STOP/START CIRCUIT).
5. PROVIDE GEC INSPECTION WELL FOR THE EXISTING GROUND ROD.
6. EXISTING PANEL AH. CONNECT ATS NORMAL FEEDER TO EXISTING 3P/50A CIRCUIT BREAKER IN SPACES #18,20,22.
7. ATS 480/277V, 4P, 4W, 70A.
8. EXISTING 30 KVA TRANSFORMER 480V, 3PH TO 208/120V, 3PH, 4W.
9. MANUAL TRANSFER SWITCH. 600V, 4P, FUSED AT 60A.
10. 2"C CONDUIT THROUGH THE EXISTING WALL (BRICK/CMU) FOR PORTABLE GENERATOR CONNECTION. INSTALL THREADED CAP ON CONDUIT END.
11. 1 1/4"C,3#3,#3N,#8G.
12. 3/4"C,2#12,2#12N,#12G BATTERY CHARGER & BLOCK HEATER CIRCUITS CONNECT TO EXISTING CIRCUIT BREAKERS (#10 & #12) IN PANEL AL1.
13. 1"C,3#6,#6N,#10G.
14. EXISTING PANEL CMDP MANUFACTURED BY CUTLER HAMMER (TYPE P4). 480/277V,3PH,4W,600A,25KAIC. PROVIDE (1) 100A/3P CIRCUIT BREAKER IN AVAILABLE SPACES #37,39,41.
15. 1 1/2"C,3#2,#2N,#8G.
16. 1 1/2"C,3#1,#1N,#6G.
17. 2"C CONDUIT FOR PORTABLE GENERATOR CONNECTION. INSTALL THREADED CAP ON CONDUIT END.
18. ATSH 480/277V, 4P, 4W, 100A.
19. MANUAL TRANSFER SWITCH. 600V, 4P, FUSED AT 100A.
20. 3/4"C,#6GEC FROM THE EXISTING INSPECTION WELL.
21. 30 KVA TRANSFORMER 480V, 3PH TO 208/120V, 3PH, 4W. NEMA-3R (PAINTED STAINLESS STEEL).
22. 3/4"C,3#6,#10G
23. 1"C,2#12,#12G (STOP/START CIRCUIT).
24. CUT & PATCH EXISTING CONCRETE TO MATCH EXISTING AFTER INSTALLING NEW RACEWAYS AS INDICATED FOR NEW GENERATOR.



SITE PLAN

SCALE: NONE

REVISION	
DATE	DESCRIPTION

PENDER COUNTY GOVERNMENT GENERATORS

ELECTRICAL RENOVATIONS
FUELING FACILITY NEW WORK
BURGAW, NORTH CAROLINA

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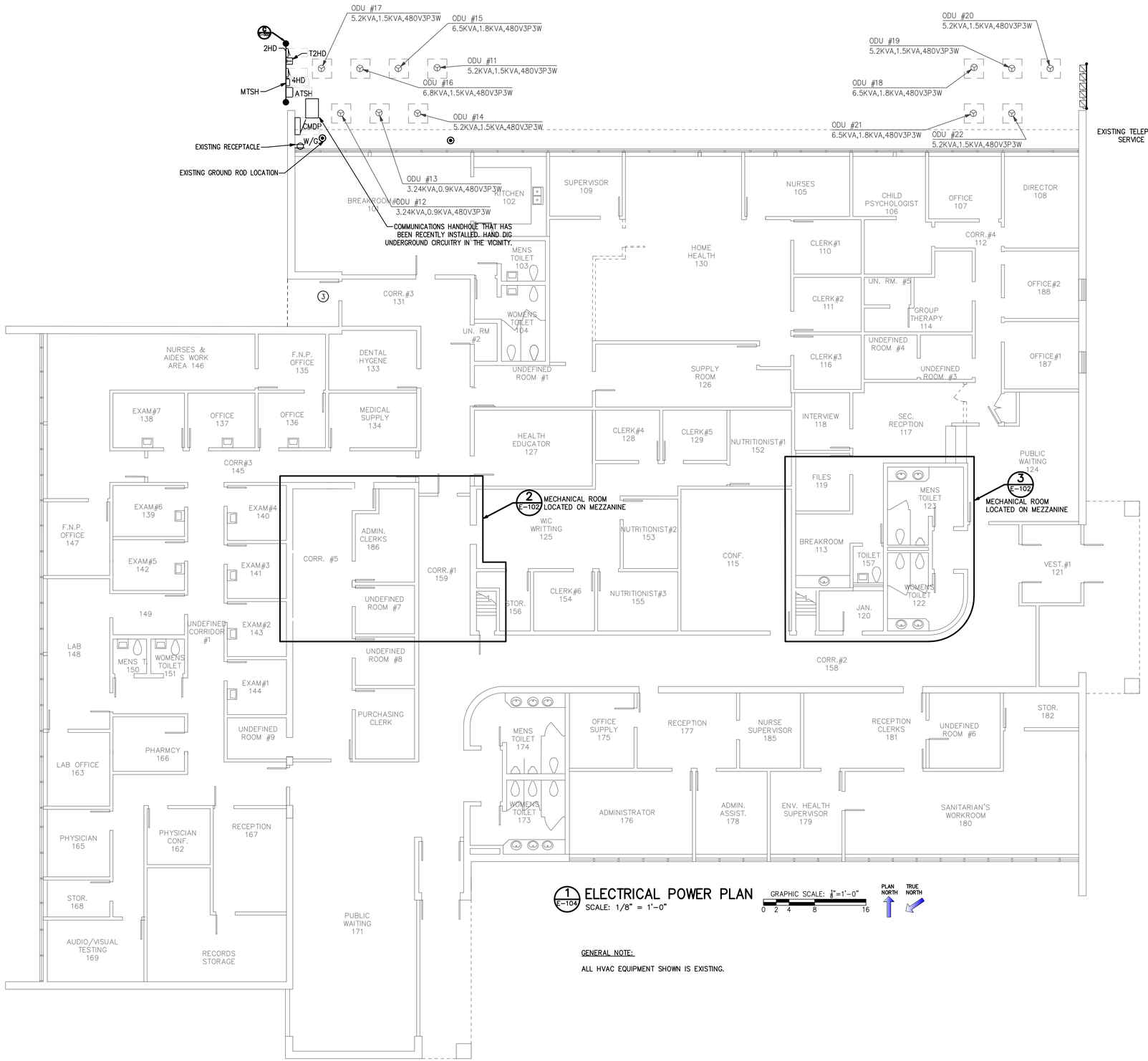
NORTH CAROLINA PROFESSIONAL SEAL 17 ENGINEER MARK A. CIARROCCA 11/18/2019

DESIGNED BY	K. FORTIER
DRAWN BY	K. FORTIER
CHECKED BY	M. CIARROCCA
JOB NUMBER	19064
SHEET	E-103
DATE	NOVEMBER 18, 2019



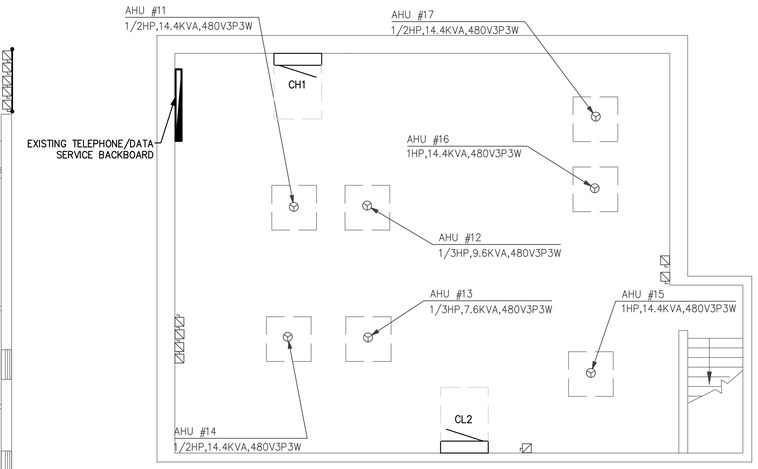
1 E-104 ELECTRICAL POWER PLAN
SCALE: 1/8" = 1'-0"

GRAPHIC SCALE: 1/8"=1'-0" (0 2 4 8 16)

PLAN NORTH TRUE NORTH

GENERAL NOTE:

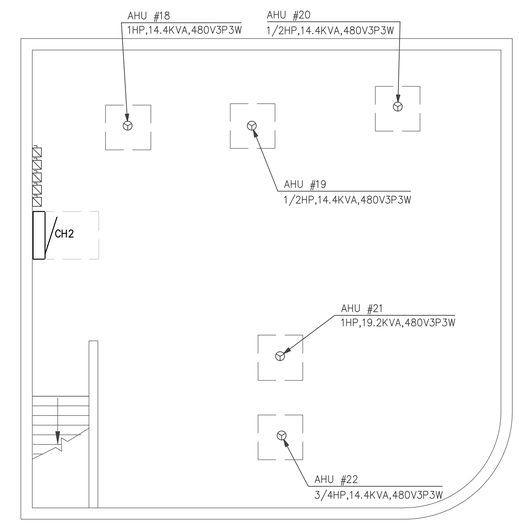
ALL HVAC EQUIPMENT SHOWN IS EXISTING.



