

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

CALL FOR BIDS

The Utility Board of the City of Key West, Florida, herein after called **KEYS**, operator of Keys Energy Services (KEYS), hereby gives notice to prospective bidders that sealed proposals will be received by said **KEYS**, at the Purchasing Department, 6900 Front Street Extended, Key West, Florida 33040, until 1:30 P.m. on **May 27, 2011** for:

KEYS BID #12-11

SPECIFICATIONS FOR EPC OF DYNAMIC VAR COMPENSATION SYSTEMS (DVC-STATCOM SYSTEMS) @ BIG PINE KEY & STOCK ISLAND GENERATION FACILITY SUBSTATIONS

The Utility Board has instituted the DemandStar.com system to provide current information to potential bidders. This system allows you to receive bid information quickly and at your convenience 24 hours a day, seven days a week. Specifications may be obtained from their website at www.demandstar.com or phone (954) 577-3915. Registered vendors will be notified automatically of all Requests for Proposals. You may also visit www.keysenergy.com for links and downloads to the DemandStar website.

All Bidders are required to submit:

One (1) original and three (3) copies of each proposal are to be enclosed in a sealed envelope marked on the outside:

"THE BID OPENING COMMITTEE"

KEYS BID #12-11 EPC OF DYNAMIC VAR COMPENSATION SYSTEMS (DVC-STATCOM SYSTEMS) @ BIG PINE KEY & STOCK ISLAND GENERATION FACILITY SUBSTATIONS

Mail to:

Keys Energy Services

KEYS Bid #12-11

"The Bid Opening Committee"

6900 Front Street Extended

Key West, FL 33040

(CAN NOT receive US Postal Service)

*****It is the sole responsibility of each Bidder to deliver its Proposal to KEYS at the place designated for receiving Proposals. Also, the Proposal must be received by Keys Energy Services prior to the time for opening Proposals last announced to Bidders. Any Proposal received after the time last announced for opening Proposals may be retained by KEYS or returned to the Bidder, but such Proposal will be rejected as not responsive.**

*****MANDATORY PRE-BID MEETING AND SITE INSPECTION:**

A mandatory pre-bid meeting will be held for this project on **May 4, 2011 at 9:00 AM** at 6900 Front Street. Extended, Key West, FL 33040 in the Stock Island Generation Facility - Training Room. Please notify Susan Ham at (305) 295-1144, if you plan on attending.

NOTE: Keys will entertain questions for clarification until May 16, 2011 from vendors who attended the mandatory pre-bid meeting. No question will be answered after that date.

Each proposal should be accompanied by a Certified Check or Bid Bond payable to the **Utility Board of the City of Key West** in an amount not less than five (5%) percent of the amount of the proposal as security.

Each proposal should constitute an offer to **KEYS**, as outlined therein, and should be irrevocable after the time announced for the opening thereof.

At a meeting of the **Bid Opening Committee** to be held in the Purchasing Conference Room, 6900 Front Street Extended, Key West, Florida on **Friday, May 27, 2011** at 1:30 p.m. proposals will be opened and publicly read aloud.

KEYS reserves the right to reject any or all proposals, to waive irregularities and informalities in any or all proposals, and to separately accept or reject any item, items, bid schedule or bid schedules of the proposal which the **KEYS** deems to be in the best interest of **KEYS**.

Peggy Walls, Asst. Director of Finance
Utility Board of the City of Key West

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SECTION 1 GENERAL INFORMATION

GENERAL

The Utility Board of the City of Key West, "KEYS Energy Services", herein after called KEYS is a municipally owned electric utility serving approximately 29,000 customers in Key West and the Lower Florida Keys.

KEYS and its representatives have exercised due care in preparing this Request for Proposals (RFP). All information contained herein is believed to be substantially correct. However, Proposers should verify information independently if desired. KEYS and its representatives do not warrant the accuracy of information contained herein.

SECTION 1 – PART1 – GENERAL INFORMATION

1.1.01 DEFINITIONS

- Owner - Utility Board of the City of Key West.
- Bidder - The party or parties submitting a proposal for performing the work and/or furnishing the equipment/system specified herein.
- Contractor- The successful bidder who accepts a purchase order from the Owner.
- Date of Commercial Operation - The date established by the Owner following the period of preliminary operations of the equipment during which necessary corrections, adjustments and/or alterations may be made to ensure the equipment's safe and reliable operation.
- Equipment/System - Any and all equipment, machinery, material, transportation, accessories and supplies complete with all usual and appropriate fittings, attachments, appurtenances, appliances and special tools necessary for erection, installation, operation and maintenance unless specifically excluded herein.

1.1.02 INTENT OF SPECIFICATION

The Bidder shall make his proposal with the understanding that the Specifications and applicable drawings are intended to cover all of the requirements for the design, equipment procurement, construction, testing, start-up, and documentation for the complete and reliable operation of the equipment described herein.

Unless expressly excluded, any and all labor and materials not indicated herein, but which may be necessary to complete any part of the system in a proper, substantial and workman-like manner are to be furnished by the contractor without additional charge or cost to the Owner. Any intended omissions or exceptions to the requirements of the Specification must be stated in writing in the proposal. Otherwise, it will be understood that all work is included.

END OF SECTION 1

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SECTION 2 GENERAL REQUIREMENTS

SECTION 2 - PART 1 – GENERAL REQUIREMENTS

2.1.01 GENERAL

All construction work shall be performed in strict accordance with the design documents prepared by the Contractor and approved by the Owner. The Contractor shall be responsible for any damages resulting from any work done in violation of the above requirement.

Manufacturers' installation, testing and calibration instructions shall be followed very closely. Services of manufacturer's field technicians shall be used extensively. For KEYS purchased material, manufacturer's field technicians or an authorized manufacturer's representative shall be used.

The substations are located in residential areas. The working hours shall be limited to 07:00-17:00 Monday through Saturday and the construction noise shall be kept to a minimum. Only required commercial Contractor vehicles will be allowed on the construction site. Construction of road crossings shall be performed in stages such that the traffic flow shall not be completely blocked at any time. The Contractor shall take other temporary measures at his own expense to maintain the flow of traffic around the substation site.

2.1.02 DISPOSAL OF MATERIAL

The contractor shall be responsible for disconnection, removal and disposal of old equipment that is being replaced. At a minimum:

1. Excess excavated material shall be removed from the job.
2. The job site shall be cleaned and restored.
3. Restoration of asphalt or concrete shall be done as necessary.
4. All old equipment shall be disposed of in accordance with all applicable federal, state and local laws and regulations.

2.1.03 OWNER INSPECTIONS/MEETINGS

The Owner will make inspections and/or meetings as deemed necessary to ensure that all work is being performed in compliance with these specifications and guarantees. KEYS' inspector will make sure work is performed as per the specifications before any approval to pay is made. Failure to obtain inspector's acceptance of work will result in non-compliance and therefore no payment will be made until corrected.

2.1.04 CONTRACTOR'S RESPONSIBILITIES

Contractor shall be responsible for all loss, damage, vandalism, theft, etc. for all equipment, tools, materials, etc. left on the job site.

Contractor shall be responsible for maintaining the site in a clean condition during installation. Contractor and Owner at which time the site should be cleaned up will make a final walk down of the sites.

Prior to completion of demobilization, Contractor shall remove all construction materials, waste, demolition debris, excess materials, temporary installation, etc. that have not been specifically turned over and accepted by Owner.

Contractor shall be responsible for any and all costs for clean up of oil or gasoline spills which result from his equipment or from any work performed as part of this contract.

Permit violations or environmental damage caused by the Contractor shall be mitigated or repaired by the Contractor, at the Contractor's expense, to the satisfaction of the governing authority citing such damage.

Items discussed in this section are not intended to be all-inclusive of Federal, State, and Local Laws and Regulations. Information is provided as anticipated minimum requirements. Contractor shall be familiar and comply with all requirements of applicable laws and regulations.

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The Contractor will assume total responsibility for materials, delivery to/from job site, installation, and testing of system.

2.1.05 CONSTRUCTION FACILITIES

The following construction facilities shall be furnished/provided by the Contractor:

- Telephone/communication
- Compressed air
- Temporary lighting
- Temporary heating
- Sanitary facilities
- All construction signs

The above facilities shall be properly maintained during the construction work and shall be completely removed upon completion of the construction by the Contractor.

The Contractor may furnish other facilities he/she may deem necessary subject to the approval by the Owner.

2.1.06 CONSTRUCTION SUPPORT SERVICES

The Contractor shall provide the construction support services including, but not limited to, the following:

- Safety
- Security
- Fire protection
- First Aid
- Trash Disposal

2.1.07 RECEIVING, HANDLING & STORAGE

The Contractor shall provide, as required by federal, state and local laws & regulations, Material Safety Data sheets covering all hazardous materials associated with the work under this contract. The Contractor shall also provide written notice of the presence of hazardous materials to local fire, medical and law enforcement agencies with a copy to the Owner.

The Contractor shall be responsible for the receiving, handling and storage of all equipment and material in strict accordance with the manufacturers' instructions and recommendations.

2.1.08 PROPOSAL ARRANGEMENT

Each bidder shall arrange his/her proposal in the following manners:

1. Part - 1 Technical Proposal
2. Part - 2 Commercial Proposal
3. Appendix Supplemental information as may be required to enhance the description of the proposal.
4. Exhibits Drawings, Catalog data, etc.

Pricing and related information shall be shown only in Part - 2.

Each bidder shall submit with his proposal a list of equipment/material Vendors and Subcontractors including Surveying, testing, inspecting and other organizations and/or persons he expects to use for this project. The Owner shall notify the Bidder of objection to, or non-acceptability of any potential organization or person prior to award of this Contract. Bidder shall then replace such organization or person with an acceptable organization or person in order to be considered responsive. The Contractor shall not contract with any organization or person rejected by the Owner. The Contractor shall not be required to contract with any organization or person against whom the Contractor has a reasonable objection. After award of the contract, substitutions shall not be made for any proposed

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Subcontractor accepted by the Owner unless the Owner accepts the substitution in writing.

Each bidder shall submit complete and definitive information on his/her proposal in sufficient detail to permit a complete analysis and evaluation of his/her proposal. Each bidder shall assemble all drawings, catalog data and any other supplementary information necessary to completely describe all the work he is proposing to perform.

2.1.09 PROJECT SCHEDULE

The Contractor shall submit a project schedule within 15 days following the Utility Board's contract award, showing all activities and major milestones. The project schedule shall include the milestones to enable the Owner to schedule his activities such as approvals, field inspections, witnessing tests, etc. No schedule revision shall be made unless approved by the Owner. Any anticipated schedule change shall be reported to the Owner with no intentional time delay.

Each bidder is required to submit his/her proposed project schedule. The Bid award is expected to be made July 27, 2011.

The anticipated schedule should make Stock Island Generation Facility Dynamic VAR Compensation equipment no later than May 1, 2012, and the Big Pine Key Substation Dynamic VAR Compensation equipment no later than June 1, 2012.

END OF SECTION 2

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SECTION 3 SUMMARY OF WORK

SECTION 3 - PART 1 - GENERAL

3.1.01 SECTION INCLUDES

- A. Work covered by Contract Documents
 1. Stock Island Generation Facility Substation (Generating Facility)
 2. Big Pine Substation
- B. OWNER Furnished Items
- C. Project Locations & Conditions
- D. Site Visit

3.1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work covered by these contract documents includes Dynamic Var Compensation installations at two distinct substation locations within the Keys Energy transmission system. The CONTRACTOR shall execute the Work in a schedule which gives priority to the completion of the Stock Island Generation Facility Substation work.
- B. Design, and supply all equipment, labor, materials, supervision and other incidental items required to perform the following general tasks at the **Stock Island Generation Facility Substation**:
 1. Construction of a new substation yard approximately 100 feet by 125 feet as shown on the contract drawings.
 2. Installation of a new 13.8-kV switchgear building which includes one main breaker and 5 feeders.
 3. Installation of 12 MVA of Dynamic Var Compensation (DVC) as specified in Section 18.
 4. Installation of 28 MVAR capacitor banks, 13.8-kV, controlled by the new DVC equipment. Alternatives will be considered pursuant to the performance requirements in Section 18.
 5. Installation of underground duct bank as specified in the Contract Documents and Drawings.
 6. Installation of overhead metal enclosed cable bus as specified in the Contract Documents and Drawings.
 7. Removal of existing transformer iso-phase bus and installation of new terminations connected to a supported metal enclosed cable bus from the existing transformer to the new switchgear building.
 8. Installation of a new 69-kV transformer disconnect switch and associated support structure.
 9. Installation of new transformer protection relays (SEL-587 & SEL-501) and associated lockouts, control switches, and test switches for the existing power transformer. The new relaying shall be installed in the new switchgear building.
 10. Installation of three new owner furnished 69-kV PTs between breaker 69W1 & 69W2 including any necessary support structures or foundations.

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11. Modification of existing breaker controls & relay settings as needed for breakers 69W1 & 69W2.
 12. Installation of a fiber optic communication cable between the existing control building RTU equipment and the new switchgear building RTU equipment.
 13. Installation of new grounding systems as specified in the Contract Documents.
 14. Installation of concrete foundations for all new equipment and facilities. Foundations shall have a top of concrete elevation of 18" above FEMA 100 year flood elevation requirements.
 15. Equipment will be elevated due to flood elevation requirements. Aluminum catwalks shall be installed around equipment in all areas that don't allow for operation and maintenance while standing on the ground.
 16. Installation of new fencing as specified in the Contract Documents. Capacitor banks at Stock Island will not require the top section of fabric discussed for Big Pine below.
 17. Installation of compacted crushed stone as specified in the Contract Documents.
 18. Perform all testing and check out, configuring, programming, and OWNER training in accordance with these specifications and in conjunction with the OWNER, make facility ready to energize and place into service.
- C. Design, and supply all equipment, labor, materials, supervision and other incidental items required to perform the following general tasks at the **Big Pine Key Substation**:
1. Modify the existing Bus 2 13.8-kV switchgear to include the installation of one new 13.8-kV double breaker switchgear cubicle, Buswork and Breakers with Kirk Key interlock to match existing equipment and associated protective relaying. Included is removal of an existing cubicle that will be retired by the OWNER prior to Contractor starting work.
 2. Relocate relaying and other existing equipment from an existing cubicle to a new cabinet provided by the OWNER. Cutouts will be provided in the new cabinet, as necessary. Contract Drawings list the equipment involved but should not be considered all-inclusive. Contractor will be responsible for removing or relocating all existing equipment mounted in or on the existing cubicle to facilitate its removal and replacement with the new 13.8-kV double breaker switchgear cubicle as outlined in Item 1.
 3. Modify the existing control building foundation to include underground conduit exits for the new switchgear cubicle. Existing slab in the proposed new location does not have conduit stubs.
 4. Installation of 12 MVA of Dynamic Var Compensation (DVC) as specified in Section 18.
 5. Installation of 12 MVAR of capacitor banks, 13.8-kV, controlled by the new DVC equipment. Modify connections to two existing 5.4 MVAR capacitor banks to be controlled by the new DVC equipment. Alternatives will be considered pursuant to the performance requirements in Section 18.
 6. Installation of new 15-kV circuit switchers for capacitor switching duty to allow for automatic switching and protective isolation of all 13.8-kV capacitor banks.
 7. Modify existing 13.8-kV breaker controls, relay settings, and new protective relays to allow for proper operation, control and protection of capacitor banks and DVC equipment as indicated on Contract Drawings.

