

City of Seaford, DE



Pine Street Electrical Substation Expansion and Reconstruction

Preliminary Design Phase Project Status Report and Estimated Project Budget

May 27, 2016

FINAL

Prepared by





May 27, 2016

Mrs. Dolores J. Slatcher
City Manager
City of Seaford
414 High Street
P.O. Box 1100
Seaford, DE 19973

Dear Dolores:

Subject: Pine Street Electrical Substation Expansion and Reconstruction
Preliminary Design Phase Status Report

Downes Associates, Inc. (DAI) is pleased to provide to the City of Seaford the enclosed Preliminary Design Phase Status Report for the Pine Street Electrical Substation Expansion and Reconstruction Project. We are happy to report that much work has been accomplished to date. Preliminary designs have been developed for the new Pine Street Substation. Preliminary specifications have been developed for the major new items of substation equipment including the power transformers, circuit breakers, control building, and relay control panels. Guidelines for the construction and reconfiguration of some 3.4 miles of 12.47 KV distribution circuits have been developed. In addition, initial soil borings have been taken on the site of the new substation and are being evaluated by our structural and site engineering teams.

Of equal importance is the development of the Preliminary Phase Project Budget. For the development of the capital costs involved with the substation construction, equipment and material vendors as well as construction contractors were contacted to obtain indicative pricing based upon the project's preliminary specifications. The indicative prices obtained were then adjusted to account for time related inflationary factors, bonding and insurance costs, delivery services, and ancillary construction factors.

To support the development of costs related to the reconfiguration and construction of the required distribution circuit modifications, DAI met with the City's Electrical Department personnel to evaluate the extent of the desired improvements and to determine the availability of Seaford's line forces to perform portions of the work. DAI also drew upon its historical knowledge of similar constructions to develop estimated costs for outside contractor support services.

Mrs. Dolores J. Slatcher

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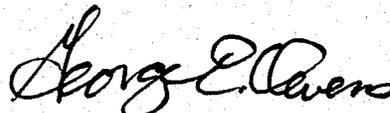
Based upon all of the described sources of cost information, DAI developed the enclosed Preliminary Phase Project Budget. Due to the fact that all of this work has been developed upon preliminary engineering studies and not final design products, an overall contingency factor of 25% was added to the project costs to account for unforeseen design and construction factors which could affect overall project costs.

The final work product included with this report is the initial application to Pepco Holdings, Inc. for a future 69 KV interconnection between the Delmarva Power North Seaford Substation and Seaford's Ross Substation. The purpose of this future proposed interconnection will be to serve as Seaford's new primary supply line which will directly connect the City's entire electrical system to Delmarva Power's main North Seaford Substation, thereby supplying a more dependable connection of the City to Delmarva Power's bulk transmission system. Although this endeavor may take several years to accomplish, this new transmission delivery point when combined with the existing Pine Street transmission delivery point will provide Seaford with redundant 69 KV ties to the Delmarva Power transmission network and ensure more reliable service of power to Seaford's citizens.

DAI would again like to extend its appreciation to the City of Seaford for the opportunity to serve as the Owner's Engineer on this vital project. With the construction of the new Pine Street Substation and the development of enhanced distribution and transmission system improvements, the City's electrical system will be equal to the energy demands of the twenty-first century.

Sincerely,

DOWNES ASSOCIATES, INC.



George E. Owens, P.E.
President

GEO/slh
Enclosure
12.1067

CERTIFICATION

The technical material and data contained in these documents were prepared under the supervision and direction of the undersigned, whose seal as a Professional Engineer is affixed below.



George E. Owens 5/27/16
George E. Owens, P.E.

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Pine Street Electrical Substation Expansion and Reconstruction

Section 1

Project Purpose and Description

PROJECT PURPOSE AND DESCRIPTION¹

The City of Seaford owns and operates a retail distribution electric utility that services approximately 3,300 residential, commercial, industrial, and institutional customers. Peak load for the entire system has recently reached 25 MW and is anticipated to increase in the future. The City of Seaford Electric Department operates and maintains three substations as part of its distribution and transmission network located throughout the City. Due to anticipated system load increases and the planned decommissioning of the Central Substation, the City desires to modernize and expand the capacity of the Pine Street facility to accommodate additional load growth and a two substation system configuration.

The proposed substation to be relocated and expanded is located at 58 N. Pine Street in the City of Seaford, Delaware. The City owns several parcels of land in the existing substation and five parcels adjacent to the existing facilities. The total land mass available for the project is approximately ± 2 acres. The existing substation is the single system transmission "tie-point" and metering location for the City Utility with the wholesale delivery utility, Delmarva Power. The original Pine Street facility was constructed in 1974 and is approaching the end of its useful life cycle. The existing substation transformer capacity is 15 MVA base load with an additional capacity up to 25 MW through the use of cooling fans.

It is desired to replace the existing substation with a new substation that incorporates a two (2) transmission to distribution voltage transformer configuration leaving the existing facilities intact during construction. Each of the two new substation transformer capacities are anticipated to be 20 MVA base load capacity and an additional capacity up to 33 MW (or greater if available) through the use of cooling fans. The design shall include all necessary associated 69 kV and 12 kV bus work, supporting structures and foundations, conductoring, grounding provisions, breakers, and control building to the north of the existing substation to provide a complete, integrated and expanded substation.

Upon completion of the new substation the existing Pine Street Substation, bus work, foundations, grounding features, (may include) control building and other associated items would be completely removed as part of the contracted efforts. This demolition and removal would be as required in two separate substation locations (Central Substation and Pine Street Substation).

The proposed distribution bus work would include the necessary breakers and space availability for an additional four distribution circuit connections. Two of the new distribution breakers would accommodate two existing City circuits (140 & 150) that are currently served by Central Substation that is scheduled to be decommissioned as part of this project. The remaining two new distribution positions are to be utilized for one future circuit and the relocation of an existing circuit from the northern portion of the Pine Street Substation. Additionally it is desired to add the necessary bus work and switching capabilities in the substation during the expansion to have the operational ability to append specific circuitry in the substation by the use of switching points.

The work effort by the consultant shall also include the design of an aerial pole line extension and interconnection of circuit 310 that currently has a point of presence just north of the US Route 13 and Herring Run Road intersection (south bound side). The consultant shall prepare the necessary plans, materials specification, coordinate with DOT, DP&L Chesapeake Utilities, Comcast, Eastern Shore Natural Gas, Delaware Electric Coop and any other affected utility required for the

PROJECT PURPOSE AND DESCRIPTION¹

proposed alignment. The proposed pole line shall be an aerial three phase 336 ACSR conductor distribution circuit extension that will extend approximately 1.2 miles along and adjacent to US Route 13 from the current location to the intersection of US Route 13 and Old Furnace Road (north bound side) then turn East on Old Furnace Road for approximately 0.2 miles. All necessary structural analysis, sag and tension calculations, utility requirements, roadway crossing, wetland and stream crossing requirements, and other design parameters shall be included in the consultant's efforts. This pole line interconnection and extension is anticipated to be an overbuild of an existing Delmarva Power and Light circuit on US Route 13 where the City would occupy the top tier of a new joint use pole line installation (to maintain proper safety clearances) and Delmarva would occupy the lower tier. The portion along Old Furnace Road is expected to be an overbuild of an existing Delaware Electric Cooperative (DEC) pole line where the City would also occupy the upper level.

The pole line extension shall include plans and details for the extension of the City dark fiber network "east loop" of 96 ct. fiber optic cable. The consultant shall include all necessary attachment, termination, and splicing details for the installation and extension of a radial tap (48 ct.) to the fiber loop to the terminus reaches of the proposed circuit 310 extension.

Also included shall be the design of an aerial pole line reconstruction of portions of the existing circuit 290/140 & 150 to the approximate limits shown in exhibit F. The City shall also consider the re-conductoring of circuit 280 over the portions of Norfolk Southern Railroad. The proposed pole line shall be an aerial three phase 336 ACSR conductor distribution circuit. The consultant shall prepare the necessary plans, materials specification, coordinate with DOT, DP&L Chesapeake Utilities, Norfolk Southern, Comcast, and any other affected utility required for the proposed reconstruction. As this facility is currently (and shall remain) in service during the project the consultant shall provide the necessary coordination and scheduling plans to minimize outages and disruptions in service.

The reconstruction of the substation will require several existing distribution circuits to be relocated (as generally described above) to accommodate the new configuration. The consultant shall prepare the necessary realignment plans and implementation schedule for this work. Some of the relocated circuitry may/will need to be installed underground to accommodate substation relocation and access to critical substation facilities. This shall include all necessary plans details structural analysis, sag and tension information, and related design features necessary to accomplish the expansion.

The project will require the removal of an adjacent commercial building and other incidental facilities (fencing and paving) to accommodate the substation reconfiguration. All circuit realignments and reconstruction must be planned, scheduled, and executed in conjunction with the overall project schedule and the anticipated distribution circuit relocations entering and exiting the proposed new substation layout. The plans for the substation reconfiguration and associated realignments must be comprehensive and include provisions for the commercial/utility truck traffic, storm water management and all other required provisions to construct a completed facility. The consultants should note that any new or modified entrances onto Pine Street Extended will require State of Delaware DOT approval and Letter of No Objection (LONO) as Pine Street

PROJECT PURPOSE AND DESCRIPTION¹

Extended is a State maintained roadway. Guard rails, barricades or other protective features may be required to protect the expanded facilities and shall be included in the proposed design plans.

Security of this facility is critical and the substation facility should be built for limited access, with the use of fencing, gates, and other measures. The City desires to expand its existing security camera system to the location and to provide 24/7/365 monitoring of activities on-site. Site lighting shall also be incorporated into the new substation design to augment facility security and workmen safety. The site lighting shall be LED type fixtures and shall fully illuminate all portions of the new facility.

The existing substation configuration includes a control facility. A new modernized, expanded control facility for the reconfigured substation arrangement will need to be planned and incorporated into the new substation layout. The City desires the control facility and site lighting features to be provided with the necessary emergency power circuitry to operate in the event of a local power interruption. The form of emergency power shall be via portable emergency generator (owned and operated by the City) connected to the facility with an appropriately sized and located plug and disconnect switch mounted on or near the control facility.

A portion of the design effort involves the evaluation of a potential new tie point between the City's 69kV transmission system and the Delmarva Power delivery network. Attachment D details three possible routes for an additional tie point. The consultant shall include in the required scope of work evaluation of the options for feasibility, cost, and long term maintenance. The consultant shall assist the City in coordinating with Delmarva Power to ensure all safety, and constructability requirements are met. Depending on budgetary and other factors the City may decide to proceed with the design and construction of a new tie point alternative.

¹ **Project Purpose and Description** verbiage was taken directly from City of Seaford, Delaware RFP issued September 11, 2015 for the Pine Street Electrical Substation Expansion and Reconstruction.

Pine Street Electrical Substation Expansion and Reconstruction

Section 2

Project Preliminary

Design Drawings



PRELIMINARY	 DOWNES ASSOCIATES INC Engineering & Management Consulting			DATE	DESCRIPTION	CITY OF SEAFORD PINE STREET SUBSTATION EXPANSION PROJECT CONCEPTUAL SITE PLAN	CAD DWG. NO. 3103 FILE NUMBER 12-1067 M.D.
	DESIGNED BY TBS	CHECKED BY GEO	DATE 05-27-16				
	DRAWN BY TBS	JOB NO. 12.1067	SCALE 1"=20'				

Pine Street Electrical Substation Expansion and Reconstruction

Section 3

Preliminary Specifications for Major Equipment

Electrical Power Transformers
Preliminary Draft Specifications

Preliminary DRAFT Specifications

SECTION 16270

ELECTRICAL POWER TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power Transformers, Quantity of Two (2): Oil immersed, three phase, substation type power transformers. Transformer ratings will be 20/27/33 MVA, OA/FA/FA, 55/65°C Rise. Transformer high voltage will be 69 KV, three phase delta. Low voltage will be 12.47 KV, three-phase grounded wye. High-voltage and low voltage bushings will be fed aerially.

1.2 REFERENCE STANDARDS

All applicable standards (latest edition) including:

- A. ANSI/IEEE:

- C57.12.00 Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- C57.12.80 Standard Terminology for Power and Distribution Transformers.
- C57.12.90 Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers.
- C57.13 Standard Requirements for Instrument Transformers.
- C57.19.00 Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.
- C57.109 Guide for Transformer Through-Fault-Current.
- NFPA 70 National Electrical Code.

1.3 APPROVAL DRAWINGS

- A. Six (6) copies each of approval drawings shall be submitted to the Buyer.
- B. Approval drawings shall consist of outline and connection drawings showing dimensions for elevations and typical section views. All proposals must contain transformer outline diagrams detailing approximate dimensions ($\pm 5\%$), location of radiators, approximate weights ($\pm 5\%$), and oil volume ($\pm 5\%$).

1.4 PROJECT CLOSEOUT SUBMITTALS

- A. Test Reports: Six (6) copies each of transformers tests performed shall be supplied to the Buyer.

Preliminary DRAFT Specifications

- B. Final Drawings: Six (6) copies each of all outline drawings, connection diagrams, and interconnection diagrams shall be supplied to the Buyer. Mechanical and electrical drawings shall be submitted to the Buyer for approval prior to manufacturing.
- C. Instruction Books and Parts Manuals: Six (6) copies of all manufacturer's technical bulletins, drawings, and operating instruction books and parts manuals for power transformers shall be supplied to the Buyer and Engineer respectively.
- D. CD ROM: Two (2) sets of drawings prepared in AutoCAD Version 2011 shall be provided to the Buyer.

1.5 QUALIFICATIONS

- A. Before a bid is considered for award, the seller must complete the Seller's Qualification Statement (contained in Section 00450 - Bid Form Supplement) regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work. Proposals not containing this information will be considered null and void.

1.6 DELIVERY

- A. The entire bid proposal shall be based upon F.O.B. Buyer's utility site, North Pine Street, Seaford, Delaware. The price quoted shall include all costs of delivery and unloading of material at the Buyer's site.
- B. Schedule: The bidder shall note on the bid form, at the place indicated, the delivery schedule for their material.
- C. Time of Delivery: Delivery of all the materials shall be made at such times as to permit unloading between the hours of 8 a.m. and 4 p.m., Monday through Friday, holidays excluded. The materialman shall give 48 hours' notice of all deliveries to Mr. Bill Bennett, Electric Superintendent, at (302) 629-9841.
- D. Transformers shall be shipped with an impact recorder during shipment whether by rail car or by truck shipment. Impact recorder chart shall be reviewed by the Buyer before each transformer is unloaded.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The Power Transformers shall be ABB Power T&D Co., Delta Star, Pennsylvania Transformer, Waukesha Electric Systems, or Virginia Transformer and shall be manufactured within the United States.

Preliminary DRAFT Specifications

2.2 DESCRIPTION

- A. Power Transformers will be three phase, oil-immersed and built in accordance with all latest applicable ANSI, NEMA, and IEEE standards including ANSI C57.12.00-2010, C57.12.10-2010/COR2-2013, and C57.12.90-2010.
- B. The transformers shall be new and of high quality.
- C. All materials shall be free from defects in appearance and performance.
- D. The materials and design shall have been proven to be satisfactory by past experience and actual service, and by comprehensive laboratory test.
- E. High-voltage and low-voltage windings shall be Copper. Transformers shall have circular coil construction.
- F. The power transformers will have normal 7.5% impedances at 20,000 KVA. The two transformers shall have the same impedances as they shall be capable of operating in parallel with each other.
- G. The transformers shall have five (5) no-load, high voltage de-energized taps with external tap changer to be operated by lockable handle and have full ampacity taps.
- H. Each transformer shall have an automatic load tap changer on the low voltage side with the following capabilities:
 - 1. LTC to be capable of withstanding full voltage short circuit conditions.
 - 2. LTC to be capable of initiating and completing desired tap change under full voltage short circuit conditions.
 - 3. LTC to be designed to provide $\pm 10\%$ voltage regulation in 16-5/8% steps above and below rated voltage.
 - 4. LTC to be capable of delivering rated KVA for voltages above and below rated position.
 - 5. LTC motor shall have solid state control manufactured by Beckwith or equivalent. Control shall have provision for reverse power lockout and automatic paralleling operation between transformers.
 - 6. LTC shall have operational counter
 - 7. LTC shall have line drop compensator.
 - 8. LTC shall have accessories for remote monitoring and control of LTC position.
 - 9. LTC to have control cabinet with the following accessories:
 - a. Lamp and manual switch for illumination.
 - b. With 120 volt convenience outlet.
 - c. With continuous and thermostatically controlled compartment heater.
 - d. With terminal blocks for remote connections.
 - e. With conduit entrance in bottom of cabinet.

Preliminary DRAFT Specifications

- I. H.V. and L.V. bushings to be light gray in color.
- J. H.V. and L.V. bushings to be mounted on the transformers' covers per ANSI Segment 3 and Segment 1.
- K. H.V. bushings to be of extra creep design with a creepage distance of 79 inches, BIL-350 KV.
- L. H.V. bushings to be of condenser type design with power factor test points.
- M. L.V. bushings to be of solid bulk type design.
- N. Neutral bushings shall be of full-rated design just as the L.V. bushings.
- O. All bushings shall be built in accordance with applicable ANSI standards with 1 1/2 inch diameter tinned copper studs with 12 threads to the inch and with 2 inch minimum of usable thread.

2.3 SERVICE CONDITIONS

- A. Power transformers will be designed for usual service conditions as defined in ANSI C57.12.4, and derating factors for unusual service conditions shall apply in accordance with this standard.

2.4 RATINGS

- A. Type OA/FA/FA
20,000/26,700/33,200 KVA, 55°C
22,400/29,792/37,184 KVA, 65°C
- B. High Voltage: 68,800 volts, three-phase delta, 350 KV BIL.
- C. Low Voltage: 12,470/7,200 volts, three-phase grounded wye, 110 KV BIL with full current neutral bushing rated for 110 KV BIL.
- D. Rated Frequency: 60Hz
- E. High voltage de-energized tap changer: Taps to be 72,400/70,600/68,800/67,000/65,200 volts.

2.5 ACCESSORIES FOR EACH TRANSFORMER

- A. Protective relays for power transformers will be separately supplied and mounted in a separate relay panel lineup.

Preliminary DRAFT Specifications

- B. Current transformers: Two (2) per bushing 1200/5 multi-ratio Class C800 current transformers will be installed in high voltage bushings. Two (2) per bushing 2000/5 multi-ratio Class C800 current transformer in low voltage bushing. Two (2) 600/5 multi-ratio bushing Class C800 current transformer will be installed in neutral bushings. One (1) current transformer for winding temperature indicator to be provided. Current transformer (CT) ratings and accuracies shall be in accordance with ANSI C57.13. CT nameplates shall be provided and information shall be in accordance with C57.13. One (1) current transformer shall be supplied in each transformer for use with the line drop compensator for each load tap changer. Secondary current transformer leads shall be brought out to shorting type terminal blocks located in terminal cabinet and properly identified.
- C. Magnetic liquid-level gauge with alarm contacts brought to control compartment terminal blocks.
- D. Dial-type liquid temperature gauge with alarm contacts brought to control compartment terminal blocks.
- E. Dial-type winding temperature gauge with alarm contacts brought to control compartment terminal blocks.
- F. Regulated nitrogen blanket with gas regulator and bottle.
- G. High voltage metal oxide station class lightning arresters and low voltage metal oxide station class lightning arrestors shall be manufactured by ABB, GE, Ohio Brass, or equivalent.
- H. Pressure-vacuum gauge.
- I. Pressure-vacuum bleeder.
- J. Combination oil drain and lower filter valve (2 inch screw end) with sampling device (3/8 inch).
- K. Upper filter valve – 1 inch.
- L. Lifting eyes for cover.
- M. Lifting hooks on tank.
- N. Provision for jacking at four corners of base.
- O. Ground pads (2) on alternate sides, copper pad NEMA 2-hole.
- P. One or more manholes in cover.

Preliminary DRAFT Specifications

- Q. Cover mounted mechanical pressure relief device with mechanical signal indication of device operation along with alarm contacts.
- R. Single-phase 240-volt fans shall be provided for fan-cooled operation. Fan operation shall be controlled by winding-temperature indicator relays.
- S. Wells for thermometer bulbs and liquid-level gauge floats shall be outside the main tank so as not to require unloading for removal.
- T. Sudden pressure relay supplied with contacts wired to terminal cabinet, 125 VDC.
- U. Diagrammatic stainless steel nameplate.
- V. Removable radiators shall be supplied with shut-off valves at tank connections. Each radiator to be supplied with drain and shut-off connection.
- W. Each transformer shall be provided with a PLC based transformer monitoring and diagnostic module which will monitor and provide SCADA output in DNP3 or Modbus protocol for all essential transformer parameters including the following: loss of life analysis, dissolved H₂ gas analysis, moisture level in the oil and paper insulation, LTC tap position, LTC differential temperature, LTC off-tap, low H₂ pressure alarm, short circuit events, fast response sensors, and fan operation and alarms.

2.6 FABRICATION

- A. General: Power Transformers will be designed, constructed, and tested in accordance with latest applicable ANSI, NEMA, IEEE, UL, and IEC Standards.
- B. All steel surfaces shall be chemically cleaned and treated to provide a bond between the primer paint and metal surfaces.
- C. Transformers to be undercoated.
- D. All windings to be copper.
- E. Transformers shall have circular coil construction.
- F. Transformers to be furnished with final paint finish of green, ANSI-45.

2.7 SOURCE QUALITY CONTROL

- A. Factory Testing: Bidder to specify standard manufacturer's tests to be performed on Transformers.