2 E-104 ENLARGED MECH. RM 184 ELECTRICAL PLAN
SCALE: 1/4" = 1'-0"

GRAPHIC SCALE: 1/4"=1'-0" (0 1 2 4 8)

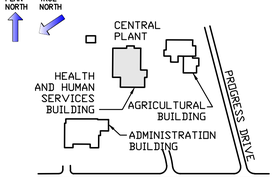
PLAN NORTH TRUE NORTH



3 E-104 ENLARGED MECH. RM 183 ELECTRICAL PLAN
SCALE: 1/4" = 1'-0"

GRAPHIC SCALE: 1/4"=1'-0" (0 1 2 4 8)

PLAN NORTH TRUE NORTH



SITE PLAN
SCALE: NONE

REVISION	
DATE	DESCRIPTION

PENDER COUNTY GOVERNMENT GENERATORS

ELECTRICAL RENOVATIONS
HEALTH DEPARTMENT BUILDING
BURGAW, NORTH CAROLINA

CHEATHAM AND ASSOCIATES, P.A.
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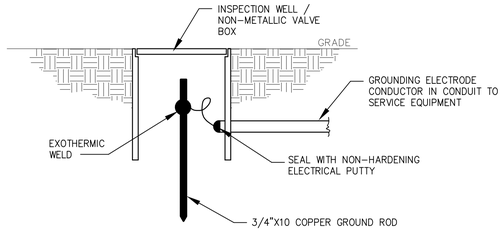
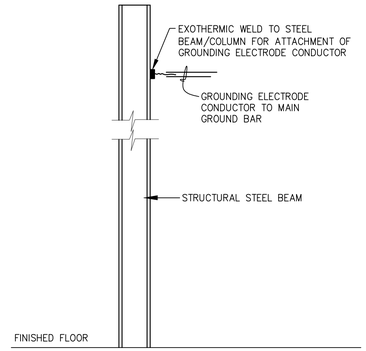
NORTH CAROLINA PROFESSIONAL SEAL 17593 ENGINEER MARK A. CIARROCCA
11 DEC 2019

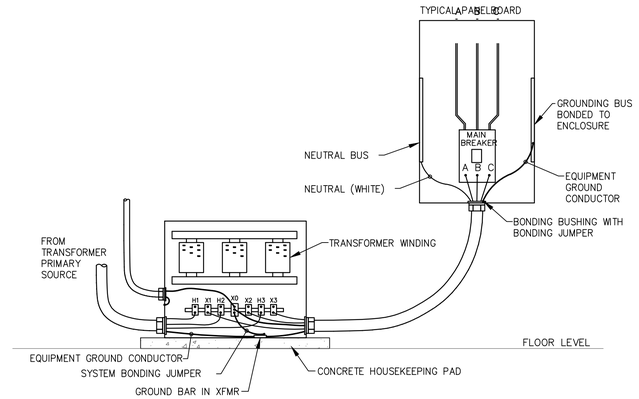
DESIGNED BY	K. FORTIER
DRAWN BY	K. FORTIER
CHECKED BY	M. CIARROCCA
JOB NUMBER	19064
SHEET	E-104
DATE	NOVEMBER 18, 2019



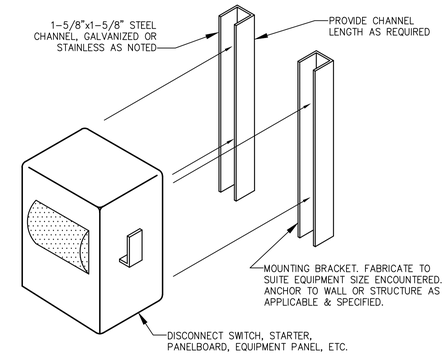
A / E-501 GROUND ROD & INSPECTION WELL
NO SCALE



B / E-501 STEEL COLUMN GROUNDING DETAIL
NO SCALE



C / E-501 DRY-TYPE TRANSFORMER GROUNDING DETAIL
NO SCALE



D / E-501 EQUIPMENT MOUNTING DETAIL
NO SCALE

PANELBOARD

PANEL DESIGNATION → PANEL: 2HD
SOURCE DESIGNATION → SOURCE: PANEL "2HD"/CKT #
RATING DESIGNATION → RATING: 100 AMPS
VOLTAGE & PHASE DESIGNATION → VOLTAGE: 120/208V,3PH,4W

HEIGHT AS REQUIRED (TYPICAL)
LENGTH AS REQUIRED (TYPICAL)

EQUIPMENT SAFETY SWITCH/ENCLOSED CIRCUIT BREAKER/MOTOR STARTER/VFD

EQUIPMENT DESIGNATION → ENCL C/B: #1
SOURCE DESIGNATION → SOURCE: PANEL"P"/CKT #
RATING DESIGNATION → RATING: 200 AMPS
VOLTAGE & PHASE DESIGNATION → VOLTAGE: 480/277V,3PH,4W

TRANSFORMER

TRANSFORMER: T1 ← TRANSFORMER DESIGNATION
SOURCE: PANEL "4M"/CKT# ← SOURCE DESIGNATION
RATING: 75 KVA ← RATING DESIGNATION
VOLTAGE: 480: 208/120V,3PH,4W ← VOLTAGE & PHASE DESIGNATION
SUPPLIES: PANEL "2P" ← EQUIPMENT SUPPLIED

MANUAL TRANSFER SWITCH

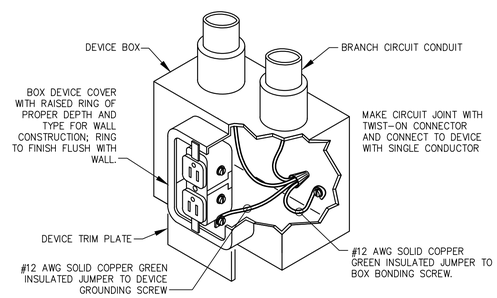
MANUAL TRANSFER SWITCH DESIGNATION → MTS: #1
NORMAL SOURCE DESIGNATION → NORMAL SOURCE: PANEL "4M"/CKT #
STANDBY SOURCE DESIGNATION → STANDBY SOURCE: GENSET
RATING DESIGNATION → RATING: 260A
VOLTAGE & PHASE DESIGNATION → VOLTAGE: 480/277V,3PH,4W

AUTOMATIC TRANSFER SWITCH

ATS: #1 ← AUTOMATIC TRANSFER SWITCH DESIGNATION
NORMAL SOURCE: PANEL "4M"/CKT # ← NORMAL SOURCE DESIGNATION
STANDBY SOURCE: GENSET C/B 225A ← STANDBY SOURCE DESIGNATION
RATING: 260A ← RATING DESIGNATION
VOLTAGE: 480/277V,3PH,4W ← VOLTAGE & PHASE DESIGNATION

NOTES:
1. ENGRAVED PLASTIC FOR NAMEPLATE.
2. HIGH PERFORMANCE, DOUBLE COATED TAPE WITH ADHESIVE TO ATTACH LABELS. DESIGN BASIS: 3M #06383 OR APPROVED EQUIVALENT.
3. 3/8" ENGRAVED LETTERS EQUIPMENT NAME DESIGNATION AND 1/4" ENGRAVED LETTERS ON ALL OTHER DESIGNATIONS.

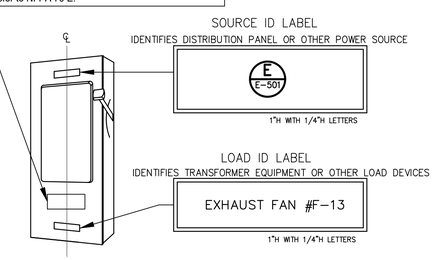
E / E-501 TYPICAL NAMEPLATE DETAILS
NO SCALE



F / E-501 OUTLET GROUNDING DETAIL
SCALE: N/A

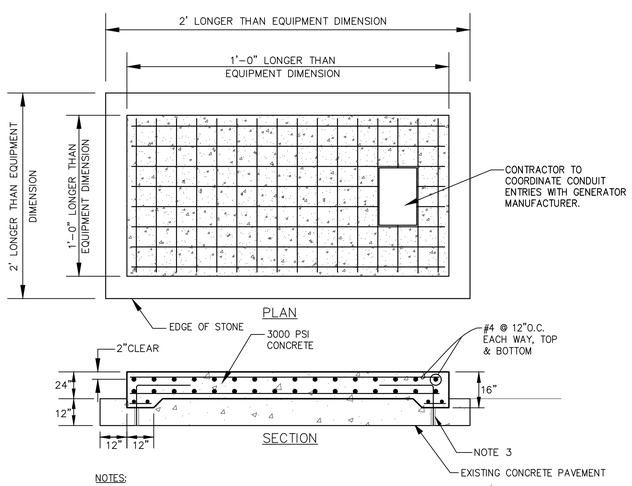
WARNING

Arc Flash and Shock Hazard.
Appropriate PPE Required.
Failure to Comply Can Result in Death or Injury.
Refer to NFPA 70 E.



NOTES:
1. ENGRAVED LABELS: TEXT & BACKGROUND COLORS AS SPECIFIED.
2. FOR APPLICATIONS OTHER THAN NEMA 1 ENCLOSURES, PROVIDE DUPLICATE ID LABELS INSIDE ENCLOSURES.
3. ATTACH WITH HIGH PERFORMANCE, DOUBLE COATED TAPE WITH ADHESIVE. DESIGN BASIS: 3M #06383, OR APPROVED EQUIVALENT.

G / E-501 EQUIPMENT NAMEPLATE IDENTIFICATION
NO SCALE

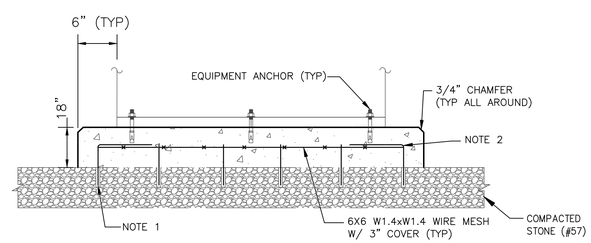


NOTES:
1. PROVIDE ANCHOR BOLTS FOR GENERATOR & ENCLOSURE PER MANUFACTURER'S REQUIREMENTS.
2. BASE PAD SIZE ON ACTUAL EQUIPMENT SUPPLIED. PAD SHOULD EXTEND 6" PAST EQUIPMENT EXTERIOR IN EACH DIRECTION.
3. #4 REBAR ADHESIVE ANCHOR W/ 4" COVER FROM EACH EDGE AND MIN. 2.75" EMBEDMENT IN SLAB. BEND AND TIE TO REBAR WITH 6" HOOK. (TYP.).

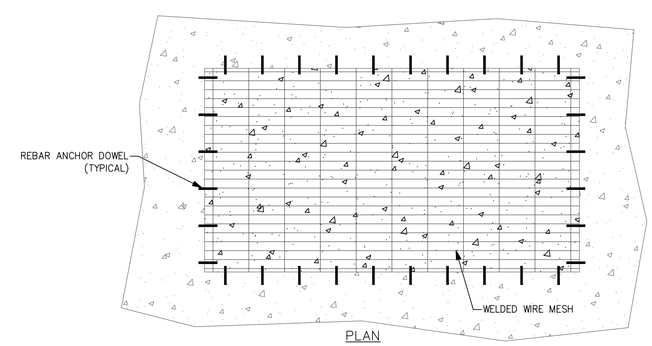
H / E-501 GENERATOR PAD DETAIL
NO SCALE

NOTES:

1. PLACE CORNER ANCHORS WITH SPECIFIED 4" COVER, THEN EQUALLY SPACE ANCHORS ALONG SIDES APPROXIMATELY 8" O.C. VERIFY SPACING WITH SEISMIC SUBMITTAL.
2. #4 REBAR ADHESIVE ANCHOR W/ 4" COVER FROM EACH EDGE AND MIN. 2.75" EMBEDMENT IN SLAB. BEND AND TIE TO WIRE MESH WITH 6" HOOK. (TYP.).