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8. Installation of underground duct bank as specified in the Contract Documents and Drawings. All connections from switchgear building are underground.
 9. Installation of new grounding systems as specified in the Contract Documents.
 10. Installation of concrete foundations for all new equipment and facilities. Foundations shall have a top of concrete elevation of 18" above FEMA 100 year flood elevation requirements.
 11. Equipment will be elevated due to flood elevation requirements. Aluminum catwalks shall be installed around equipment in all areas that don't allow for operation and maintenance while standing on the ground.
 12. Installation of new fencing as specified in the Contract Documents. Fencing around capacitor banks at Big Pine will include a top section of fabric above the banks for animal protection.
 13. Installation of compacted crushed stone surfacing as specified in the Contract Documents.
 14. Perform all testing and check out in accordance with these specifications and in conjunction with the OWNER, make facility ready to energize and place into service.
 15. Provide four (4) new Breakers for Bus 1. These are as follows:
 - Two (2) for Dvar control
 - One (1) for capacitor control
 - One (1) spare
- D. Provide temporary buildings, trailers or structures required for the CONTRACTOR'S work, including offices, a telephone, sanitary facilities, office equipment, furniture, and other items necessary for the performance of Work. CONTRACTOR shall apply for and provide electrical service.
- E. Coordinate with the OWNER in the development of outdoor storage space, parking areas and construction site offices. These areas are to be developed in close proximity to the Work area and shall not impinge in any way on property not owned by the OWNER.
- F. Furnish all welding machines, cable, welding electrodes, rods, burning and cutting equipment, oxygen, acetylene, oil, gasoline, cleaning fluids and miscellaneous supplies of every kind required for use in the CONTRACTOR'S work. Provisions for safe storage of any combustible materials used during erection are the responsibility of the CONTRACTOR.
- G. Provide all secured areas for storage of tools, equipment and materials to be installed or used in the installation of Contract Work. CONTRACTOR shall be responsible for all items until accepted by the OWNER.
- H. Provide weather protection, including temporary heat, electric power, plastic coverings, or other items required for the protection of materials for installation, or being installed on site, until the Contract Work is accepted by the OWNER.
- I. Furnish and erect or install any staging, shoring, bracing, temporary steel and any and all falsework of any character, whatsoever, necessary for the erection of the CONTRACTOR'S work. Include any relocation of equipment, and all such items shall be furnished, placed, and removed by the CONTRACTOR.
- J. Provide in the work areas in close proximity to the Work, fire extinguishers of sufficient size and quantity satisfactory to the OWNER and the local fire department having jurisdiction.

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- K. Perform and construct work in accordance with all federal, state, and local laws, regulations, and codes, including those regulating the environment.
- L. Obtain and pay for all construction permits and licenses.
- M. Conform all material, equipment, and services furnished to the accepted standards and practices of the electric utility industry.

3.1.03 OWNER-FURNISHED ITEMS

- A. The following items have been or will be obtained by the OWNER prior to the start of on-site construction:

Item	Estimated Delivery Date
1. 69-kV PTs (3)	September 1, 2011

3.1.04 PROJECT LOCATIONS

- A. The Stock Island Generation Facility Substation is located at 6900 Front Street, Extended., Stock Island, FL 33040.
- B. The Big Pine Substation is located at 434 County Road, Big Pine Key, FL 33043.
- C. Project/Site Conditions:

Element	Value
Elevation	Less than 100 feet above sea level
Maximum Ambient Temperature	38°C (100° F)
Minimum Ambient Temperature	5°C (41° F)
Annual Average Min.Temperature	23°C (73° F)
Fastest Mile Wind Speed	150 mph
Keraunic Level	100 thunderstorm-days per year
Seismic Level	0

3.1.05 SITE VISIT

- 1. The Contract Work stated and specified herein involves on-site excavation and placement with compaction of selected fill material, construction on pads and foundations, and augured piered foundations. Though the OWNER has attempted to depict construction conditions as accurately as possible, the CONTRACTOR is strongly advised to undertake the following:
 - a. Visit site prior to submitting a bid for Contract Work.
 - b. Pay special attention to scheduling Work activities to permit expeditious accomplishment of the requirements.
 - c. Pay special attention to the requirements necessary to provide proper drainage away from adjacent property and to prevent erosion during construction activities.
- 2. The OWNER will not consider adjustments to the Contract Price after award due to the CONTRACTOR'S failure to recognize the conditions under which Work is to be performed.

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SECTION 3 - PART 2 – PRODUCTS

3.2.01 EQUIPMENT INSULATORS

- A. All equipment insulators shall be extra high leakage type design.

END OF SECTION 3

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SECTION 4 SUBMITTAL PROCEDURES

SECTION 4 - PART 1 - GENERAL

4.1.01 SECTION INCLUDES

- General Procedures
- Construction Progress Schedule
- Schedule of Submittals
- Shop Drawings and Samples
- Record documents

4.1.02 GENERAL PROCEDURES

- A. Attach a copy of a transmittal form to each group of Shop Drawings, manufacturer's literature, equipment Data and Samples submitted. Use a sufficient number of transmittal forms so that:
1. Items on a single transmittal form pertain to the same equipment item, specification section or element of Work;
 2. Items on a single transmittal form are either original submittals or the same number resubmittal; and
 3. Each material sample is listed on a separate transmittal form.
- B. Schedule submittals to expedite the Project and coordinate with schedules required by Article 1.03 of this Section. Deliver each submittal to Owner at the following addresses.
1. Address correspondence to Owner as follows:

Attention: ***Dale Finigan, Director of Engineering***
P.O. Box 6100
Key West, FL 33040

Project Title: **DYNAMIC VAR COMPENSATION SYSTEMS**
- C. Present submittals in a clear and thorough manner and use sheet size of not less than 8-1/2 by 11 inches and not more than 24 by 36 inches. Provide space for Contractor, and Owner's review stamps.
- D. Complete a submittal transmittal form, numbering each submittal consecutively. Assign resubmittals the same transmittal number as the original with a suffix of a sequential letter to indicate the resubmittal (e.g. the first resubmittal of submittal 25 would be number 25A.) Include only those documents previously issued under original transmittal number in resubmittals. Do not combine new submittals with resubmittals.
- E. Submittals which do not have a fully completed transmittal form will be returned along with unreviewed attachments. Returned submittals, even though incomplete, will be counted as a submittal in accordance with the Supplementary Conditions.
- F. Revise and resubmit documents as required. Identify all changes made since previous submittal. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions. Submittals not requested on the submittal schedule will not be recognized or processed.

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4.1.02 CONSTRUCTION PROGRESS SCHEDULE

- A. Submit a preliminary and final Progress Schedule as specified in Section 2 of the General Requirements.
- B. Submit revised Progress Schedule on monthly basis and with each Application for Payment, identifying changes since previous version.
- C. Submit a horizontal bar chart (GANTT schedule) with separate line for each section of Work, identifying first work day of each week. Coordinate content with Schedule of Values.
- D. Submit complete factory fabrication and delivery schedules for all major equipment indicated in the Schedule of Values.
- E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- F. Indicate estimated percentage of completion for each item of Work at each submission.
- G. Indicate dates for fabrication, factory testing, delivery, shipping and field testing, and material and equipment delivery dates, including those furnished by Owner. Coordinate with Schedule of Submittals.
- H. Include a narrative of problems experienced that could impact progress of work.

4.1.03 SCHEDULE OF SUBMITTALS

- A. Submit preliminary and final Schedule of submittals.
- B. Include description of each Submittal, date by which each Submittal will be delivered to the Owner, date by which each submittal must be approved to maintain project schedule, and relevant specification section reference.
- C. Allow 10-15 days for Engineer review of submittals and possible resubmittal from receipt of submittal/resubmittal.

4.1.04 SHOP DRAWINGS AND SAMPLES

- A. Submit and coordinate with the Schedule of Submittals required in Article 1.03 of this Section.
- B. Manufacturers' Installation Instructions and Certificates.
 - 1. Submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing. Indicate special procedures, perimeter conditions requiring special attention and special environmental criteria required for application or installation.
 - 2. Submit manufacturers' certificates for recent or previous test results on material or equipment, but they must be acceptable to Owner. Indicate material or equipment conforms to or exceeds specified requirements and provide supporting reference date, affidavits, and certifications as appropriate.
- C. Submit test results, data, and reports and certifications to Engineer based on tests performed. Submit test reports and certifications for Independent Testing Services.

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- D. Submit Turnover Packages to include as a minimum, the description and function of equipment, setpoint and operating parameters, checklists, calibration and alignment records (if applicable), testing documentation and applicable drawings.
- E. Submit one copy to the Owner if providing in hardcopy. Otherwise submit in PDF format to Owner.
- F. Identify variations from Contract Documents and material and equipment or system limitations which may be detrimental to successful performance of the completed Work and identify reasons therefore in the space provided on the transmittal form or in a referenced serial letter. Clearly identify requests for "Or-Equal" items and submit.

4.1.05 RECORD DOCUMENTS

- A. Submit full set of record documents to Engineer with claim for final Application for Payment.
- B. Store Record Documents separate from documents used for construction. Record information concurrent with construction progress.
- C. Legibly mark each item to record description of actual equipment and material installed actual construction on approved submittals, including the following:
 - 1. Manufacturer's name and equipment and material model and number.
 - 2. Material and equipment substitutions or alternates utilized.
 - 3. Approved changes.
 - 4. Measured depths of foundations.
 - 5. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 6. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 7. Field changes of dimension and detail.
 - 8. Details not on original Contract Documents or Shop Drawings.
- D. As-Built for Material and Equipment: 3 prints and electronic files in ".DWG" or "PDF" format. Indicate "As-Supplied" in revision block and sign. Show all changes and revisions to date of completion.
- E. Conformed to Construction Record Drawings: 3 full size prints and electronic files in ".DWG" format. Indicate "Conformed by Contractor to Construction Records" in revision block and sign. Show all changes and revisions to date of completion.
- F. Warranties: Submit duplicate notarized copies of warranty documents which are executed and transferable from Subcontractors, Suppliers, and manufacturers. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period. Assemble in three ring binders with durable plastic cover with a table of contents.

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G. Operation and Maintenance Data.

1. Submit data in ring binders with durable plastic covers with 8-1/2 by 11-inch text pages.
2. Cover: title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of Project, and subject matter of binder when multiple binders are required.
3. Subdivide binder contents with permanent page dividers, logically organized as described below with laminated plastic tabs and clearly printed the contents.
4. Prepare a Table of Contents for each volume, with material, equipment, or system description identified, in three parts as follows:

Part 1: Directory, listing names, addresses, and telephone numbers of Contractor, Subcontractors, and major equipment Suppliers.

Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Identify the following:

- Significant design criteria
- List of equipment
- Parts list for each component
- Operating instructions
- Maintenance instructions for equipment and systems
- Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents

Part 3: Other Project documents and certificates, including the following:

- Shop Drawings and product data
 - Certificates
 - Photocopies of warranties
5. Submit one draft copy of completed volumes 15 days prior to factory testing and 15 days prior to final inspection. Include 2 copies of completed manuals with major equipment when equipment is shipped. Draft copies will be reviewed and returned prior to factory testing and after final inspection, with Engineer's comments. Revise content of all sets as required prior to final submission. Submit 6 copies of revised final volumes within 10 days after final inspection.

H. Spare Parts and Maintenance Materials: Furnish spare parts, maintenance and extra materials in quantities specified. Deliver to Project Site and place in location as directed.

END OF SECTION 4

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SECTION 5 TESTING LABORATORY SERVICES

SECTION 5 - PART 1 - GENERAL

5.1.01 SECTION INCLUDES

- Responsibilities and rights
- Laboratory and individual information
- Laboratory facilities
- Responsibility of Contractor and soils testing laboratory

5.1.02 RESPONSIBILITIES AND RIGHTS

- A. Provide all supervision, labor, materials, facilities, services and other items needed, and perform all inspecting and testing of soils, earthwork, and materials required under Sections 6, 11, 13 and 14 of this document, and all applicable codes and standards pertaining thereto.
- B. Maintain quality personnel on site as necessary to perform all Work to the satisfaction of the Owner and Engineer.
- C. Provide quality assurance and testing for all fill areas, backfill in trenches, on the site surface during proof-rolling, for the surfacing materials, and for compliance with material quality and compaction requirements.
- D. Use only personnel who are thoroughly trained and experienced in the necessary skills, completely familiar with the requirements specified, the pertinent portions of the Contract Documents, the particular geographic and geologic areas in which construction is taking place, and the selected standards for inspection and testing, and who are approved for this purpose by the Owner.
- E. The Owner reserve the right to remove from the site at any time, individual testers who, because of incompetence or carelessness, fail to perform tests in accordance with accepted practice.

5.1.03 RELATED WORK

- A. Section 6 – Cast-In-Place Concrete
- B. Section 10 – Earthwork
- C. Section 11 - Excavation, Trenching and Backfill
- D. Section 13 - Drilled Concrete Piers and Shafts
- E. Section 14 - Crushed Stone Surfacing

5.1.04 QUALITY ASSURANCE

- A. Provide quality assurance and testing for the following activities:
 - 1. Correct gradations of site surfacing materials;
 - 2. Proper compaction of subgrade and of site surfacing materials;
 - 3. Proper compaction of trench bottoms before installing trenching materials;
 - 4. Proper compaction of trench backfill;

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5. Proper strength of concrete mix and of concrete cast-in-place;
6. Proper slump;
7. Such other concrete quality tests as required by Owner;

5.1.05 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 1. T217
- B. American Society for Testing and Materials (ASTM)
 1. D698
 2. D1557
 3. D2216
 4. D3017

5.1.06 SUBMITTALS

- A. Laboratory and individual information as indicated in Section 2.01 of this specification document.
- B. Results of all laboratory tests, including basic curves and analyses performed to establish points of comparison of ideal conditions.