Preliminary DRAFT Specifications

- B. Testing Notice: Bidder to give adequate notice (at least two weeks) to permit the Buyer to be present during the transformer testing at the manufacturer's facility.
- C. Transformers to be tested in accordance with latest applicable standards IEEE, ANSI, NEMA and IEC standards including ANSI C57.12.00-2015, Sec. 8, Routine Tests, Impulse Tests, and Corona Tests.
- D. Transformers shall be tested with its full complement of accessories and not with standard items used only for test purposes.
- E. Transformers shall be designed to meet short circuit design requirements of ANSI C57.12.00-2015 and Short Circuit Test Code C57.12.90-2010.
- F. Warranty: Transformers shall be guaranteed by the manufacturer against all defects in material and workmanship for a period of five (5) years from the date of delivery to the Owner's site.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Seller's Responsibilities:
 - 1. Delivery of Power Transformers to be F.O.B. to the job site.
 - 2. Supply labor, equipment, and technical supervision to place each transformer on the pad at the Buyer's substation and to mount all accessories, including bushings, lightning arresters, and cooling fins, and fill the transformer with insulating oil. Oil shall be filtered during filling. Transformer shall be vacuum-filled if windings are exposed during shipment or installation. All oil shall be tested.
 - 3. In addition, the services of a factory engineer shall be supplied for two (2) days per transformer, not including travel, of additional on-site work to check out and perform all pre-energizing tests recommended by the manufacturer to determine that each transformer is totally covered for all requirements of the manufacturer's warranty, perform final service, and make operational each transformer at the Buyer's substation.

PART 4 SPARE EQUIPMENT

4.1

- A. Each transformer to be furnished with a complete set of spare gaskets.
- B. One (1) spare HV and LV bushing shall be supplied, packed for long-term storage.

Preliminary DRAFT Specifications

PART 5 TECHNICAL SUBMITTALS TO BE FURNISHED WITH TRANSFORMER BID

5.1

- A. Percent Regulation at:
 - 100% P.F.
 - 80% P.F.
- B. Percent Exciting Current at:
 - 100% Voltage
 - 110% Voltage
- C. Guaranteed loss data based on 20,000 KVA base.
- D. Auxiliary power required.
- E. Percent impedance at 20,000 KVA.
- F. Sound level at 20,000 KVA.
- G. Efficiency at 1/4, 1/2, 3/4 and full load.
- H. Approximate dimensions, weights, and outline drawing.

END OF SECTION

Substation Circuit Breakers
Preliminary Draft Specifications

Preliminary DRAFT Specifications

SECTION 16342

SUBSTATION TYPE ELECTRICAL POWER CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. 72.5 KV, 1200 Amp, main circuit breaker to be used on 69 KV circuit.
 - 1. Quantity one (1) circuit breaker.
- B. 15.5 KV, 2000 Amp, main circuit breakers to be used on 12.47 KV circuits.
 - 1. Total quantity shall be two (2).
- C. 15.5 KV, 1200 Amp feeder circuit breakers to be used on 12.47 KV circuits.
 - 1. Total quantity shall be six (6).

1.2 REFERENCE STANDARDS

All applicable standards (latest edition) including:

A. ANSI/IEEE:

- C37.04 Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
- C37.06 Preferred Ratings and Related Required Capabilities for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
- C37.09 Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
- C37.10 Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
- C37.11 Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis or a Total Current Basis.
- C37.12 Guide to Specifications for AC High-Voltage Circuit Breakers Rated on a Symmetrical Basis and a Total Current Basis.
- C57.13 Requirements for Instrument Transformers.

Preliminary DRAFT Specifications

IEEE 24	Performance Characteristics and Dimensions for Outdoor Apparatus Bushings.
NETA ATS	Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).
NFPA 70	National Electrical Code.
UL	Underwriters Laboratories

1.3 APPROVAL DRAWINGS

- A. Six (6) copies each of approval drawings shall be submitted to the Buyer.
- B. Approval drawings shall consist of:
 - 1. Outline drawings showing dimensions for elevations, plan view, weights, and typical section views.
 - 2. Schematics and wiring diagrams.
 - 3. Connection diagrams.
 - 4. Device summary.

1.4 PROJECT CLOSEOUT SUBMITTALS

- A. Test Reports: Six (6) copies each of all equipment tests performed shall be supplied to the Buyer and Engineer respectively.
- B. Final Drawings: Six (6) copies each of all outline drawings, connection drawings, and schematics shall be supplied to the Buyer. Mechanical and electrical drawings shall be submitted to the Buyer for approval prior to manufacturing.
- C. Instruction Books and Parts Manuals: Six (6) copies of all manufacturer's technical bulletins, drawings, and operating instruction books and parts manuals for all equipment shall be supplied to the Buyer.
- D. CD-ROM: Two (2) sets of drawings prepared in AutoCAD Version 2011 shall be provided to the Buyer.

1.5 QUALIFICATIONS

- A. Before a bid is considered for award, the bidder must complete the Bidder's Questionnaire (contained in Instructions to Bidders Section 00450 - Bid Form Supplement) regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and the plant available to be used in performing the work.

Preliminary DRAFT Specifications

Proposals not containing this information will be considered null and void.

1.6 DELIVERY

- A. The entire bid proposal shall be based upon F.O.B. Buyer's site, North Pine Street, Seaford, Delaware. The price quoted shall include all costs of delivery and unloading of material at the Buyer's facility.
- B. Schedule: The bidder shall note on the bid form, at the place indicated, the delivery schedule for their material.
- C. Time of Delivery: Delivery of all the materials shall be made at such times as to permit unloading between the hours of 8 a.m. and 4 p.m., Monday through Friday, holidays excluded. The materialman shall give 48 hours' notice of all deliveries to Mr. Bill Bennett, Electric Superintendent, at (302) 629-9841.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The circuit breakers shall be as manufactured by ABB Power T&D Co., General Electric, Siemens, Square D Company, or equivalent and be manufactured within the United States.

2.2 DESCRIPTION

- A. Circuit breakers will be constructed with separate mechanism and control wiring compartments.
- B. To be outdoor substation frame mounted.
- C. To include two stage heaters in both mechanism housing and control cabinet, thermostatically controlled.
- D. To have three-pole single throw, one interrupter bottle per phase.
- E. Bushings will be ANSI-70 light gray with NEMA 4-hole, spade-type tinned copper terminals on all bushings.
- F. The low-voltage compartment shall be isolated from the high-voltage compartment and shall be provided with a removable pad-lockable, gasketed, swing-door panel with glass viewing window.
- G. The operating mechanism of the circuit breakers shall be of the spring stored-energy type or magnetically operated type design for high speed closing and opening operation. Optional pneumatic mechanism will be considered for closing operation.

Preliminary DRAFT Specifications

- H. The mechanism shall be capable of accomplishing one open-close-open operation without recharging the springs.
- I. The circuit breakers shall be new and of high quality. All material shall be free from defects in appearance and performance.
- J. The 72.5 KV circuit breaker shall be station type, with SF6 interrupters, non-oil for use outdoors. The breaker shall have an interrupting rating of 40 KA.
- K. The 15.5 KV circuit breakers shall be station type, with vacuum interrupters, non-oil, for use outdoors. The breakers shall have an interrupting rating of 31.5 KA.

2.3 SERVICE CONDITIONS

- A. Circuit breakers will be designed for usual service conditions as defined in ANSI C37.13.2, and derating factors for unusual service conditions shall apply in accordance with this standard.

2.4 RATINGS

- A. The circuit breaker ratings shall be as specified and described in Part 4, Materials List.

2.5 PROTECTIVE RELAYS AND INSTRUMENTS

- A. Control and protective devices for each circuit breaker will include:
 - 1. Control switch or push button trip and close switch.
 - 2. Local/remote switch.
 - 3. To include red and green position indicating lamps.
 - 4. Control voltage will be 125 Volt DC.
 - 5. Protective relaying will be mounted in a separate relay panel lineup.
- B. Current Transformers: Each circuit breaker to be equipped with twelve (12) relaying accuracy class, multi-ratio, bushing current transformers (two in each bushing), ASA C800 class. Current Transformer (CT) ratings and accuracies shall be in accordance with ANSI C57.13. CT Ratios are to match continuous current rating of breaker. CT nameplates shall be located on the CT housing, and information provided shall be in accordance with C57.13. The CT winding shall terminate to short circuiting type terminal blocks in control cabinet and properly identified.

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2.6 ACCESSORIES

- A. Relay/test plug for each type of device, as applicable.
- B. Identification Nameplates: Phenolic nameplates shall be included in control cabinet for all devices.
- C. A handle for manually charging the stored energy system on circuit breakers.
- D. Necessary maintenance hand tools.
- E. External hand trip device and 69 device.
- F. Fused control knife switches.
- G. Two stage heaters in both mechanism housing and control cabinet, thermostatically controlled.
- H. Minimum of 8"a" and 8"b" auxiliary switches wired to terminal blocks in control cabinet and identified for customer use.
- I. Cabinet light and one (1) 120 VAC and one (1) 240 VAC single phase convenience outlet within cabinet.
- J. Alarm indication for appropriate mechanical and electrical devices.
- K. To be furnished with operation counter and phase position indicators.
- L. To be furnished with copper NEMA two-hole grounding pads.
- M. To be furnished with lifting lugs.

2.7 FABRICATION

- A. General: Circuit breakers will be designed, constructed, and tested in accordance with latest applicable ANSI, NEMA, IEEE, UL, and IEC Standards.
- B. All steel surfaces shall be chemically cleaned and treated to provide a bond between the primer paint and metal surfaces. Standard finish color will be ANSI-45, light green.

2.8 SOURCE QUALITY CONTROL

- A. Factory Testing: Bidder to specify standard manufacturer's tests to be performed on circuit breakers.

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2.9 WARRANTY

- A. All breakers shall be guaranteed by the manufacturer against all defects in material and workmanship for a period of two (2) years from date of delivery to the Owner's site.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Bidder's Responsibilities:
 - 1. Provide F.O.B. delivery to Buyer's site, North Pine Street, Seaford, Delaware.

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PART 4 MATERIALS LIST

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
1.1.	<p>72.5 KV, 1200 Amp Main Circuit Breakers to be used on 69 KV Circuit</p> <p><u>Ratings:</u></p> <p>A. 72.5 KV Voltage Rating. B. 350 KV BIL. C. Rated Continuous Current: 1200 Amps. D. SF6 interrupting medium. E. Rated Frequency: 60 Hz. F. Interrupting capacity at rated voltage: 40,000 Amps. G. Closing time: 6.0 cycles. H. Minimum interrupting time: 3.0 cycles. I. Reclosing capability: 30 cycles. J. Rated Trip Coil Voltage: 125 VDC. K. Rated Closing Coil Voltage: 125 VDC. L. Rated Charging Motor Voltage: 125 VDC M. Twelve (12) relaying accuracy class, multi-ratio, ASA C800 class bushing current transformers. N. Pressure gauge for gas pressure in each module. O. To be of dead tank design. P. To have pneumatic operating mechanism with pressure gauge and low pressure alarm switches. Q. One (1) spare tank of SF₆ gas to be supplied. R. To be electrically and mechanically trip free.</p>	1	ABB Power T & D Co., Mitsubishi, Siemens, or equivalent	
2.	<p>15.5 KV, 2,000 Amp Main Circuit Breakers to be used on 12.47 KV Mains</p> <p><u>Ratings:</u></p> <p>A. 15.5 KV Voltage Rating. B. 110 KV BIL. C. Rated Continuous Current: 2,000 Amps. D. Vacuum interrupting medium E. Rated Frequency: 60 Hz.</p>	2	ABB Power T & D Co., Mitsubishi, Siemens, General Electric, Square D, or equivalent	

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ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
	F. Interrupting capacity at rated voltage: 31,500 Amps. G. Closing time: 6.0 cycles. H. Minimum interrupting time: 3.0 cycles. I. Reclosing capability: 15 cycles. J. Rated Trip Coil Voltage: 125 VDC. K. Rated Closing Coil Voltage: 125 VDC. L. Rated Charging Motor Voltage: 240 VAC. M. Twelve (12) relaying accuracy class, multi-ratio, ASA C800 class bushing current transformers. N. To be of dead tank design. O. To be electrically and mechanically trip free.			
3.	15.5 KV, 1200 Amp Feeder Circuit Breakers to be used on 12.47 KV Circuits <u>Ratings:</u> A. 15.5 KV Voltage Rating. B. 110 KV BIL. C. Rated Continuous Current: 1200 Amps. D. Vacuum interrupting medium. E. Rated Frequency: 60 Hz. F. Interrupting capacity at rated voltage: 31,500 Amps. G. Closing time: 6.0 cycles. H. Minimum interrupting time: 3.0 cycles. I. Reclosing capability: 15 cycles. J. Rated Trip Coil Voltage: 125 VDC. K. Rated Closing Coil Voltage: 125 VDC. L. Rated Charging Motor Voltage: 240 VAC. M. Twelve (12) relaying accuracy class, multi-ratio, ASA C800 class bushing current transformers. N. To be of dead tank design. O. To be electrically and mechanically trip free.	6	ABB Power T & D Co., Mitsubishi, Siemens, General Electric, Square D, or equivalent	

END OF SECTION

Control Building
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SECTION 05000

CONTROL BUILDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. NEMA 3R weatherproof walk-in module to be utilized as a control building.
- B. Cable Tray to be furnished and installed.
- C. Heating, Air Conditioning, Exhaust Fan, and Louvers to be furnished and installed.
- D. Electrical Material Items 801-899, which shall be furnished and installed by the Seller.
- E. Electrical Panel Schedules.

1.2 REFERENCES

- A. IBC - International Building Code
- B. NEC - National Electric Code
- C. NFPA - National Fire Protection Association
- D. ANSI/ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
- E. SSPC - The Society for Protective Coatings
- F. AISC - American Institute of Steel Construction
- G. ANSI/AWS D1.1 - Structural Welding Code - Steel
- H. UL - Underwriters Laboratories

1.3 SCOPE

- A. It is the intent of these control building specifications to procure a factory manufactured, NEMA 3R walk-in module, equipped with electrical, H.V.A.C., and other equipment. The module shall be completely fabricated, assembled, and tested in a factory environment. The module shall be pre-installed and pre-wired with specified equipment prior to shipment. The control building shall be delivered to the Buyer's Delaware site as a pre-designed, factory manufactured, and tested unit.

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- B. It is the Seller's responsibility to include all items necessary for a functional installation. Any item not specifically mentioned in these specifications, but required by the Seller's interpretation, should be separately noted on the Form of Proposal.
- C. Electrical materials and equipment detailed in this specification, on the drawings listed in Section 00015 and specified at the end of this section in the material list shall be furnished and installed by the Seller. *(Note: Blank spaces on the material list shall be used by the Seller to complete the final bill of material).*
- D. The cable tray, heating, air-conditioning exhaust fan, and louvers shall be furnished and installed by the Seller. These items are indicated on Drawing No. _____.
- E. The indoor electrical switchboards shall be installed and furnished by the Seller.
- F. The Seller shall install the control building on the pier foundation system. The Seller is required to furnish the Buyer with the maximum building loads required to be supported by each pier foundation. The Seller is also required to furnish the Buyer with horizontal and vertical tolerances required for adequate pier construction. All foundation loading pier information is required to be submitted with control building shop drawings.

1.4 SHOP DRAWINGS

- A. In accordance with Section 00520, the Seller shall prepare and submit the complete shop drawings for approval of the Buyer. The drawings shall include: (a) exterior elevations, (b) interior elevations, (c) base frame and ceiling plan, (d) electrical plan, (e) electrical panelboards, cable tray, lighting fixtures, and all other electrical and mechanical equipment required to be furnished and installed by the Seller, (f) sectional details, (g) anchor bolt details, foundation loadings, and building weight, and (h) other details that may be necessary. Six (6) sets of complete drawings for approval plus one (1) set of reproducible for final submittal shall be submitted to the Buyer together with two (2) sets of CD ROM drawings in AutoCAD Version 2011 compatible.
- B. Engineering drawings shall be developed using AutoCAD Version 2011 or later.

1.5 DOCUMENTATION

After production, manufacturer shall provide corrected, six (6) sets of as-built drawings and six (6) copies of operation & maintenance instructions for the control building. The operation & maintenance manuals shall include reduced copies of the as-built drawings, wiring diagrams and color codes, and bulletins for installed equipment. Any drawings made in the field during testing shall be incorporated in an additional issue.

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1.6 GENERAL GUIDELINES

- A. Design and construction techniques shall follow industry standards, to support the manufacturing of the components and of the complete assembly of the control building. At a minimum, the latest revision of the applicable sections of the following standards shall govern:

IBC	International Building Code
NEC	National Electric Code
AWS D1.1	American Welding Society
SSPC	The Society for Protective Coatings
AISC	American Institute of Steel Construction Manual of Steel Construction
AISI	American Iron and Steel Institute – Specifications for the Design of Cold Formed Steel Design
NFPA 101	National Fire Protection Association – Life Safety Code
UL	Underwriters Laboratories

- B. Building Codes: The building construction shall conform to all applicable state and municipal building codes.

1.7 GENERAL DESCRIPTION

- A. The control building shall be of the highest quality, and all materials shall be new, unused, and free from defects affecting performance, serviceability, and appearance.
- B. The exterior dimensions of the control building shall be 14 feet wide, 38 feet long, and 11 to 13 1/2 feet high. The control building shall have a minimum interior height dimension of 10 feet. Interior widths and lengths shall be 6 inches less than exterior dimensions.
- C. The control building shall be fabricated and constructed using non-combustible materials. Additionally, all insulation shall have a flame spread of less than 25.
- D. Floor and sidewall insulation value shall be not less than R11. Ceiling/roof insulation value shall be not less than R19. All insulated areas shall include a vapor barrier. Air infiltration shall be less than 300 cu. ft./hr.
- E. The building shall be protected against the entrance of blowing rain or snow. All doors, equipment openings, cable penetrations, etc. shall be suitably protected and sealed.
- F. Structural design calculations for the control building shall be submitted to the Buyer for review within forty-five (45) calendar days after award of contract. Structural design calculations are required to be stamped and signed by a professional structural engineer licensed in the state of Delaware.

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- G. Conform to AISC Manual of Steel Construction, AWS D1.1 fabrication tolerances.

1.8 DESIGN REQUIREMENTS

- A. The control building and all its parts shall be designed and detailed in accordance with the applicable sections of the latest edition of the AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and the AISI "Specifications for the Design of Cold Formed Steel Design."
- B. Design control building to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
- C. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.

1.9 DESIGN CRITERIA

A. Base & Floor

1. The control building base shall be fabricated from ASTM A-36 structural steel members sized and arranged in such a manner to limit deflection during lifting and transportation of the completed module. Each base shall be completely welded with certified welders (AWS D1.1) whom are accustomed to working and handling structural steel. The base structural members shall be so arranged as to not interfere with floor openings and/or other bottom entrance/exit areas.
2. The flooring of the base shall consist of 3/16 inch carbon steel plate welded to the top of the structural support frame. Gaps between floor plate butts shall be continuously welded and ground smooth. The floor loading shall be rated for not less than 250 pounds/square foot. Additional reinforcing channels shall be installed in the battery room to distribute the battery weight mounted on its two-tiered rack. The flooring shall be flat and free from bows and depressions.
3. Deflection during lifting shall not exceed 1/4 inch per 10 feet. Base shall be designed for mounting on piers as indicated on Drawing No. _____.

B. Walls

1. The control building exterior wall shall be constructed from a formed 14 gauge galvanized steel. Exterior panels shall be designed to mechanically interlock to provide a weather resistant barrier. Exterior wall panels are to be a maximum of 4 feet wide and 10 feet high. Stiffeners shall be welded in the midpoint between each panel.

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2. Each exterior wall panel shall be welded or bolted to the base frame.
3. The interior wall shall be fabricated from 16 gauge galvanized steel and be mechanically fastened to the formed exterior wall. Interior wall panels shall be a maximum of 4 feet wide and 10 feet high.
4. The wall cavity shall be a nominal 3 inches.
5. Each exterior wall seam shall be liberally caulked and covered with a 14 gauge galvanized steel seam cap.
6. The walls shall be designed to withstand winds of 100 mph, in addition to all vertical and horizontal loadings created by all equipment required to be installed by the Seller.

C. Roof/Ceiling

1. The roof panels shall be fabricated from 14 gauge galvanized steel. The roof panels shall be formed and mechanically interlocked to provide a weather resistant barrier.
2. The roof shall be gable type with 1/2 inch per 12 inch slope. A minimum of 3/4 inch overhang from the exterior wall shall be provided.
3. Each exterior roof seam shall be liberally caulked and covered with a 14 gauge galvanized steel seam cap.
4. The ceiling panels shall be fabricated from 16 gauge galvanized steel and mechanically fastened to the roof truss system. The ceiling structure shall be designed to retain the insulation and provide a steel surface to install light fixtures and hang overhead cable tray.
5. The roof/ceiling systems shall be designed for the following loading conditions which may occur simultaneously:
 - a. Roof live load = 40 psf.
 - b. Estimated vertical dead load of cables to be furnished and installed during the substation project equal to 90 pounds per lineal foot of 30 inch wide cable tray.
 - c. An additional single vertical live load of 200 pounds at any location on the 18 inch and 30 inch wide cable tray is to be assumed.
 - d. Dead load of roof/ceiling system.