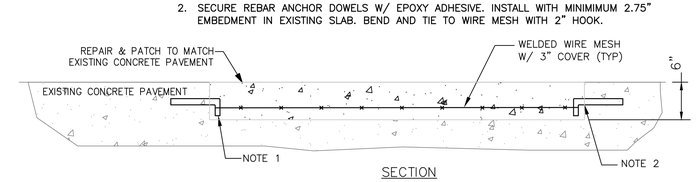


I / E-501 TYPICAL HOUSEKEEPING PAD DETAIL
NO SCALE



NOTES:

1. #4 REBAR ANCHOR DOWELS. INSTALL W/ APPROXIMATELY 3" COVER. LOCATE EQUALLY SPACED AROUND PERIMETER APPROXIMATELY 8" O.C.
2. SECURE REBAR ANCHOR DOWELS W/ EPOXY ADHESIVE. INSTALL WITH MINIMIMUM 2.75" EMBEDMENT IN EXISTING SLAB. BEND AND TIE TO WIRE MESH WITH 2" HOOK.



J / E-501 CONCRETE REPAIR DETAIL
NO SCALE

REVISION	
DATE	DESCRIPTION

PENDER COUNTY GOVERNMENT GENERATORS
ELECTRICAL RENOVATIONS
DETAILS
BURGAW, NORTH CAROLINA

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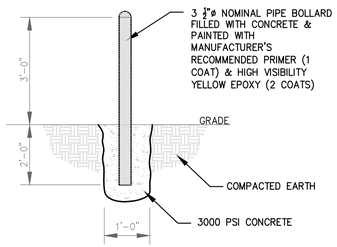
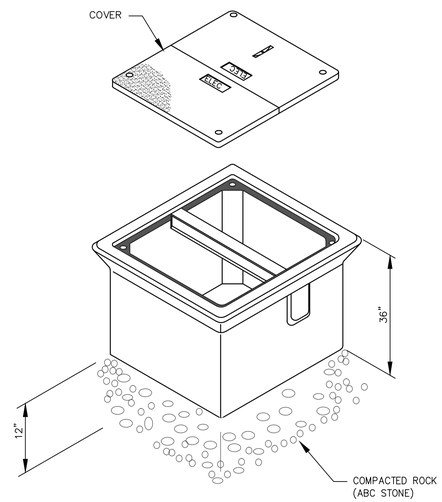
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 17993 MARK A. CIARROCCA 11/18/2019

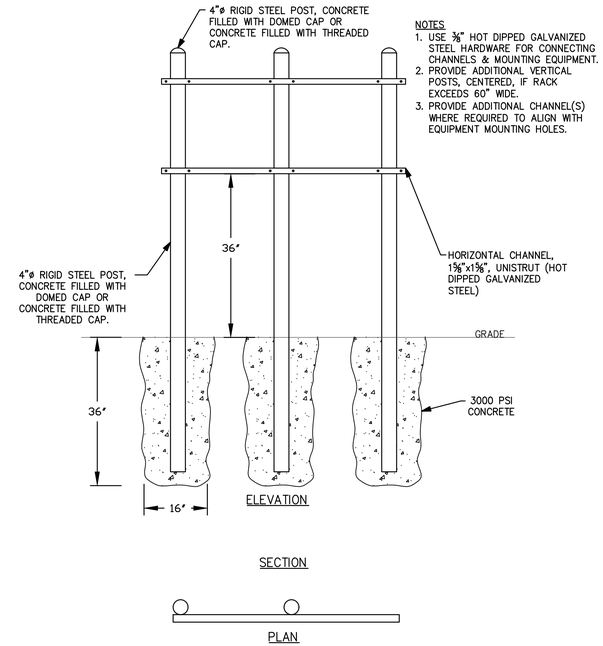
DESIGNED BY	K. FORTIER
DRAWN BY	K. FORTIER
CHECKED BY	M. CIARROCCA
JOB NUMBER	19064
SHEET	E-501
DATE	NOVEMBER 18, 2019



A E-502 PIPE BOLLARD DETAIL
NO SCALE



B E-502 TYPICAL HANDHOLE DETAIL
NO SCALE
DESIGN BASIS: QUAZITE #PG1212HH00–PG1212BA12 (12"X12")



C E-502 EQUIPMENT RACK DETAIL
NO SCALE

REVISION

DATE	DESCRIPTION

PENDER COUNTY GOVERNMENT GENERATORS
ELECTRICAL RENOVATIONS
DETAILS
BURGAW, NORTH CAROLINA

CHEATHAM AND ASSOCIATES, P.A.
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DRAWN BY	K. FORTIER
CHECKED BY	M. CIARROCCA
JOB NUMBER	19064
SHEET	E-502
DATE	NOVEMBER 18, 2019

Electrical Specifications Table of Contents
For
Pender County Government Generators

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26 28 16	Enclosed Switches and Circuit Breakers
26 32 13	Engine Generators
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SECTION 26 00 00 – ELECTRICAL, BASICS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 CONTENTS

A. See Electrical Table of Contents.

1.3 GENERAL

A. Applicable requirements of the Instructions to Bidders and General Conditions of the Contract shall be a part of the Electrical Specifications. The electrical contractor shall examine the general and special conditions before submitting a proposal.

B. The electrical work shall be performed by a licensed electrical contractor.

C. The electrical contractor shall assume total responsibility for any portion of the work provided by his subcontractors.

1.4 CODES AND STANDARDS

A. Building Codes:
1. National Fire Protection Association No. 70, National Electrical Code
2. North Carolina State Building Code, Latest Edition and Revisions (NCSBC)
3. National Electrical Safety Code (NESC)
4. National Bureau of Standards (NBS)
5. Local Codes where applicable

B. Industry Standards:
1. Underwriter's Laboratories, Inc. Standards and approved listings (UL)
2. Electrical Testing Laboratories Standards (ETL)
3. National Electrical Manufacturers Association Standards (NEMA)
4. Insulated Power Cable Engineers Association Standards (IPCEA)
5. American National Standards Institute (ANSI)
6. American Society for Testing Materials Standards (ASTM)
7. Canadian Standards Association (CSA)

1.5 SCOPE OF WORK

A. It is the intent and meaning of the drawings and specifications to call for finished work that has been tested and is ready for operation. The electrical contractor shall take this into consideration and include in his proposal allowance for contingencies that will allow him to provide minor pieces of materials and labor not specifically indicated but required for the job to

operate properly. This paragraph is intended to insure a complete job will be provided without requests for minor extras.

1.6 ELECTRICAL SERVICE

A. The electrical contractor shall be totally responsible for coordination with the Utility Company and assistance to the OWNER for service rework that will be required at the Agriculture Building.

1.7 RECORD DRAWINGS

A. A set of drawings covering the electrical contract will be provided to the electrical contractor to mark all changes, modifications, or revisions effected during construction. These field mark-up drawings are to be turned over to the electrical designer.

B. The electrical contractor shall provide photographs of switchboards and panelboards. Photographs shall clearly show equipment designations, manufacturer nameplates, breaker positions, breaker ratings, and directory descriptions.

1.8 APPROVAL OF MATERIALS

A. Construction phase: The CONTRACTOR shall submit his proposal on the specified materials and equipment, or their equivalent, provided the words "or equal" or "or approved equal" follow the named manufacturers. If the above phrases do not appear, the specified manufacturers shall be furnished without substitution. Equivalent shall be interpreted to mean an item of material or equipment, similar to that named and which is suitable for the same use and capable of performing the same functions as that named, the Engineer being the judge of equality.

B. Where no specific material or equipment type is mentioned, any first-class product of a reputable manufacturer may be used provided it conforms to the requirements of the specifications. These materials shall be third party listed or labeled in accordance with the General Statutes of the State (example: UL, ETL, CSA, etc).

1.9 SHOP DRAWINGS AND SUBMITTAL DATA PROCEDURES

A. Unless directed otherwise in the General Provisions and/or Conditions of the Contract, the CONTRACTOR shall submit PDF files of shop drawings, certified prints, literature, and cuts to the Engineer for all major items of equipment and materials for review and approval. It is preferred that all electrical submittals for the project shall be submitted at one and the same time.

B. Product data cut sheets with multiple components, part numbers, etc. shall be clearly marked to identify what is proposed for this project.

C. The CONTRACTOR shall analyze all shop drawings and submittal data and certify that they meet requirements of Contract Drawings and Specifications, prior to delivery to the Engineer. CONTRACTOR Certification shall be in the form of suitable approval stamp placed on each shop drawing submitted for approval.

D. If the Engineer deems submittal data is either incomplete or incorrect, a resubmittal submittal will be required.

E. At least one set of all "approved" shop drawings, certified prints, etc., shall be maintained at the job site and available to representative of the Engineer.

F. Approval by the Engineer of shop drawings for any materials, apparatus, devices, and layouts shall not relieve the CONTRACTOR from the responsibility of furnishing same of proper dimensions, size, quantity, quality and all performance characteristics to efficiently perform the requirements and intent of the contract documents. Such approval shall not relieve the CONTRACTOR from responsibility for errors of any sort on the shop drawings. If the shop drawings deviate from the Contract Documents, the CONTRACTOR shall advise the Engineer of the deviations in writing, accompanying the shop drawings, including the reason for the deviations.

G. Physical sizes of equipment used in the design layout are those of reputable equipment manufacturers. The CONTRACTOR is responsible for providing equipment that will fit the space available. If the CONTRACTOR elects to use equipment that results in conflicts with space clearance or codes, it shall be the responsibility of the CONTRACTOR to correct at his expense. The CONTRACTOR shall assume responsibility for providing code clearances. Where equipment is designated for existing space, the CONTRACTOR shall make necessary field measurements to ascertain space requirements, including those for connections; and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the intent and meaning of the drawings and specifications.