SECTION 5 - PART 2 - PRODUCTS

5.2.01 LABORATORY AND INDIVIDUAL INFORMATION

- A. Within 7 days after Notice to Proceed, submit complete data relative to the testing laboratory proposed for this Work for approval by the Owner. Information shall include, but not be limited to:
 1. Qualifications of individual personnel, including brief history of all individuals Contractor proposes to employ for inspection and testing.
 2. A listing of all work done by the laboratory within the past 5 years. Include location, name of project, Owner, and a summary of services performed.
 3. A listing of all equipment proposed for use on this Project. Include date purchased and age of equipment.

5.2.02 LABORATORY FACILITIES

- A. Provide testing laboratory facilities required to satisfactorily perform the testing required under this Section, pertinent to the other sections of this document referenced, and within the increments of time essential to timely completion of the work.
- B. Owner has right to inspect at any time the facilities and operations of the testing laboratory.
- C. If incongruities and/or unacceptable testing practices are observed, the Contractor will be notified that action is required to correct the situation. If such incongruities continue, the Owner has the

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right to require either 1) replacement of any or all laboratory personnel, or 2) a new testing laboratory be obtained.

SECTION 5 - PART 3 - EXECUTION

5.3.01 RESPONSIBILITY OF CONTRACTOR AND SOILS TESTING LABORATORY

- A. The Contractor shall be responsible for obtaining and utilizing a testing laboratory to perform the test required by this Contract.
- B. Perform in-place density and moisture content determinations to verify that the fill is being compacted to the criteria required.
- C. Perform in-place moisture content tests using the quick-dry procedure in accordance with SCS 19-S-11, the speedy moisture tester in accordance with AASHTO T217, or by nuclear methods in accordance with ASTM D3017. Calibrate testers by oven drying in accordance with ASTM D2216.
- D. Use ASTM D698, Method C to establish moisture-density relationships to act as a standard for maximum dry densities and optimal moisture contents.
- E. Inspect excavations to detect unanticipated conditions which may affect structure foundation performance. Observe too moist or too dry soil conditions, organics in place, or other Specification deviations and direct replacement of unacceptable material to assure adequate bearing capacity.
- F. Perform additional tests when soil material consistency changes or as directed by the Engineer.
- G. Perform tests as specified in Sections 6, 11, and 14.
- H. Results of all tests specified within shall be provided with the installation maintenance and operation manual provided by the Contractor in accordance with Section 4.

END OF SECTION 5

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SECTION 6 CAST-IN-PLACE CONCRETE

SECTION 6 - PART 1 - GENERAL

6.1.01 SECTION INCLUDES

- A. Formwork
- B. Concrete reinforcement and accessories
- C. Cast-in-place concrete

6.1.02 RELATED SECTIONS

- A. Section 5 - Testing Laboratory Services
- B. Section 13 - Dilled Concrete Piers and Shafts

6.1.03 REFERENCES

- A. Use most recently adopted edition of standards and publications.
 - 1. Specifications for Structural Concrete for Buildings (ACI 301) as supplemented and modified herein.
 - 2. Hot Weather Concreting.
 - 3. Cold Weather Concreting.
 - 4. Standard Practice for Curing Concrete (ACI 308).
 - 5. Standard Practice for Selecting Proportions for Normal and Heavy-weight Concrete (ACI 211.1).
 - 6. Manual of Standard Practice for Detailing Reinforced Concrete Structures (ACI).
 - 7. Building Code Requirements for Reinforced Concrete (ACI 318).
 - 8. Recommended Practice for Evaluation of Strength Test Results of Concrete (ACI 214).
 - 9. Admixtures for Concrete and Guide for Use of Admixtures in Concrete (ACI 212.2).
 - 10. ASTM A615 - Deformed and Plain Billet - Steel for Concrete Reinforcement.
 - 11. ASTM C33 - Concrete Aggregates.
 - 12. ASTM C94 - Ready-Mixed Concrete.
 - 13. ASTM C150 - Portland Cement.
 - 14. ASTM C260 - Air Entraining Admixtures for Concrete.
 - 15. ASTM C295 – Guide for Petrographic Examination of Aggregates for Concrete.
 - 16. ASTM C309 - Liquid Membrane - Forming Compounds for Curing Concrete.

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- 17. ASTM C586 – Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method).
 - 18. ASTM C1105 – Standard Test Method for Length Change of Concrete due to Alkaline Carbonate Rock Reaction.
 - 19. ASTM D2103 - Polyethylene Film and Sheeting.
- B. All specifications, reports and recommendations referenced above are specifically incorporated herein. Where a conflict may occur between these Contract Documents and other referenced specifications, reports or recommendations, these Contract Documents shall govern.

6.1.04 QUALITY ASSURANCE

- A. Perform all work in accordance with ACI 301.
- B. Perform all tests as specified in Contract Documents or as requested.
- C. The Contractor shall be responsible for the testing of concrete by an independent testing firm, approved by the Owner. Tests will include slump and air testing in the field and preparation and storage of cylinders for compressive strength testing. Concrete cylinders shall be prepared from samples obtained at the point of truck discharge. Three cylinders shall be prepared for each 30 cubic yards of concrete or portion thereof, placed in one day. Cylinders shall be prepared, cured and tested by the testing firm in accordance with ASTM C31 and ASTM C39. One cylinder shall be tested at seven days, one at 28 days, and one kept in reserve to be tested as directed by the Owner. These tests shall be at Contractor's expense.
- D. Where the 28 day compressive strength of concrete in any test cylinder does not satisfy the requirements of Paragraph 2.04 of this Section, the Contractor shall be held responsible for additional tests and removal and replacement of unacceptable concrete work at no additional cost to the Owner.
- E. Concrete not conforming to required elevations, tolerances, or not properly placed or not of the specified type and quality shall be corrected or replaced at Contractor's expense.
- F. Concrete mix design:

Concrete mix proportions and strength test results shall either be prepared by a testing agency, paid by the Contractor and approved by the Owner, or be based upon the test results of a similar mix made in the last 120 days and certified by the Contractor. Mixes shall be made using aggregates proposed to be used for the structure. Compression test cylinders made from concrete mixes using the coarse aggregates specified shall be tested for each size of coarse aggregate specified and used. Test cylinder ages shall be 7, 14 and 28 days for each size of coarse aggregate specified. The Contractor shall certify compliance with sieve analyses for the aggregates used. Tests shall be performed in accordance with ASTM Tests C31, C39, C143, C172 and C173 as applicable. Tests, if required, will be at Contractor's expense.
- G. Test results of aggregates to be used for concrete shall either be prepared by a testing agency, paid by the Contractor and approved by the Owner, or based upon the test results of the same material source made in the last 120 days and certified by the Contractor. Tests shall, at minimum, include ASTM C295. If petrographic examination does not determine conclusively that the aggregate is not reactive, then samples should be tested per ASTM C586 and concrete tests in 1.04F, above, shall also include ASTM C1105. The Contractor shall certify that the aggregates to be used are not reactive. Tests, if required, will be at Contractor's expense.

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6.1.05 SUBMITTALS

- A. Submit concrete mix designs (proportions) and strength test results in accordance with the General and Special Conditions and as specified in 6.1.04.F above.
- B. Submit results of petrographic examination of aggregates as specified in 6.1.04.G above.
- C. Submit, when requested, Shop Drawings for review in accordance with Section 4. The Shop Drawings shall show complete details and arrangement of reinforcing steel with added details of Contractor's method to prevent misalignment, warping or damage to the reinforcing bar cage while being transported, raised and positioned in the excavated shaft.
- D. Obtain batch tickets from the concrete manufacturer, properly completed and issued to the purchaser, in compliance with ASTM C94 for each load of concrete before unloading at the site. Submit one copy to Owner and one copy to Engineer.
- E. Submit manufacturer's literature, specifications and installation instructions for each item of proprietary material used (admixtures, etc.).
- F. Submit one copy of test reports to Owner within three days after the completion of individual tests.

SECTION 6 - PART 2 - PRODUCTS

6.2.01 FORM MATERIALS

- A. Forms may be of $\frac{5}{8}$ inch or $\frac{3}{4}$ inch structural plywood, or steel forms with steel or wood facing, or approved equal.

6.2.02 REINFORCING STEEL

- A. Reinforcing bars shall be deformed steel bars conforming to the requirements of ASTM A615, Grade 60, having a minimum yield of 60,000 psi. Reinforcing bars will be clean and free of loose rust and/or any substance that would hinder bond strength.

6.2.03 CONCRETE MATERIALS

- A. All concrete shall be plant mix and delivered in accordance with Standard Specifications for Ready Mixed Concrete, ASTM C94. Mixing time in ASTM specification shall be observed. Concrete shall be composed of Portland cement, air entraining agent (if used), fine aggregate, coarse aggregate and water. Materials from the same source from start to finish of the job shall be used.
- B. Portland cement shall conform to ASTM C150, Type I or II. Only one brand of cement shall be used.
- C. Aggregates:
 - 1. Fine aggregates shall conform to the requirements of ASTM C33, except that the first sentence of Paragraph 4.1 shall be changed to read, "Fine aggregate shall be graded within the following limits;" and Paragraph 4.2 shall be deleted in its entirety.
 - 2. Coarse aggregate shall conform to the requirements of ASTM C33, Table 2. Coarse aggregate shall be as specified on Contract Drawings.
 - 3. Use only aggregates with good service records for producing durable, long-life concrete.
- D. Water: Mixing water for concrete shall be fresh, clean and potable.

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E. Admixtures:

1. If air entraining agent is used, it shall be stored in such a manner as to avoid contamination and damage. It shall be protected from freezing and other temperature changes which would adversely affect its characteristics. Only one brand of air entraining agent shall be used.
2. Concrete that is to be installed in marine environments shall contain an admixture which adds corrosion resistant properties to the finished product. The corrosion resistant admixture shall be FX-32 Silica Fume, or approved equal.
3. Concrete that is to be installed underwater shall contain a combination of admixtures that promotes a low water/cement ratio and prevents washout of cements and fines. The low water/cement ratio and washout resistant admixtures shall be ADVA® 100 Superplasticizer and RHEOMAC® UW 450 respectively.
4. Calcium chloride and other chlorides shall not be used under any circumstances.
5. Air entraining agent shall conform to the requirements of ASTM C260 and shall not contain chlorides. The air entraining agent shall be Master Builders' MBVR, or approved equal. Air entraining agent shall be in solution and introduced into the concrete mix by dispenser. The amount of air entraining agent used shall be based upon consultation with a field representative trained by the manufacturer of the product. Tests for air content shall be made in accordance with ASTM C231.

F. Curing compound may be used if approved, subject to the requirements of this Section. The compound shall be SONOSIL, by Sonneborn Building Products Company, or approved equal.

G. Form release agent shall be Nox-Crete, or approved equal.

6.2.04 CONCRETE MIX

- A. The concrete mix shall be designed for a marine environment to produce the design strength (f'_c) and to provide durability, workability, and mixture consistency to facilitate placement without segregation or bleeding and conform to "Recommended Practice for Selecting Proportions for Normal and Heavy-weight Concrete" (ACI 211.1), less Appendices 1, 2, and 4 and ASTM C 94, Ready-Mix-Concrete. Aggregates shall be normal weight. The water cement ratio shall not exceed 0.40 for any condition or use. The minimum cementitious material shall be 675 pounds per cubic yard. Portland cement shall be a minimum of 50 percent of the cementitious material.
- B. Minimum ultimate compressive strength shall be 5,000 psi at 28-day age. Compressive strength shall be determined by testing on standard 6-inch by 12-inch cylinders tested in accordance with ASTM C39.
- C. Slump shall be maximum 3-inches for spread foundations and maximum 7-inches for drilled piers.
- D. Entrained air content shall be 5½-percent within the limits of +/- 1-percent.

6.2.05 CURING MATERIALS

- A. Water: clean and drinkable.
- B. Membrane curing compound: ASTM C309 or FS TT-C-800.
- C. Polyethylene Film: ASTM D2103 0.15 mm thick, clear color.

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6.2.06 FOUNDATION BASE MATERIAL

- A. Vapor Barrier: 6 mil polyethylene.
- B. Crushed Stone: Crushed Limestone.

SECTION 6 - PART 3 - EXECUTION

6.3.01 GENERAL EXECUTION

- A. Perform all concrete work as specified in Contract Specifications, and in accordance with the requirements of ACI 301.
- B. The condition of all foundation excavations and of the pier excavation, above-ground formwork, in-place reinforcing steel and embedded items (e.g., anchor bolts or anchor bolt cage) are subject to field review by the Owner prior to placing of concrete. Concrete shall not be placed until reinforcing steel and embedded items have been reviewed by Owner.
- C. Foundation excavations and drilled pier shafts shall not be left open overnight. Concrete shall be poured immediately after excavation is ready and reinforcement and anchor bolts are set.
- D. Preparation:
 - 1. Precautionary plans shall be submitted for hot and cold weather concreting for review at the same time the reinforcing placement Shop Drawings are submitted.
 - 2. Precautionary plans shall be submitted for meeting unexpected water problems and/or unexpected soil caving problems at the same time the reinforcing placement Shop Drawings are submitted.
 - 3. Verify that positioning of reinforcement and orientation of anchor bolts (anchor bolt cage) are accurately placed and securely held in position, as shown on the Contract Drawings, and that they will not be displaced during concrete pouring.

6.3.02 FORMWORK

- A. Verify lines and levels before proceeding with formwork.
- B. Hand trim sides and bottoms of earth forms; remove debris, loose and wet soil.
- C. Tolerances shall be as specified in Table 4.3.1 of ACI 301.
- D. Formwork shall be properly oiled or coated with a form release agent prior to the pouring of the revealed above-ground level portion of the pier.
- E. Formwork shall be removed in accordance with the recommendations of ACI 305R and ACI 306R.

6.3.03 REINFORCING STEEL AND EMBEDDED ITEMS

- A. Reinforcing steel will be placed and held securely in place as shown on the Contract Drawings.
- B. Welding, hot bending and rebending of reinforcing bars are not permitted.
- C. Splices of reinforcing steel shall be avoided. If unavoidable, lap splices shall be as per ACI 318 Sections 12.14 and 12.15.