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- D. Partition Wall: Partition walls shall be provided as shown on Drawing No. _____. The partition walls shall permit the attachment of equipment cabinets and electrical panels in the locations detailed on Drawing No. _____. The partition walls shall be of similar construction to exterior walls, having similar insulation and interior panels on both sides. The partition wall shall extend from the floor to the gable roof and completely seal off the battery room from the office room. The office shall have access as shown on Drawing No. _____. Each wall shall have penetrations as indicated.
- E. Framing: All necessary framing and connectors shall be provided to structurally replace the panels removed by any wall openings such as doors, windows, and air conditioner. All trims and flashings required to make the unit weather-tight in any opening shall be installed. All other special openings or penetrations through the exterior wall shall be properly and completely trimmed.
- F. Doors: All doors shall be 3/4 inches thick flush construction. Doors shall be minimum 20 gauge galvanized steel reinforced by lamination to a small cell honeycomb core and manufactured in accordance with ANSI/SDI-100, Grade 1, Model 1. The hinge reinforcement shall be minimum 7 gauge and lock reinforcement shall be minimum 16 gauge. Door frames shall be 4 3/4 inches deep, double rabbeted type, of minimum 16 gauge galvanized steel. All leaves and frames shall be factory primed and painted. All exterior doors shall open outward. A drip shield shall be provided over each door.
1. Doors:
 - a. The two (2) office entry doors and the battery room entry door shall be provided with fixed wire mesh reinforced shatter proof glass on the top part of the door, and solid on the bottom part of the doors. Reinforced shatter-proof glass shall be clear polished glass with a minimum thickness of 1/4 inch.
 - b. The door for the control room exterior entry shall be as for paragraph a., but solid throughout.
 2. The following door hardware shall be provided with each door assembly:
 - a. Three (3) 4 1/2 inches x 4 1/2 inches stainless steel hinges.
 - b. Three (3) 1 1/16 inches wide, 5/8 inch high extruded aluminum threshold.
 - c. 3/16 inch x 1/2 inch polyurethane and vinyl weather-stripping.
 - d. Mortise cylinder lock-set, satin chrome finish and cross bar panic device.

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- e. Hydraulic door closer, aluminum lacquered finish.
- f. The office to the control room door shall have a 180° swing (90° about the wall plane) and shall be self-centering.

G. Insulation

- 1. Fiberglass batch insulation with a flame spread of 25 or less shall be used in all exterior walls, floors, and ceiling.
- 2. Exterior walls shall be insulated to a minimum of R11 value.
- 3. Ceiling/roof shall be insulated to a minimum of R19 value.
- 4. Floor shall be insulated to a minimum of R11 value.

H. Paint

- 1. Steel Structures Painting Council standards shall be followed in all preparation and application of primer and finish coatings. Surfaces to be painted shall be inspected for burrs and blemishes prior to paint application and corrected as required.
- 2. Surfaces to be painted shall be cleaned, rinsed, and etched with a rust inhibitive solution. Primer coats shall be applied and the surfaces sanded smooth and filled where necessary.
- 3. Interior surfaces shall be finished with a minimum of two (2) coats of polyurethane enamel. Finish color shall be white.
- 4. Exterior surfaces shall be finished with a minimum of three (3) coats of polyurethane enamel. Finish color shall be an ANSI standard, which shall be specified when shop drawing review is completed. Color charts shall be submitted with each proposal.
- 5. The floor shall be primed with corrosion resistant paint and finish coated with gray industrial non-skid enamel.
- 6. Paint manufacturer's recommendations shall be followed on application and drying times.

I. Electrical

- 1. Control building wiring, lighting, receptacles, and load centers as indicated in the material list at the end of this section shall be furnished and installed by the Seller.

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2. Installed equipment shall be interconnected with cable or wire depending on manufacturer's recommendation.
3. All wiring shall be installed in specified conduit or other approved raceway or wire way.
4. All equipment and wiring shall be installed as indicated on Drawing No. ____.
5. Any additional materials required shall be at engineer's approval.
6. Wiring: All electrical equipment and installation work shall comply with the 2014 National Electrical Code. All building wiring shall be in electrical metallic conduit either concealed or exposed as necessary. All raceways shall run vertical and horizontal exemplifying excellent workmanship and using solid and proven methods and practices. Conduits shall be mounted tight against walls or ceiling with straps. Offset bends shall be made at each box or conduit termination as appropriate. All wiring shall be type #12 THHN, stranded copper, minimum and fully color coded and circuit numbered for easy identifications and trouble shooting. A green grounding conductor shall be installed in the wiring system. All electrical equipment shall be securely fastened in place.
7. AC Service: The building electrical system will be connected to a 120/240 volt AC single phase service rated 225 amps. The Seller shall install the main service equipment consisting of an automatic transfer switch, Item No. 815 and an emergency power service manual transfer switch, Item 841 and generator hookup receptacle. The automatic transfer switch shall be piped to AC Panel A, Item No. 811, bottom fed, piped to AC Panel B, top fed. Seller shall be responsible for installing all branch wiring for lighting (indoor and outdoor and emergency), convenience receptacles (indoor and outdoor), exhaust fan, electric forced air fans, air conditioning units, and all other electrical equipment as shown on Drawing No. ____ and as necessary.
 - a. See attached/included panel schedule for types of breakers to be included and circuit assignment.
 - b. Incoming service conductors shall be installed from substation transformers to transfer switch and terminated by others.
8. Lighting: Lighting fixtures shall be of the following types:
 - a. Inside Control Room and Battery Room:
 - b. General Lighting - Four foot wrap around lens type fluorescent, Item Nos. 806 and 807. Fixtures shall be mounted level and as high above cable tray as possible.

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- c. Emergency Lighting Fixtures - Item No. 808 shall be installed as shown on Drawing No. ____.
 - d. Outside Lighting Fixtures - 100 watt LED wall packs with bulb and integral photocell, Item No. 809. Fixtures shall be mounted according to manufacturer's specifications and as shown on Drawing No. ____.
 - e. All fixtures shall be wired for use on 120 volt AC circuit.
 - f. Circuiting and location shall be as indicated on Control Building Electrical Layout Drawing No. ____.
9. Receptacles & Switches:
- a. Receptacles and switches shall be installed and circuited as shown on Control Building Electrical Layout Drawing No. ____.
10. Conduit, Boxes, Covers, Fittings, Wiring: All devices and junction boxes shall be 4 inches x 4 inches x 1 1/2 inches deep minimum. No smaller boxes shall be allowed. Outdoor receptacles shall be installed in weatherproof boxes and provided with weatherproof covers.
- a. Device covers shall be steel and of the type designed for 4 inch x 4 inch boxes.
 - b. Electrical metallic tubing in 3/4 inch trade size shall be the smallest conduit used unless shown otherwise. Fittings shall be steel set screw type.
 - c. No conduit shall be installed on the exterior of the building.
 - d. PVC conduit stubs shall be attached to wall and cable tray with strut and conduit clamps designed for use with associated strut. Ends of conduit shall be terminated with plastic bushings and locknuts where connected to panelboards and load centers, and plastic end bells where stubbed to cable tray and batteries.
11. AC Panelboards: Seller shall make provision for conduits to connect to transfer switch (No. 815) and junction box (No. 817) from underground entrance conduits.
- a. AC Panelboards shall be 225A rated, 42 circuit as identified on the panelboard schedule. Each panelboard shall be fed from the automatic transfer switch.
12. DC Panelboards shall be equipped with 2-pole circuit breakers feeding the dc circuits which shall be as per the attached schedule.

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- a. Two, 125 volt DC rated, two wire, panelboards, Items 813 and 814 shall be installed as shown on Drawing No. ____ and the panel schedules included in these specifications.
- b. Panel "DC-A" shall be equipped with a 2-pole 100 amp main breaker and installed as "top feed" and equipped with feed through 100 amp rated lugs installed at bottom of interior bus. DC-A will feed DC-B, which shall be a 100 amp main lug only panelboard installed as "bottom feed." Both panels shall be equipped with ground bars.

1.10 CABLE TRAY

- A. Cable tray shall be furnished and installed by the Seller. Cable tray systems shall be made of straight sections, fittings, and accessories as defined in the latest NEMA standards publication VE-1.
- B. Materials - Straight section and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. Fabricated parts shall be made from Aluminum Association Alloy 5052.
- C. Tray Types - Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 9 inches on center. Rung spacing in radiused fittings shall be 9 inches on center measured at the center of the tray's width. Rungs shall have a minimum cable bearing surface of 3/4 inch with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails.
- D. Tray Size - Trays shall have an overall side rail height of 6 inches clear minimum loading depth as indicated on Drawing No. _____. Width shall be 30 inches and 24 inches. Straight section side rails shall be of I-Beam design with a rung retaining weld bead. All straight sections shall be supplied in standard lengths of 144 inches (12 ft.). Fitting radius shall be 12 inches. Side rails of straight sections and fittings shall be compatible so that standard splice plates can be used to join straight sections and fittings. Fittings shall have 3 inch tangents beyond the curved section to accommodate the standard splice plates.
- E. Splice Plates and Accessories - Aluminum splice plates shall be wedge lock design, using four square neck carriage bolts and serrated flange locknuts. Splice plates shall be furnished with straight sections and fittings and shall be included in unit prices. Accessories shall be furnished as required to protect, support, and install a cable tray system.
- F. Loading Capacities - Cable tray shall meet NEMA class 8.C. with a safety factor of

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1.5. The 8 designates the support spacing in feet with 100lbs/ft loading.

- G. Manufacturer - Cable tray shall be made to manufacturing tolerances as specified by NEMA (see NEMA VE1). Cable trays shall be manufactured by B-Line Systems, Inc. of Highland, Illinois, or approved equal. Refer to Drawing No. ____ for location and major parts required.

1.11 CONTROL BUILDING CABLE ENTRIES

- A. The cable entrance from the existing cable trench shall be through the West wall as indicated, by means of a 30 inch wide fire wall sleeve. The 30 inch tray shall be supported by structural steel channel attached to the wall with stainless steel hardware from the finished grade surface to a point coincident with top of the sleeve. Solid aluminum covers and heavy duty clamps shall be used to secure the covers. The cable shall be secured to the tray and enter the building on a Ladder Drop-out fitting attached to the top rung of the tray, and attached to the wall sleeve.
- B. Two 3 inch conduits from the station service transformers shall be installed by others to enter the building through the floor on each side of the cable tray described in Paragraph A. above, as shown on Drawing No. _____. Seller shall provide entry holes as shown.
- C. The cable entrance from the South end of the building shall be the same method as described in paragraph A above using 18 inch tray, covers, and drop out fitting. This shall be complete with an 18 inch wide wall sleeve located as shown on Drawing No. _____.

1.12 HEATING (EUH-1)

- A. Electric Unit Heaters (EUH): Shall be furnished and installed where shown on the drawings. Heaters shall be Chromalox Type LUH or approved equal furnished for ceiling mount, integral thermostat kit, factory mounting bracket (swivel type), built in fuse protection, 18 gauge steel die formed cabinet with baked enamel finish, totally enclosed continuous duty fan motor, built in thermal overload (automatic reset type), four-way air throw.
- B. Mount units with bottom at 7 feet 6 inches above finished floor and at approximately 12 inches from side walls. Allow room to service unit.
- C. EUH-1 (battery room) shall be 240V, 1 ϕ , 2.6 KW.

1.13 AIR CONDITIONING (AC-1 & AC-2) – **OPTION A**

- A. Shall be furnished and installed where shown on the drawings.

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- B. Electric Air Conditioner (AC-1 & AC-2) shall be a vertical wall mount type Bard Manufacturing, Model W12AAAA05XXXXJ (nominal 1 ton) or approved equal.
- C. Each unit shall have low ambient capability with fan cycle switch and bypass for 0°F operation, 5 KW of heating capacity, 2 inch pleated filter, supply and return grilles (supply grille to be directional), an economizer, sheet metal wall sleeves, high pressure and loss of charge switches with lockout and manual reset, time delay/anti-short cycle timer, internal circuit breaker, and thermostat with subbase.
- D. Controls shall have the capability to alternate the operation between the two units (LEAD/LAG) along with the simultaneous operation of the units. Control module shall also include dry contacts (for field connection) for detection of any air conditioning system malfunction.
- E. Unit shall have spare dry contacts for remote alarm on lockout.
- F. Construction shall be copper tube, aluminum fin evaporator and condenser coil, quiet twin blowers, high efficiency rotary compressor, decorative coil guard and baked enamel finish over galvanized steel cabinet. Consult with Engineer on color.
- G. Cabinet shall have built-in mounting flanges, top flashing, and sloped top to shed rain.
- H. Building wall shall be internally constructed with additional framing for continuous perimeter around wall sleeve and at unit flanged mounting.
- I. Furnish each unit with three (3) sets of extra filters.
- J. Supply non-fused 60 amp, 120/240 VAC, 1φ NEMA 3R non-fused disconnect switch to be mounted adjacent to conduit entrance to AC-1 & AC-2.
- K. Install per manufacturer's instructions.

1.13 AIR CONDITIONING/HEATING (Heat Pump-1 and Heat Pump-2) – **OPTION B**

- A. Shall be furnished and installed where shown on the drawings.
- B. Ductless heat pump system (Heat Pump1 and Heat Pump 2) Mitsubishi Model MSZ-FH12NA and MSZ-FH12NA nominal 1 ton or approved equivalent.
- C. Each unit shall consist of an indoor unit blower and an outdoor compressor unit. The compressor shall use inverter driven technology. The indoor blower will be wall mounted. Low ambient capability at 5°F, 13,600 Btu/h of heating capacity. Washable filters.

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- D. Wireless remote controller kit. Wall mounted remote controller and a wireless receiver within the wall mounted blower.
- E. The controller will have error alarms with error codes in the case of a malfunction.
- F. Furnish each blower unit with three sets of extra filters.
- G. Supply non-fused 60 amp, 120/240 VAC 1 ϕ NEMA 3R non-fused disconnect switch to be mounted adjacent to conduit entrance to Heat Pump-1 and Heat Pump-2.

1.14 PACKAGED TERMINAL AIR CONDITIONING UNIT (AC-3) – **OPTION A**

- A. Manufacturers:
 - 1. Carrier
 - 2. General Electric
 - 3. Amana
 - 4. Or equal as approved by Buyer
- B. Description: Packaged, self-contained, through-the-wall, 3/4 Ton (Nominal) air cooled terminal heat pump unit (5 KW of heat) with wall sleeve, electric refrigeration system, electric resistance auxiliary heat in addition to heat pump, with outside air louvers, built-in temperature controls: fully charged with refrigerant and filled with oil.
- C. General: Factory-assembled, single-piece heating and/or cooling unit. Contained within the unit enclosure shall be compressor, coils, fans and fan motor, heating means, controls, all wiring and piping, and full refrigerant charge (R-22).
- D. Front Panel (supplied with unit) and Wall Sleeve: Wall sleeve and front panel shall be of plastic material. Front panel to have louvers in front surface.
- E. Fans and Motor:
 - 1. Evaporator (indoor) fan shall be a propeller type with corrosion-resistant finish, discharging air upwards. Fans shall be dynamically balanced.
 - 2. Condenser (outdoor) fan shall be a propeller type with corrosion-resistant finish, discharging air upwards. Fans shall be dynamically balanced.
 - 3. Motor shall be totally enclosed, permanently lubricated, and multiple speed.

Preliminary DRAFT Specifications

- F. Compressor: The compressor shall be fully hermetic with internal and external vibration isolation.
- G. Coils: The coils shall have aluminum plate fins mechanically bonded to seamless copper tubes internally enhanced (grooved) with all joints brazed.
- H. Controls and Safeties:
 - 1. Controls shall consist of pushbutton OFF/FAN/HEAT/COOL adjustable thermostat with upper and lower limits, VENT OPEN/CLOSE, and FAN CYCLE switches. Additional controls for heat pumps shall include outdoor coil defrost thermostat.
 - 2. Safeties shall consist of automatic reset over-temperature and overcurrent protection for compressor, inherent, automatic reset over-temperature protection for fan motor, two over-temperature protectors for heater.
- I. Operating Characteristics: Unit shall be capable of starting and running at 115° F ambient outdoor temperature per maximum load criteria of ARI Standard 310, Compressor with standard controls shall be capable of operation down to 25° F ambient outdoor temperature for heat pump and 55° F ambient outdoor temperature for cooling.
- J. Electrical Requirements: 120/240 volt shall be pre-wired with one plug, with appropriate wall receptacle as specified on unit nameplate.
- K. Filter:
 - 1. One-piece washable type that filters supply air.
 - 2. One-piece washable type filter in vent door that filters outdoor air.
- L. Accessories: The unit shall be provided with the following factory accessories:
 - 1. Factory installed electric heater for use with heat pump or heat/cool units.
 - 2. Architectural grille (plastic or aluminum).
 - 3. Hard wire kit.
- M. Building wall shall be internally constructed with additional framing for continuous perimeter around wall sleeve and at flange mounting.
- N. Install units level and plumb and according to manufacturer's instructions.
- O. Supply non-fused 60 AMP, 120/240 VAC, single phase NEMA 3R non-fused disconnect switch to be mounted adjacent to conduit entrance to AC-3.

Preliminary DRAFT Specifications

1.14 AIR CONDITIONING/HEATING (Heat Pump-3) – **OPTION B**

- A. Shall be furnished and installed where shown on the drawings.
- B. Ductless heat pump system (Heat Pump 1 and Heat Pump 2) Mitsubishi Model MSZ-FH09NA and MSZ-FH09NA nominal 3/4 ton or approved equivalent.
- C. Each unit shall consist of an indoor unit blower and an outdoor compressor unit. The compressor shall use inverter driven technology. The indoor blower will be wall mounted. Low ambient capability at 5°F, 10,900 Btu/h of heating capacity. Washable filters.
- D. Wireless remote controller kit. Wall mounted remote controller and a wireless receiver within the wall mounted blower.
- E. The controller will have error alarms with error codes in the case of a malfunction.
- F. Furnish each blower unit with three sets of extra filters.
- G. Supply non-fused 60 amp, 120/240 VAC 1 ϕ NEMA 3R non-fused disconnect switch to be mounted adjacent to conduit entrance to Heat Pump 1 and Heat Pump 2.

1.15 EXHAUST FAN (EF-1)

- A. Fan shall be as described in attached schedule.
- B. Fan shall be Model G as manufactured by Greenheck Fan Corporation of Schofield, Wisconsin or equal. Fan shall be of the centrifugal, direct driven type.
- C. The fan housing shall be of the round design, constructed of heavy gauge aluminum and shall include round duct mounting collars.
- D. The fan wheel shall be non-overloading centrifugal wheel, backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- E. Motor shall be permanently lubricated and carefully matched to the fan load. Motor shall be readily accessible for maintenance.
- F. Fan shall bear the AMCA Certified Ratings Seal for both sound and air performance.

Preliminary DRAFT Specifications

- G. Fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

EXHAUST FAN SCHEDULE

FAN NO.	CFM	S.P. IN H2O	SONES	VOLTS	AMPS	GREENHECK MODEL NO.	ACCESSORIES
EF-1	140	.125	3	115	.5	G-060 HP-D	See Below

ACCESSORIES:

1. Furnish with totally enclosed motor, direct drive type fan.
2. Fan shroud shall be heavy gauge aluminum construction.
3. Bearings shall be tested for 200,000 hours.
4. Furnish with NEMA 1 disconnect switch.
5. Furnish with inlet gravity operated damper. Greenheck part No. WD-90-PB-8 x 8.
6. Fan assembly to include vibration isolation.
7. Fan motor shall be easily accessible for maintenance.
8. Fan shall be interlocked to run on a predetermined timed cycle and also interlocked to run during battery "booster" charge cycle.
9. Furnish one enclosed industrial 120V 24 hour mechanical timer with 15 minute intervals. UL & CSA listing required.

Contact Ratings:

1. 40 AMP Tungsten 120VAC

Manufacturers:

1. Tork
2. Intermatic
3. Or approved equal

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10. Furnish galvanized birdscreen with the fan.
11. Furnish required roof curbing for proper installation.
12. Furnish one thermostat switch to override/bypass the timer at high ambient temperatures.

- Temperature Range of Operation: 30°F to 110°F
- Rating: 120V/16AMPS
- Greenheck Part No. 380044

13. Furnish a three position selector switch with contact block mounted in an enclosure for remote mounting. Assembly must be appropriately labeled with "Hand-Off-Auto." Install for exhaust fan control. See Material List items 825, 827, and 828.

1.16 LOUVERS (L-1)

- A. Furnish and install louvers as hereinafter specified where shown on the plans or as described in the schedules. Louvers shall be "Stationary and Drainable" type entirely contained with a 4 inch frame. Louver components (heads, jambs, sills, blades, and mullion) shall be factory assembled by the louver manufacturer. Louver design shall incorporate structural supports required to withstand a wind load of 25 lbs. per sq. ft. (equivalent of a 100 mph wind). Louvers shall be architectural style with continuous appearing stationary blades - intermediate support mullions shall not interrupt blade appearance when viewed from outside of louver. Color shall be approved by the Engineer.

Louvers shall be:

Frame: .081inch wall thickness

Blades: .081inch wall thickness at 37°/45° angle on 3 3/4 inch centers

Screen: Provide standard insect screen 0.11 diameter, 18 x 16 inches mesh aluminum

Published louver performance data bearing the AMCA Certified Ratings Seal for Air Performance & Water Penetration must be submitted for approval prior to fabrication and must demonstrate pressure drop and water penetration equal to or less than the Greenheck model specified. Submit installation method to Engineer for approval prior to installation.