H. Catalog Data for OWNER
   1. The CONTRACTOR shall provide compilations of catalog data, bound in suitable loose-leaf binders, for each manufactured item of equipment used in the electrical work. These shall be presented to the Engineer for transmittal to the OWNER before the final inspection is made. Data shall include printed installation, operation, and maintenance instructions for each item, indexed by product with heavy sheet dividers and tabs. All warranties shall be included with each item. Each manufacturer's name, address, and telephone number shall be clearly indicated. Generally, shop drawings and submittal data alone are not adequate for catalog data.

I. Record Documents for OWNER
   1. Conductor and cable megger test results.
   2. Grounding electrode system test results.
   3. Transformer tap settings and output voltages.
   4. Generator start-up test results.
   5. Automatic transfer switch settings.

1.10 DRAWINGS AND SPECIFICATIONS

A. The Electrical drawings and specifications are complementary each to the other, and what may be called for by one shall be as binding as if called for by both. The drawings are diagrammatic and indicate generally the location of outlets, devices, equipment wiring, etc and show the general arrangement of raceways, fixtures, and equipment. Drawings shall be followed as closely as actual building construction and the work of other trades will permit; however, all work shall suit the finished surroundings and/or trim.

B. It shall be understood that where the words “furnish,” “provide,” and/or “install” are used, it is intended that this CONTRACTOR shall purchase and install completely all material necessary and required for this particular item, system, equipment, etc.

C. Any omission from either the drawings or the specifications are unintentional, and it shall be the responsibility of the CONTRACTOR to call to the attention of the Engineer any pertinent omissions before submitting a proposal. Complete and working systems are required, whether every small item of material is shown and specified or not.

D. The electrical work shall conform to the requirements shown on all of the drawings. General and Structural drawings shall take precedence over Electrical Drawings. Because of small scale of the electrical drawings, it is not practical to indicate offsets, fittings and accessories that may be required. The CONTRACTOR shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as may be required to meet such conditions, without additional cost to the OWNER and as directed by the Engineer.

E. Load circuits shall be installed as indicated on the drawings. Circuit number revisions will not be accepted unless approved in writing by the Engineer.

1.11 COORDINATION OF WORK

A. It is understood and agreed that by submitting a bid, the CONTRACTOR has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the general and local conditions and all other matters which can and may affect the work under this contract. The CONTRACTOR shall be held responsible for visiting the site and thoroughly familiarizing himself with the existing conditions and also any contractual requirements as may be set forth in the other divisions of these specifications. No extras will be considered because of additional work necessitated by obvious job conditions that are not indicated on the drawings.

B. The CONTRACTOR shall compare the electrical drawings and specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Engineer and obtain from him written instructions for changes necessary in the electrical work. The electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the CONTRACTOR shall make proper provisions to avoid interferences in a manner approved by the Engineer. All changes required in the work of the CONTRACTOR caused by his neglect to do so shall be made by him at his expense.

C. Location of electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The CONTRACTOR shall determine the exact route and location of each electrical raceway prior to make up and assembly.

D. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example, steam, condensate and plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.

E. Offsets and changes in direction of electrical raceways shall be made as required to maintain proper headroom and to clear pitched lines whether or not indicated on the drawings. The CONTRACTOR shall furnish and install elbows, pull boxes, etc., as required to affect these offsets, transitions, and changes in directions. Conflicts between electrical raceways, fixtures, etc., and ductwork which cannot be resolved otherwise, will be resolved by the Engineer.

F. The CONTRACTOR shall install all electrical work to permit removal (without damage to other parts) of any equipment requiring periodic replacement or maintenance. The CONTRACTOR shall arrange electrical raceways and equipment to permit ready access to valves, cocks, traps, starters, motors, control components, etc., and to clear the opening of swinging and overhead doors and of access panels.

G. Work at Existing Facilities:

1. Where work may be required to be performed at existing and/or occupied facilities, such work shall be scheduled and arranged to be done at the convenience of the OWNER so as not to interfere with, disrupt, or disturb normal operations at the facilities. The CONTRACTOR shall obtain written approval from the OWNER before proceeding with work at existing facilities and shall work at existing facilities on schedule as agreed upon with the OWNER. This is not to be necessarily construed to mean that the CONTRACTOR is expected to perform work at existing facilities on holidays, weekends, etc., but that the Contractor must schedule work with the OWNER for the OWNER's beneficial and normal usage of the facilities, and that the CONTRACTOR will be required to maintain the schedule as approved by the OWNER.
2. The CONTRACTOR shall, at all times, provide safety barriers, protective devices, screening, dust barriers, etc., as required to maintain the safety and comfort of the building's personnel and/or occupants in or near his work area.
3. The CONTRACTOR shall be responsible for cleanup in connection with his work at existing facilities. At the end of each working day, all debris, boxes, waste, etc. shall be removed from the facilities and properly disposed of. Equipment, materials, etc. may be left inside the facilities, but such must be properly stored, stacked, and located as approved by the OWNER.
4. The CONTRACTOR shall do all cutting, patching, finishing, repairing, painting, etc., necessary for electrical work to be installed at existing facilities. All finishes shall be left to equal finish and condition prior to cutting. No cutting of structural members will be allowed. All cutting of walls, floors, roofs, etc. shall be repaired and/or replaced to equal finish prior to cutting. The CONTRACTOR shall route conduits and locate equipment as approved by the OWNER and Architect and/or Engineer. Routing and locations shall be firmly established and approved before proceeding with any phase of the work.
5. The CONTRACTOR shall be responsible for any and all damage to the existing facilities, grounds, walkways, paving, etc. caused by the work, the CONTRACTOR and/or his personnel, and/or his equipment in the accomplishment of this work. Such damages shall be repaired and/or replaced by the CONTRACTOR at no additional cost to the OWNER, to equal finish prior to damage. The ENGINEER shall be the judge as to equal finishes, etc.
6. Certain power requirements must be met without interruption during certain times on the existing electrical system. It is anticipated that partial power outages will be necessary to accomplish the work covered by these drawings and specifications. The CONTRACTOR shall determine in advance the dates, times and duration of these outages and shall obtain permission from the OWNER to shut down the electric power. Unauthorized power outages will not be tolerated.

H. Equipment and Materials (General):

1. Materials shall be new and shall bear the manufacturer's name, trade name, and listing label in every case where a standard has been established for the particular material. The equipment to be furnished under this specification shall be essentially the standard product of manufacturers regularly engaged in the production of the required type of equipment and shall be the manufacturer's latest approved design.
2. Electrical motors shall meet the minimum efficiency requirements of applicable tables in the North Carolina Energy Conservation Code.
3. Delivery and Storage:
   a. Store products to allow for inspection and measurement of quantity or counting of units.
   b. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
      1) Electrical equipment shall be delivered to the site and stored in original containers. Store protected from the elements, but readily accessible for inspection by the Engineer until installed. Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury and theft. Corrosion inhibitors shall be installed in all panelboards, switches, starters and control panels immediately upon receipt. Install one inhibitor for every 8 cubic feet of enclosure volume. Replace inhibitors every 90 days and at final inspection in the ARCHITECT AND/OR ENGINEER 's presence. Rusty and/or corroded materials and equipment will be replaced at the direction of the Engineer.
      2) Rusty and/or corroded materials and equipment will be replaced at the direction of the Engineer.
   c. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   d. Protect stored products from damage.
4. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
5. At the completion of the work; fixtures, equipment, and materials shall be cleaned and polished thoroughly and turned over to the OWNER in a condition satisfactory to the Engineer. Damage or defects, developing before acceptance of the work shall be corrected at the CONTRACTOR's expense.
6. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. The CONTRACTOR shall promptly notify the Engineer, in writing, of any conflicts between any requirements of the Contract Documents and the manufacturer's directions and shall obtain the Engineer's written instructions before proceeding with the work. Should the CONTRACTOR perform any work that does not comply with the manufacturer's instructions, recommendations, or requirements; it shall be corrected at the direction of the Engineer at no additional cost to the Owner.

I. Sleeves, Inserts, Openings, Etc.:

1. Anchor bolts, sleeves, inserts, supports, etc., that may be required for electrical work shall be furnished, located, and installed by the electrical contractor.

J. Cutting and Patching:

1. The electrical contractor shall do all rough cutting and patching as required for the proper installation of work under this contract. Cutting shall be kept to a minimum, and finishes shall be restored to the satisfaction of the Owner and Engineer.

K. Locations and Measurements:

1. Outlets, equipment, and appliances are shown and located on the drawings as accurately as possible. All measurements shall be verified on the project and coordinated with the drawings of other disciplines. In all cases, the work shall suit the surrounding trim and/or decoration and construction. The locations of outlets for special appliances shall be installed so that when extended, they are flush with the finished wall, floor, or ceiling and permit the proper installation of fixtures, devices, equipment, appliances, etc. Heights of all outlets shown on the drawings are approximate only. Slight relocations of outlets, devices, and equipment shall be made by the electrical contractor as required or as directed by the Engineer at no additional cost to the OWNER.

L. Workmanship:

1. Work shall be executed as required by the specifications and the accompanying drawings and shall be done in a workmanlike manner by skilled mechanics, and shall present a neat, trim, and mechanical appearance when completed. All work shall be performed as required by the progress of the job.

M. Final Inspections and Equipment Demonstrations:

1. The CONTRACTOR shall acquire permits for construction & coordinate all required inspections with the office of the local electrical inspector and/or local authority having jurisdiction, if required. The CONTRACTOR shall provide the Owner two (2) copies of Electrical Inspectors' written reports.
2. The CONTRACTOR shall furnish ladders, required tools, and men to open fixtures, boxes, panels, or any other equipment to enable the Engineer representatives to see into any parts of the installation he may request.
3. The CONTRACTOR shall furnish meters for observation of readings as directed by the Engineer representative. Meters to be furnished include: clamp-on type ammeter, voltmeter, megger, and clamp-on type ground resistance tester.