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- D. Items to be embedded (e.g., anchor bolts) in concrete shall be placed accurately and held in the correct position while the concrete is placed. The surfaces of metalwork in contact with or embedded in concrete shall be cleaned of all rust, dirt, grease, loose scale, grout, mortar and other foreign matter. After anchor bolts (or anchor bolt cage) have been embedded and caisson surface finished, the threads on anchor bolts will be thoroughly cleaned of all concrete, and shall be protected by grease, and by having the nuts screwed on or by other acceptable means until the time of installation of the pole or metalwork.

6.3.04 PLACING CONCRETE

- A. All foundations shall be poured to grade and troweled. Edges shall be finished. No grout caps shall be used under baseplates.
- B. Contractor shall notify the Owner a minimum of 24 hours prior to commencement of placing the concrete.
- C. No admixtures shall be allowed to be added to the concrete at the job site.
- D. If concrete is to be placed under water, contractor shall utilize methods and concrete admixtures to allow for such installation and to prevent cement and fine washout.
- E. Concrete shall be placed in such a manner that the concrete does not strike against the reinforcing bars or the anchor bolts (anchor bolt cage).
- F. Concrete shall be placed in one pour and without joints.
- G. Spread foundations and the top 10' of the pier foundations will be vibrated. No vibrator shall be raised at a rate faster than one inch per second. A spare vibrator in operating condition shall be on-site.
- H. During hot weather, concrete work shall be performed in accordance with ACI 305R. Hot weather shall not be based on air temperature alone. The Contractor shall take into consideration the air temperature, relative humidity, wind velocity, temperature of the ingredients to be used for producing the concrete to determine the precautions the Contractor shall take during the production, transportation, handling, placing, finishing and curing of the concrete.
- I. During cold weather, concrete work shall be performed in accordance with ACI 306R. Cold weather is considered to occur when the air temperature of the surrounding air is expected to be below 40 degrees Fahrenheit during placing or within 24 hours thereafter. The Contractor shall provide temporary housing over all concrete work. Temporary housing enclosures shall be maintained and heated to a minimum temperature of 50 degrees Fahrenheit for six full days.

6.3.05 FINISHING

- A. All exposed form concrete shall be smooth form finish as defined by ACI 301 and ACI 308, Standard Practice for Curing Concrete.
- B. Chamfer exposed edges as shown on the Contract Drawings.

6.3.06 MONOLITHIC SLAB FINISHES

- A. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified.

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1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- B. Apply trowel finish to monolithic slab surfaces to be exposed to view.
 1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled.
- C. Apply nonslip broom finish to exterior concrete paving, approach slabs, platforms, and ramps.
 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route.

6.3.07 PLACING ANCHOR BOLTS

- A. Anchor bolts shall be set by clamping in a template conforming to the anchor bolt pattern and orientation. Template shall remain in place until concrete has hardened.
- B. Contractor shall supply required templates, clamps, and accessories.
- C. The surfaces of metal work in contact with or embedded in concrete shall be cleaned of all rust dirt, grease, loose scale, grout, mortar and other foreign matter.
- D. Do not weld anchor bolts.
- E. Threads on anchor bolts will be thoroughly cleaned of all concrete after concrete is poured. Threads will then be protected by application of grease.

6.3.08 CURING

- A. All concrete shall be cured continuously in accordance with ACI 301 and ACI 308, Standard Practice for Curing Concrete for at least seven days immediately after completion of placement and finishing. Curing time and procedures shall be adjusted to suit hot and cold weather conditions. Curing shall be initiated as soon as the concrete is finished. Curing water shall not be excessively cooler than the concrete. All concrete cast in hot weather shall have an initial moist cure.

6.3.09 PATCHING

- A. Any surface defects larger than ¾-inch in the longest dimension shall be repaired by sacking or rubbing after filling the defective area with matching grout.

6.3.10 HOT WEATHER CONCRETING

- A. Concrete operations performed in hot weather conditions will be accomplished in strict accordance with ACI 305.

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6.3.10 COLD WEATHER CONCRETING

- A. Concrete operations performed in cold weather conditions will be accomplished in strict accordance with ACI 306.

6.3.11 PROTECTION

- A. Immediately after placement, Contractor shall protect finished concrete from premature drying, hot or cold temperatures, and mechanical injury. The concrete will be maintained with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

END OF SECTION 6

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SECTION 7 JOINT PROTECTION

SECTION 7 - PART 1 GENERAL

7.1.01 SECTION INCLUDES

- A. Sealant for Concrete Oil Retention System Components.

7.1.02 SUBMITTALS

- A. Submit in accordance with Section 4.
- B. Product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability.
- C. Manufacturer's installation instructions.

SECTION 7 - PART 2 - PRODUCTS

7.2.01 SEALANTS

- A. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding, non-sagging type; as manufactured by Bostik Construction Products, with the following properties:
 - Joint Movement: 25-percent
 - Service Temperature Range: -200° to 1500°F
 - Shore A Hardness: 40 to 50
- B. Joint Sealer: Swell Seal, combiseal type, as manufactured by DeNeef America, Inc., St. Louis, MO.

7.2.02 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

SECTION 7 - PART 3 - EXECUTION

7.3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means installer acceptance of existing surfaces.

7.3.02 PREPARATION

- A. Clean and prime joints in accordance with manufacturer's instructions.
- B. Remove loose materials and foreign matter that will impair adhesion of sealant.
- C. Protect adjacent work from damage and disfiguration.

7.3.03 INSTALLATION

- A. Install sealants in accordance with sealant manufacturer's instructions.
- B. Apply sealants within temperature ranges recommended by sealant manufacturer.

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- C. Install sealant free of air pockets, foreign embedded matter, ridges and sags.

7.3.04 CLEANING, REPAIRING AND PROTECTING

- A. Clean adjacent soiled surfaces.
- B. Repair or replace damaged adjacent finishes caused by sealing operations.
- C. Protect sealants until cured.

END OF SECTION 7

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SECTION 8 PAINTING

SECTION 8 - PART 1 GENERAL

8.1.01 SECTION INCLUDES

- A. Surface and materials preparation, coatings applications, painting systems, and clean-up procedures for touch-up painting to cover dings, scrapes, or scratches on equipment incurred during construction of the project.

8.1.02 RELATED WORK

- A. Section 4 - Submittal Procedures.
- B. Section 9 – Special Coatings.

8.1.03 QUALITY ASSURANCE

- A. Conform to the requirements of SSPC, the Steel Structures Painting Council.
- B. Requirements of the paint coating systems manufacturer shall be considered minimum application requirements, and shall be supplemented by the requirements of this Section where more restrictive.
- C. Intent of this Section is for Contractor to perform touch-up Work that results in a completely coated facility devoid of tack marks or signs of construction when the prime Contractor completes all construction activities and demobilizes from the site.

8.1.04 REFERENCES

- A. Codes and standards referred to in the text of Part 2 and Part 3 of this section.
- B. Standards of the American Society for Testing and Materials (ASTM).
- C. Standards of the American National Standards Institute (ANSI).
- D. The term "paint" as used herein means all coating system materials, which includes primers, emulsions, enamels, stain sealers and fillers, and other applied materials, whether used as prime, intermediate or finish coats.

SECTION 8 - PART 2 - PRODUCTS

8.2.01 PAINTING SYSTEMS REQUIRED

- A. Sufficient paint of the color identical to the finish coat will be provided by Owner for the electrical equipment. This will include transformers, circuit breakers, and control building.

SECTION 8 - PART 3 - EXECUTION

8.3.01 GENERAL REQUIREMENTS

- A. Clean and touch up all painted surfaces on the transformers, breakers, control building, and incidentals to remove dings, scrapes or scratches incurred as a result of Contract Work.

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- B. Do not paint the following:
1. Finished metal surfaces, including metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials. These will not require finish painting unless otherwise indicated.
 2. Operating parts are not to be painted. Do not paint moving parts of operators, mechanical and electrical parts such as pulleys, linkages, sensing devices, and similar.
 3. Do not paint over any code-required labels, such as Underwriter's Laboratories, NEMA, or any equipment identification, performance rating, warning plate, name or nomenclature plates.
 4. Leave concrete floors, walls and piers in their natural color.

8.3.02 SURFACE PREPARATION

- A. Clean exterior surfaces of breakers and regulators of all oil, grease, dirt, minor rust, and other foreign substances by solvent and only where necessary, power tool cleaning, in accordance with, and in full compliance with, SSPC-SP1 and -SP3.

8.3.03 MATERIALS PREPARATION

- A. Mix and prepare painting materials in strict accordance with the manufacturer's recommendations.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.
- C. Stir all materials before application to produce a mixture of uniform density and as required during application of the materials. Do not stir any film which may form on the surface into the material. Remove film and if necessary, strain materials before using.

8.3.04 COATINGS APPLICATION

- A. Employ dropcloths, proper masking methods and other methods prudent to providing a clean, professional appearance.
- B. Apply coatings in strict accordance with SSPC-PA1, as supplemented by the requirements of the coating manufacturer.
- C. Apply paint with brush, roller, spray or other acceptable practice in accordance with the manufacturer's directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back or high pile sheep's wool as recommended by the paint manufacturer for material and texture required.
- D. The number of coats and paint film thickness required is the same, regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried. Sand between each application if required by the manufacturer. Remove dust before painting again.
- E. Apply additional coats when undercoats or other conditions show through the final coat of paint until the paint film is of uniform finish, color, and appearance. Give special attention to ensure that all surfaces including edges, corners, crevices, welds and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

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- F. Apply each material at not less than the manufacturer's recommended spreading rate to provide total dry film thickness, as indicated in other Sections of this specification.

8.3.05 PAINTING PROCEDURES

- A. Apply the touch-up paint to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as is practicable after preparation and before subsequent surface deterioration.
- B. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- C. Do not apply paint in snow, rain, fog or mist or when relative humidity exceeds 85-percent.
- D. Apply paint only if metal surfaces and the surrounding air temperature are between 50 degrees F and 90 degrees F, unless specifically permitted otherwise by paint manufacturer's printed instructions.
- E. Do not apply paint to damp or wet surfaces unless specifically permitted by the paint manufacturer's printed instructions.
- F. Employ dropcloths or mask off areas where painting is being done to protect floors and other work from damage during execution of the Work. Where it becomes necessary to remove temporary coverings placed by others in every branch of the Work, replace same in proper manner.
- G. Remove oily rags and waste from site every night. Do not allow to accumulate.

8.3.06 CLEAN-UP FROM FIELD PAINTING ACTIVITIES

- A. Upon conclusion of painting activities conducted on site, collect and dispose of in a manner acceptable to the Owner, all paint cans, buckets and thinner, rags, paper, drop cloths and incidentals used in the performance of Contract Work.
- B. In areas where field painting has taken place, Contractor shall thoroughly clean all splatter, spills and drops to the satisfaction of the Owner. Leave finished spaces clean and in a condition acceptable to the Owner.

END OF SECTION 8

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SECTION 9 SPECIAL COATINGS

SECTION 9 - PART 1 GENERAL

9.1.01 SECTION INCLUDES

- A. Touch-up and repair of damaged galvanized coatings on structures.
- B. Surface preparation.
- C. Application requirements.

9.1.02 RELATED WORK

- A. Section 4 - Submittal Procedures.
- B. Section 8 – Painting.

9.1.03 QUALITY ASSURANCE

- A. Conform to the requirements of SSPC, the Steel Structures Painting Council.
- B. Requirements of the paint coating systems manufacturer shall be considered minimum application requirements, and shall be supplemented by the requirements of this Section where more restrictive.
- C. Intent of this Section is for CONTRACTOR to perform touch-up Work that results in a completely coated facility devoid of tack marks or signs of construction when the prime CONTRACTOR completes all construction activities and demobilizes from the site.

9.1.04 REFERENCES

- A. Codes and standards referred to in the text of Part 2 and Part 3 of this section.
- B. Standards of the American Society for Testing and Materials (ASTM).
- C. Standards of the American National Standards Institute (ANSI).

9.1.05 SUBMITTALS

- A. Manufacturer's information showing galvanized repair material, application information and substrate preparation required for minimum application integrity.

SECTION 9 - PART 2 - PRODUCTS

9.2.01 COATINGS

- A. Use zinc-rich paint; Manufacturer, Keeler & Long, 4400 or 4400/2000 or approved equal.

SECTION 9 - PART 3 - EXECUTION

9.3.01 SURFACE PREPARATION

- A. Wire brush areas to be coated with galvanizing repair.

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- B. Remove grease, dirt and other deleterious materials in accordance with Steel Structures Painting Council Specifications, SP-1.

9.3.02 APPLICATION REQUIREMENTS

- A. General:
 - 1. Apply all coatings in strict accordance with the manufacturer's instruction.
 - 2. Do not apply until any preceding coat is dry and hard.
 - 3. Apply only to thoroughly dry surfaces.
 - 4. Do not apply galvanizing repair in rainy, damp or frosty weather.
 - 5. Do not use materials which have exceeded the pot life stated by the manufacturer.
 - 6. Where installation of equipment makes surfaces inaccessible, repair these surfaces prior to installing the equipment.
- B. Workmanship requirements:
 - 1. Coat to achieve neat appearance of finished surfaces.
 - 2. Inspect for and also repair paint ridges, sags, runs, drops, laps and unnecessary brush marks.
 - 3. Mix coating thoroughly and limit the use of thinners.
 - 4. Allow for proper drying time between coats.
 - 5. Protect all surfaces to remain uncoated, and all finish coated surfaces.
- C. Mechanically mix repair compound before using.
- D. Thinning requirements:
 - 1. Dilute only as required to achieve suitable viscosity.
 - 2. Use only thinner type and amount recommended by manufacturer.

END OF SECTION 9

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SECTION 10 EARTHWORK

SECTION 10 - PART 1 GENERAL

10.1.01 SECTION INCLUDES

- A. Work to be performed
- B. Select Fill Material
- C. Common Back Fill
- D. Excavation and Fill

10.1.02 WORK TO BE PERFORMED

- A. After the stripping operation is completed, the Contractor shall:
 - 1. Excavate and fill materials as required to establish the finished grade elevations.
- B. Repair final subgrade surface to establish the finished grade elevations as shown on the Contract Drawings after the site work construction is completed.