LOUVER SCHEDULE

ITEM	SIZE	MANUFACTURER	MODEL	CFM	AIR PATTERN	P.D. IN W.C.	REMARKS
L-1	12" x 12"	Greenheck	ESD-435	140	--	0.04	See Below

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REMARKS:

1. Furnish 4 inches deep, .081inch nominal wall thickness, extruded aluminum with clear anodized finish.
2. Furnish with 0.11 diameter 18 x 16 inches aluminum mesh insect screen.
3. Furnish flanged for installation in prefabricated wall section with bottom as shown on Drawing No. _____.
4. Furnish filter rack assembly with 1 inch washable filter.

1.17 TEMPERATURE SENSOR

Provide two (2) mechanical temperature sensors to be wall mounted (location as shown on Drawing No. _____), with adjustable high and low set points. Sensors are to have two (2) separate pairs of contacts that close when the high or low limits are reached. Install in the control room and the battery room. Install according to manufacturer's instructions. Contacts to be wired to the annunciator.

Manufacturer: 1. Sensaphone Temp Alert Model FGD0022
2. Winland Electronics, Inc. Temp Alert Model TA-2HL
3. Approval equal

1.18 TESTING AND CHECKOUTS

- A. After manufacturing, equipment installation, and wiring of the control building, the Seller shall perform the following test to insure conformance with engineering drawings and specifications.
1. Physical inspection of control building and mounted equipment.
 2. Physical inspection of wiring and verification of circuit correctness.
 3. Physical inspection of structural integrity.
 4. Continuity checks of all wires installed by the Seller.
 5. Functional test of electrical circuits, HVAC, and other auxiliary equipment.

1.19 SHIPPING

- A. Removable or loose items shall be marked, tagged, and shipped with the unit(s) they

Preliminary DRAFT Specifications

support. These items shall be properly packed to insure protection during transit.

1.20 DRAWING REFERENCE

- A. Drawing No. ____ plan and elevation views of the control building.
- B. Drawing No. ____ and Control Building Electrical Materials List details all materials which are required to be installed by the Seller.
- C. Drawing No. ____ indicates the on-site location in which the control building is required to be installed.

1.21 MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Maintenance Data: Indicate surface touch-up painting instructions and painting materials required for maintenance.

1.22 QUALIFICATIONS

- A. Fabricator: Company specializing in performing the work of this Section with a minimum of three years documented experience.
- B. Design units under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Delaware.
- C. Welder: Qualified within previous 12 months in accordance with ANSI/AWS D1.1.

1.23 PRE-INSTALLATION TELEPHONE CONFERENCE

- A. Conference call one week prior to installation of the control building specified in this Section, under provisions of Section 01039.

1.24 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products under provisions of Section 01650.
- B. Handle control building, consistent with shape and design. Lift and support only from support points.
- C. Lifting or Handling Equipment: Capable of maintaining units during manufacture, storage, transportation, erection, and in position for fastening. Control building module shall be lifted in such a manner to allow accurate placement on foundation piers.

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- D. Blocking and Lateral Support During Transport and Storage: Clean, non-staining, without causing harm to exposed surfaces. Provide temporary lateral support, if necessary to prevent movement, bowing and warping.
- E. Protect units to prevent staining or chipping of painted surfaces.

1.25 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Contract Drawings.

1.26 COORDINATION

- A. Coordinate work under provisions of Section 01039.

1.27 SMOKE DETECTORS

Each room shall be fitted with strategically placed smoke detectors; each of which shall be powered from 120 VAC with battery back-up. Each unit shall be wired to the alarm circuit and when initiated, give a signal to the annunciator located in panel 200 via a terminal block.

- 1.28 Seller shall provide telephone and data connection points in each room that shall be brought out to a telephone connection box mounted on the outside, East side of the building. There will be provision for eight (8) circuits. Exterior connections will be made by others.
- 1.29 Each room shall have a wall mounted dry chemical Class A, B, C size 10, extinguisher adjacent to each exit door (three total), item 850.

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**CONTROL BUILDING ELECTRICAL MATERIALS LIST
ITEMS 801-899
REFERENCE DRAWING NO. 1500**

ITEM No.	DESCRIPTION	MINIMUM QUANTITY REQUIRED	SPARE	MANUFACTURER	CATALOG NO.
801.	20 Amp Duplex Outlet	20	4	Hubbell	CR20
802.	20 Amp Single Pole Switch – Battery Room	2		Hubbell	CS120I
803.	20 Amp, Three-Way Switch – CR/Office	6		Hubbell	CS320I
804.	20 Amp, Two Pole Switch			Hubbell	CS220I
805.	GFI Duplex Receptacle, 20 Amp, Single Phase	2		Hubbell	GF201L
806.	Fluorescent Fixture, Low Profile Wrap Around, 4-T8-32 w/3500, 1-Electronic Ballast	12		Lithonia	LB432120 1/4 GEB
807.	32 Watt T8 Lamps w/3500 Color Temp (for Above)	48	4	G.E.	F32T8SP35
808.	Thermoplastic Emergency Light with White LED Lamps	4		Lithonia	ELM2 LED
809.	Wall Pack with Polycarbonate Refractor, w/100w HPS Lamp, w/Photocell	4		Lithonia	TWP100S120LP1
811.	ACA - 225 Amp Single Phase 120/240 VAC; 3 Wire, 42 Circuit, Bottom Feed, Panelboard, Supplied With 20" Wide NEMA 1 Surface Mount Type Enclosure Without Knockouts, 225 Amp 2 Pole Bottom-Fed Main Breaker, 225 Amp Feed Through Lugs, 2-20 Circuit Ground Bars, Copper Bus. See Attached Panel Schedule for Circuit Breaker Assortment. Breakers to be Bolt-in Type.	1		Square D	NQOD Type

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**CONTROL BUILDING ELECTRICAL MATERIALS LIST
ITEMS 801-899
REFERENCE DRAWING NO. 1500**

ITEM No.	DESCRIPTION	MINIMUM QUANTITY REQUIRED	SPARE	MANUFACTURER	CATALOG NO.
812.	ACB - 225 AMP Single Phase 120/240 VAC; 3 Wire Main Lugs Only, 42 Circuit, Top Feed, Supplied with Surface Mount Type NEMA-1 20" Wide Enclosure Without Knockouts; 2-20 Circuit Ground Bars; Copper Buss. See Attached Panel Schedule For Breaker Assortment. Breakers To Be Bolt-In Type.	1		Square D	NQOD Type
813.	DCA - 100 Amp 2 Pole Main Breaker (225 Amp Frame Interior) 125 Volt DC Rated, 42 Circuits, Copper Bus, Supplied with 20" Wide Surface Mount Type NEMA 1 Enclosure without Knockouts, Main Breaker to Have 42 KAIC Rating and Top Feed; Panel to be Provided with Feed Through Lugs; See Attached Panel Schedule for Breaker Assortment.	1		Square D	NQOD Type
814.	DC-B - 225 Amp Main Lug Only 2 Wire 125 Volt DC, 42 Circuits, Copper Bus, Supplied with 20" Wide Surface Mount Type NEMA-1 Enclosure without Knockouts. See Attached Panel Schedule for Breaker Assortment.			Square D	
815.	Automatic Transfer Switch - 120/240 Volt AC 1 ϕ , 3 Wire 60 Hz. 260 Amp 2 Pole NEMA I Enclosed with MSTDS Accessories.	1		GE/Zenith Controls	ZTS-BO-U-026-B 01-20-MSTDS

Preliminary DRAFT Specifications

**CONTROL BUILDING ELECTRICAL MATERIALS LIST
ITEMS 801-899
REFERENCE DRAWING NO. 1500**

ITEM No.	DESCRIPTION	MINIMUM QUANTITY REQUIRED	SPARE	MANUFACTURER	CATALOG NO.
816.	Time Clock; 24 Hour	1		Intermatic	T-101
817.	12"x 12"x 6" Enclosure, NEMA 1; One Panel	2 - enc. 1 - panel		Hoffman Mfr.	2 ea.- A12N126 1 ea.- A12N12P
818.	General Purpose Relay; 120 VAC Coil, with Base	1		Square D	8501-KP12-V20
819.	Schedule 40 PVC Conduit	As required			
820.	Fittings	As required			
821.	Emt Conduit	As required			
822.	Emt Fittings	As required			
823.	Conduit Boxes, Covers	As required			
824.					
825.	Contactora	1		Square D	8903L030V02
826.	Photocell and Enclosure	1		Square D	
827.	Selector Switch	1		Square D	9001KS46FB 9001KA1
828.	Lighting Box	1		Stahlin	RJ1008HPL
829.					

Preliminary DRAFT Specifications

**CONTROL BUILDING ELECTRICAL MATERIALS LIST
ITEMS 801-899
REFERENCE DRAWING NO. 1500**

ITEM No.	DESCRIPTION	MINIMUM QUANTITY REQUIRED	SPARE	MANUFACTURER	CATALOG NO.
830.	Battery System - Lead Calcium Type with 250 AMP Hour Capacity, 125 Volt DC System Voltage (60 Cells), 2 Volt Battery	60		GNB/Exide	2-MX-7
832.	Fiberglass 2 Step Rack with Complete Fiberglass 4" Catchment Tray			Quality Fiberglass 817-473-3563	
833.	Battery Handling PPE Kit - To include gloves, apron, face shield, headgear, goggles Battery Acid Spill Kit	2 1		New Pig New Pig 1-800-468-4647	WPL105 KIT322
834.	Portable Eye Wash Station - 7 Gallons Gravity-Fed Wall Mount	1 each		Conney Safety Products 800-356-9100	59448
835.	Temperature Sensor	2		Sensaphone Temp. Alert	FGD0022
836.					
837.					
838.					
839.					

Preliminary DRAFT Specifications

CONTROL BUILDING ELECTRICAL MATERIALS LIST

ITEMS 801-899

REFERENCE DRAWING NO. 1500

ITEM No.	DESCRIPTION	MINIMUM QUANTITY REQUIRED	SPARE	MANUFACTURER	CATALOG NO.
840.	Battery Charger Input: 240 Vac, 1 Phase, 60 Hz Output: 125 Vdc 30 Amp To include: Primary Alarm Board W/ Summary Contact Temperature Compensation Battery Eliminator Filtering Communication Module	1		EnerSys	AT30
841.	400 A Manual Transfer Switch 250V Single Phase, 2 Pole, NEMA 3 R Outdoor Enclosure, for external generator hook-up	1		Durham	SV410
842.	Generator power inlet plug to transfer switch	1		TBD	TBD
843.					
844.					
845.					
846.					
847.					
848.					

Preliminary DRAFT Specifications

**CONTROL BUILDING ELECTRICAL MATERIALS LIST
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REFERENCE DRAWING NO. 1500**

ITEM No.	DESCRIPTION	MINIMUM QUANTITY REQUIRED	SPARE	MANUFACTURER	CATALOG NO.
849.					
850.	20 Lb. Fire Extinguisher Type Abc With Hanger One For Each Room	3			
851.					
853.					
854.					
855.					
856.					
857.					
858.					
859.					
860.					
861.					
862.					
863.					
864.					

Preliminary DRAFT Specifications

**CONTROL BUILDING ELECTRICAL MATERIALS LIST
ITEMS 801-899
REFERENCE DRAWING NO. 1500**

ITEM No.	DESCRIPTION	MINIMUM QUANTITY REQUIRED	SPARE	MANUFACTURER	CATALOG NO.
865.					
866.					
867.					
868.					
869.					
870.					
871.					
872.					
873.					
874.					
875.					
876.					
876.					
877.					
878.					
890.					

Preliminary DRAFT Specifications

**CONTROL BUILDING ELECTRICAL MATERIALS LIST
ITEMS 801-899
REFERENCE DRAWING NO. 1500**

ITEM No.	DESCRIPTION	MINIMUM QUANTITY REQUIRED	SPARE	MANUFACTURER	CATALOG NO.
897.					
898.					
899.					

Contractor to return unused portions of materials to Owner with shipment of building.

Preliminary DRAFT Specifications

PANEL SCHEDULE

SCHEDULE OF PANEL: ACA

SURFACE MOUNTED 225 AMP., MAIN BREAKER, 22 KAIC RATED, 120/240 VOLTS AC 1 ϕ , 3 WIRE
W/ 2-20 CIRCUIT GND. BAR W/ 225 AMP. FEED THRU LUGS, ALL BRANCH BREAKERS RATED 22 KAIC

CKT.	FOR	POLE	AMP.	CKT.	FOR	POLE	AMP.
1	Outside Receptacles R3, R4	2	30	2	Yard lights YL 1, 7, 10	2	20
3	240 Vac Twistlock		30	4	240 Vac		20
5	Outside Receptacles R1, R2	1	20	6	Yard Lights YL 3, 9, 11	2	20
7	Outside Building Recps. (4)	1	20	8	240 Vac		20
9	Building Security Lights (4 x 100 w)	1	15	10	Yard Lights YL 2, 4, 5, 6, 8 (pc)	2	20
11	Sp	1	20	12	240 Vac.		20
13	Battery Charger	2	30	14	AC-1 (Control Room)	2	30
15	240 Vac		30	16	240 V		30
17	Unit Heater Battery Room	2	20	18	AC-2 (Control Room)	2	30
19	240 V 2.6kw		20	20	240 V		30
21	Receptacles Battery Room/Office	1	20	22	Lights Battery Room/Office	1	15
23	Receptacles Control Room N	1	20	24	Lights Control Room N	1	15
25	Control Room S	1	20	26	Lights Control Room S	1	15
27	Sp	1	20	28	Battery Room Exhaust Fan	1	20
29	Control Panel AC, LTG, Receps.	1	20	30	Yard Lighting Pc. Control	1	15
31	RTU Panel AC PWR	1	20	32	AC-3 (Office)	1	20
33	Sp	1	20	34	Sp	1	20
35	Sp	1	20	36	Sp	1	20
37	Sp	1	20	38	Sp	1	20
39	Sp	1	20	40	Sp	1	20
41	Sp	1	20	42	Emergency Lighting (Red, Lockable)	1	20

Preliminary DRAFT Specifications

PANEL SCHEDULE

SCHEDULE OF PANEL: ACB

SURFACE MOUNTED 225 AMP., M.L.O., 22 KAIC RATED, 120/ 240 VOLTS AC 1 ϕ , 3 WIRE
W/ 2-20 CIRCUIT GND. BAR W/ 225 AMP. FEED THRU LUGS, BOTTOM FEED - 20" WIDE ENCLOSURE, ALL BRANCH BREAKERS RATED 22 KAIC

CKT.	FOR	POLE	AMP.	CKT.	FOR	POLE	AMP.
1	Circuit Breaker 6240	2	30	2	Circuit Breaker 7240	2	30
3	240 V		30	4	240 V		30
5	Circuit Breaker 210	2	30	6	Circuit Breaker 8240	2	30
7	240 V		30	8	240 V		30
9	Circuit Breaker 220	2	30	10	Circuit Breaker 250A	2	30
11	240 V		30	12	240 V		30
13	Circuit Breaker 230	2	30	14	Circuit Breaker 250B	2	30
15	240 V		30	16	240 V		30
17	Circuit Breaker 270	2	30	18	Transformer TA	2	30
19	240 V		30	20	240 V		30
21	Circuit Breaker 280	2	30	22	Transformer TB	2	30
23	Future		30	24	240 V		30
25	Circuit Breaker 290	2	30	26	Sp	2	30
27	240 V		30	28			30
29	Sp	2	30	30	Sp	2	30
31			30	32			30
33	Sp	2	30	34	Sp	2	30
35			30	36			30
37	Sp	2	30	38	Sp	2	30
39			30	40			30
41				42			

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PANEL SCHEDULE

SCHEDULE OF PANEL: DCA

SURFACE MOUNTED 100 AMP., MAIN BREAKER, 22 KAIC RATED, ___/125 VOLTS DC , 2 WIRE
W/ 20 CIRCUIT GND. BAR W/ 100 AMP. FEED THRU LUGS, BOTTOM FEED - 20" WIDE ENCLOSURE, ALL BRANCH BREAKERS RATED 22 KAIC

CKT.	FOR	POLE	AMP.	CKT.	FOR	POLE	AMP.
1	6240 Trip	2	20	2	TB DC Control/LO	2	20
3			20	4			20
5	6240 Close	2	20	6	TB Sudden Pressure	2	20
7			20	8			20
9	7240 Trip	2	20	10	TA DC Control/LO	2	20
11			20	12			20
13	7240 Close	2	20	14	TA Sudden Pressure	2	20
15			20	16			20
17	8240 Trip	2	20	18	290 Trip	2	20
19			20	20			20
21	8240 Close	2	20	22	290 Close	2	20
23			20	24			20
25	210 Trip	2	20	26	230 Trip	2	20
27			20	28			20
29	210 Close	2	20	30	230 Close	2	20
31			20	32			20
33	220 Trip	2	20	34	270 Trip	2	20
35			20	36			20
37	220 Close	2	20	38	270 Close	2	20
39			20	40			20
41				42			

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PANEL SCHEDULE

SCHEDULE OF PANEL: DCB

SURFACE MOUNTED 100 AMP., M.L.O., 22 KAIC RATED, ___/125 VOLTS DC , 2 WIRE
W/ 20 CIRCUIT GND. BAR 20" WIDE ENCLOSURE, ALL BRANCH BREAKERS RATED 22 KAIC

CKT.	FOR	POLE	AMP.	CKT.	FOR	POLE	AMP.
1	280 Trip	2	20	2	Panel 200	2	20
3	Future		20	4			20
5	280 Close	2	20	6	Panel 300	2	20
7	Future		20	8			20
9	Spare	2	20	10	Panel 400	2	20
11			20	12			20
13	Spare	2	20	14	Panel 500	2	20
15			20	16			20
17	Spare	2	20	18	Panel RTU	2	20
19			20	20			20
21	Spare	2	20	22	Lock Out Relays	2	20
23			20	24	Panels 200, 300		20
25	Spare	2	20	26	Lock Out Relays	2	20
27			20	28	Panels 400, 500		20
29	Spare	2	20	30	Spare	2	20
31			20	32			20
33	Spare	2	20	34	Spare	2	20
35			20	36			20
37	Spare	2	20	38	Spare	2	20
39			20	40			20
41				42			

END OF SECTION

Relay Control Panels
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SECTION 16165

RELAY CONTROL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Relay Control Panels.
- B. Execution.

1.2 REFERENCE STANDARDS - LATEST EDITIONS OF THE FOLLOWING:

- A. EIA:
 - RS-485
 - RS-232C
- B. ANSI:
 - C37.11 Requirements for Electrical Control
 - C37.2 Standard Electrical Power System Device Function Numbers
 - C37.21 Standards for Control Switchboards
 - C37.90 Standard for Relay and Relay Systems Associated with Electric Power Apparatus
 - C37.90.1 Standard Surge Withstand Capability (SWC) Test for Protective Relays and Relay Systems
 - C37.91 Guide for Protective Relay Applications to Power Transformers
- C. NFPA 70 National Electric Code
- D. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
- E. DNP V3.00 Subset Definition as published by the DNP User Group
- F. Schneider Modicon - Modbus Protocol Document
- G. NECA/FOA – 301 Installing Fiber Optic Cables
- H. IEEE 802.3 Standard for Ethernet

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1.3 SYSTEM DESCRIPTION

- A. The Relay Control Panel shall provide metering, protection, annunciation, and control of the substation equipment. The four (4) sections shall house all protective relays, meters, annunciators, control switches, and other auxiliary devices necessary to meet the functional requirements of the Relay Control Panel as specified in this section. A fifth panel shall be provided for the RTU equipment and functions of this installation. Refer to Paragraph 1.3.F of this Section. Collectively, they represent the Indoor Electrical Switchboard.
- B. The Seller shall be required to build the panel in accordance with the provided arrangement Drawing, utilizing the materials specified in Part 4 and from the provided Three Line, One Line, Protection Schemes, Typical DC control schemes, Annunciator Layouts and supportive drawings provided by the Buyer.

The equipment controlled, monitored, and/or supervised is as follows:

- 1. Circuit Breakers: 6240, 7240, 8240
250A, 250B
210, 220, 230, Future 4
270, 280, 290, Future 6
 - 2. Transformers: TA, TB
 - 3. Load Tap Changers: LTCA, LTCB
- C. The relay panel shall have an associated mimic diagram, depicting the major equipment and their single line arrangement. The required scheme is shown on Drawing No. _____. The material used for this mimic diagram shall be a durable HDPE material 1/4 inches wide, permanently secured to the panel sections. The devices shown shall indicate their function with accompanying open/closed indicating lamps. The circuit breakers for 69 KV shall have the illuminated close/trip switches as specified, located as on single line diagram. The transformer shall be suitably represented in accordance with standard IEEE practices. The LTC shall be shown as identified. The 12.47 KV breakers shall have lamp indication only since the protection relays have the close/trip controls incorporated in them.
 - D. Each piece of equipment indicated in paragraph A. above, is provided with multi-conductor cables for CTs, PTs, and control indication. All these cables are shown on the cable and conduit schedule Drawing Nos. _____ and _____. Each conductor shall be landed on terminals in the panel for use as shown on the accompanying drawings. Generally, all current connections into meters and relays shall have paired disconnect and shorting switches operable from the front of the panel and properly labeled as

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shown on accompanying drawings. The potential signals and trip signals shall be similarly isolatable, labeled and identified in accordance with the supplied drawings.