N. Operating Instructions:

1. At the completion of the entire installation, the CONTRACTOR shall arrange to operate each component of systems and then systems as a whole. When all the requirements of the plans and specifications have been met, the CONTRACTOR shall then arrange to instruct the OWNER's operating and maintenance personnel in the correct and proper procedures for the operation and maintenance of the systems

END OF SECTION 26 00 00

SECTION 26 05 00 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Supporting devices for electrical components.
   2. Cutting and patching for electrical construction.
   3. Touchup painting.
   4. Concrete equipment bases.
   5. Electrical demolition.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 ELECTRICAL EQUIPMENT

A. Provide new electrical equipment with minimum 75 degrees C terminations.

2.2 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.
   1. Channel Thickness: Selected to suit structural loading.
   2. Fittings and Accessories: Products of the same manufacturer as channel supports.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Expansion Anchors:
   1. Inside: Carbon-steel wedge or sleeve type.
   2. Outside: Stainless-steel wedge or sleeve type.

F. Toggle Bolts:
   1. Inside: All steel springhead type.
   2. Outside: Stainless-steel springhead type.

2.3 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.4 CONCRETE BASES

A. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength with welded wire fabric reinforcement.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange during progress of construction to facilitate the electrical installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

3.2 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Selection of Supports: Comply with manufacturer's written instructions.

B. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

3.4 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate pipe hangers or clamps.

F. Install 1/4-inch- diameter or larger threaded hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

J. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
   1. Wood: Fasten with wood screws or screw-type nails.
   2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
   3. New Concrete: Concrete inserts with machine screws and bolts.
   4. Existing Concrete: Expansion bolts.
   5. Steel: Spring-tension clamps on steel.
   6. Light Steel: Sheet-metal screws.
   7. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site after coordination with the Owner’s representative. Equipment and/or materials that the Owner desires to retain shall be moved to a location designated by the Owner’s representative.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.8 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work.

3.9 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint.
   1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
   3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Final Acceptance.

END OF SECTION 26 05 00

SECTION 26 05 19 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field Quality-Control Test Reports: From Contractor.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 POWER CONDUCTORS AND CABLES

A. Manufacturers:
1. Cerro Wire LLC.
2. Colonial Wire and Cable.
3. Encore Wire Corporation.
4. General Cable Corporation.
5. Okonite.
6. Prysmian Group.

7. Republic Wire, Inc.
8. Southwire.
9. Or approved equal.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material:

1. Copper complying with NEMA WC70 / ICEA S-95-658 solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
2. Power and lighting circuitry: Minimum conductor size shall be #12, and maximum conductor size shall be #500 kcmil.

D. Conductor Insulation Types: Type THHN/THWN-2 complying with NEMA WC70 / ICEA S-95-658.

2.3 CONTROL CONDUCTORS AND CABLE

A. Discrete control conductors: Copper, stranded, type THHN/THWN-2.
1. Manufacturers:
a. Cerro Wire LLC.
b. Colonial Wire and Cable.
c. Encore Wire Corporation.
d. General Cable Corporation.
e. Okonite.
f. Prysmian Group.
g. Republic Wire, Inc.
h. Southwire.
i. Or approved equal.

2.4 CONNECTORS AND SPLICES

A. Manufacturers:
1. AFC Cable Systems.
2. AMP Incorporated/Tyco International.
3. FCI.
4. Greaves Polaris.
5. Hubbell/Anderson.
6. ILSCO.
7. NSI.
8. O-Z/Gedney; EGS Electrical Group LLC.
9. Penn Union.
10. 3M Company; Electrical Products Division.
11. Or approved equal.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
1. For conductors #8 & smaller, use wirenut type twist connectors.

2. For conductors #6 & larger, use pre-insulated solderless connectors with one spare port(s) for future cable connection.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance, Feeders, Branch Circuits: Type THHN/THWN-2, single conductors in raceway.

B. Discrete Control Circuits: Type THHN/THWN-2, in raceway.

C. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

3.2 INSTALLATION

A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables, conductors, or raceway.

C. Identify and color-code conductors and cables according to Section "Electrical Identification."

D. Shared neutral conductors shall not be used unless specifically indicated so on homerun circuitry designations on the drawings.

3.3 CONNECTIONS

A. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
   1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
   2. Inspect for physical damage; test conductors and cable for continuity and shorts.
   3. Megger testing for building wire and cable:

a. All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt megger. Megger testers shall not be electronic type. Megger testers shall be hand crank or power driven crank type. Minimum readings between conductors and between conductor and the grounded metal raceway shall be: 25 mega-ohms for #6 wire and smaller; 50 mega-ohms for #4 wire or larger.

b. The CONTRACTOR shall correct malfunctioning conductors and cables, including replacement if necessary, and retest to demonstrate compliance.

c. Certify compliance with test parameters.

4. Control / Signal Transmission Media Tests:

a. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

b. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
4. Provide tabulated megger readings for each panel circuit.

C. Witness Tests:

1. The CONTRACTOR shall furnish a megger and show A/E representative and/or Owner that the conductors and panels comply with the above requirements.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Ground rods.
   2. Connection / test / inspection wells.

B. Field Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grounding Conductors, Cables, Connectors, and Rods:
      a. Chance/Hubbell.
      b. Copperweld.
      c. Erico Inc.; Electrical Products Group.

d. Framatome Connectors/Burndy Electrical.
e. Galvan Industries.
f. Harger.
g. Heary Brothers Lightning Protection Co.
h. Ideal Industries.
i. ILSCO.
j. Kearney/Cooper Power Systems.
k. Lyncole XIT Grounding.
l. O-Z/Gedney Co..
m. Raco, Inc.
n. Salisbury: W. H. Salisbury & Co.
o. Southern Grounding / South Atlantic LLC.
p. Thomas & Betts.
q. Thompson Lightning Protection.
r. Or approved equal.

2. Connection Test / Inspection Wells:
   a. ALT Fabrication.
   b. Charles Industries.
   c. Harger Lightning Protection, Inc.
   d. Heary Brothers Lightning Protection Co.
   e. Quazite / Strongewell.
   f. PVC piping manufacturers.
   g. Or approved equal.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Section "Conductors and Cables."

B. Grounding Electrode Conductors: Stranded cable.

C. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

D. Bare Copper Conductors: Comply with the following:
   1. Solid Conductors: ASTM B 3.
   2. Assembly of Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Sectional type; copper-clad steel, ¾" diameter by 120 inches in length.

B. Connection / Test / Inspection Wells: Provide handholes as specified below:
   1. Cylinder, minimum dimensions of 12" diameter x 19" deep, PVC, with cover.
   2. Box, minimum dimensions of 12" x 12" x 12" deep with cover, green PVC or polyethylene.

PART 3 - EXECUTION

3.1 APPLICATION

A. In raceways, use insulated equipment grounding conductors.

B. Exothermic-Welded Connections: Use for connections to ground rods, structural steel and for underground connections.

C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

D. Underground Grounding Conductors: Use tinned- copper conductor. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

3.3 INSTALLATION

A. Ground Rods: For service entrance, install a minimum of two rods spaced at least twenty feet from each other and located at least the same distance from other grounding electrodes.
   1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
   2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds for connections. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Building Steel: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to building steel. Connect grounding conductors to building steel by exothermic weld.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to

building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Connection shall be made within the first five feet of where the water service line enters the building. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

E. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
   1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      a. Perform tests by the fall-of-potential method according to IEEE 81; or
      b. Perform tests with a clamp-on ground tester.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
   a. Equipment Rated 500 kVA and Less: 10 ohms.
   b. Equipment Rated 500 to 1000 kVA: 5 ohms.
   c. Equipment Rated More Than 1000 kVA: 3 ohms.
   d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
   e. Manhole Grounds: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect and/or Engineer promptly and take corrective action to reduce ground resistance to comply with specified values. Demonstrate compliance by retesting.

END OF SECTION 26 05 26

SECTION 26 05 33- RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:
   1. Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
   2. Section "Wiring Devices" for devices installed in boxes.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. LFMC: Liquidtight flexible metal conduit.

C. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For raceways, fittings, wireways, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 FIELD CONDITIONS

A. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

A. Manufacturers:
1. Alflex Inc.
2. Allied Tube and Conduit.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Atkore International / Calbrite.
5. Conduit Pipe Products Company.
6. Electri-Flex Co.
7. Gibson Stainless.
8. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
9. Manhattan/CDT/Cole-Flex.
10. Maverick Tube.
11. O-Z Gedney; Unit of General Signal.
12. Patriot Industries.
13. Republic Conduit.
14. Shaw Stainless and Alloy.
15. Wheatland Tube Co.
16. Or approved equal.

B. Rigid Aluminum Conduit: Produced to ANSI C80.5; listed to UL 6A.

C. EMT and Fittings: Produced to ANSI C80.3; listed to UL 797.
1. Fittings: Plated-steel, hexagonal, compression type.

D. LFMC: Listed to UL 360.

E. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:
1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco.
4. Blue Diamond Industries.
5. Cantex.
6. Certainteed.
7. Condux International.
8. ElecSYS.
9. Electri-Flex.
10. Heritage Plastics / Atkore International.
11. Lamson & Sessions; Carlon Electrical Products.
12. Manhattan/CDT/Cole-Flex.

13. Queen City Plastics.
14. RACO.
15. Southern Pipe, Inc.
16. Spiralduct, Inc./AFC Cable Systems, Inc.
17. Thomas & Betts.
18. Or approved equal.

B. RNC: Produced to NEMA TC 2; listed to UL 651.
1. Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: Produced to NEMA TC 3; listed to UL 514B; match to conduit or tubing type and material.

2.4 METAL WIREWAYS

A. Listed to UL 870.

B. Manufacturers:
1. Austin.
2. B-Line.
3. Hammond.
4. Hoffman.
5. Milbank.
6. Square D.
7. Thomas & Betts.
8. Unity Manufacturing.
9. Or approved equal.

C. Material and Construction: Sheet metal sized and shaped as indicated.
1. Indoors: NEMA 1.
2. Outdoors: NEMA 3R.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

F. Wireway Covers:
1. Indoors: Hinged type.
2. Outdoors: Flanged-and-gasketed type.

G. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:
1. Arlington.