10.1.03 QUALITY ASSURANCE

- A. Provide copies of all material gradations and test reports of granular backfill material (before finalization of any agreements with supplier), and any compaction work for review and acceptance by the Owner.
- B. Coordinate excavation and fill operations with the Owner and Engineer. Inform both parties when unanticipated conditions are encountered; do not proceed with Work until resolution is provided in writing.

10.1.04 REFERENCES

- A. Codes and standards referred to in the text of Part 2 and Part 3 of this document.
- B. Standards of the American Society for Testing and Materials, in particular, ASTM D698, latest revision.

10.1.05 SUBMITTALS

- A. Submit in accordance with Section 4.
- B. Borrow Materials:
 - 1. Source.
 - 2. Gradation and Compaction Test Results.
 - 3. Certification that materials meet specifications.

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SECTION 10 - PART 2 - PRODUCTS

10.2.01 SELECT FILL MATERIAL

- A. On-site excavated soil. On-site excavated soil may be used for select fill material provided that the material is approved by the Owner. Material shall have acceptable plasticity, liquid limit less than 50, and be free of organics and debris. Material shall also be dried to obtain the moisture content needed to achieve the required compaction.
- B. Imported fill material. If on-site excavated soil is unsuitable, in the opinion of the Owner, for select fill material, the Contractor shall import select fill material. Imported select fill material shall have acceptable plasticity, liquid limit less than 50, and be free of organics and debris. Material shall be capable of obtaining the required compaction at the specified moisture content.

10.2.02 COMMON BACKFILL

- A. Excavated material developed in the work, containing no topsoil, organic material and debris, having a maximum dimension of 6 inches in its largest dimension.

SECTION 10 - PART 3 – EXECUTION

10.3.01 EXCAVATION AND FILL

- A. Excavate as follows:
 - 1. Excavate to elevation and slopes.
 - 2. Provide positive drainage on-site to prevent water accumulations. Scarify exposed cut slopes as necessary to control moisture.
 - 3. Take necessary action to prevent slopes and drainage ditches from erosion due to wind, temperature, and water during construction. Take action to prevent silting of drainage ditches during construction.
 - 4. Determine acceptability of excavated material for select fill and stockpile suitable material for future use.
 - 5. Remove unsuitable or excess excavated materials from the Work area in accordance with this Section.
 - 6. Blasting is not permitted.
 - 7. Proof-roll excavated area to locate areas of unsuitable materials. Proof-roll during dry weather and with the Owner present. Use a loaded, rubber-tire dump truck or similar vehicle, traversing the site in two perpendicular directions.
 - 8. Unsuitable material shall be removed at the direction of the Owner and replaced with select fill material.
 - 9. Upper 6 inches of exposed excavation surface shall be compacted to 98-percent of the standard Proctor maximum dry density (ASTM D698).
 - 10. Moisture control may require drying by disking or wetting with sprinklers.
 - 11. Areas exposed to weather or traffic for significant period of time will be retested prior to proceeding with construction. Contractor will be required to recompact as necessary.

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- B. Prepare ground surface to receive fill as follows:
 - 1. Level as required to remove ruts, bumps and uneven features.
 - 2. Widen depressions as required to accommodate compaction equipment.
 - 3. Cut level benches to accommodate compaction equipment in areas where the existing surface is steeper than 5 horizontal to 1 vertical.
 - 4. Scarify in place soil materials to a depth of 6 inches and compact to 98-percent of ASTM D698.
 - 5. Prior to placement of any fill, proof-roll all areas using a loaded, rubber tire dump truck or similar vehicle traversing the site in two perpendicular directions. Undercut as necessary any and all areas identified as soft or unstable and replace with compacted select fill.
 - 6. Additional removal to be by Owner's approval only.
- C. Select fill material and placement:
 - 1. Select fill material shall be either on-site excavated soil or imported fill material meeting the above-requirements.
 - 2. Place in horizontal layers not exceeding 8 inches in loose thickness.
 - 3. Compact to minimum 98-percent of the standard Proctor maximum dry density as determined per ASTM D698.
 - 4. Fill slopes to be as shown on the Contract Drawings. Flatten fill slopes and extend fill areas with excess excavated material.
 - 5. Field density tests shall be performed as specified by the Owner at a minimum of every 2,000 square feet of soil placed per 6-inch lift.
 - 6. Select fill shall either be dried or mixed with water to within ± 3 percent of optimum moisture.
 - 7. If fill material must be obtained from off-site sources, it shall be suitable select fill meeting the approval of the Owner. No additional compensation shall be given for material obtained off-site.
- D. Repair and bring to finish grade, compacted, final/subgrade elevation and slopes as shown on the Contract Drawings.
- E. If perched water is encountered, inform the Engineer and Owner immediately. Construct trenches or French drain system as directed in the field by the Owner.
- F. Install stone to substation and road area where indicated on Contract Drawings.

END OF SECTION 10

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SECTION 11 EXCAVATING, TRENCHING, AND BACKFILLING

SECTION 11 - PART 1 - GENERAL

11.1.01 SECTION INCLUDES

- A. Granular Backfill Materials
- B. Common Backfill
- C. Trench Excavation
- D. Protection of Banks and Existing Foundations
- E. Backfilling and Compacting

11.1.02 RELATED WORK

- A. Section 5 - Testing Laboratory Services
- B. Section 26 - Substation Grounding

11.1.03 QUALITY ASSURANCE

- A. Provide copies of all material gradations and test reports of granular backfill material (before finalization of any agreements with supplier), and any compaction work for review and acceptance by the Owner.
- B. Coordinate excavating, trenching and backfill operations with the Owner and Engineer. Inform both parties when unanticipated conditions are encountered; do not proceed with Work until resolution is provided in writing.

11.1.04 REFERENCES

- A. Standards of the American Society for Testing and Materials, in particular, ASTM D698, latest revision.

11.1.05 SUBMITTALS

- A. Gradations of granular borrow backfill for review by the Owner.
- B. Source of borrow materials.
- C. Test reports on compaction.

SECTION 11 - PART 2 - PRODUCTS

11.2.01 GRANULAR BACKFILL MATERIALS

- A. Material of predominately natural sand or natural sand containing minor amounts of fine gravel, crushed gravel, or crushed stone. Materials shall contain no topsoil, silty or potentially swelling clay, organic material, trash, lumber and sticks.

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- B. Material shall be devoid of all sharp or angular stone material, and any other rock, stone or foreign material that might be the cause of damage to buried pipe, cable or similar.
- C. Use only where specifically indicated as necessary for bedding of pipe, cable, trenchway, or other buried device, as bedding material.

11.2.02 COMMON BACKFILL

- A. Excavated material developed in the work, containing no topsoil, organic material, trash, lumber or sticks, stones, broken concrete or brick of such size as to damage the Work to be installed.
- B. Stones, broken concrete or brick larger than 3 inches shall not be allowed.

SECTION 11 - PART 3 - EXECUTION

11.3.01 TRENCH EXCAVATION

- A. Remove materials required to install electrical grounding, pipe, and cable.
- B. Work may be accomplished by mechanical means, or by hand, except that excavation work close to structures where damage to foundations or existing structures is possible shall be accomplished by hand.
- C. Remove soft, muddy and undesirable materials from the bottom of all excavations.
- D. Protect cut slopes from erosion due to wind, temperature and water.
- E. Stockpile suitable material for backfilling a sufficient distance away from edges of excavations to prevent overloading, slides and cave-ins.
- F. Transport, separate and stockpile unsuitable or excess excavated materials from the Work area as directed.
- G. Provide additional localized excavation and backfill where determined appropriate and as directed by the Engineer to correct areas of poor compaction of material.
- H. If perched water is encountered, inform Owner immediately. Construct trenches or French drain system as directed in field by Owner.
- I. Backfill over excavated areas under foundations with 2000 psi concrete or granular backfill in accordance with this Section.
- J. Compact excavation bottom to 98-percent of ASTM D698.

11.3.02 PROTECTION OF BANKS AND EXISTING FOUNDATIONS

- A. Maintain excavation banks as follows:
 - 1. Prevent movement of soil, slides and cave-ins in areas supporting existing foundations and slabs.
 - 2. Sheath and brace banks as required to protect adjacent structures and personnel.

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11.3.03 BACKFILLING AND COMPACTING

- A. Place either acceptable material available on site or borrow backfill materials as required, to the lines and grades shown on the Contract Drawings.
- B. Place in horizontal layers not to exceed eight inches in thickness, except that granular backfill shall be placed in lifts not to exceed 6 inches.
- C. Compact common backfill with hand guided compaction equipment which applies an impact load of 2.5 tons or more within two feet of existing foundations. Compact granular backfill with hand guided compaction equipment over entire installation length.
- D. Do not allow compaction equipment to come in contact with pipes, conduit, cables, cable trenches, ductbanks or concrete.
- E. Compact to 95-percent maximum dry density at optimum moisture content ± 2 -percent as determined by ASTM D698.
- F. Field density tests shall be performed as specified by Owner by Testing Laboratory in accordance with Section 5 at a minimum of every 2,000 square feet of soil packed per 6 inch lift.
- G. Protect bottom of excavation, backfill material and soil adjacent to and beneath trenches from frost or dispose of excess material as directed by the Owner.

END OF SECTION 11

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SECTION 12 EROSION AND SEDIMENTATION CONTROLS

SECTION 12 - PART 1 - GENERAL

12.1.01 SECTION INCLUDES

- A. Filter Fabric Fence

SECTION 12 - PART 2 - PRODUCTS

12.2.01 FILTER FABRIC FENCE

- A. Filter Fabric:

1. Provide filter fabric composed of strong rot-proof woven or nonwoven polymeric fibers oriented into a stable network such that the fibers retain their relative positions with respect to each other.
2. Provide filter fabric free of any chemical treatment or coating which may significantly reduce permeability and flaws and defects which could significantly alter its physical properties.
3. Provide filter fabric with ultraviolet ray inhibitors and stabilizers.
4. Silt film woven fabric will not be allowed.
5. Provide standard strength filter fabric that meets the following physical property requirements (values indicated are minimum average roll values):

Property	Value	Test Method
Grab Tensile Strength	110 lbs. min.	ASTM D1682
Puncture Strength	40 lbs. min.	ASTM D751 Modified
Apparent Opening Size (AOS)	30 - 100	ASTM D4751 Based on U.S. Std. Sieves

6. If wire mesh fabric is not used, provide extra strength filter fabric that meets the following physical property requirements (values indicated are minimum average roll values):

Property	Value	Test Method
Grab Tensile Strength	150 lbs. min.	ASTM D1682
Puncture Strength	40 lbs. min.	ASTM D751 Modified
Apparent Opening Size (AOS)	30 - 100	ASTM D4751 Based on U.S. Std. Sieves

- B. Posts: 2-inch x 4-inch wood posts, standard or better; or steel fence posts.
- C. Wire Mesh Fabric: 2-inch x 2-inch x 14 gauge.
- D. Gravel Backfill:

Sieve Size	Percent Passing
3/4" square	100%
3/8" square	40%
U.S. No. 4	4%
U.S. No. 200	2%

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SECTION 12 - PART 3 - EXECUTION

12.3.01 FILTER FABRIC FENCE

- A. Install filter fabric fences down-slope from all disturbed areas not already having erosion prevention and/or sediment control measures in place.
- B. Purchase filter fabric fences in continuous roll cut to the length of the barrier to avoid use of joints. When joints are necessary, splice filter fabric together only at a support post, with a minimum 6-inch overlap, and both ends securely fastened to the post.
- C. Install filter fabric fence to follow ground contours, where feasible. Space fence posts a maximum of 6 feet apart and drive securely into the ground a minimum of 30-inches.
- D. Excavate a trench, approximately 8-inches wide and 12-inches deep, upslope and adjacent to the fence post to allow the filter fabric to be buried.
- E. When standard strength filter fabric is used, provide a wire mesh support fence fastened securely to the upslope side of the posts using heavy duty wire staples at least 1 inch long, tie wires or hog rings. Extend wire into the trench a minimum of 4-inches and not more than 36-inches above the original ground surface. Do not staple filter fabric to existing trees.
- F. When extra-strength filter fabric and 4 feet maximum fence posts spacing are used, the wire mesh support fence may be eliminated. Staple or wire extra-strength filter fabric directly to the posts with all other provisions of paragraph E above applying.
- G. Backfill the trench as indicated in Paragraph 12.2.01.D above.
- H. Upon completion of project, or when directed by the Engineer, remove and dispose of filter fabric fences.
- I. Inspect the silt fence weekly. In addition, inspect immediately after each rainfall and at least daily during prolonged rainfall. Make any required repairs immediately.
- J. Remove accumulated sediments and keep the silt fences in good condition.

END OF SECTION 12

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SECTION 13 DRILLED CONCRETE PIERS AND SHAFTS

SECTION 13 - PART 1 GENERAL

13.1.01 SECTION INCLUDES

- A. Shaft Liners
- B. Installation Procedures

13.1.02 RELATED WORK

- A. Section 5 - Testing Laboratory Services.
- B. Section 6 – Cast-In-Place Concrete.

13.1.03 REFERENCES

- A. Standard Specification for the Construction of End Bearing Drilled Piers ACI 336.1-79.
- B. ACI 318.83, Building Code Requirements for Reinforced Concrete.
- C. Drilled Shafts: Construction procedures and design methods. ADSC: The International Association of Foundation Drilling.

13.1.04 QUALITY ASSURANCE

- A. Perform work in accordance with Drilled Shafts.
- B. Refer to Section 6 for specifications relating to concrete and concrete placement.
- C. During construction, the Contractor will maintain a field record (to be given upon completion of construction to the Engineer) of any caving of materials, trickling of water, water table, or any unusual condition giving location and action taken.

13.1.05 TESTS

- A. Refer to Section 5.
- B. Refer to Section 6 for specifications relating to concrete and concrete testing.

SECTION 13 - PART 2 - PRODUCTS

13.2.01 SHAFT LINERS

- A. Shaft liners, if required, shall consist of straight steel pipe conforming to ASTM A252, grade 2, of diameters and weight per linear foot to properly retain walls for the required operation. Splicing or butting of shaft liners shall be avoided by using maximum lengths for individual steel liner pieces.
- B. Drilling - mud or slurry, if wet-hole construction is used, will be pre-mixed prior to placing in the hole. Density of the slurry shall be 65-85 pcf as determined by a representative sample at the time concrete is placed.