1. Circuit breaker control schematics are provided and shall be verified and modified to match any single line changes issued by the Buyer. The Buyer shall prepare final drawings showing the individual circuit breakers control schematics as purchased by them.
 2. The Seller shall provide, in addition to the required wiring diagrams, a scheme for each 43, CS, and 86 device, showing the DC trip circuits, permissives, and indications as depicted on the single line diagrams to be reviewed by the Buyer.
 3. The transformers TA, TB and their respective LTC controls, shall require termination of all conductors as described above. Some of these shall be cross-connected within the sections.
 4. The Seller shall note and include the provision of the specified Schweitzer protective relays.
- E. The panels shall have rear doors with lockable handles, three point latch, full height piano type hinges, and door stays. Each section door shall operate an interior light switch with a double 2 ft fluorescent lamp unit for maintenance purposes. All cable entry shall be from the top with suitable racking provided to support the incoming multi-conductor cables from the cable tray above. A removable plate shall be provided on each side of the top of each section 6 inches wide and 12 inches deep, to allow the Buyer to drill holes for conduit fittings to receive each cable. This shall be located immediately above the terminal blocks so that the shortest cable run is required from the field.
1. Provisions shall be made for running cables from section to section and to the RTU section. All subfusing and/or circuit breakers shall be easily accessible and protected from exposed live parts.
- F. RTU Panel: Relay control panels shall support the integrated substation design concept. The RTU panel shall serve as the substation communications center and shall be designed and constructed to house all equipment required to support communications from all IEDs (Intelligent Electronic Devices) to the Buyer's SCADA master station (by others). Functions and design features of the RTU panel and the equipment provided and installed therein shall include but not be limited to the following:

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1. RTU panel shall be constructed with the same materials and methods as the other relay control panels. Panel dimensions shall be as indicated on Drawing No. _____.
 - a. RTU panel shall provide for front and rear mounting of 19 inches rack mount devices. Panel shall have front and rear doors with the SEL-2240 communications processors and SEL-2730 Ethernet switches mounted on the front door. Alternately, the panel would allow flush mounting of 19 inches rack mount devices on the front side and would include removable cover plates along the full mounting height of the front face of the panel to accommodate future devices including a possible HMI interface panel.
 - b. RTU panel shall include ventilation and air filtration equipment as required to meet the environmental specifications of the equipment mounted inside the panel. Ventilation capacity shall allow for future additional equipment installations of approximately 250% of the heat output of the initial equipment.
 - c. Panel shall include space and devices for cable management. Cable entry shall be from the top for outside cables and from the side for cross-connect wiring.
2.
 - a. Equipment provided and installed in the RTU panel by the Seller shall be as indicated in Part 4, Materials List of Section 16165 and Drawing No. _____.
3. Two (2) SEL-2240 RTAC real-time automation controller and I/O processors shall be provided and installed by the Seller and shall serve as data concentrators for all IEDs connected to them. One (1) 2240 RTAC will be the primary unit and the second unit will be a backup unit.
 - a. IEDs shall be connected to the SEL-2240 as indicated on Drawing No. _____. Seller shall provide and install all communications cables, connectors, adapters, etc. as required for completed communications paths from IEDs to SEL-2240.
 - b. All SEL IEDs shall utilize SEL protocol and DNP3/IP Ethernet communications.
 - c. All non-SEL IEDs shall use non-proprietary protocols in the following order of preference depending on availability from IED manufacturer:
 - i. DNP 3.0

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- ii. Modbus RTU
 - iii. Other non-proprietary protocols subject to approval by Buyer
 - d. Three ports on one of the SEL-2240 shall be configured as a DNP3/RS232 server for communication of data to the Buyer's SCADA and HMI master station via the Buyer's fiber optic network. One port will be for interface with Delmarva Power.
 - i. SCADA master station protocol shall be DNP 3.0 utilizing a SEL-2812 transceiver fiber optic cable interface.
 - ii. Provide a local HMI output from the SEL-2240 through the SEL-2730 Ethernet switch for data acquisition and control.
 - iii. Provide a remote HMI output from the SEL-2240 utilizing a SEL-2812 transceiver fiber optic interface.
 - iv. Provide and install multi-mode fiber optic patch cables as required from transceivers to fiber patch panel.
- 4. Seller shall be responsible for complete configuration and programming of all IEDs, SEL-2240, media converters, etc. as required to provide a complete and functional substation communications network capable of performing normal SCADA functions as requested by Buyer's SCADA master station. Responsibilities shall include but not be limited to:
 - a. Communication port configuration.
 - b. SCADA point mapping and scaling.
 - c. SCADA master station point list will be provided to successful bidder.
 - d. On-site testing (and factory acceptance testing if applicable) of all SCADA communications functions - IED and master station.
 - i. If Buyer's SCADA master station is not available for testing, Seller shall provide a testing device capable of emulating a SCADA master station for on-site testing purposes. The testing device shall be certified by the DNP Users Group, such as ASE Test Set or other approved equal.
 - ii. If FAT (Factory Acceptance Test) is desired by Buyer, Seller shall utilize the same master station test device as specified in sub-paragraph "i" above.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01330 and Section 00520.

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- B. Product Data:
 - 1. Provide manufacturer's data for each system component.
- C. Shop Drawings: Provide six (6) copies each of shop drawings to Buyer.
 - 1. Schematics and wiring diagrams
 - a. Circuit breaker trip and close schemes (circuit breaker data to be supplied to successful bidder).
 - b. Provide in addition to the required wiring diagrams, a scheme for each 43, CS, and 86 device, showing the DC trip circuits, permissives, and indications as depicted on the single line diagrams to be reviewed by the Buyer.
 - 2. Connection Diagrams
 - 3. Complete bill of materials.
 - 4. Dimensioned panel layout drawings
 - 5. Front and side view layout drawings

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Test Reports: Six (6) copies each of all equipment tests performed shall be supplied to the Buyer and Engineer.
- B. Record Drawings: Six (6) copies each of all outline drawings, connection drawings, schematics, and logic diagrams shall be supplied to the Buyer.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - 2. Include data specified in Submittals in final Record Documents form.
 - 3. Submit copy of Record Drawings in AutoCAD Version 2011 compatible on CD-ROM.
- C. Operation and Maintenance Data: Six (6) copies each of instruction books and parts manuals for all equipment shall be supplied to the Buyer.
 - 1. Include all hardware, software, and system operating manuals.

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2. Include interconnection wiring diagrams of complete field installed systems with identified and numbered, system components and devices.
- D. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Buyer's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Before a bid is considered for award, the bidder must complete the Bidder's Questionnaire (contained in Section BFS 00450) regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work. Proposals not containing this information will be considered null and void.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.7 DELIVERY

- A. In accordance with Section 01650 - Product Delivery Requirements.
- B. Schedule: The bidder shall note on the bid form, at the place indicated, the delivery schedule for their material.

1.8 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 RELAY CONTROL PANELS

A. MANUFACTURERS

1. The relay control devices, meters, and equipment manufacturers shall be as specified and described in Part 4, Materials List.

B. DESCRIPTION

1. General: Relay Control Panels shall be constructed for indoor application. Indoor frame size will be 36 inches wide x 90 inches high. Depth will be 30 inches. The RTU section shall be 24 inches wide.

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C. SERVICE CONDITIONS

1. Relay Control Panels shall be designed for usual service conditions as defined in ANSI C37.21.3, and derating factors for unusual service conditions shall apply in accordance with this standard.

D. RATINGS

1. DC Control power voltage: 125 VDC (devices rated for 120V \pm 15%)
2. AC Control power voltage: 120/240 VAC, 3-wire (devices rated for 115/230V)
3. CT Rated Secondary Current: 5 Amps
4. PT Rated Secondary Voltage: 120 VAC
5. Rated Frequency: 60 Hz

E. PROTECTIVE RELAYS AND INSTRUMENTS

1. General: Protective Relays shall be as specified in Part 4, Materials List. Control voltage will be 125 VDC.
2. Wiring and Interconnection:
 - a. The relay control panel shall use 14 AWG Type SIS stranded extra flexible, 600 volt flame retardant and UL-listed wire suitable for normal application as required by ANSI 12 AWG Type SIS wire shall be used for CT circuits. Individual DC feeders, and not control bus, shall be utilized for control circuits.
 - b. Terminal blocks for buyer connections shall be provided in accordance with project drawings. Internal wiring shall be connected to only one side of these terminal blocks, with a maximum of two wires per terminal, and terminals shall be clearly marked.
 - c. Splices shall not be permitted. Wiring shall be neatly bundled and tied or secured in plastic wireways on the panels, and shall be protected from rubbing against door flanges or other parts of the enclosure.
 - d. Control circuits shall incorporate all necessary switching and protective devices, such as fuses or molded case circuit breakers. Circuit breaker close and trip circuits shall be separately fused.

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Vendors recommended fuse sizes for each control voltage shall be used.

- e. Ends will terminate with ring-tongue terminals on screw-type terminal blocks, unless prohibited by the design of connection points on control devices. Terminal block screws will use vibration-resistant hardware.
 - f. All available annunciator points shall be terminated at control panel terminal blocks for Buyer connection of inputs.
 - g. Labeling instructions for annunciator display panels will be provided by Buyer or Engineer after award of contract.
 - h. All wires shall be identified at each end with permanent wire markers giving destination terminal point and device tag.
 - i. All terminal blocks, switches, and devices shall be clearly labeled with phenolic labels giving device tag reference.
3. Provide communications cabling throughout panels as required to provide data paths from all devices with communications capabilities to SEL-2240. Cabling shall support Ethernet, RS-232 and RS-485 serial communications and fiber optic as required.
 - a. Connect all devices to network per manufacturer's instructions and in accordance with applicable EIA standards.
 - b. Use shielded communications cable in accordance with manufacturer's specifications and applicable EIA standards.

F. ACCESSORIES

1. Relay and control device software: Programming software for all devices to be included where applicable. Devices include all relays, control devices, and meters.
2. Identification Nameplates: Phenolic nameplates shall be included on relay control panels as shown on project drawings. Nameplates for individual devices not shown are to be approved as part of the submittal review with the successful bidder.
3. Spare Bulbs/Leds: Minimum of twenty (20) of each type used.
4. Spare Fuses: Minimum of ten (10) of each type and rating used.

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G. FABRICATION

1. General: Relay Control Panels will be of modular construction and fabricated as specified in Part 4, Materials List.

H. FACTORY FINISHES

1. All steel surfaces shall be chemically cleaned and treated to provide a bond between the primer paint and metal surfaces. Standard finish color will be ANSI 61 gray, outside and white enamel inside.

I. SOURCE QUALITY CONTROL

1. Factory Testing: Bidder to specify standard manufacturer's tests to be performed on Relay Control Panels.

PART 3 EXECUTION

3.1 TESTING AND TRAINING

- A. Buyer and Engineer shall have the opportunity to witness the factory acceptance tests. Seller shall provide a minimum of two weeks' notice to Buyer.
- B. Factory acceptance tests shall demonstrate to the satisfaction of the Buyer full compliance with the functional requirements of this section.
 1. The Seller shall satisfactorily demonstrate proper operation and wiring of all panel devices and functions including:
 - a. All AC and DC power circuits.
 - b. All control switches, control circuits, and indicator lights.
 - c. All meters and panel displays. Provide 3-phase voltage and current sources as required for testing meters. Provide precision current and voltage sources for testing displays.
 - d. All protective relay inputs and outputs including trip outputs.
 - e. All IED inputs and outputs. Provide precision voltage and current sources as required.
 - f. All annunciator panels and associated input and output circuits.

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PART 4 MATERIALS LIST

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
1.	<p>REAL TIME AUTOMATION CONTROLLER AND I/O PROCESSOR</p> <p>Capable of communications with all IEDs and serving as data concentrator for HMI and SCADA master. Local and remote HMI access Plug-in protocol processors for SEL Protocol/IP, DNP3/IP, RS-232, RS-485 and configurable for other communications protocols and connectors Control breakers and devices local and remote through HMI (Full RTU) Power supply: 125 VDC, 72 Digital Inputs, 16 Digital Outputs</p>	2 (Primary and Secondary)	Schweitzer	2240 Axion System: 2241X01211X0XXXXXX Axion RTAC Module 224R1X0 10 slot 19" Rack 224311X0 Power Coupler (3) 22442424X0 Input Modules 22443131X0 Output Module
2.	<p>36 POINT ALARM ANNUNCIATOR PANEL</p> <p>125 VDC power supply and inputs Digital I/O sequential events recorder, slave to 2240 RTAC With acknowledge and reset available locally and remotely</p>	2	Schweitzer	SEL-2523 2523013130XA0XX
3.	<p>THREE PHASE AC SOLID STATE PROTECTIVE RELAY</p> <p>125 VDC power with the following functions as a minimum: 50/51, 50N/51N, 81 UF, 27, 59, 79 with energy metering and breaker close/trip control and indication 125 VDC with peak 30A/short term 12A dc for close and trip operation output contacts. Communications: SEL protocol/IP Device designations: 50-210,50- 220, 50-230,50- 270, 50-280, 50-290</p>	6	Schweitzer	SEL-751 751101A1A0X0X850620 (STD +79)

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
4.	<p>THREE PHASE AC SOLID STATE PROTECTIVE DEVICE</p> <p>125 VDC power with the following ASNI functions as a minimum. 51/51N, 81 UF, 27, 59 (with 79 as an option) 125 VDC with peak 30A/short term 12A dc for close and trip operation output contacts. Communications: SEL protocol/IP Device designations: 51-6240, 51-7240, 51 -8240, 51- 250A , 51- 250B</p>	5	Schweitzer	SEL-751 751101A1A0X0X850620 (STD +79)
5.	<p>DIGITAL THREE PHASE AMMETER WITH DEMAND</p> <p>Three continuous phase displays of current with demand (15 min interval) Power supply: 125 VDC Device designations: 210 AM, 220 AM, 230 AM, 270 AM, 280 AM, 290 AM</p>	6	Bitronics	ATADE120001400
6.	<p>DIGITAL THREE PHASE VOLTMETER</p> <p>Three continuous line displays of voltage Power: 125 VDC Device designations: VM-BUSA, VM-BUSB</p>	2	Bitronics	VTAIE1200003
7.	<p>DIGITAL THREE PHASE MULTI-FUNCTION METER</p> <p>Multi-function reading kWh, kVAh, kVARh, kV, PF Power supply: 125 VDC Communications: RS-485, DNP 3.0 protocol Device designations: MFM-210, MFM-220, MFM-230, MFM-270, MFM 280 MFM 290</p>	6	Bitronics	MTWIE1B2C001N00

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
8.	DIGITAL THREE PHASE MULTI-FUNCTION METER Multi-function meter reading V, A, kW, kVAR, kVA, kV, PF Power supply: 125 VDC Communications: RS-485, DNP 3.0 protocol Device designation: MFM-250A, MFM-250B	2	Bitronics	MTWIE1B2C001N00
9.	DIGITAL THREE PHASE AMMETER WITH DEMAND With 3 continuous displays of phase current with demand (15 min interval) Power supply: 125 VDC Device designation: AM-250A, AM-250B	2	Bitronics	ATADE120001400
10.				
11.	REVENUE AND POWER QUALITY METER Measuring kWh, kVARh, kVAh ANSI C12.20.0.2 accuracy class Additional functions shall be up to 35 days of 12 channel data at 5 minute interval Time of day synchronized, harmonic recording up to 3kHz, voltage sag/swell, line and transformer loss compensation Communications: SEL Protocol/IP Power supply: 125 VDC Device designation: KWH-TB, KWH-TA, KWH-210, KWH-220, KWH-230, KWH-270, KWH-280, KWH-290	8	Schweitzer	SEL-735 0735AX00944FXXXXXX1 6101XX
12.				
13.				
14.				

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
15.				
16.				
17.				
18.				
19.				
20.	<p>THREE PHASE AC SOLID STATE TRANSFORMER DIFFERENTIAL PROTECTIVE RELAY</p> <p>Power supply: 125 VDC ANSI/IEEE functions for 81UF, 27, 59, 51, 51N, 51G, 87T Trip circuit shall be rated 30A, 125 VDC Communications: SEL protocol/IP Device designations: 87TA, 87TB</p>	2	Schweitzer	SEL-787 0787EX1ACA0X75850620
21.	<p>THREE PHASE AC DIGITAL AMMETER WITH DEMAND</p> <p>With three continuous displays of current with demand (15 min interval) Device designations: AM-TA, AM-TB Power supply: 125 VDC</p>	2	Bitronics	ATADE120001400
22.	<p>HIGH SPEED CIRCUIT BREAKER MANUAL RESET LOCKOUT RELAY</p> <p>Power supply: 125 VDC Contacts: 20A, 600V continuous, 5 deck, 4 cells, double contact Pistol grip handle, two position, energized coil retained in vertical "reset" mode, released to "tripped" mode at 10 o'clock position complete with "circuit healthy" white light in reset position and blue indicating light in tripped/do not reset position Device designations: 86TA, 86TB</p>	2	Electroswitch	78PB05D

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
23.				
24.				
25.				
26.				
27.	<p>THREE PHASE AC DIGITAL VOLTMETER</p> <p>With three continuous displays of line voltage Power supply: 125 VDC Device designation: VM-7240, VM-6240</p>	2	Bitronics	VTAIE12000300
28.				
29.				
30.	<p>12 POINT TERMINAL BLOCK 600 V, 30A</p> <p>Screw type terminal blocks, heavy duty</p>	44	Marathon	1512 STD
31.	<p>SIX POLE KNIFE SWITCH CONFIGURATION</p> <p>With three (3) double pole current circuit shorting switches Clear plastic cover Stud terminals w/washers and nuts, rated 9A @ 300 VAC Two for amp meters, two for diff relays</p>	4	ABB	CS129A516G01 FT-1 Flexitest
32.	<p>TEN POLE KNIFE-SWITCH CONFIGURATION</p> <p>With three (3) pairs of connected double pole current shorting switches and four (4) single pole disconnect witches Clear plastic cover Stud terminals w/washers and nuts, rated 9A @ 300 VAC Panel 500, 400, 300 and 200 devices</p>	35	ABB	CS129A514G01 FT-1 Flexitest

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
33.	<p>FOUR POLE KNIFE SWITCH CONFIGURATION</p> <p>Four single pole hinged switches. Clear plastic cover Stud terminals w/washers and nuts, rated 9A @ 300 VAC For four (4) volt meters</p>	4	ABB	CS129A524G01 FT-1 Flexitest
34.				
35.	<p>TEN POLE KNIFE-SWITCH CONFIGURATION</p> <p>With ten (10) single pole isolating switches Stud terminals w/washers and nuts, rated 9A @ 300 VAC For panel 400, 300 and 200 trip output isolation</p>	3	ABB	CS129A501G01 FT-1 Flexitest
36.	<p>FOURTEEN POLE KNIFE_SWITCH CONFIGURATION</p> <p>With seven (7) double pole isolating switches Stud terminals w/washers and nuts, rated 9A @ 300VAC For panel 500 trip isolation</p>	1	ABB	FT4A14T146N4001 FT-1 Flexitest
37.	ET-16 LED PANEL LAMPS RED	15	GE	116B6708G43R73R4
38.	ET-16 LED PANEL LAMPS GREEN	15	GE	116B6708G43G73G4
39.	<p>LOCAL/REMOTE SELECTOR</p> <p>Two (2) position (11 o'clock/1 o'clock) selector switch Device designation: 43-6240, 43-7240, 43-8240, 43-250A, 43-250B, 43-210, 43-220, 43-230, 43-270, 43-280, 43-290</p>	11	Electroswitch	24203B
101	<p>ETHERNET SWITCH</p> <p>19" rack mount, 125 VDC power supply (24) Ethernet 10/100 MB ports</p>	2	SEL	2730

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
102	FIBER OPTIC CLOSET HOUSING 19" rack mount w/cable attachment and strain relief With bulk heads and adapters for terminating 36 fibers ST style connectors	1	Corning	CCH-03U
103	FIBER OPTIC PATCH CABLES Multi-mode, duplex, ST-ST connectors Length: 6 ft.	6		
104	SEL-2812 Fiber Optic Transceiver EIA -232 communication to F.O. cable 4 km distance	3		
105	19" RACK MOUNT EQUIPMENT SHELVES-VENTILATED	2		
106	FREE STANDING 36" RELAY CONTROL PANELS No. 11 gauge (1/8") steel Overall dimensions: 36" wide 30" deep 90" high Paint ANSI-61 light gray, interior white Control cable will enter from bottom A ground bus shall be provided at bottom of portion of cabinet to connect to station ground system, bus size 1/4" x 1" copper Ground lug for 4/0 copper shall be fastened to bus as well as 6 holes drilled and tapped for #8 machine screws Plastic vertical wiring troughs, with slots (4" x 4" or suitable size similar to Taylor Wiring Duct Cat. No. 94040) shall be provided, with covers Wire size shall be #14 SIS switchboard wire, except current circuits shall be #12 Wires connecting the terminal blocks located on either side of the hinge shall be stranded and protected for the application of a hinged area	4		

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
	<p>Lugs shall be insulated ring type Rear of panel shall include a continuous hinge on rear door, on left side when viewed from rear Provision for mounting switchboard to floor with anchor bolts Nameplates will be required for each device Nameplates shall be white letters on block lamacoid or equivalent A mimic bus shall be provided on the front panels Color of bus: Yellow for 69 KV Lt. Blue for 12.5 KV Width of bus shall be 1/4" Bus to be applied per drawings Arrows to be black Opening to be provided on upper section of side sheets on all panels for cross wiring A cover plate shall be supplied for the exposed side openings of end panels</p>			
107	<p>FREE STANDING 24" RELAY CONTROL PANEL</p> <p>No. 11 gauge (1/8") steel Overall dimensions: 24" wide 30" deep 90" high</p> <p>Paint ANSI-61 light gray, interior white Control cable will enter from bottom A ground bus shall be provided at bottom of portion of cabinet to connect to station ground system, bus size 1/4" x 1" copper Ground lug for 4/0 copper shall be fastened to bus as well as 6 holes drilled and tapped for #8 machine screws Plastic vertical wiring troughs, with slots (4" x 4" or suitable size similar to Taylor Wiring Duct Cat. No. 94040) shall be provided, with covers Wire size shall be #14 SIS switchboard wire, except current circuits shall be #12 Wires connecting the terminal blocks located on either side of the hinge shall be stranded and protected for the application of a hinged area</p>	1		

ITEM	DESCRIPTION	MINIMUM QUANTITY REQUIRED	MANUFACTURER	PART NO.
	Lugs shall be insulated ring type Rear of panel shall include a continuous hinge on rear door, on left side when viewed from rear Provision for mounting switchboard to floor with anchor bolts Nameplates will be required for each device Nameplates shall be white letters on block lamacoid or equivalent Opening to be provided on upper section of side sheets on all panels for cross wiring A cover plate shall be supplied for the exposed side openings of end panels			

END OF SECTION

Pine Street Electrical Substation Expansion and Reconstruction

Section 4

Proposed Distribution Circuit Improvements

PROPOSED DISTRIBUTION CIRCUIT IMPROVEMENTS

SEGMENT 1

Location:
Middleford Road

Goal:
Complete circuit tie near hospital between Poplar Street and Middleford Road

Solution:
After review and discussion, it was mutually agreed to extend the existing alignment along E. Poplar Street to intersect with the existing circuit along Middleford Road. The existing pole on Middleford Road may require the neutral to be lowered slightly to accommodate the new dead-end arm needed for the conductor from E. Poplar Street. An additional in-line pole may also be installed and framed with double dead-end construction with a GOABS installed for better sectionalizing capability of the circuit.