2. Austin.
3. B-Line.
4. Cooper Crouse-Hinds.
5. Emerson/General Signal; Appleton Electric Company.
6. Erickson.
7. FSR.
8. Hammond.
9. Hoffman.
10. Hubbell.
11. Milbank.
12. O-Z/Gedney.
13. Peerless.
14. RACO.
15. Robroy Industries.
16. Rose + Bopla.
17. Scott Fetzer Co.; Adalet-PLM Division.
18. Spring City Electrical.
19. Strong.
20. Thomas & Betts.
21. Vynckier.
22. Walker Systems.
23. Woodhead Industries.
24. Or approved equal.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Metal Hinged-Cover Enclosures:
1. Interior Locations: NEMA 250, Type 1 with continuous hinged cover, concealed hinge, and flush latch. Finished inside and out with manufacturer's standard enamel.
2. Exterior Locations: NEMA 250, Type 3R galvanized steel with continuous hinged cover and 3-point latch.
3. Removable interior panel.
4. Metal barriers to separate wiring of different systems and voltages.
5. Accessory feet where required or freestanding applications.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:
1. Exposed: Rigid aluminum conduit.
2. Underground, Single Run: RNC.
3. Underground, Grouped: RNC.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. For grounding electrode conductors: RNC Schedule 80.
6. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors:
1. Exposed, Higher than 10' AFF: EMT**.**
2. Exposed, Lower than 10' AFF: Rigid aluminum conduit.
3. Concealed: EMT.
4. Boxes and Enclosures: NEMA 250, Type 1.

C. Minimum Raceway Size: 3/4-inch trade size (DN 21).

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

E. Do not install aluminum conduits embedded in or in contact with earth or concrete. For direct burial or concrete encasement or penetrations, coat conduit with asphaltum or bituminous type coating.

3.2 INSTALLATION

A. Keep raceways a minimum of 6 inches away from runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Section "Basic Electrical Materials and Methods."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conduits installed on the inside face of exterior building walls shall be spaced off the wall surface a minimum of ¼" using strut-type channel or "clamp-backs".

H. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

I. Join raceways with fittings designed and approved for that purpose and make joints tight.

J. Raceway connectors shall be insulated throat type. If uninsulated throat connectors are installed, use insulating bushings to protect conductors.

K. Expansion joints: Where raceways of any type pass a building or structure expansion joint, a standard expansion joint fitting, compatible with the type of raceway being used, shall be provided and installed. Review architectural and structural drawings for locations of expansion joints.

L. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
   1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   2. Space raceways laterally to prevent voids in concrete.
   3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

M. Underground raceways:
   1. Where turning up to cabinets, equipment, poles, etc.; transition from horizontal underground PVC to rigid metal for elbows & raceway stub-ups.

N. Terminations:
   1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
   2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
   3. Where using boxes with concentric, eccentric, or over-sized knockouts; provide bonding bushings and jumpers. Size bonding jumpers in accordance with NEC Table 250-122, connecting to the box with ground lugs.

O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Label each end of pull wires with location of opposite end.

P. Flexible Connections:

   1. Use maximum of 24 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors.

Q. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Final Acceptance.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.
   1. Exposed threads on galvanized conduits and fittings, installed outdoors, shall be coated with galvanizing paint or equivalent protective coating.

3.5 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section for the installation of underground circuitry. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 26 05 33

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electrical identification materials and devices intended to comply with NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

A. Product Data:
   1. For each electrical identification product indicated.
   2. For double coated, adhesive tape product indicated.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 CABLE LABELS

A. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches.

B. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
   1. Not less than 6 inches wide by 4 mils thick.
   2. Compounded for permanent direct-burial service.
   3. Embedded continuous metallic strip or core.
   4. Printed legend indicating type of underground line.

2.2 NAMEPLATES AND SIGNS

A. Engraved Plastic Nameplates and Signs: Engraving stock, plastic laminate, minimum 1/16” thick for signs up to 20 sq. in. and 1/8” thick for larger sizes.

B. Fasteners for Nameplates and Signs:

1. High performance, double coated tape with adhesive. Design Basis: 3M #06383, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Circuit Identification Labels on Boxes: Panel and circuit number.
   1. Interior Boxes:
      a. Exposed: Pressure-sensitive, self-adhesive plastic label on cover.
      b. Concealed:
         1) Pressure-sensitive, self-adhesive plastic label on cover; or
         2) Permanent marker on cover, legible by Architect, Engineer, and Owner.
   2. Exterior Boxes:
      a. Engraved plastic label on cover; and
      b. Pressure-sensitive, self-adhesive plastic label inside cover.

F. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground-line warning tape located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

G. Color-Coding of Phase, Neutral, and Ground Conductors: Use the following colors for service, feeder, and branch-circuit phase conductors:

1.

Configuration	Phase A	Phase B	Phase C	Neutral	Ground
120/240-V, 1 Ph, 3W	Black	Red	N/A	White	Green
120/240-V, 3 Ph, 4W	Black	Orange	Blue	White	Green
120/208-V, 3 Ph, 4W	Black	Red	Blue	White	Green
277/480-V, 3 Ph, 4W	Brown	Orange	Yellow	Gray	Green

2. For conductors #6 AWG and smaller, factory apply color the entire length of conductors.
3. For conductors #4 AWG and larger, field apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible

unwinding. Use 1-inch- wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

4. At each panelboard, a color code legend shall be permanently posted corresponding to the conductors and voltage in that panelboard.

H. Apply identification to conductors as follows:
   1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
   2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
   3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

I. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment unless units are delivered with their own self-explanatory identification. Attached engraved labels with high performance double coated adhesive tape. Apply labels for each unit of the following categories of equipment:
   1. Disconnect switches and enclosed circuit breakers.
   2. Transformers.
   3. Transfer switches.

   Nameplate colors shall be: White surface with black core.

END OF SECTION 26 05 53

SECTION 26 22 00 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C 57.12.91, “Standard Test Code for Dry-Type Distribution and Power Transformers”.

C. Comply with IEEE C 57.96, “Guide for Loading Dry-Type Distribution and Power Transformers”.

D. Comply with IEEE C 57.110, “Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents”.

E. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP 2.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is

not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme Electric Corporation; Power Distribution Products Division.
   2. Eaton / Cutler-Hammer.
   3. GE Electrical Distribution & Control.
   4. Hammond Power Solutions.
   5. Siemens Energy & Automation, Inc.
   6. Sola/Hevi-Duty Electric.
   7. Square D / Schneider.

2.2 MATERIALS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices, except for taps.
   1. Internal Coil Connections: Brazed or pressure type.
   2. Coil Material: Copper or aluminum.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure:
   1. Indoors: Ventilated, NEMA 250, Type 2.
   2. Outdoors: Ventilated, raintight, NEMA 250, 3R, painted stainless steel.
   3. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Outdoor Transformer Enclosure Finish: Comply with NEMA 250 for "Outdoor Corrosion Protection"; Finish Color: Gray.

E. Efficiency: Meet or exceed DOE 2016 efficiency standards for distribution transformers.

Distribution Transformer Energy Efficiency Minimum Requirements

kVA	Single Phase Efficiency	Three Phase Efficiency
15	97.7%	97.89%
25	98.0%	-
30	-	98.23%
37.5	98.2%	-
45	-	98.40%
50	98.3%	98.60%
75	98.5%	98.60%
100	98.6%	-
112.5	-	98.74%
150	-	98.83%
167	98.7%	-
225	-	98.94%
250	98.8%	-
300	-	99.02%
333	98.9%	-
500	-	99.14%
750	-	99.23%
1000	-	99.28%

F. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls and floors for suitable mounting conditions where transformers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

B. Install floor-mounting transformers level on concrete bases. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit and 4 inches high. Reinforce concrete bases with welded wire fabric.
   1. Anchor transformers to concrete bases according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Ground equipment according to Section "Grounding and Bonding."

B. Connect wiring according to Section "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 26 22 00

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles.
2. Device wall plates.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:
   a. Bryant Electric, Inc./Hubbell Subsidiary.
   b. Eagle Electric Manufacturing Co., Inc.
   c. Hubbell Incorporated; Wiring Device-Kellems.
   d. Leviton Mfg. Company Inc.
   e. Lutron.
   f. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

B. Straight-Blade and Locking Receptacles:

1. Heavy-Duty grade.
2. Arranged for back and side wiring with brass screws.
3. Grounding type with hex head ground screw terminal.
4. 15-amp and 20-amp, 125-Volt and 250-Volt receptacles in damp or wet locations shall be listed weather-resistant type.
5. Receptacles shall accommodate back and side wiring and shall be grounding type with separate single or double grounding screw terminals.

C. GFCI Receptacles:

1. Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle.
2. Comply with UL 498 and UL 943.
3. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
4. For devices indicated, provide units with integral audible unit that sounds an alarm to indicate that the device is tripped.

2.3 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Size: All plates shall be oversized / jumbo with matching vertical dimension.
2. Plate-Securing Screws: Metal with head color to match plate finish.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Wet Locations: Cast aluminum, weatherproof, extra-duty rated, "in-use" type. Receptacle box covers shall be weatherproof whether or not a cord & plug are inserted or not.

2.4 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: Brown, unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

3.2 IDENTIFICATION

A. Comply with Section “Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped / thermal printing with black-filled lettering on face of plate, and durable wire markers inside outlet boxes.

3.3 CONNECTIONS

A. Ground equipment according to Section "Grounding and Bonding."

B. Connect wiring according to Section "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 262726

SECTION 26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers.
   4. Enclosures.

1.3 DEFINITIONS

A. HD: Heavy duty.

B. RMS: Root mean square.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current rating.
   4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. If Section “Operation and Maintenance Data” is included in the project manual, in addition to items there, include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

3. Circuit breaker trip settings.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Hubbell.
4. Legrand.
5. Siemens Energy & Automation, Inc.
6. Square D/Group Schneider.

B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and defeatable door interlocks when the operating handle is in the “ON” position. Short-circuit withstand ratings of 100kA or 200kA require Class R or Class J rejection fuse block feature.

C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and defeatable door interlocks when the operating handle is in the “ON” position.

D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   3. Siemens Energy & Automation, Inc.
   4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.

C. Molded-Case Circuit-Breaker Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:
   1. Inspect mechanical and electrical connections.
   2. Verify switch type and labeling verification.
   3. Verify rating of installed fuses.
   4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in manufacturer's installation instructions for switches and molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

B. Prepare documentation of circuit breaker trip settings for Owner record documents.

3.6 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 28 16

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged engine-generator sets for optional standby power supply. Include the following features:
   1. Diesel engine.
   2. Unit-mounted cooling system.
   3. Unit-mounted control and monitoring.
   4. Fuel system.
   5. Outdoor enclosure.