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SECTION 13 - PART 3 - EXECUTION

13.3.01 INSTALLATION PROCEDURES

- A. Perform all work as specified in Contract Documents.
- B. Ensure pier shafts are drilled vertically with allowed deviation from true vertical alignment of no more than two percent of pier length, and not more than one inch off center from true location.
- C. Ensure elevation of top of pier and of top of anchor bolts, and that orientation of anchor bolts are as specified.
- D. Provide a suitable method of holding reinforcing steel specified in position. Reinforcement shall be placed as per Contract Drawing. Splices of reinforcing steel shall be avoided. If unavoidable, lap splices shall be as per ACI 318 Sections 12:14, 12:15. Welded splices shall be avoided. Handling and placement of reinforcing bar cage will be accomplished in such manner to maintain circular shape and to prevent permanent buckling.
- E. Piers shall be poured to grade and troweled to shed water. Top of piers shall be bevel edged to prevent chipping. Grout shall not be used under baseplates, but shims up to 0.25 inch will be permitted.
- F. Report immediately to Owner any unusual or unexpected conditions encountered during any of the construction procedures.
- G. Place concrete in accordance with Section 6.
- H. Remove shaft liners if used. Unexpected conditions dictating that liners be left in place must be reported to the Engineer. Leaving liners in place must be previously approved by the Engineer. Removal shall begin less than 60 minutes after pouring has started, and shall continue as appropriate thereafter, as the pour continues.
- I. Immediately after drilling and placing shaft liners (if required):
 - 1. Clean pier bases of loose material, position reinforcing steel, anchor bolts or anchor bolt cage as specified in Contract Drawings, and place concrete to include formwork and concrete placement above ground level. These operations shall be performed on the same day for each pier. Shafts will not be left open overnight.
 - 2. Pour concrete monolithically and in such manner that it does not strike the reinforcement nor the anchor bolts (or anchor bolt cage), and in such a manner as to not disturb the position of the reinforcement of the anchor bolts (or anchor bolt cage). Concrete may be placed in lower portion of shaft before anchor bolts (or cage) are positioned. In this case, however, anchor bolts (or cage) must be positioned before concrete pier reaches an elevation no less than 12-inches below the bottom of anchor bolts (or cage).
- J. Shaft Liners:
 - 1. Temporary steel shaft liners shall be used. Shaft liners shall be of sufficient strength and rigidity to withstand all installation stresses, and to prevent collapse due to soil or hydrostatic pressure.
 - 2. Shaft liners shall fit snugly in the shaft without voids between the liner and the laterally supporting soil.

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3. A shaft liner should be driven (pounded) such that it penetrates equally, rather than crooked.
4. After the shaft liner is in place, the shaft liner and hole shall be cleared of water, sediment, and debris prior to pouring concrete.

END OF SECTION 13

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SECTION 14 CRUSHED STONE SURFACING

SECTION 14 - PART 1 - GENERAL

14.1.01 SECTION INCLUDES

- A. Surfacing Materials
- B. Weed Control Chemicals
- C. Installation of Surfacing Materials

14.1.02 WORK INCLUDED

- A. Weed control for the Project Site.
- B. Site stone surfacing on the access roads and on the Project Site.
- C. Repair disturbed area on the Project Site.

14.1.03 RELATED WORK

- A. Section 5 - Testing Laboratory Services.

14.1.04 QUALITY ASSURANCE

- A. Provide copies of all material gradations and test reports of stone material (before finalization of any agreements with supplier), and any compaction work for review and acceptance by the Owner.
- B. Coordinate surfacing operations with the Owner and Engineer. Inform both parties when unanticipated conditions are encountered, do not proceed with Work until resolution is provided in writing.
- C. Retain services of individual experienced in land surveying to confirm lines, grades and final elevations of Work as installed. Supply results of survey with written confirmation to Owner upon request.

14.1.05 REFERENCES

- A. Codes and standards referred to in the text of Part 2 and Part 3 of this document.

14.1.06 SUBMITTALS

- A. Gradations of surface materials.
- B. Results of Compaction Tests performed on site.

SECTION 14 - PART 2 - PRODUCTS

14.2.01 SURFACING MATERIALS

- B. Material obtained off site at Contractor's expense from an approved source of materials and containing no topsoil, silt, or potentially swelling clay, organic material, trash, lumber and sticks.

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- C. Provide adequate material to not only install to required minimum depth, but also to meet lines and grades shown on drawings, PLUS minimum surfacing depth. Contractor shall provide adequate material to fill in low spots and ruts on site with surfacing material, such that site is of a uniform surface and slope over the entire area.
- D. Crushed stone surface for substation yard shall be No. 57 crushed stone per ASTM D 448.

SECTION 14 - PART 3 - EXECUTION

14.3.01 INSTALLATION OF SURFACING MATERIALS

- A. Do not install stone surfacing until site has been proof-rolled, and acceptable compaction has been achieved.
- B. Prior to the installation of stone surfacing, weed control chemicals shall be sprayed.
- C. Perform installation of stone surfacing for substation yard as last Contractual Activity, but before energizing substation.
- D. Place surfacing materials on site to the limits indicated on the drawings.
- E. Adjust moisture and compact in place to a minimum compaction level of 95-percent of ASTM D1557.
- F. Maintain accessibility and maneuverability to energized equipment by placing necessary stone and repair of grade.

END OF SECTION 14

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SECTION 15 CHAIN LINK FENCES AND GATES

SECTION 15 - PART 1 - GENERAL

15.1.01 WORK INCLUDED

- A. Furnishing and installation of security fencing and gates.

15.1.02 RELATED WORK

- C. Section 6 – Cast-In-Place Concrete.

15.1.03 REFERENCES

- A. Codes and standards referred to in the text of Part 2 and Part 3 of this section.
- B. Standards of the American Society for Testing and Materials, in particular, ASTM F567, latest revision.

15.1.04 SUBMITTALS

- A. Manufacturer's information on fencing and gates to be provided, including assurances of conformance to specification.

SECTION 15 - PART 2 - PRODUCTS

15.2.01 GENERAL MATERIAL REQUIREMENTS

- A. Fence Fabric (Stock Island Generation Facility Substation): 2-inches chain link of 9 gauge wire. Fabric shall be 8-foot high.
- B. Fence Fabric (Big Pine Substation): 1-inch chain link of 9 gauge wire. Fabric shall be minimum 8-foot high. Fence shall completely enclose the Big Pine Key (only at Big Pine Key) capacitor banks, including a section above the banks, for animal protection.
- C. Installation of barbed wire is prohibited in Monroe County code.

15.2.02 POSTS, RAILS AND ACCESSORIES

- A. All materials, fabric, gates and hardware to be schedule 40 aluminum.
- B. End, corner and pull posts: 4 inch outside diameter pipe.
- C. Line posts: 2 $\frac{3}{8}$ -inches outside diameter pipe.
- D. Gate details including hardware and accessories: As indicated in the included standard details.
- E. Top Rail: 1.625-inches outside diameter pipe with sleeve-type couplings with provisions for expansion and contraction.
- F. Post bracing assembly: pipe to match top rail and truss rods of $\frac{3}{8}$ -inches diameter with adjustable take-up.

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- G. Bottom tension wire: 7 gauge wire.

15.2.03 ADDITIONAL ACCESSORIES

- A. Post tops: weathertight closure caps that permit passage of top rail where required.
- B. Stretcher bars: one piece of a length equal to full height of fabric. Minimum cross-section to be ¼-inch × ¾-inch.
- C. Wire ties: minimum 9 gauge aluminum.

SECTION 15 - PART 3 - EXECUTION

15.3.01 INSTALLATION REQUIREMENTS

- A. Conform to requirements of ASTM F567.

15.3.02 INSTALLATION OF FENCE FABRIC

- A. Pull taut and connect to posts, rails and tension wires. Bottom of fabric shall be 2-inches below top of final stone surface.
- B. Connect to line posts with wire ties spaced at 15-inches maximum.
- C. Connect to top rail, braces and tension wire with wire ties spaced at 18-inches maximum.
- D. Connect to each gate and end post with one stretcher bar secured with bands spaced at 12-inches maximum.
- E. Connect at each corner and pull post with 2 stretcher bar secured with bands spaced at 12-inches maximum. Diameter of post holes to be a minimum of 7-inches larger than post diameter.

15.3.03 INSTALLATION OF TOP RAIL AND POSTS

- A. Pass top rail through intermediate post tops and form a continuous brace within each stretch of fence.
- B. Fasten securely to terminal posts.
- C. Brace end, corner, pull and gate posts with bracing assembly so posts are plumb.
- D. Evenly space line posts. (10-foot maximum)
- E. Align and set posts plumb and centered in concrete bases.
- F. Install bracing assemblies spaced 400-foot maximum in straight sections of fence.

15.3.04 GATES

- A. Install gates plumb, level and secure for full opening without interference.
- B. Install gatepost width in accordance with standard details provided herewith.
- C. Adjust gate hardware for smooth operation.

END OF SECTION 15

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SECTION 16 ELECTRICAL UNDERGROUND DUCT BANK

SECTION 16 - PART 1 – GENERAL

16.1.01 SUMMARY

- A. Section Includes - Requirements for installation of duct bank for high voltage cable, medium voltage cable, and fiber optic communications.
- B. Related Requirements
 - Section 4 – Submittal Procedures.
 - Section 6 – Cast-In-Place Concrete.
 - Section 10 – Earthwork.
 - Section 11 – Excavating, Trenching and Backfilling.

16.1.02 REFERENCES

- A. Reference Standards
 - 1. ASTM (American Society for Testing and Materials).
 - 2. NFPA 70 (National Fire Protection Association) – National Electric Code.
 - 3. NEMA TC2 and TC3 (National Electrical Manufacturers Association).

16.1.03 SUBMITTALS

- A. Record Documents
 - 1. Show dimensioned locations of underground duct bank from nearest permanent structure or survey control points.
 - 2. Show as built ductbank elevations and cover.

16.1.04 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products that are listed and labeled as defined in NFPA 70, article 100, and marked for intended use for the location and environment in which they are installed.
- B. ANSI C2 "National Electric Safety Code" for components and installation.

16.1.05 FIELD CONDITIONS

- A. If the field conditions warrant change in the routing or configuration of duct banks and/or location, shape and size of manholes, obtain the OWNER'S approval for such field changes. Such changes shall be done at no additional cost to the OWNER and the Contract Price is deemed to be inclusive of such changes.

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SECTION 16 - PART 2 – PRODUCTS

16.2.01 DUCT BANK

- A. The duct system shall consist of 2-6" PVC conduits encased in concrete.
- B. Duct Bank to be per KEYS drawing M-729.

16.2.02 CONDUIT

- A. All duct shall be tightly jointed and sealed with a PVC rating sealer to be approved by the OWNER.
- B. Conduit shall be straight and true and shall be furnished in lengths of 20 feet. A cross section taken at any point perpendicular to duct shall not vary more than 1/8 inch from a true circle.
- C. Conduits shall be complete with all couplings, adaptors, bends and supports as required. All couplings and fittings shall be the products of conduit manufacturer and shall be secured to the conduit with an adhesive in strict accordance with the manufacturer's recommendations. End bells are required to provide smooth and rounded surfaces at the edge of the duct to prevent injury to the cable during normal movement.
- D. Changes in directions in duct runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet. At the end of the conduit run, manufactured elbows having a minimum radius of 60 inches may be used. Standard radius bends, elbows or other fittings shall not be used.

16.2.03 CONCRETE

- A. Class 3000 concrete per Section 6.
- B. Permanent red dye shall be sprinkled on top of duct bank freshly poured to indicate "power."

16.2.03 SPACING BLOCKS

- B. Spacing blocks shall be made of PVC or other suitable non-metallic, non-decaying material, with spacing as indicated on Drawings.

16.2.04 FITTINGS

- A. PVC conduit and tube fittings: NEMA TC2 and TC3.

16.2.05 BALL MARKER

- A. Ball markers shall be 3M type Power 1402-XR, 4" Extended Range Ball Marker 5 with 5' range.

SECTION 16 - PART 3 – EXECUTION

16.3.01 DUCT BANK

- A. A minimum of 4" of concrete shall be installed below, above and on both sides of bank.
- B. Duct shall be tied in place by means of tie wire or spacers around the outside of duct and fastened to the bottom spacer to prevent movement during placement of concrete. Duct bank shall also be anchored to ground to prevent floating of conduits. In no case shall complete wire loop be installed around duct bank.

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16.3.02 CONDUIT

- A. The conduits shall be a minimum of 30" deep, unless otherwise indicated.
- B. The joints shall be staggered 6 – 8" with spacers approximately 5' apart.
- C. Conduit shall be installed in not less than 20 foot lengths, except at the ends of runs or at bends. Conduit shall be free of cracks and chipped ends. Have available at the job site a sufficient quantity of conduit so that cracked pieces or those with chipped ends may be discarded.
- D. All field cuts of PVC conduit shall be made with a hack saw. Cuts shall be smooth and square to conduit axis. The cut end of conduit shall be reamed smooth. Field-cut conduits shall be joined with double-ended couplings designed for the purpose.
- E. Repairs to conduits shall not be permitted. All individual lengths of broken, cracked, chipped or impaired conduit shall be removed and replaced with new conduit.
- F. When changes in the formation of a bank of conduits within a duct run are necessary, the transition shall be accomplished in as straight an alignment as possible, maintaining continuous earth support under the conduits.
- G. After the conduits and reinforcements are in place with proper spacing and joints made tight, the entire assembly is raised from the bottom of the trench on concrete or plastic blocks placed at intervals, so that concrete bed of specified depth is formed below the conduit assembly. The entire conduit envelope assembly shall be firmly anchored in position to prevent "floating" when concrete is placed.
- H. After the installation is complete, a flexible duct rodding device shall be passed through each completed conduit to check for continuity and cleanliness.
- I. Following the duct rodding device, a mandrel not less than 1/4 inch smaller than the inside diameter of the conduit preceded by a wire brush tied to the same string shall be pulled through the conduit once in each direction. If difficulty is encountered in passage of the duct rodding device or mandrel, a series of wire brushes shall be drawn through the conduit, once in each direction, using a trailing line. The wire brushes shall be 1/8 inch less in diameter than the diameter of the conduit, and if the correct size cannot be passed through on the initial attempt, the operation must be repeated until accomplished as specified. When the conduit is partially or fully obstructed with mud, dirt, or gravel, the duct shall be flushed clean by use of water from a long flushing nozzle attached to a water hose which shall be pushed into the conduit and applied until the conduit is clear. After cleaning, the procedure outlined above for rodding and wire brushing shall be followed. Any damaged conduit shall be replaced with a new conduit.
- J. After all obstructions have been removed and the conduits wire-brushed clean, a nylon cord of suitable strength shall be threaded in each conduit of duct bank and tied to the nearest pulling eye with a six foot length left at each end. Immediately upon completion of threading the conduit with a nylon cord, both ends of the conduit shall be plugged to prevent entry of foreign matter before the cables are pulled.