SEGMENT 2

Location:
Porter Street from Stein Highway to Harrington Street

Goal:
Upgrade circuit conductors. Assess condition of existing structures and identify and poles, crossarms, or braces with defects that diminish structural integrity.

Solution:
City Electric Department will replace any defective or deficient poles, crossarms, or braces in preparation for conductor upgrade. Then, a utility contractor will perform all work (outrigging, temporary transformer taps, pulling in of new conductor, etc.) associated with upgrading the existing phase and neutral conductors along this segment. DAI will assist in obtaining the necessary utility permits from DelDOT.

SEGMENT 3

Location:
Pine Street Substation – Circuit 280 and Circuit 290 to Hurley Park Drive

Goal:
To upgrade the existing primary and neutral conductors from the Pine Street Substation to Hurley Park Drive.

Solution:
City Electric Department desires to have existing utility pole located on common side property line eliminated. DAI to evaluate structure requirements to determine possibility of this request. Set a new structure at Hurley Park Drive that is better suited to accommodate both Circuit 280 and

PROPOSED DISTRIBUTION CIRCUIT IMPROVEMENTS

Circuit 290. May require steel pole due to significant conductor loading. All work for this segment to be performed by a utility contractor.

SEGMENT 4

Location:

Hurley Park Dr, Tulip Place, North Porter Street to Stein Highway

Goal:

Upgrade circuit conductors. Assess condition of existing structures and identify and poles, crossarms, or braces with defects that diminish structural integrity.

Solution:

City Electric Department will replace any defective or deficient poles, crossarms, or braces in preparation for conductor upgrade. Then, a utility contractor will perform all work (outrigging, temporary transformer taps, pulling in of new conductor, etc.) associated with upgrading the existing phase and neutral conductors along this segment.

SEGMENT 5

Location:

Pine Street Substation – Proposed Circuit 230

Goal:

Construct a new circuit route that connects to existing overhead circuit infrastructure along Stein Highway at Arch Street

Solution:

Utility contractor will install new directional bore underground conduits between Oak Street and State Street. Once completed, City Electric Department will pull new URD conductors through conduit and terminate URD conductors at both riser pole locations. City Electric Department to upgrade existing circuit along Maple Street to Oak Street. City Electric Department to build new overhead three phase circuit along portions of State Street and Arch Street. A utility contractor will install the phase and neutral conductors across Stein Highway. DAI will assist in obtaining the necessary utility permits from DelDOT.

SEGMENT 6

Location:

Pine Street Substation – Proposed Circuit 270

PROPOSED DISTRIBUTION CIRCUIT IMPROVEMENTS

Goal:

Construct a new circuit route that connects to existing overhead circuit infrastructure along Cedar Avenue at Stein Highway.

Solution:

Utility contractor will install new directional bore underground conduits along Cedar Avenue under the Stein Highway Bridge. An easement may be required from DelDOT for the installation of the required conduits. Once completed, City Electric Department will pull new URD conductors through conduit and terminate URD conductors at both riser pole locations. City Electric Department to build new overhead circuit along existing 6 9kV pole line and Cedar Avenue prior to the Stein Highway Bridge. Additional structures will likely be required to minimize long span length and subsequent structure loading as well as to minimize potential vertical clearance issues. DAI will assist in obtaining the necessary utility permits and easements from DelDOT.

SEGMENT 7

Location:

Pine Street Substation – Existing Circuit 210

Goal:

Remove existing overhead facilities from the Cummings property to facilitate the upcoming site work and substation expansion.

Solution:

City Electric Department will set a new riser pole near existing overhead takeoff pole from Pine Street Substation as well as a new riser pole on Virginia Avenue complete with downguys and anchors to facilitate circuit conductor dead-ending. City Electric Department will excavate for new concrete utility vault and prepare subbase in preparation for placement of concrete vault by vault manufacturer. City Electric Department will install new conduit between new riser pole at Pine Street Substation and the concrete utility vault. A utility contractor will directional bore new conduits between the concrete utility vault and the new riser pole on Virginia Avenue. City Electric Department will pull new URD conductors between the riser poles and terminate conductors as required. Once the new URD conductors are energized in parallel with the overhead circuit, the overhead circuit will be de-energized. The dismantling of the overhead circuit on the Cummings property can now be completed.

SEGMENT 8

Location:

Pine Street Substation – Existing Circuit 220

Goal:

Remove existing overhead facilities from the Cummings property to facilitate the upcoming site work and substation expansion.

PROPOSED DISTRIBUTION CIRCUIT IMPROVEMENTS

Solution:

City Electric Department to construct a new deadend pole within the existing Circuit 220 alignment just north of and outside of the Cummings property. Install anchors and downguys as necessary. Remove jumpers and/or taps as necessary to allow the removal of the existing overhead conductors back to the Pine Street Substation. All load will be transferred to Circuit 320 from Ross Substation. Back-up for Circuit 320 can be achieved via the Circuit 280 GOABS located near the well house off of Arbutus Drive.

SEGMENT 9

Location:

Pine Street near the existing Central Substation – Existing Circuits 140 and 290

Goal:

Provide circuit tie between Circuit 140 (future Circuit 290) and Circuit 290 (future Circuit 270).

Solution:

City Electric Department to construct a new circuit tie with some minor pole modifications to facilitate this work. Also includes the installation of a new GOABS to be located on the existing riser pole located near the intersection of Pine Street and High Street. The scope of work in this area may be drastically enhanced if the proposed development of the river shore in this area occurs in advance of when the circuit tie work is required.

SEGMENT 10

Location:

US Route 13 – Just north of Lowe's

Goal:

Provide circuit tie for Circuit 310

Solution:

Construct a new segment of Circuit 310 from near the water tower on US Route 13 north to the city owned electric crossing just north of Herr's distribution warehouse. Also includes the installation of a new GOABS. Work must be coordinated with Delmarva Power as this new circuit segment will be overbuilt on Delmarva Power's existing distribution circuit. Work to be performed by a utility contractor due to overbuild of existing Delmarva Power circuits, permitting and maintenance of traffic requirements.

SEGMENT 11

Location:

US Route 13 – Northbound

Goal:

Provide circuit extension for Circuit 310

PROPOSED DISTRIBUTION CIRCUIT IMPROVEMENTS

Solution:

Construct a new extension of Circuit 310 from its present deadend location north to Old Furnace Road. Work must be coordinated with Delmarva Power as this new circuit segment will be overbuilt on Delmarva Power's existing distribution circuit. This new circuit will also likely require the portion that migrates under the existing 138kV circuit to be installed underground due to limited vertical clearance. Work to be performed by a utility contractor due to overbuild of existing Delmarva Power circuits, permitting and maintenance of traffic requirements.

SEGMENT 12

Location:

Stein Highway and Shipley Street

Goal:

Provide circuit tie between Circuit 290 and Circuit 140. This will be a future tie for Circuit 280.

Solution:

Extend existing overhead facilities along Shipley Street to the new joint use overhead pole line along Stein Highway at E. Ivy Drive. This will likely require an aerial easement agreement for the installation of a new span guy over the 7/11 property owned by Peninsula Oil Company. A proposed stub pole, downguys, and anchors will be required within existing city right-of-way for E. Ivy Drive adjacent to the 707 E. Ivy Drive property owned by Ashley A. Millman. Work to be performed by a utility contractor due to the extensive maintenance of traffic requirements. DAI will assist in obtaining the necessary utility permits from DelDOT.

SEGMENT 13

Location:

Between Pine Street Substation and Central Substation along Cedar Avenue, High Street, and Church Street

Goal:

Dismantle existing 69kv circuit

Solution:

Dismantle and remove portions of the existing 69kV circuit that are no longer required. Work to be performed by a utility contractor due to height of structures as well as the extensive maintenance of traffic requirements required when removing the overhead conductors that cross over Stein Highway.



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	DESIGNED BY TBS	DATE 04-15-16	 DOWNES ASSOCIATES INC Engineering & Management Consulting	FILE NUMBER
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	CHECKED BY GEO	JOB NO. 12.1067		M.D.



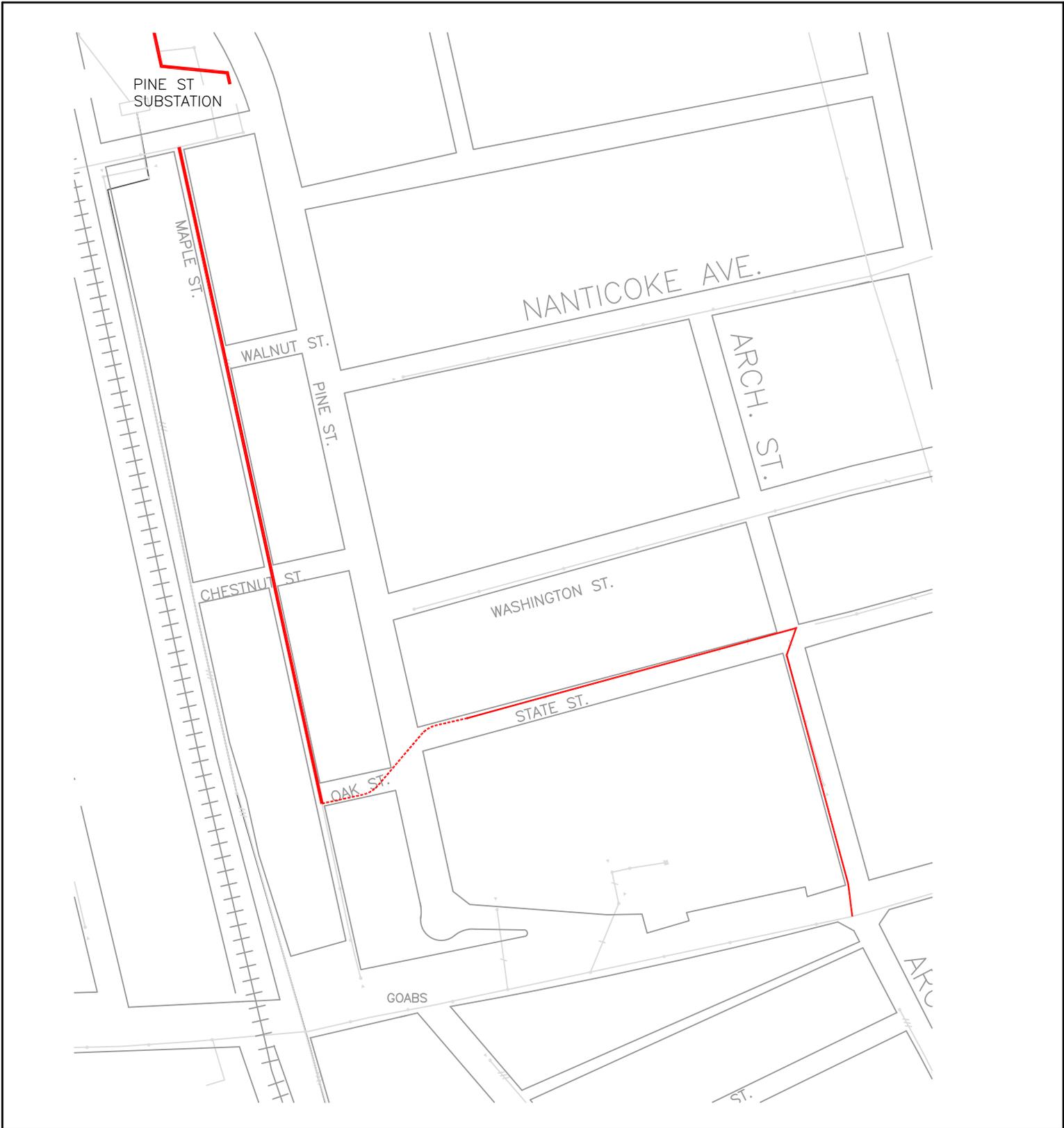
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CHECKED BY GEO	JOB NO. 12.1067	M.D.		



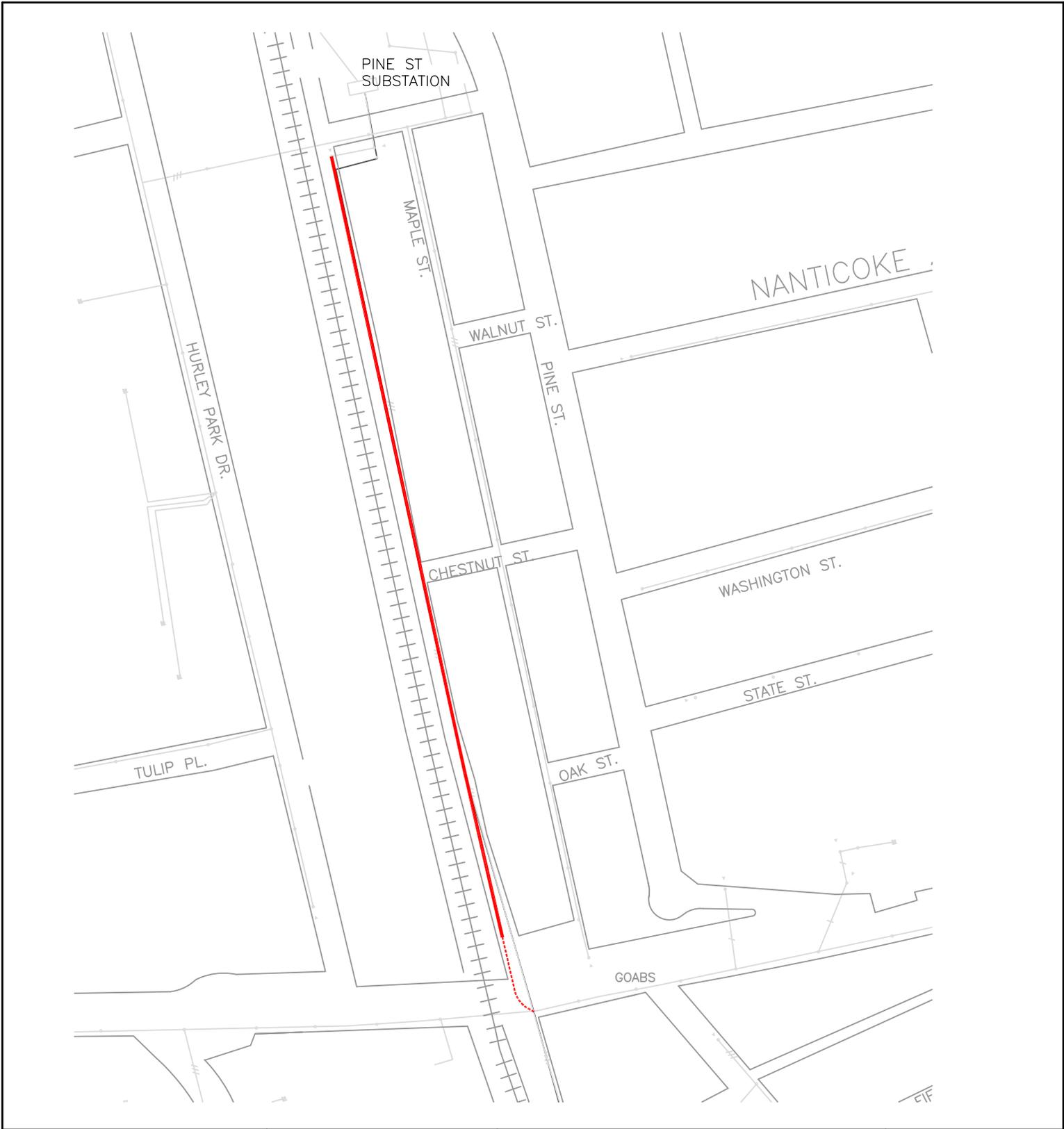
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DRAWN BY TBS	SCALE N.T.S.	M.D.		
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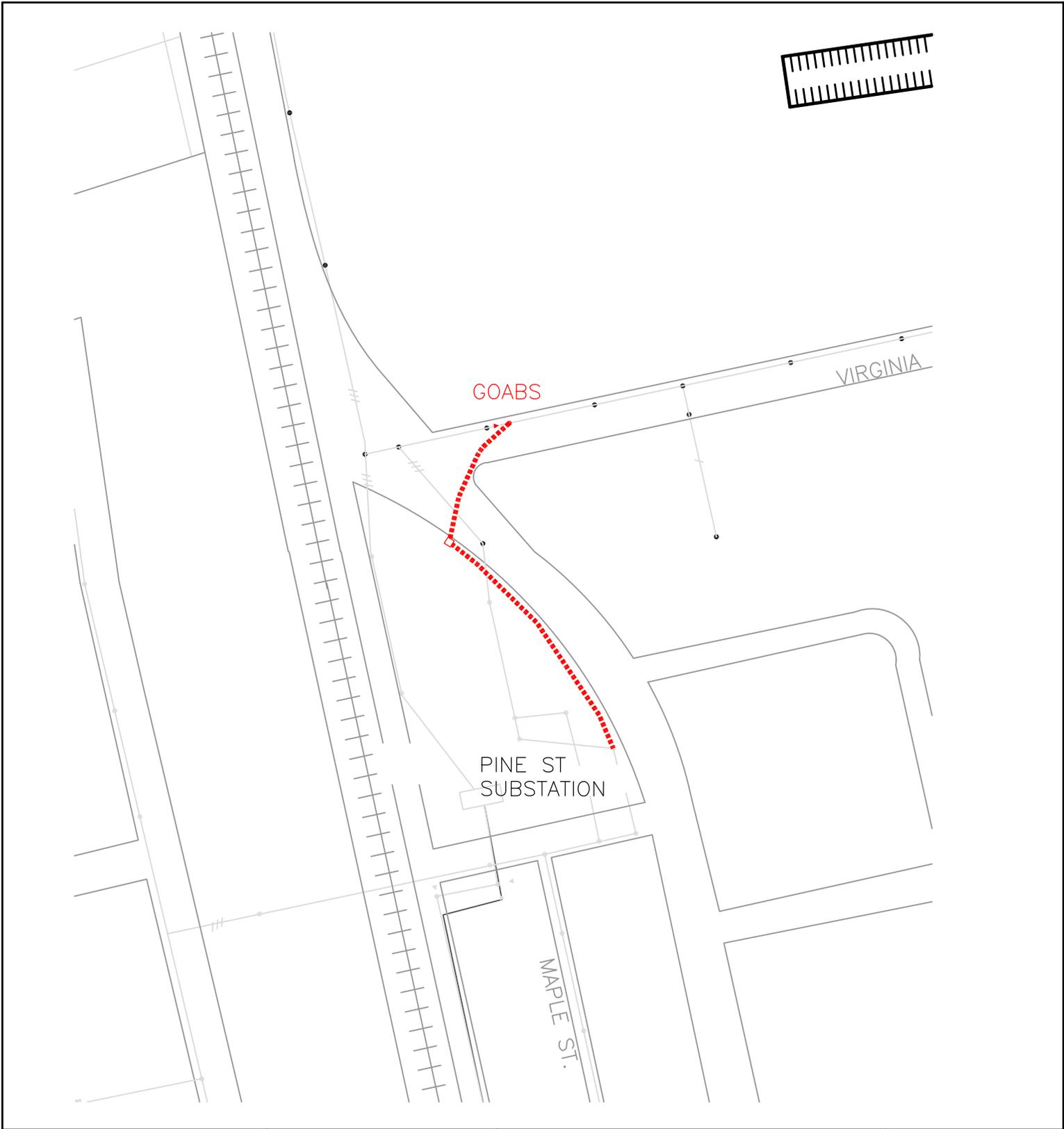
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CHECKED BY GEO	JOB NO. 12.1067	M.D.		