B. Related Requirements:

   1. Section " Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. ECM: Engine Control Module.

C. Optional Standby Power Supply: NEC 702, optional standby.

1.4 SUBMITTALS

A. PDF files with submittal data shall be provided for pre-installation submittals. Four sets of printed and bound Closeout Submittals shall be provided.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, standard accessories, and optional accessories.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Include motor starting performance curve(s) indicating voltage drop for motor starting conditions.
   3. Include thermal damage curve for generator.
   4. Include time-current characteristic curves for generator protective devices.
   5. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.

6. Include generator efficiency at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
7. Include generator characteristics, including, but not limited to kw rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:
1. Include plans and elevations for engine-generator set, subbase fuel tank, enclosure, and other components specified and/or provided. Indicate recommended equipment pad dimensions. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, center of gravity of full assembly, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
5. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment, automatic transfer switch, and functional relationship between all electrical components.

1.6 INFORMATIONAL SUBMITTALS

A. Specification Compliance Markup: Submit a mark-up copy of this specification with notations and explanations comprehensively showing all deviations and / or exceptions to these Specifications.

B. Qualification Data: For supplier / installer.
1. Statement from supplier / installer detailing local service capability, factory-trained service personnel, and details of service response required in accordance with this specification. Reference section 1.9A.3 for service response guarantee.

C. Field quality-control reports.

D. Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Initial Manual Submittal for Review: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Owner and/or Engineer will comment on whether scope and content of manual are acceptable.
1. Correct or revise each manual to comply with Owner and/or Engineer comments. Submit copies of each corrected manual as the Final Manual Submittal.

B. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training.
1. Format: Submit operations and maintenance manuals in the following formats.
a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory Submit electronic file on both digital disc and USB drive.

b. Two paper copies in heavy-duty, three-ring, loose-leaf binders. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

C. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. Data shall be provided and identified that is specific to the site where equipment is installed.

1. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
2. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
   a. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents.
   b. Product information.
   c. Maintenance procedures.
   d. Maintenance and service schedules.
   e. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
   f. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
   g. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
   h. Warranties: Include copies of warranties and lists of circumstances and conditions that would affect validity of warranties. Include procedures to follow and required notifications for warranty claims.
3. Operation Manuals: Assemble a complete set of operation data indicating operation of each system, subsystem, and piece of equipment not part of a system.
   a. System, subsystem, and equipment descriptions.
   b. Operating procedures.
   c. Wiring diagrams.
   d. Control diagrams.
   e. Piped system diagrams.
4. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
5. Additionally, include the following:
   a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
   b. Operating instructions laminated and mounted adjacent to generator location.
   c. Training plan.
   d. Software for unit controller with diagnostic, troubleshooting, and maintenance functionality.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating but no fewer than one of each.
   2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
   4. Paint: Two spray cans of each color.
   5. Keys: Four keys for enclosure access doors.
   6. Special Tools: Tools unique to the product for standard maintenance, listed by part number in operations and maintenance manual.

1.9 QUALITY ASSURANCE

A. Supplier / Installer Qualifications:
   1. Manufacturer and factory authorized representative who is trained and approved by manufacturer.
   2. Maintain, within 125 miles or two hours of Burgaw, North Carolina; a factory certified service center capable of providing training, parts, and emergency maintenance repairs.
   3. Response for emergency repairs shall be guaranteed to be four hours or less upon receipt of service call notification.
   4. Manufacturer's authorized representative shall employ factory-trained and certified service personnel and shall carry single-source responsibility for warranty, parts, and service.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period at no additional cost to the Owner.
   1. Warranty Period: 2 years or 2500 hours, whichever occurs first, from date of start-up and Substantial Completion.

1.11 SERVICE CONTRACT

A. Manufacturer’s service representative shall provide a service contract at no additional cost to the Owner for a period of 2 years from date of start-up and Substantial Completion of the generator set installation.

B. At the Owner’s option, the service agreement shall be renewable on a year-to-year basis, thereafter, with costs being paid by the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Caterpillar.
   2. Cummins.

3. MTU.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer. Generator set shall be standard offering from manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. NFPA Compliance:
1. Comply with NFPA 30.
2. Comply with NFPA 37.
3. Comply with NFPA 70.
4. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

B. UL Compliance: Comply with UL 2200/CSA.

C. Engine Exhaust Emissions: Comply with applicable EPA Tier requirements and applicable state and local government requirements.

D. Noise Emission:
1. At a minimum, sound level measured at a distance of 23 feet from the unit after installation is complete shall be 85 dBA or less.

E. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
1. Ambient Temperature: Minus 15 to plus 50 deg C.
2. Altitude: Sea level to 100 feet.

2.3 ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. EPSS Class: Engine-generator set shall be classified as a Class 72 in accordance with NFPA 110.

D. Governor: Adjustable isochronous, with speed sensing.

E. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

F. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated on the drawings at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Output Connections: As indicated on the drawings.
3. Voltage: As indicated on the drawings.
4. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. Nameplate shall be in accordance with NFPA70.

G. Generator-Set Performance:
1. Oversizing alternator compared with the rated power output of the engine is permissible to meet specified performance.
   a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 2 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance:
   a. Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 3 seconds.
   b. Not more than 25 percent dip under worst case motor starting conditions. See Informational Submittals, Voltage Drop Calculations for specific step loading criteria.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
8. Block Load Performance: per NFPA110, the unit shall be able to fully recover from a 100% block load.
9. Excitation System: Performance shall be unaffected by 10% total voltage distortion (THD) caused by nonlinear load.
   a. Provide permanent magnet excitation (PMG) for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.4 ENGINE

A. Fuel: Diesel Fuel oil, Grade DF-2.

B. Engine Rating: Prime mover shall have adequate horsepower to meet the specified kW at the specified site altitude and temperatures. Products that de-rate below specified kW for temperature or altitude shall not be accepted.

C. Rated Engine Speed: 1800 rpm.

D. Cylinders: For units 300 kW and larger, cylinders shall be cast iron, sleeved.

E. Lubrication System: The following items shall be mounted on engine or skid:
   1. Positive displacement, full pressure lubrication oil pump.
   2. Filter and Strainer: Per manufacturer recommendations.
   3. Dipstick to check oil level.
   4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

F. Jacket Coolant Heater:
   1. Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Heater(s) shall be 3rd party listed.
   2. 1500-watts, 120 volt minimum. Provide higher capacity heater as required based on manufacturer requirements for engine size.
   3. Thermostatically controlled to maintain engine coolant at not less than 90 deg F in 32 deg F ambient.
   4. Shut-off valve to simplify replacement of the heater.

G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
   1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
   2. Cooling System Sizing: Sized to adequately cool the generator set, including aftercooler, without de-rate to an ambient temperature of 122 deg F (50 deg C) for diesel. Maximum external restriction shall be no greater than 0.5 inch of water column.
   3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
   4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
   5. Blower fan, water pump, thermostat, and radiator duct flange shall properly cool the engines in 105 deg F ambient with up to 0.5 inches H20 static pressure on the fan. Radiator shall include a duct flange adapter for connection to the discharge air vent.
   6. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
      a. Rating: 50-psig maximum working pressure with coolant at 180 deg F (82 deg C), and non-collapsible under vacuum.
      b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 12 or 24-V electric, with negative ground.
   1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.

2. Cranking / Starting Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
    a. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
    a. Cranking cycler with 15 second ON and OFF cranking periods.
    b. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
    c. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
5. Battery: Lead acid, certified to meet NFPA 110, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
6. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and continuous rating adequate for batteries provided, 35-A minimum.
9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with and be listed to UL 1236 and include the following features:
    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain +/- 1% constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates. Fuse protection. Reverse polarity and transient protected.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet with adequate vibration isolation if mounted within the generator set.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 30.

B. Flexible fuel lines rated 300 deg F and 100 psi ending in pipe thread.

C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions. Engine-driven or electric fuel transfer pump capable of lifting fuel 4.7 feet minimum.

D. Fuel Filtering: Primary fuel filter to remove water and contaminants larger than 10 micron. Secondary filter to remove contaminants larger than 2 micron.

E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
   1. Fuel-Tank Capacity: Fuel for 48 hours continuous operation at 100 percent rated power output (200 gallons minimum). Tanks larger than the minimum capacity specified are acceptable
   2. Tank level indicator gauge.
   3. Low Fuel Sensing Switch: shall be provided, in accordance with NFPA110, to indicate when less than the minimum fuel necessary for full load running, as required by the specified EPSS class.
   4. Leak detection in interstitial space.
   5. Vandal-resistant fill cap.
   6. Spill containment box for filling location.
   7. Normal vent shall extend to 12’ above grade. Adequately brace extended vent so that attachment of the vent to the tank is not the sole means of support.
   8. Containment Provisions: Comply with requirements of authorities having jurisdiction.
   9. Tank shall be production tested to 2 psi.
   10. Tank shall be equipped with overfill protection, fuel line check valve, fuel level gauge, low fuel level alarm contact, low fuel level shutdown contact, and fittings for fuel supply, return, fill and vent.
   11. The tank shall feature all welded construction and have the structural integrity to support the genset, accessories, and the weather-protective enclosure.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown with a programmed 5 minute cooldown period. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Activation of a remote emergency-stop switch also shuts down generator set. When mode-selector switch is in the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.

B. Provide minimum run time control set for 15 minutes with override only by switching the model-selector switch to Off or by operation of a remote emergency-stop switch. Provide engine cooldown timer, factory set at 5 minutes, to permit unloaded running of the standby set after transfer of the load to normal.

C. Comply with UL 508A.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine-generator set battery.
   1. Engine and generator control wiring shall be multi-stranded annealed copper conductors encased by cross-linked polyethylene insulation resistant to heat, abrasion, oil, water, diesel fuel, and antifreeze. Wiring shall be suitable for continuous use at 250 deg F (121 deg C) with insulation not brittle at minus 60 deg F (minus 51 deg C). Cables shall be enclosed in nylon flexible conduit, which is slotted to allow easy access and moisture to escape.
      a. Engines that are equipped with an electronic engine control module (ECM) shall monitor and control engine functionality and seamlessly integrate with the generator set controller through digital communications. ECM monitored parameters shall be integrated into the genset controllers NFPA 110 alarm and warning requirements.
   2. Construction: All circuitry within the control panel shall be individually environmentally sealed to prevent corrosion. Encapsulated circuit boards with surface mounted components and sealed, automotive-style connectors for sensors and circuit board connectors.