END OF SECTION 16

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SECTION 17 OUTDOOR CAPACITOR BANK AND ASSOCIATED EQUIPMENT

SECTION 17 - PART 1 – GENERAL

17.1.01 SUMMARY OF WORK

- A. Design, manufacture, deliver, & install open rack type outdoor substation capacitor banks and associated equipment.

17.1.02 STANDARDS

- A. All equipment covered under this Specification shall conform to the applicable sections of the latest revisions of the following standards:
 - 1. National Electrical Manufacturers Association (NEMA), CP-1, Shunt Capacitors.
 - 2. American National Standards Institute, Inc. (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE), Standard ANSI/IEEE Std. 18, Shunt Power Capacitors.

SECTION 17 - PART 2 – PRODUCTS

17.2.01 TECHNICAL REQUIREMENTS

- A. Capacitor Bank
 - 1. Total Bank 3-phase Reactance:
 - a. Big Pine Substation – 22.8 MVAR (12 MVAR of new capacitor banks and two existing 5.4 MVAR capacitor banks).
 - b. Stock Island Substation – 28 MVAR (all new capacitor banks).
 - 2. Voltage Rating: 13.8 kV phase to phase (7.96 kV phase to ground).
 - 3. Nominal System Voltage: 13.8 kV phase to phase (7.96 kV phase to ground).
 - 4. Frequency: 60 Hz.
 - 5. Basic Impulse Level (BIL): 110 kV.
- B. Mountings
 - 1. Capacitors shall be assembled and mounted edgewise in aluminum or stainless steel stacking racks, complete with all bus work, individual can fusing, ejector springs, extra high leakage station post insulators and aluminum or steel elevating structure ready for mounting on foundation.
 - 2. The support structure shall be designed and constructed to withstand external force loadings, including extreme wind, as defined in the National Electrical Safety Code (NESC), latest Edition.
- C. Connection: Three-phase grounded Wye, with neutral PT for indication to protection equipment.

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17.2.02 CAPACITOR UNITS – RATINGS

- A. Ratings and other specific requirements shall be in accordance with ANSI/IEEE 18 unless otherwise stated herein.
 - 1. The rated voltage of each capacitor shall be 13.8 kV phase to phase (7.96 kV phase to ground).
 - 2. The rated BIL shall be 110 kV.
 - 3. 200-kVAR cans shall be used to construct the total bank size, for interchangeability with KEYS' existing banks.
- B. The equipment shall be new and of standard, commercial, first-grade quality with respect to materials, workmanship, and design; in accordance with the best engineering practice; and proven suitable for the intended purpose. Departures from previous designs will be permitted in minor details, provided such departures are definite improvements over earlier products.
- C. The capacitor shall be hermetically sealed and filled with a biodegradable dielectric impregnating liquid. The solid portion of the capacitor dielectric system shall be all film. The case shall be coated with a durable paint. The bottom surface of mounting brackets shall be unpainted to ensure a good electrical contact between case and rack or hanger. All joints and openings shall be welded or solder sealed; no gasket joints are permitted.
- D. The capacitor shall have a discharge device that will reduce the residual voltage across the capacitor terminals to 50 volts or less from rated voltage in 5 minutes or less.
- E. The capacitor shall be suitable for mounting in standard NEMA capacitor hangers or racks. The mounting dimensions shall be in accordance with ANSI/IEEE 18.
- F. The capacitor shall be thermally stable. The internal hottest-spot temperature of the capacitor unit shall not exceed 70 degrees Celsius during the standard thermal stability test.
- G. The capacitors shall be single-phase with one extra high leakage porcelain bushing per can.
- H. The discharge inception voltage shall be greater than rated voltage by a factor of 1.5 at -40 degrees Celsius, 1.6 at 0 degrees Celsius, and 1.9 at +40 degrees Celsius.
- I. The voltage stress on the dielectric film shall not exceed 1,700 volts per mil when the capacitor is energized at rated voltage. The dielectric film voltage stress shall be calculated using the dry thickness of the dielectric film. Rated voltage of each pack shall not exceed 2,000 volts.
- J. The color for the capacitor case and the bushings shall be ANSI No. 70 gray (light gray) in accordance with ANSI/IEEE 18 and ANSI Z55.1.
- K. Clamp connectors shall be provided for the capacitor terminals in accordance with ANSI/IEEE 18.
- L. The trade name of the dielectric impregnating liquid shall be stated on the nameplate.
- M. In all other respects, the capacitors shall meet ANSI/IEEE 18, where applicable. Where capacitors are not covered in ANSI/IEEE 18, they shall meet NEMA CP-1, where applicable.

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17.2.03 SPARE PARTS AND SPECIAL TOOLS

- A. The CONTRACTOR shall submit with its proposal a list of all recommended spare parts, special tools, and related items sufficient for the number of capacitor banks specified.

END OF SECTION 17

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SECTION 18 DYNAMIC VAR COMPENSATION EQUIPMENT

SECTION 18 - PART 1 - GENERAL

18.1.01 SUMMARY

- A. Section includes furnishing, testing, delivery, and field assembly of Dynamic Var Compensation (DVC) equipment suitable for outdoor installation within a substation in a coastal environment.
 - 1. Physical Requirements.
 - 2. Performance Characteristics.
 - 3. Power Electronic Converter Modules.
 - 4. Operator Interface.

18.1.02 REFERENCES

- A. American National Standards Institute (ANSI).
 - 1. C37.21, IEEE Standard for Control Switchboards.
 - 2. C37.90, IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
 - 3. C57.12.29, American National Standard for Switchgear and Transformers—Pad-Mounted Equipment—Enclosure Integrity for Coastal Environments.
 - 4. C62.41, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - 5. C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- B. Insulated Cable Engineers' Association (ICEA).
 - 1. ICEA, Specifications for Wire and Cable.
- C. Institute of Electrical and Electronics Engineers (IEEE).
 - 1. IEEE, Requirements for Short Circuit Withstand.
- D. National Electrical Code (NEC).
 - 1. Current Rating of Control Wiring.
- E. International Electrotechnical Commission (IEC).
 - 1. Std. 62040-1-2, General and Safety Requirements for UPS used in restricted access locations.

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2. EN 61000-4-2 through 4-6, 4-8 and 4-11: EMC Directive tests and Immunity.
3. EN 55011: Radiated and Conducted Emissions.

18.1.03 SYSTEM DESCRIPTION

A. General

1. Design, manufacture, and test in accordance with this Section and applicable sections of standards listed in Article 1.02. in effect at the Issue Date of this Section.
2. Space and size of equipment—Contract Documents and Drawings indicate substation areas available for use. DVC and associated equipment should be designed accordingly.
3. Materials – Outdoor DVC Equipment and associated step-up transformers and switches shall be contained in stainless steel housings due to the corrosive environment at the proposed substations.
4. Physical housing of controls – The existing control building at Big Pine Substation has space to house a wall-mounted control rack or cabinet, to the extent one is required for control of the DVC Equipment. Contractor should verify the amount of wall space is sufficient during the site-visit. It is anticipated that the new switchgear building at Stock Island would be used in a similar fashion, if such a rack or cabinet is needed.

B. Performance Characteristics of DVC Equipment shall be the following for the electrical system characteristics included table 1.03-B.1 below:

1. Continuous Characteristics of DVC Equipment:

- a. Primary terminal voltage – DVC shall be capable of continuous operation from 0.2 pu to 1.1 pu at the point of common coupling (primary side of any step-down transformer if such is utilized).
- b. The DVC shall be capable of continuous operation for frequencies in the range specified in Table 1.03-B.1.
- c. The DVC shall be capable of continuously controlling voltage at the point of common coupling (primary side of any step-down transformer if such is utilized) in the range of 0.98 to 1.05 pu.
- d. Voltage droop (slope of voltage error over Var output) shall be continuously controllable from 1% to 10% and shall have independent settings for boost and buck (lagging and leading) operation in increments of 0.5% or less.
- e. DVC voltage control shall have an optional adjustable dead band about the desired reference voltage.

2. Short-Time Characteristics of DVC Equipment:

- a. That portion of the DVC equipment for which a dynamic range is specified shall have a short time output rating of 2.67 times its continuous output current for 2 seconds.

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- b. DVC equipment shall be designed to withstand overvoltage of the magnitude and duration specified in Table 1.03-B.1 and 1.03-B.2 items 4 and 5.
 - c. DVC equipment shall be capable of operating under temporary frequency deviations specified in Table 1.03-B.1 and 1.03-B.2 items 12 -18.
 - d. That portion of DVC equipment for which a dynamic range is specified shall have dynamic short-term system and self protection from extreme overvoltages by supplying inductive vars in case of voltages above 1.30 pu.
- 3. DVC Control
 - a. The DVC shall be applied with a control system integrating the operation of the dynamic and static components (as applicable) for coordinated voltage control. The control system shall be programmable and have sufficient scope and flexibility to permit re-programming according to future changes in the power system, and shall be completely contained on a modern computing platform.
 - b. The DVC shall be capable of operating in Voltage Control mode as identified in section 103.B.1 above as well as Power Factor Control mode and fixed MVAR Control mode. Control modes shall be selectable by the customer and switchable remotely via SCADA.
 - c. The DVC shall be capable of controlling and soft-switching co-located external devices/shunts including and in addition to those utilized to achieve the total required system reactive operating range specified for each installation.
 - d. Control – Under/Overvoltage Conditions – For voltages below 0.2 pu in all three phases, control dynamic output to zero. For voltages above 1.30 pu, inject inductive vars.
 - e. DVC Control shall be capable of providing disturbance recording and event recording, at a resolution of 1ms or better, stored on recoverable media for retrieval remotely and at a later point in time. At minimum these functions should capture:
 - i. Voltages and Currents of the DVC at the point of common coupling.
 - ii. Internal control variables of the DVC.
 - iii. Indication of equipment status through the immediate path of connection from the DVC to the 138-kV system.
 - iv. Alarms of the DVC and any associated equipment.
 - v. Command signals to any remote operating equipment.
 - vi. Capture of setting changes made to the system.
- 4. Stock Island Substation DVC
 - a. Nominal Dynamic Range (min): 12 MVar Capacitive to 12 MVar Inductive as measured at the point of common coupling (primary side of any transformer if such is utilized).

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- b. Total Nominal Reactive Support (min) at nominal rated voltage as measured at the point of common coupling of the equipment, including any combination of dynamic power converter equipment with overload capability, thyristor switched capacitors and/or reactors or mechanically switched capacitors and/or reactors: 40 MVAR Capacitive, 12 MVAR Inductive.
 - c. DVC device set to regulate the 69-kV bus voltage. The device will be co-located with several generators (connected to the 69-kV bus), and as such, settings for voltage regulation should allow for appropriate reactive sharing (droop).
- 5. Big Pine Substation DVC
 - a. Nominal Dynamic Range (min): 12 MVar Capacitive to 12 MVar Inductive as measured at the point of common coupling (primary side of any transformer if such is utilized).
 - b. Total Nominal Reactive Support (min) at nominal rated voltage as measured at the point of common coupling of the equipment, including any combination of dynamic power converter equipment with overload capability, thyristor switched capacitors and/or reactors or mechanically switched capacitors and/or reactors: 24 MVAR Capacitive, 12 MVAR Inductive.
 - c. BPS Substation DVC will be connected on buses that share distribution feeders to KEYS customers. Although the DVC goal is to provide support to the 138-kV transmission system, care must be taken to minimize impact to KEYS customers.

Table 1.03-B.1 – Big Pine Key Substation

1	Nominal ac system voltage, line-to-line	138	kV
2	Maximum continuous ac system voltage, line-to-line	145	kV
3	Minimum continuous ac system voltage, line-to-line	131	kV
4	Maximum short-term ac system voltage, line-to-line	151.8	kV
5	Maximum duration of item 4)	10	s
6	Minimum short-term ac system voltage, line-to-line	124	kV
7	Maximum duration of item 6)	10	s
8	Typical negative sequence voltage component	3	%
9	Continuous zero-sequence voltage component	1	%
11	Nominal ac system frequency	60	Hz
11	Maximum continuous ac system frequency	60.5	Hz
12	Minimum continuous ac system frequency	59.5	Hz
13	Maximum short-term ac system frequency	61.8	Hz
14	Maximum duration of item 14)	10	s
15	Maximum rate of change of frequency (df/dt)	46.4	Hz/s
16	Minimum short-term ac system frequency	57.5	Hz
17	Maximum duration of item 17)	1	s
18	Basic insulation level (BIL)	650	kV peak
19	Switching impulse level (SIL)	NA	kV peak
20	Power frequency withstand voltage	230	kV
21	Maximum three-phase fault current -for performance requirements -for rating of DVC (CB rating)	5.0 14.1	kA kA
22	Existing three-phase fault current	3.3	kA

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23	Minimum three-phase fault current -for performance requirements -for safe operation of DVC	2.0 3.3	kA kA
24	Maximum single-phase fault current	3.7	kA
25	Existing single-phase fault current	2.5	kA
26	Minimum single-phase fault current	1.8	kA

Table 1.03-B.2 – Stock Island Generation Facility Substation

1	Nominal ac system voltage, line-to-line	69	kV
2	Maximum continuous ac system voltage, line-to-line	72.5	kV
3	Minimum continuous ac system voltage, line-to-line	65.6	kV
4	Maximum short-term ac system voltage, line-to-line	76	kV
5	Maximum duration of item 4)	10	s
6	Minimum short-term ac system voltage, line-to-line	62	kV
7	Maximum duration of item 6)	10	s
8	Typical continuous negative sequence voltage component	2	%
9	Continuous zero-sequence voltage component	1	%
10	Nominal ac system frequency	60	Hz
11	Maximum continuous ac system frequency	60.5	Hz
12	Minimum continuous ac system frequency	59.5	Hz
13	Maximum short-term ac system frequency	61.8	Hz
14	Maximum duration of item 14)	10	s
15	Maximum rate of change of frequency (df/dt)	38.4	Hz/s
16	Minimum short-term ac system frequency	57.5	Hz
17	Maximum duration of item 17)	1	s
18	Basic insulation level (BIL)	350	kV peak
19	Switching impulse level (SIL)	NA	kV peak
20	Power frequency withstand voltage	140	kV
21	Maximum three-phase fault current -for performance requirements -for rating of DVC (CB rating)	5.0 14.10	kA kA
22	Existing three-phase fault current	9.4	kA
23	Minimum three-phase fault current -for performance requirements -for safe operation of DVC	9.4	kA
24	Maximum single-phase fault current	17.4	kA
25	Existing single-phase fault current	11.6	kA
26	Minimum single-phase fault current	4.6	kA

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18.1.04 POWER ELECTRONIC CONVERTER MODULES

A. General

1. It is expected that the Dynamic Var Compensation devices offered in the received bids will include some portion of STATCOM devices. This section describes the Power Electronics requirements associated with these devices.