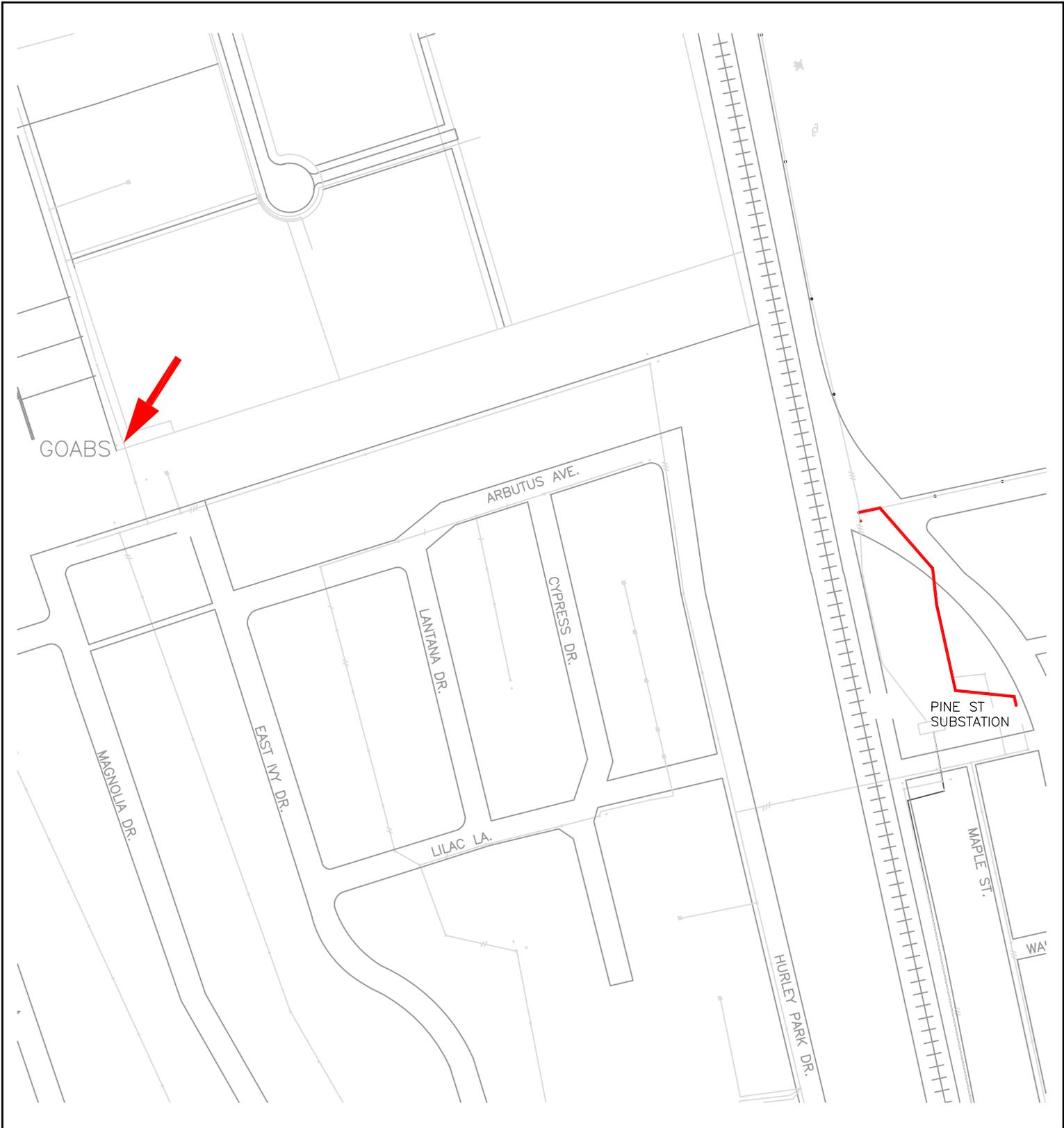
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 DOWNES ASSOCIATES INC Engineering & Management Consulting				



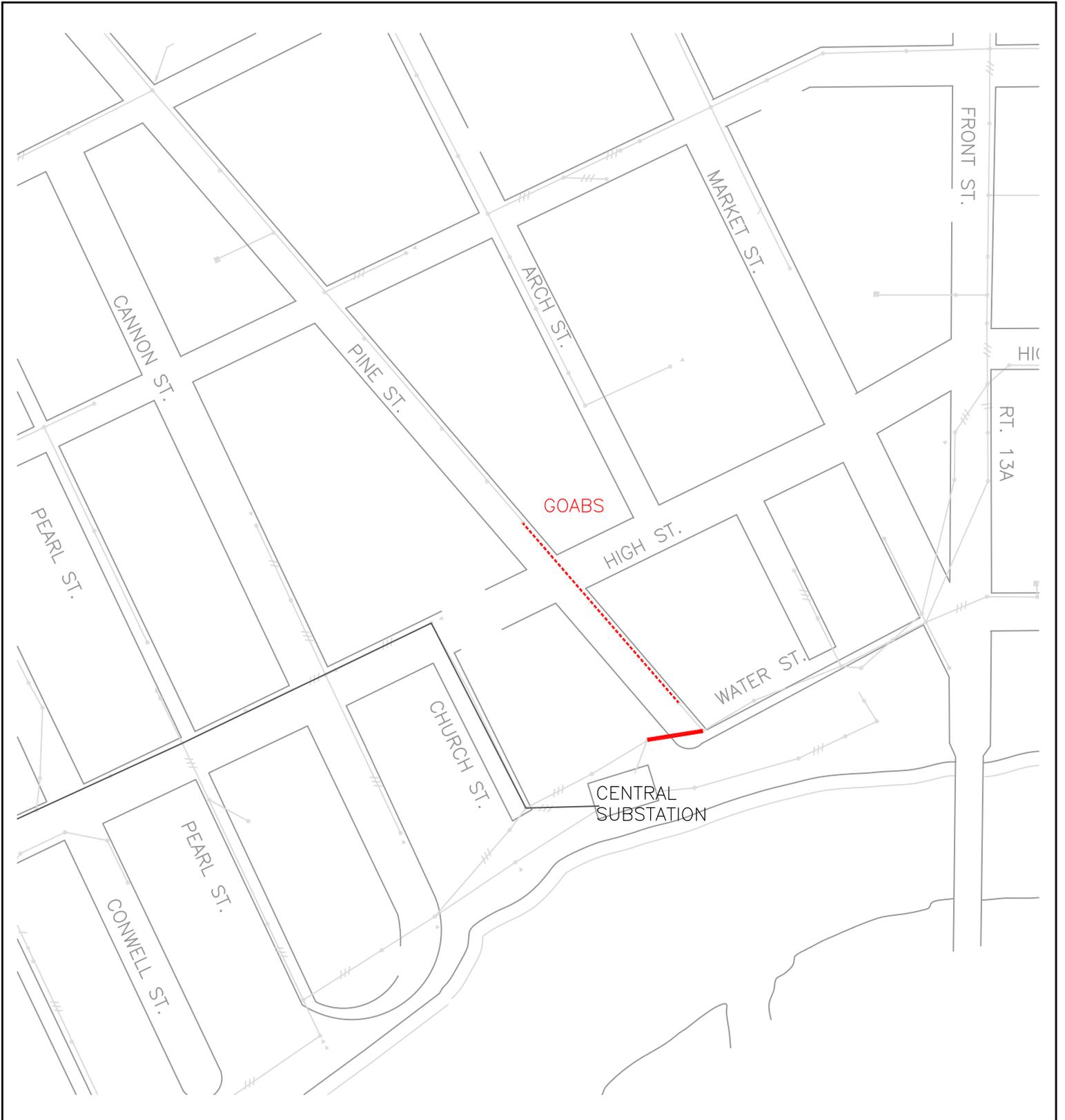
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<p>DRAWN BY TBS</p>		<p>SCALE N.T.S.</p>				<p>12-1067</p>	
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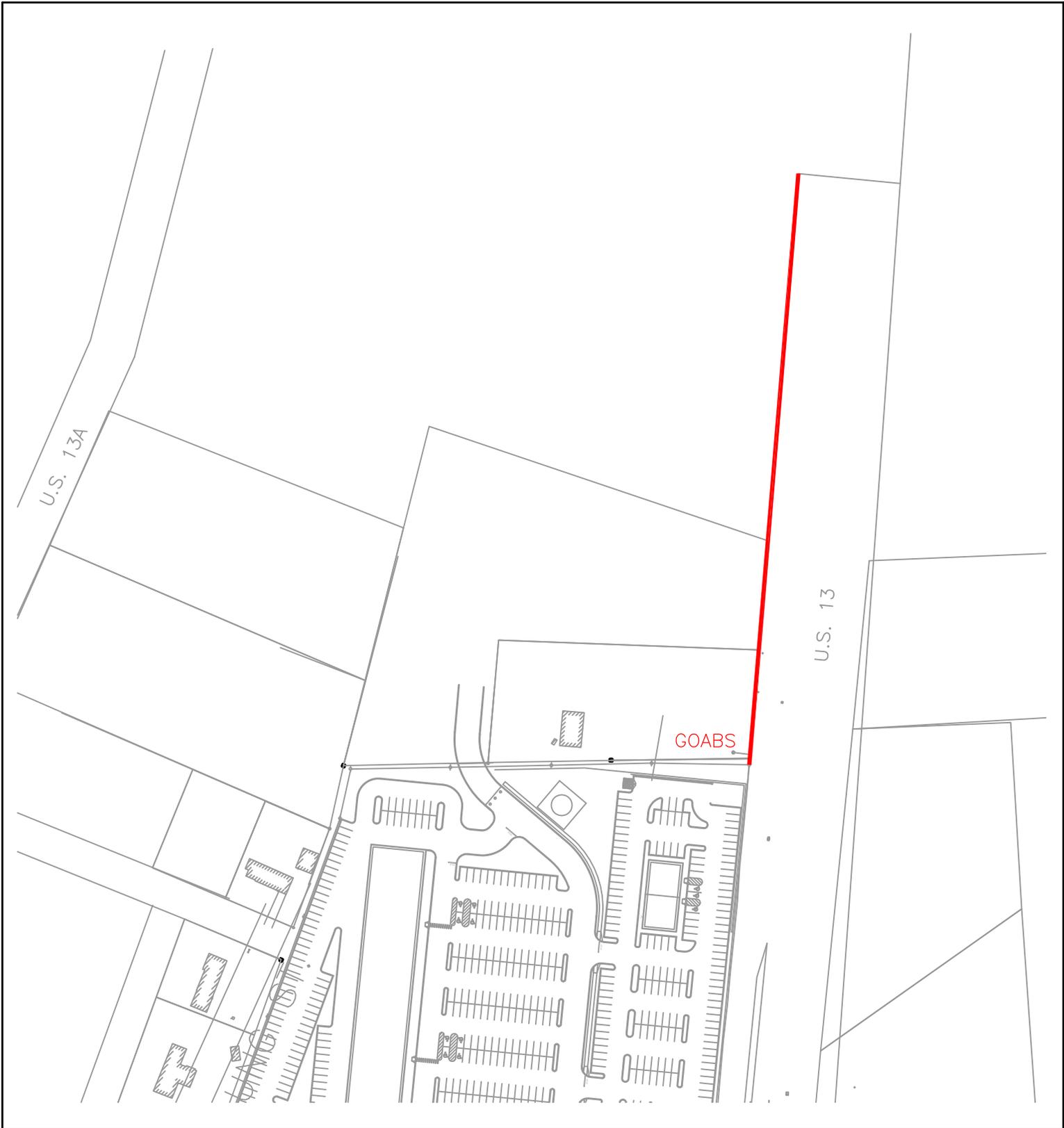
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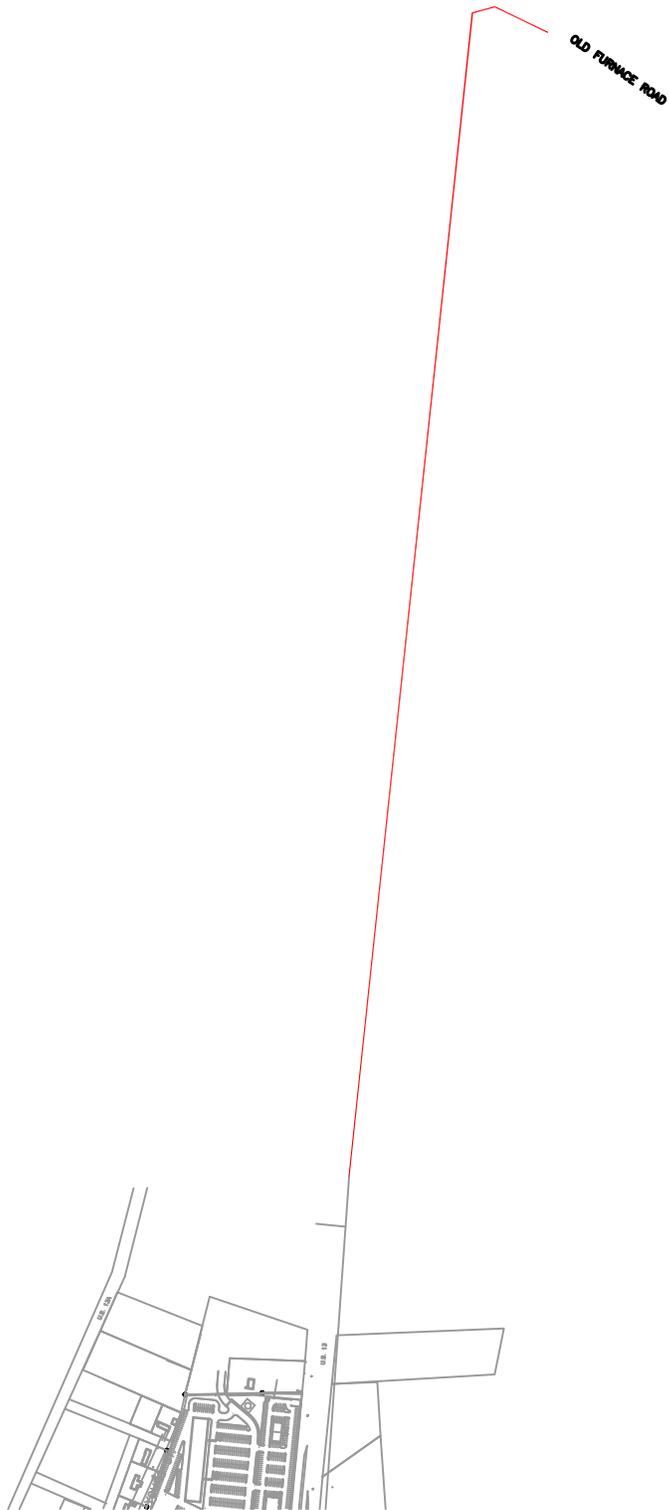
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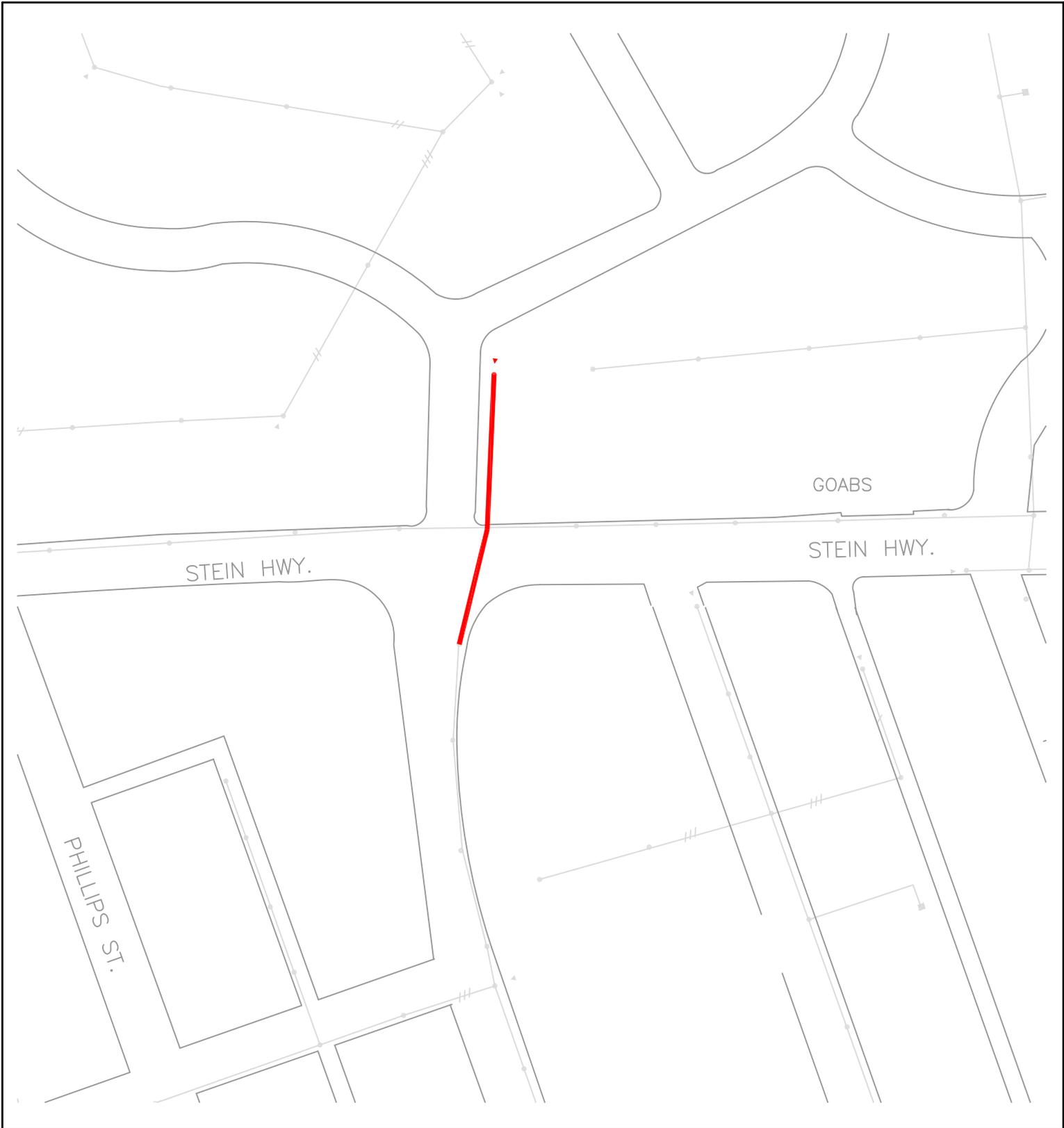
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		DOWNES ASSOCIATES INC Engineering & Management Consulting		



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	DESIGNED BY TBS	DATE 04-15-16	 DOWNES ASSOCIATES INC Engineering & Management Consulting	
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DRAWN BY TBS	SCALE N.T.S.	12-1067		
CHECKED BY GEO	JOB NO. 12.1067	M.D.		



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	DESIGNED BY TBS	DATE 04-15-16		
DRAWN BY TBS	SCALE N.T.S.	 DOWNES ASSOCIATES INC Engineering & Management Consulting		
CHECKED BY GEO	JOB NO. 12.1067			

Pine Street Electrical Substation Expansion and Reconstruction

Section 5

Recommendations for Construction Phase Services



April 28, 2016

Mrs. Dolores J. Slatcher
City Manager
City of Seaford
414 High Street
P.O. Box 1100
Seaford, DE 19973

Dear Dolores:

Subject: Pine Street Electrical Substation Expansion and Reconstruction
Proposed Project Tasks

Thank you for providing DAI with a list of proposed project tasks (enclosed) to be carried out by both Seaford staff and DAI staff. We are especially pleased to see that the City of Seaford has chosen to assume the duties of general project management. This will result in benefits to Seaford in several important areas. First, the decision by Seaford to directly purchase the major items of substation equipment should result in significant project cost savings of over \$500,000 because the contractor will not have to procure and then invoice for these items including his overhead costs. Second, Seaford's management of the project should result in as much as a six month reduction in total construction time due to Seaford's ability to schedule equipment deliveries to coordinate with the contractor's construction schedule instead of the construction contractor having to order major equipment items before starting his work on site. Lastly, the active involvement of Seaford's staff with the various phases of the project will result in a much greater working knowledge of the new electrical facilities once completed.

Task I

With regard to the suggested work tasks which you provided, we would like to provide important observations borne out of our forty-plus years of working with the construction of high voltage substation systems. Under Task I, Items 1-7 are all items of work which will be provided by DAI under our existing Agreement Between Owner and Engineer for Professional Services, dated February 1, 2016. Item 8, which covers the review of all major equipment upon receipt by the City, is outside the scope of our existing agreement but is an extremely important item of work and one which we highly recommend that the City have performed by the Owner's Engineer.

The issue at hand is that the services described under Item 8 should involve a thorough review of the major equipment items and components and thus entails far more effort and expertise than appears to be implied. The task to identify manufacturing problems actually begins with the review of factory submittals and the in-person observation of factory testing for the power transformers and the relay

control panels. Seaford personnel may desire to witness these tests, but it is very important that the Owner's Engineer have the opportunity to witness these critical tests and speak with factory engineers about test results.

Once the transformers, breakers, structures, relay panels, and control house arrive in Seaford, the Owner's Engineer should be present to perform a thorough review of the physical condition of all major components as well as conformance with requirements of the specifications. The Owner's Engineer should issue to the Owner a report of findings from these reviews. The City of Seaford will be receiving well over \$3 million of highly technical equipment and will want to have this equipment carefully reviewed before the contractor begins installation. DAI, as the Owner's Engineer, will be pleased to provide all of these necessary services to Seaford which will be defined under a future amendment to our existing EJCDC Agreement Between Owner and Engineer and detailed within Exhibit K, Construction Phase Services.