E. Indicating Devices: As required by NFPA 110 for Level 1 system. All ECM fault codes shall be displayed at the generator set controller in standard language; fault code numbers are not acceptable. Utilizing a digital display, including the following:
   1. AC voltage: True three-phase sensing.
   2. AC current.
   3. Frequency.
   4. EPS supplying load indicator.
   5. DC voltage (alternator battery charging).
   6. Engine-coolant temperature.
   7. Engine lubricating-oil pressure.
   8. Running-time meter.
   9. Current and Potential Transformers: Instrument accuracy class.

F. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:
   1. Start-stop switch.
   2. Overcrank shutdown device.
   3. Overspeed shutdown device.
   4. Coolant high-temperature shutdown device.
   5. Coolant low-level shutdown device.
   6. Low lube oil pressure shutdown device.
   7. Overcrank alarm.
   8. Overspeed alarm.
   9. Coolant high-temperature alarm.
   10. Coolant low-temperature alarm.
   11. Coolant low-level alarm.
   12. Low lube oil pressure alarm.
   13. Lamp test.
   14. Contacts for local and remote common alarm.

15. Coolant high-temperature prealarm.
16. Generator-voltage; digitally adjustable via controller, password protected.
17. Fuel tank low-level alarm.
18. Run-Off-Auto switch.
19. Control switch not in automatic position alarm.
20. Low cranking voltage alarm.
21. Battery-charger malfunction alarm.
22. Battery low-voltage alarm.
23. Battery high-voltage alarm.

G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

H. Data Connection: Provide an RS-485 ModBus port.

I. The control system shall provide pre-wired customer use dry contact outputs (4 minimum). Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. For the initial installation, configure:
1. One relay output shall be configured for a summary indication of pre-alarm / alarm / shutdown conditions.
2. One relay output shall be configured for RUN indication of the generator.

J. Programmable Cycle Timer: To start and run the generator for a predetermined time. The timer shall use 14 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
1. Day of the week.
2. Time of the day start.
3. Duration of cycle.
4. Option to exercise at reduced speed for quiet test mode.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breakers: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator output rating.
3. Trip Settings:
   a. Selected to coordinate with generator thermal damage curve.
   b. Selected to coordinate with magnetic only, motor circuit protector breaker at a fire pump controller, as applicable.
   c. The instantaneous trip setting shall not exceed the calculated short circuit fault current available from the generator.
4. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

5. Mounting: Each circuit breaker installed in separate box in accordance with NEC 700 separation of circuits.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1 and UL2200, sized for 248 deg F (120 deg C) temperature rise above ambient at rated load.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H, vacuum impregnated with epoxy varnish in accordance with MILSPEC 1-24092 for improved fungus and salt spray resistance.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide twelve lead alternator.

E. Range: Provide broad range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rated speed, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Drip-proof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type on a sealed circuit board, separate from exciter, providing performance as specified and as required by NFPA 110. Must be 3-phase sensing.
   1. Voltage Adjustment on Control and Monitoring Panel: Provide plus or minus 10 percent adjustment of output-voltage operating band.
   2. Provide anti-hunt provision to stabilize voltage.
   3. Isolated to prevent tracking when connected to SCR loads.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum for sites with motor load supplied from VFDs or solid state soft starters.

L. Excitation: Permanent magnet (PMG) type providing 300 percent current output for up to 10 seconds to a downstream breaker for selective coordination and improved motor starting.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof housing, wind resistant up to 130 mph. Roof shall be peaked or sloped for water runoff. Access doors shall be positioned to provide adequate access to components requiring maintenance. Instruments and controls shall be mounted within enclosure.
   1. Structural Design and Anchorage: Comply with North Carolina Building Code for wind loads up to 150 mph. Enclosure shall be mounted to the subbase fuel tank.
   2. Aluminum alloy, 0.063” thick minimum (14 gauge equivalent).

3. Enclosure exterior shall be primed and finish coated with machinery gray, powder baked manufacturer standard paint.
4. Hinged Doors:
    a. Provide a minimum of two doors per side for operator and service access. A rear door or removable access panel shall provide access to generator end of unit.
    b. Door Panels: With integral stiffeners, and capable of being removed by one person without tools. In lieu of being removed, hardware that retains doors in fully open position are acceptable.
    c. Slip-pin hinges and latches stainless steel with nylon spacers.
    d. Gasketed for weather and rodent protection.
    e. Handles to have padlocking provisions.
    f. Door locks, hardware, and fasteners shall be stainless steel. Locks shall be keyed alike
5. Silencer:
    a. Located within enclosure.
    b. Super critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. At a minimum, sound level measured at a distance of 23 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
    c. Coated to be temperature and rust resistant.
    d. Integral condensate drain.
    e. Gas proof, stainless steel, flexible exhaust bellows with threaded NPT or flanged connections.
    f. All exhaust piping shall be wrapped for personnel protection and to eliminate excessive heat build-up during generator operation.
6. Assembly Hardware (Nuts and Bolts): Use stainless steel hardware and nylon washers to prevent paint deterioration.

B. Sound Attenuation: Factory or third party enclosure, designed to meet the following design criteria:
    1. Sound attenuated enclosure designed to match the criteria for the silencer. Reference section A.5.b. Enclosure shall have intake and discharge hoods, as needed to reduce the mechanical and exhaust noise to an acceptable level.
    2. Sound attenuation materials shall be securely supported, attached, and mechanically held in place; preferably with aluminum perforated metal sheeting.

C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
    1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow. Screened openings to prevent rodent entry.

D. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
   2. Additionally, test and document the following:
      a. Maximum power (kW).
      b. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
      c. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1 -22.40.
      d. Governor speed regulation under steady-state and transient conditions.
      e. Voltage regulation and generator transient response.
      f. Fuel consumption at 1/4, ½, 3/4, and full load.
      g. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
      h. Three-phase short circuit tests.
      i. Alternator cooling air flow.
      j. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
      k. Endurance testing.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
   1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Test generator, exciter, and voltage regulator as a unit.
   3. Full load run.
   4. Maximum power.
   5. Voltage regulation.
   6. Transient and steady-state governing.
   7. Single-step load pickup.
   8. Safety shutdown.
   9. Report factory test results within 5 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DELIVERY

A. Generator equipment shall be shipped to the site as a “single-source” item for which responsibility for overall installation, maintenance, spare parts, and service is through the local factory representative.

B. Delivery of the generator shall include off-loading and setting the generator in place on a concrete slab. Installation shall include mounting of all accessories specified elsewhere in this specification along with external power and control connections of the unit.

3.3 PREPARATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Owner no fewer than two weeks in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Owner’s written permission and without the presence of an Owner representative on site.

3.4 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Equipment Mounting:
   1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified and/or as detailed in the drawings.
   2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases.

C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install engine-generator in enclosure with elastomeric isolator pads on concrete base. Secure set as required by the manufacturer.

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

F. Provide fuel as required for startup, testing, and demonstration.

3.5 CONNECTIONS

A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.

B. Connect engine exhaust pipe to engine with flexible connector.

C. Ground equipment according to Section "Grounding."

D. Connect wiring according to Section "Wire and Cable." Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   a. Visual and Mechanical Inspection
      1) Compare equipment nameplate data with drawings and specifications.
      2) Inspect physical and mechanical condition.
      3) Inspect anchorage, alignment, and grounding.
      4) Verify the unit is clean.
      5) Provide fluids and check levels of fuel, lubricating oil, and antifreeze for conformity to the manufacturer’s recommendations, under the environmental conditions present and expected.
      6) Accessories that normally function while each set is standing by shall be checked prior to cranking the engines. These shall include: block heaters, battery chargers, etc.
   b. Electrical and Mechanical Tests
      1) Test protective relay devices per manufacturer recommendations.
      2) Verify phase rotation, phasing, and synchronized operation as required by the application.
      3) Start-up test mode to check for exhaust leaks, path of exhaust gases outside buildings, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation.
      4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
      5) Conduct performance test in accordance with NFPA 110.
      6) Verify correct functioning of the governor and regulator.
      7) Four hour load bank test with an external load bank as follows: 1 hour @ 50% load, 1 hour @ 75% load, 2 hours @ 100% load, monitor and record the following data in 15 minute intervals: engine coolant temperature, oil pressure, battery charge level, generator output voltage, amperes, and frequency.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks. Repair leaks and retest until no leaks exist.
6. Voltage and Frequency Transient Stability Tests:
   a. Use data capture from manufacturer control panel and software for measurements.
   b. Measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

C. Coordinate tests with tests for transfer switches and run them concurrently. Perform automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown.

D. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Remove and replace malfunctioning units and retest as specified.

G. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

H. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

I. Under the service contract, provide full service and maintenance by certified employees of manufacturer's designated service organization.
   1. Quarterly: Include inspection, testing, exercising, and adjustments to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation.
   2. Yearly: Along with quarterly activities, include a load bank test for a minimum of 3 hours at 100% load.
   3. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
   4. Include certification in the Owner’s maintenance log of repairs made and proper functioning of all engine and auxiliary systems.

3.7 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation, maintenance, and repair of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner. Time permitting, training will be tentatively scheduled after start-up.

END OF SECTION 263213

SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches (ATS).

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:
1. Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
2. Wiring diagrams.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than three hours from time of notification.

B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 70.

F. Comply with NFPA 110.

G. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Architect/Engineer/Owner no fewer than two weeks in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Owner Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. Emerson; ASCO Power Technologies, LP.
b. ABB / GE / Zenith Controls.
c. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated for 3-phase distribution systems and three-pole switches are indicated for single phase distribution system, provide neutral pole switched simultaneously with phase poles.

H. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Section "Electrical Identification."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

J. Enclosures: General-purpose, complying with NEMA ICS 6 and UL 508.

1. Agriculture Building: NEMA 250, Type 3R.
2. Fuel Facility: NEMA 250, Type 1.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Switch Configurations:

1. Agriculture Building: Closed transition type.
2. Fuel Facility: Open transition type.

B. Comply with Level 1 equipment according to NFPA 110.

C. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

D. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

F. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:

1. Fully automatic make-before-break operation.
2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
   a. Initiation occurs without active control of generator.
   b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
4. Failure of power source serving load initiates automatic break-before-make transfer.
5. Configure reverse power relay to comply with Duke Energy interconnection requirements.

G. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identify components according to Section "Electrical Identification."

B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section " Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
   a. Check for electrical continuity of circuits and for short circuits.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00