Task II

The list of professional services described under Task II are vital to the success of the project and should be detailed through the use of Exhibit K, Amendment to Owner-Engineer Agreement for Construction Phase Services. The one item, however, which DAI does not believe is adequately addressed is that of required site visits. As described within Seaford's wording of Task II, site visits by the Owner's Engineer would be limited by the City to monthly progress meetings, visits upon the request of the City, and the final inspection visit. Based upon our forty-plus years of substation work, DAI strongly believes that such a limit on the involvement of the Owner's Engineer during the project construction would be a serious error and potentially lead to major problems. The following list of construction activities is provided for consideration by the City of Seaford for the types of activities which should be observed by the Owner's Engineer:

1. Verification of substation stake-out of established horizontal and vertical controls.
2. Verification of proposed foundation elevations.
3. Verification of proposed horizontal foundation spacings.
4. Verification of rebar sizes and accurate spacings in reinforcement cages and mats.
5. Verification of caisson foundation dimensions and forms.
6. Verification that augured and excavated areas are not over-dug resulting in potential future settlement.
7. Verification that anchor bolts are correctly located with the proper spacing and proper thread exposure.
8. Verification if unstable soil conditions are discovered that appropriate ground sleeves are incorporated to strengthen the excavated area.
9. Verification of proper placement and consolidation of concrete into formed foundations.
10. Verification of proper installation of rubber water-stop material across all cold joints where required.
11. Verification of accuracy and levelness of concrete surfaces at time of concrete placement to ensure proper equipment placement will be achieved.
12. Verification of proper grounding grid installation and ground weld connections.
13. Observation of transformer rigging and placement.
14. Observation of installation of transformer bushings, cooling fans, and insulating oil.

Mrs. Dolores Slatcher

Page 3

April 28, 2016

15. Observation of control house rigging and placement.
16. Observation of on-site testing and commissioning of transformers and relay control panels.
17. Observation of critical line construction activities.
18. On-call site visits with Seaford and contractor personnel to address construction issues.

The above list is not meant to be all-inclusive but instead is offered as indicative of the type of construction activities that DAI has been requested by substation owners to be involved with over our many years of experience in order to improve the outcome of the construction activities and the ultimate operation of the new systems for years to come.

Task III

With regard to the items listed under Task III, DAI will include all of the requested services in its list of services to be provided within Exhibit K, Amendment to Owner-Engineer Agreement for Construction Phase Services. It should be noted, however, that the factory testing of the transformers and relay panels required of the manufacturers will be carried out prior to the completed construction by the construction contractor of the new substation. Therefore, a full commissioning and acceptance testing of the completed substation including all equipment assemblies will still have to be carried out by the City of Seaford and Owner's Engineer prior to the placement of loads on the new equipment. Additionally, it must be noted that this work will have to be sequenced and phased in with the construction contractor's work due to the phasing requirements of the overall project including Central Substation de-energization and existing Pine Street Substation de-energization. Finally, the interconnection of all new distribution circuits with the new substation will have to be properly sequenced and coordinated between the City of Seaford and the construction contractor. Lastly, we should point out that DAI's foundation and structural engineering consultants as well as its site engineering consultant will be required from time to time to observe the contractor's work is in conformance to the specifications prepared by these consultants.

In closing, these professional observations are offered in the spirit of clarification and overall improvement for the ultimate success of this major work being undertaken by the City. These new systems, if installed properly, will serve the City of Seaford for 40 to 50 years into the future and bring great value to its citizens. DAI strongly recommends that the City of Seaford gives consideration to increasing the involvement of the Owner's Engineer as suggested above during the project construction phase. The benefits of experienced professionals providing vital assistance to the City's staff will be evident as the project unfolds.

Sincerely,

DOWNES ASSOCIATES, INC.



George E. Owens, P.E.

President

GEO/slh
Enclosure
12.10167

Pine Street Electrical Substation Expansion and Reconstruction

TASK I Related to the contract administration portion of the project the City will request that Downes:

1. Provide the technical portions of the bid documents for incorporation into the City's bidding format and standard documents.
2. Assist with identifying potential bidders.
3. Review and make recommendations regarding shop drawings and certifications submitted by the contractor with the bids.
4. Evaluate any specification deviations or "or equal" submissions provided by the bid responses.
5. Respond to questions and miscellaneous consultation, as requested by the City.
6. Assist the City staff with addendum preparation as required for the technical portions of the documentation.
7. Assist the City staff in the bid review and provide a recommendation to the City Manager for award.
8. Review all major material components and equipment upon receipt by the City to verify that it meets minimum acceptability and compatibility standards and is free of defects. Supt. of Electric will notify Downes upon receipt of these items as the minor materials and equipment will be inspected and approved by City personnel.

The following services are not included, as these will be handled by the City staff during the contract administration portion of the project:

- a) Prepare final bid packages for advertisement.
- b) Schedule advertisement, bid receipt and date for City Council consideration.
- c) Execute advertisement.
- d) Distribute to potential bidders - contractors, vendors and/or suppliers.
- e) Maintain bidders list and plan holder's listing.
- f) Prepare and issue addendum packages.
- g) Issue PO (or other instrument) and notice of award to vendors, contractors or suppliers.
- h) Coordinate safe and insured storage of materials and equipment received by the City after approval and acceptance.

TASK II Assuming the project is awarded and proceeds to construction we will need what we term a "limited construction phase services contract" with Downes as the engineer of record. The scope would be:

1. Assist the City Manager with preparation and execution of the construction contract.
2. Attend Pre-construction Conference and monthly progress meetings. Since this will be a long project; 10 months we anticipate monthly progress meetings.
3. Review and approval of shop drawings and certifications submitted by the contractor.
4. Preparation of change orders.

5. Site visits - upon request. We typically have the engineer do this in conjunction with the progress meetings to save travel time.
6. Attend the final inspection and assist with preparation of a punch list. You will also need to issue a project certification if required once the project is complete and can be accepted by the City.
7. Preparation of Record (as-built) Drawings based on the contractors "red-line" documents.
8. Response to questions and miscellaneous consultation, as requested by the City.

The following services are not included, as these will be handled by the City staff:

- a) Checking and processing of contractor's requisitions,
- b) Chair all meetings and issue meeting minutes,
- c) Routine daily site inspections beyond those defined above.
- d) Coordination with the contractor for picking up City owned and stored materials and equipment.

TASK III Checkout and Commissioning Services - These costs need to be identified for inclusion in the project budget. The City would like a proposal from DAI to assist City personnel with the checkout and commissioning tasks. The proposal should include all costs for Downes personnel to assist the City with labor and equipment to perform the following tasks:

1. Hi-pot testing of 69kV bus
2. Hi-pot testing of 12kV bus
3. Ground grid resistance test
4. Commissioning tests for all circuit breakers to include:
 - a. Hi-pot testing of bushings (where applicable)
 - b. Hi-pot testing of vacuum bottles (where applicable)
 - c. Contact resistance tests
 - d. CT ratio tests
 - e. Breaker operational checks
5. Confirm all PT and CT secondary circuits from all field devices to control panels with voltage or current injection
6. Confirm all other control wiring from all field devices to control panels.
7. Provide all test equipment required to perform the above work, including but not limited to:
 - a. DC hi-pot (stackable unit)
 - b. AC hi-pot unit (Meggar)
 - c. Micro-ohmmeter (Ductor)
 - d. 120V AC variable voltage source
 - e. 5A AC variable current source
 - f. Earth Ground Resistance tester
8. At this time commissioning of the transformers and relay panels is included as part of the vendor/manufacturer responsibilities in the draft bid specifications and therefore is not considered part of this scope. City staff will monitor those functions as part of our scope.

Please feel free to comment regarding any errors or omissions in the above list of commissioning services.

Pine Street Electrical Substation Expansion and Reconstruction

Section 6

Preliminary Design Phase Estimated Project Budget

PRELIMINARY PROJECT BUDGET SUMMARY

	<u>Item</u>	<u>Budgetary Cost</u>
1.	Power Transformers	\$1,552,500
2.	Circuit Breakers	\$279,730
3.	Control Building with Relay Panels	\$689,100
4.	Substation Structures and Equipment	\$874,650
5.	Substation Construction Services	\$1,680,000
6.	Distribution Construction Services and Materials	\$1,500,000
7.	Project Design Engineering Services	\$315,000
8.	Construction Phase Technical and Engineering Services	\$200,000
9.	Site Demolition and Remediation Services	\$100,000
	Total Base Preliminary Estimate	\$7,190,980
	Preliminary Phase Contingency of 25%	\$1,797,750
	Preliminary Design Phase Project Budget	\$8,988,730
	Recommend the Use of Preliminary Project Budget	\$9,000,000

Pine Street Electrical Substation Expansion and Reconstruction

Section 7

Proposed Project Schedule

Gantt Chart

**Pine Street Electrical Substation
Expansion and Reconstruction**

Appendix A

**Application to Pepco Holdings, Inc.
for Additional 69 KV
Interconnection “New Service
Request Form”**



New Service Request Form

This form is to be used to request new wholesale interconnection delivery points and/or modifications to existing delivery points. Once submitted, PHI will review and begin compiling estimates for available options to accommodate the need. PHI and the wholesale interconnection customer will discuss any questions, etc. as needed.

Submit Completed Form to:

Marianne Abdul, PHI Wholesale Affairs

Director: Marianne.abdul@delmarva.com

302.454.5191

Wholesale Interconnection Customer Company: City of Seaford, Delaware

Wholesale Interconnection Customer contact information to discuss request:

Name: Dolores Slatcher

Company: City of Seaford

Phone Number: (302) 629-9173

Email Address: dslatcher@seafordde.com

Company Address: 414 High Street
P.O. Box 1100
Seaford, DE 19973

Type of request (e.g. new delivery point, modification to or expansion of existing delivery point): New 69 KV delivery point connecting to North Seaford Substation

Location where work is to occur (attach geographic map of area impacted): Direct 69 KV interconnection to Delmarva Power's North Seaford Substation. See attached aerial map.

Proposed In-Service Date: 4th quarter 2017

Desired interconnection voltage level: 69 KV

General description of project: Seaford desires to obtain a new primary delivery point for its 69 KV transmission system to augment its historic delivery point that is located at its Pine Street Substation. The new delivery point is desired to serve a new Seaford 69 KV tie substation to be located adjacent to the City's Ross Substation.

Justification/Need: The City desires to have a new primary 69 KV delivery point of its Ross Substation and then utilize the existing 69 KV interconnection at its Pine Street Substation as a backup interconnection point.

Estimated 10 year load forecast for new delivery point or delivery point requiring modification:

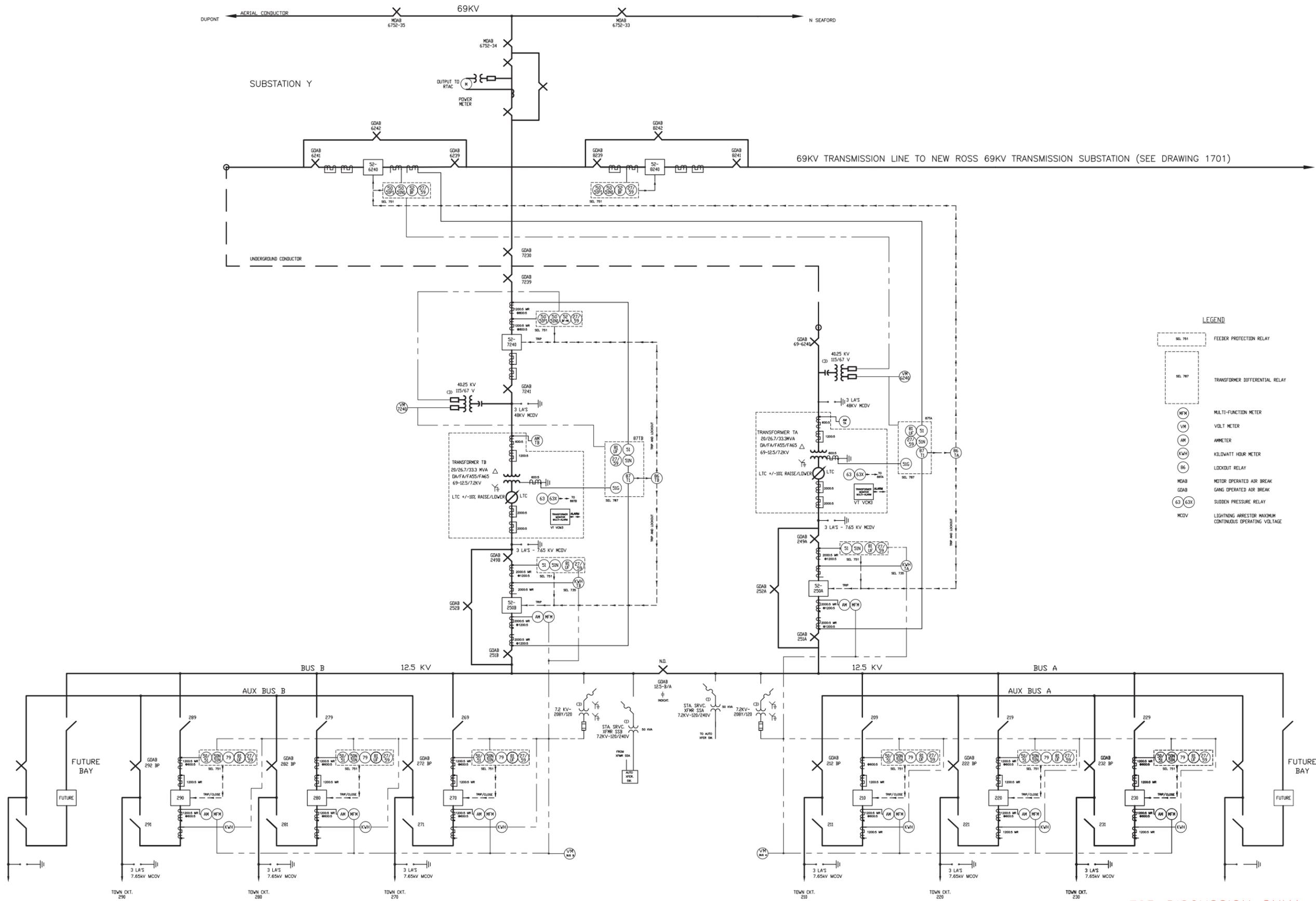
<u>Historic Peak Load As of 2015</u>	<u>Projected Peak Load As of 2025</u>
25 MW	30 MW

Description of any unusual load characteristics or generation behind the interconnection point: There are no unusual load characteristics or behind-the-meter generation facilities at this time. The City anticipates the installation of a 1.0 MW solar farm within its distribution system at a future date.

Description of where load is being transferred from (if applicable): The entire load of the City of Seaford's electrical system would be transferred from its present interconnection point at its Pine Street Substation to the new primary 69 KV interconnection substation adjacent to its existing Ross Distribution Substation. The new 69 KV Ross Substation would be directly connected to Delmarva Power's North Seaford Substation.

One-Line Diagram: (Please attach a one-line diagram of the proposed facility. This drawing should provide details of automatic switching devices, and any protective relay schemes that may be proposed as well as transformer sizes and customer owned generation) **Note, if one-line is not available upon submittal of the new request form, please indicate when such drawing will become available.)

Attached please find the conceptual one-line diagram for Seaford's proposed new 69 KV Ross Substation as well as the conceptual one-line diagram for Seaford's planned upgrades to be constructed at the City's existing Pine Street Substation.



- LEGEND**
- FEEDER PROTECTION RELAY
 - TRANSFORMER DIFFERENTIAL RELAY
 - MULTI-FUNCTION METER
 - VOLT METER
 - AMMETER
 - KILOWATT HOUR METER
 - LOCKOUT RELAY
 - MOTOR OPERATED AIR BREAK
 - GANG OPERATED AIR BREAK
 - SUDDEN PRESSURE RELAY
 - LIGHTNING ARRESTER MAXIMUM CONTINUOUS OPERATING VOLTAGE

FOR DISCUSSION ONLY

PRELIMINARY

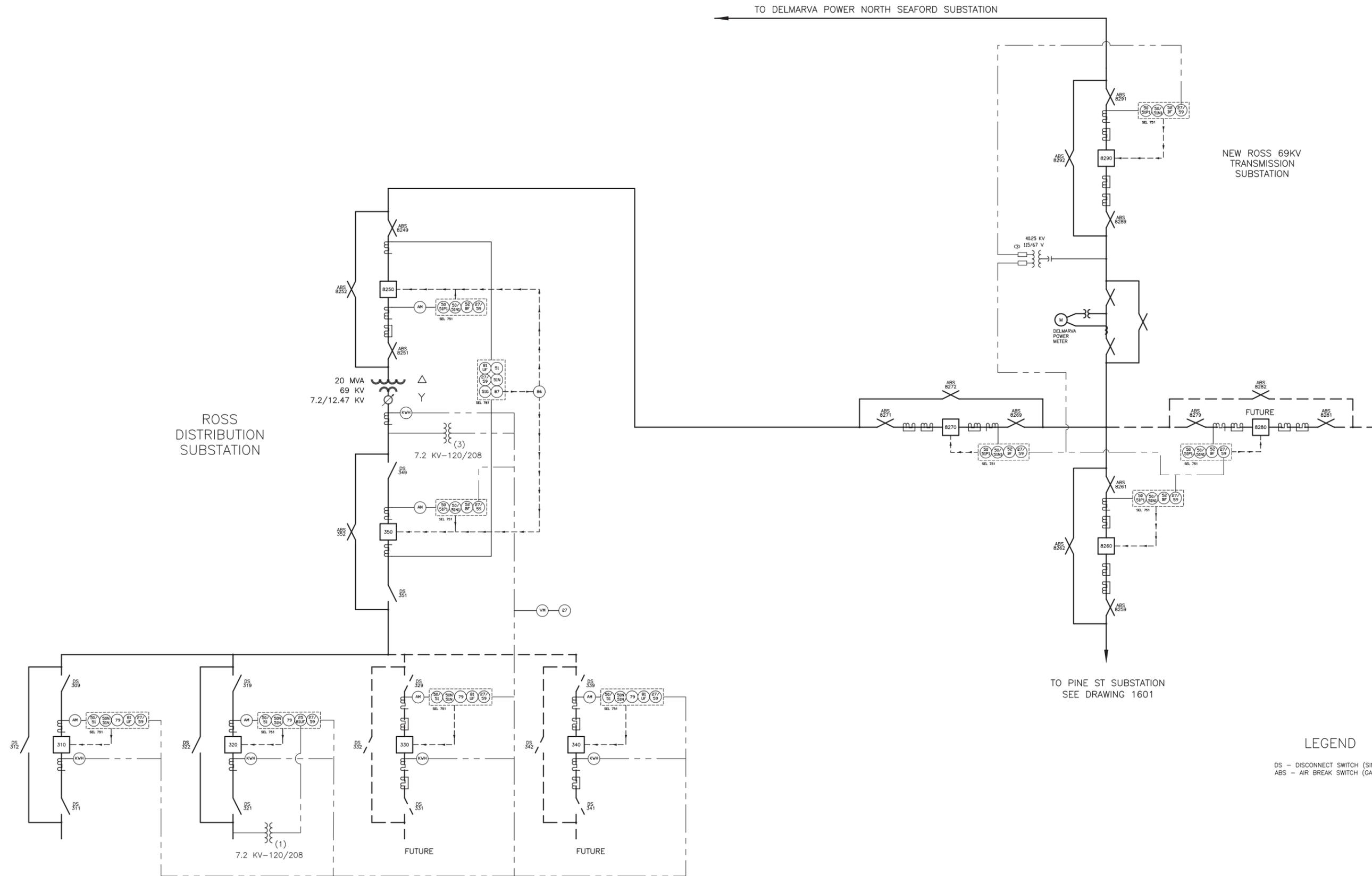
DA DOWNES ASSOCIATES INC
Engineering & Management Consulting

DESIGNED BY MWM CHECKED BY GEO DATE 03-29-16
DRAWN BY CEM JOB NO. 12.1067 SCALE N.T.S.

DATE	DESCRIPTION

CITY OF SEAFORD
69/12.5KV SUBSTATION
SINGLE LINE DIAGRAM
NEW SUBSTATION

CAD DWG. NO.
1601
FILE NUMBER
012-1067
M.D.



ROSS
DISTRIBUTION
SUBSTATION

NEW ROSS 69KV
TRANSMISSION
SUBSTATION

TO PINE ST SUBSTATION
SEE DRAWING 1601

LEGEND
DS - DISCONNECT SWITCH (SINGLE PHASE)
ABS - AIR BREAK SWITCH (GANG OPERATED)

FOR DISCUSSION ONLY

PRELIMINARY

DA DOWNES ASSOCIATES INC
Engineering & Management Consulting

DESIGNED BY	MWM	CHECKED BY	GEO	DATE	03-29-16
DRAWN BY	CEM	JOB NO.	12.1067	SCALE	N.T.S.

DATE	DESCRIPTION

CITY OF SEAFORD
NEW 69KV INTERCONNECTION
SYSTEM SINGLE LINE

CAD DWG. NO.
1701
FILE NUMBER
012-1067
M.D.



EXISTING PHI – NORTH SEAFORD SUBSTATION
SCALE: 1"=100'



EXISTING CITY OF SEAFORD – ROSS SUBSTATION
SCALE: 1"=100'



EXISTING CITY OF SEAFORD – PINE STREET SUBSTATION
SCALE: 1"=50'

FOR DISCUSSION ONLY

PRELIMINARY

DA DOWNES ASSOCIATES INC
Engineering & Management Consulting

DESIGNED BY	TBS	CHECKED BY	GEO	DATE	03-29-16
DRAWN BY	TBS	JOB NO.	12.1067	SCALE	1"=300' UNO

DATE	DESCRIPTION

CITY OF SEAFORD
PROPOSED SECOND 69kV
DELIVERY POINT FROM PHI TO
THE CITY OF SEAFORD

CAD DWG. NO.
3300
FILE NUMBER
12-1067
M.D.