B. Characteristics

1. Power electronic converters shall be Insulated Gate Bipolar Transistor (IGBT) semiconductor based Pulse Width Modulated (PWM) devices, switched at a minimum frequency of 2 kHz.
2. Converters must have independent phase control as an option for transient events.
3. Converters shall be capable of true four-quadrant operation and shall be air cooled. Devices requiring air conditioning will be considered, but are not preferred. Vendors wishing to submit air conditioned equipment should provide sufficient detail on the air conditioning system to permit an evaluation of the potential for outages and/or reductions in capability.
4. Converters shall have robust IGBT firing and must provide alarms for gating malfunctions.
5. Converter design should permit easy access for visual inspection and maintenance.
6. Converter shall be designed with parallel blocks such that loss of one block shall not reduce the capability of the remaining blocks, and the converters shall be protected with fuses.
7. Converter shall be designed with appropriate reactors or other necessary equipment for filtering.
8. Parallel design as specified in item 6 should include parallel heat sinks, snubber circuits and gate drivers to facilitate the requirement that parallel block failure shall not inhibit continued operation of other blocks.
9. Converter shall be furnished with a continuous monitoring system to detect failed semiconductor switch blocks and provide an indication of each failure and its location. The converter shall be capable of operating at reduced output with the loss of a semiconductor switch block.

C. Minimum Information Required in Bid Package.

1. Provide Continuous and Short Time ratings of power converter modules/blocks.
2. Characterization of the switching principles and monitoring system.
3. Cooling requirements and characteristics, and suitability for operation in harsh coastal environments.
4. Weights and Physical Dimensions.
5. Characteristics of overvoltage, overcurrent and other applied protection schemes.
6. Losses
 - a. Calculation of Losses.

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The bidder shall provide a summarized loss evaluation of the total proposed DVC system. The summarized losses shall include losses on all DVC components up to the main 13.8 – kV bus connection at each location (Stock Island Plant and Big Pine) and shall at minimum include:

1. Any DVC system power converters (inverters, rectifiers etc).
2. Any DVC system transformers.
3. Capacitor banks.
4. Reactors (if used).
5. Control and protection equipment.

The total system losses shall be calculated, assuming an outside temperature of 20 deg. C and with the 13.8 kV bus voltage at 1.0 pu, at the following operating points;

1. Total system losses, P_1 (kW), at full 100% inductive output. This operating point will be considered at time t_1 , which will be assumed at 2% of the total system operating time.
2. Total system losses, P_2 (kW), at full 50% inductive output. This operating point will be considered at time t_2 , which will be assumed at 8% of the total system operating time.
3. Total system losses, P_3 (kW), at 0 MVar output. This operating point will be considered at time t_3 , which will be assumed at 80% of the total system operating time.
4. Total system losses, P_4 (kW), at 50% capacitive output. This operating point will be considered at time t_4 , which will be assumed at 8% of the total system operating time.
5. Total system losses, P_5 (kW), at full 100% capacitive output. This operating point will be considered at time t_5 , which will be assumed at 2% of the total system operating time.

As-built DVC losses should be based on factory measurements and calculations.

b. Evaluation of Losses.

The DVC system bid prices shall, as part of the bid evaluation process, be adjusted to take into account the present value of the total DVC system losses over a 20 year period using a discount rate of 5 % and a cost of 500 USD per year per kW of losses in order to determine comparable prices between proposed systems.

The total cost for losses used in the evaluation will be calculated by the OWNER using the following formulas:

1. Average DVC system losses, ΣP (kW) = $P_1 \times t_1 + P_2 \times t_2 + P_3 \times t_3 + P_4 \times t_4 + P_5 \times t_5$.
2. Present value of total DVC system losses, PV_p (USD);

$$PV_p = (\Sigma P \times 500) \times \frac{\left(1 - \left(\frac{1}{1.00 + DR\%}\right)^{20}\right)}{DR\%}$$

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Example:

Property	Value	Unit
$\sum P$	700	kW
Yearly interest	5	%/Year
Evaluation period	20	Years
Cost per Year per kW of Losses	500	USD/kW
PV_P	\$4,361,774	USD

7. Specific information on training for OWNER's staff included in the bid – amount of time allotted and number of representatives should be offered at minimum. See 18.2.01.B below.
8. Warranty details and information on options and costs.

18.1.05 SUBMITTALS

- A. Provide in accordance with Section 4.
- B. Product Data: Specifications and Instruction Manuals/Cut Sheets.
- C. Shop Drawings
 1. Power Electronic Converter enclosure:
 - a. Outline showing general arrangement, legend, anchor details, and overall arrangement.
 - b. Arrangement drawings of each section or compartment showing the physical location and arrangement of all devices, terminal blocks, and power and control cable entrance areas.
 - c. Installation diagrams showing anchoring method.
 2. Nameplate or Specification sheet listing technical characteristics.
 3. Three-line diagrams of each Power Electronic Converter showing main terminal connections and all instrument transformer sensing locations. Typical drawings will not be accepted.
- B. Quality Assurance/Control Submittals
 1. Design Data.
 2. Certified protective relay design test report for surge withstand capability.
 3. Test Reports: Certified ratio and phase angle test reports for each type of metering accuracy current and voltage transformer.

18.1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver equipment F.O.B. to the Project Site. Contractor shall be responsible for arranging, paying freight and shipping, and handling equipment between factory and site.

18.1.07 MAINTENANCE

- A. Extra Materials.

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1. Make interchangeable with and same material and workmanship as, corresponding original part.
2. Deliver with DVC assembly to Project Site.
3. Materials or parts:
The bidder shall provide a spare parts list with the proposal. Spare parts offered must be of the same quality as, and completely interchangeable with, the original parts.

SECTION 18 - PART 2 - PRODUCTS

18.2.01 MANUFACTURER'S FIELD SERVICES

- A. General – The specific items listed in this section are not intended to be all-encompassing. DVC manufacturer's representatives shall be on-site to perform all testing, verification, and related activities that would be required for DVC manufacturer's warranty. Manufacturer's representatives shall be on site for testing and commissioning activities along with CONTRACTOR. See Section 27 for additional information on Testing.
- B. Manufacturer shall provide technically knowledgeable representatives for on-site meetings with KEYS staff, to discuss and configure the DVC equipment for proper performance within KEYS' system. This shall be accomplished prior to commissioning and testing of the installed system. Manufacturer is responsible for allowing enough time for pre-commissioning meetings and training.
- C. Representatives of the manufacturer shall be on-site to perform the following services with respect to the fully assembled DVC system:
 1. Test of control and monitoring system and power converters.
 2. Check proper operation and indication of circuit breakers and switches back to the control system.
 3. Verify proper cooling system operation.
 4. Check proper instrument transformer operation and indication to DVC control system.
- D. Representatives of the manufacturer shall be on-site to perform the following services with respect to the fully operational DVC system:
 1. Measure and verify DVC operation at nominal power system operating conditions.
 2. Verify start, stop, and idle sequences, including device behavior upon loss of system voltage.
 3. Verify changes in control mode, reference voltage and droop/slope are properly processed and achievable via local and remote commands.
 4. Verify that DVC safety related functions, including lockout of any controlled external devices, are correctly handled and indicated.
- E. Staff Training
 1. DVC Manufacturer's staff shall provide training to OWNER's staff as necessary to allow for proper operation and maintenance of the DVC and all associated control equipment. This

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should include providing training to engineering and operations staff on all control system settings and characteristics, as well as use of any remote access and monitoring systems.

F. Warranty and Maintenance.

1. DVC Manufacturer to include at least a three (3) year extended maintenance package option in addition to the standard one year base maintenance. The three (3) year extended warranty is for DVC components only. Provide KEYS with options for a continuing maintenance service package, along with details and cost.
2. Manufacturer to provide details on equipment monitoring and necessary minor and major inspection and maintenance intervals.

END OF SECTION 18

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SECTION 19 MEDIUM VOLTAGE POWER CABLE AND ACCESSORIES

SECTION 19 - PART 1 – GENERAL

19.1.01 SUMMARY

- A. Section Includes
 - 1. Installation of 13.8-kV, copper cable for UG distribution circuits.
 - 2. Cable fittings and accessories.
- B. Related Requirements
 - 1. Section 4 – Submittal Procedures.
 - 2. Section 27 – Substation Calibration and Testing.

19.1.02 REFERENCES

- A. Reference Standards
 - 1. ANSI/IEEE C2, National Electrical Safety Code.
 - 2. ASTM B33, B189, B3, B8, B172, B173, B174, B230, B231, B496, Copper and Aluminum Conductor Specifications.
 - 3. AEIC CS8, Cross-linked Polyethylene (XLPE) Shielded Power Cables Rated 5 through 46-kV.
 - 4. IEEE-48, Test Procedures and Requirements for High Voltage Alternating Current Cable Terminations.
 - 5. IEEE-404, Standard for Power Cable Joints.
 - 6. NEMA WC74, 5–46-kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
 - 7. ICEA/IEEE 400, Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.
 - 8. UL 1072, Medium Voltage Power Cables.
 - 9. ICEA 5-66-524, Specification for Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electric Power.
 - 10. NETA Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, 2003.

19.1.03 SUBMITTALS

- A. Submit in accordance with Section 4 – Submittal Procedures.

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- B. Shop Drawings:
 - 1. Cable pulling calculations, including maximum pulling tension and minimum bending radius.
 - 2. Recommended pulling lubricants.
 - 3. Fireproofing materials.
 - 4. Cable terminations.
- C. Cable test results.
- D. Cable Splices Qualifications: Provide proof of certification, training, names of personnel, years of experience performed with Raychem accessories.

19.1.04 QUALITY ASSURANCE

- A. Installer: Specializing in installation of medium voltage cable and accessories with minimum of three years' experience.
- B. Field and Functional Testing: In accordance with provisions of Section 27 – Substation Calibration and Testing.

SECTION 19 - PART 2 - PRODUCTS

19.2.01 MEDIUM VOLTAGE POWER CABLE

- A. Cable shall have an insulation rating of 133%.
- B. Manufacturer: Okonite.
- C. Type: Okoguard-Okolon, MV-105, 15-kV Shielded Power Cable.
- D. Size and Material: Contractor to determine cable size. Conductor shall be copper, class B stranded.

19.2.02 POWER CABLE TERMINATIONS

- A. 13.8-kV Power Cable.
 - 1. Single conductor terminators capable of indoor/outdoor cable terminations as required.

19.2.03 CABLE PULLING LUBRICANT

- A. Lubricity: Coefficient of dynamic friction less than or equal to 0.15 on PVC-jacketed cable and PVC conduit with 200 lbs./ft. of normal pressure.
- B. Temperature range: 20°F–110°F.
- C. Compatible with PVC-jacketed cable.
- D. Non-toxic, non-flammable, water-based gel.
- E. Manufacturer: American Polywater, Stillwater, MN, Type Polywater® J. or Polywater® Plus Silicone™.

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F. Listing: UL.

19.2.04 Cable Identification Tags

- A. Type: Horizontal-reading, strapped to cables with Mylar, self-locking tabs at each end of holder.
- B. Tags: Polyethylene, with black 1-inch high characters on a yellow background, integrally molded with locking grid, injection molded.
- C. Holders: Black polyethylene.
- D. Marking as follows: Feeder or circuit number and phase, e.g. "201A."
- E. Furnish blank yellow characters to fully fill the holder, as required.
- F. Manufacturer: Tech Products, Inc., Staten Island, NY, Type PH 105.

SECTION 19 - PART 3 - EXECUTION

19.3.01 INSTALLATION

- A. Install cables in accordance with ANSI, and IEEE C2.
 - 1. Do not exceed cable pulling tensions and bending radius recommended by manufacturer.
 - 2. Pull cable using specified lubricants and cable pulling equipment. Locate reels conveniently for feeding cable into the conduit without causing excessive bending or possible injury to cable by abrasion and place on reel stands.
 - 3. Pull cable using pulling eyes in accordance with manufacturer's recommendations except as otherwise specified. Pull cables with gradual and uniform tension utilizing a dynamometer. Attach lines to cables with ball bearing swivels to prevent twisting of cable during pulling. Provide a cable protector at each end of the conduit to prevent damage to the cables.
 - 4. Pull all cables together where several cables are to occupy one conduit.
 - 5. Seal cable ends when pulling into conduit. Do not leave cable ends exposed to moisture unless splicing is to be done immediately.
 - 6. Station sufficient personnel along the cable route at all conduit entrances and exits to direct the passage of cable as required.
 - 7. Protect the cable from chafing on the ground, conduit edges or other sharp surfaces during pulling. Provide timbers and flexible cable pulling tubes to guide and protect the cable.
 - 8. Rack cables neatly in manholes or trenches. Bend and rack so that cables do not bind at the conduit entrance. Install cable racks so as to permit a neat arrangement of cables. Cables and cable supports shall not project beneath the manhole opening.
 - 9. Apply identification tags to cables at terminal points, conduit entrances and manholes. Refer to Drawings for the numbering sequence for the cables.
 - 10. Install cable anchors against creepage where conduit line grades exceed 8 percent after obtaining approval from **PROJECT ENGINEER**.

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11. Permanently support cable ends prior to terminating. Support vertical cable runs having a total vertical drop in excess of 15 feet at the top and as specified in NEC Article 300-19 with cable grips or other approved devices, with provision for cable expansion and contraction.
12. Install cables in manholes with freedom of horizontal movement to accommodate expansion and contraction. Cables passing through manholes shall have at least one bend to accommodate such changes in length.
13. Rack cables at both sides of manholes so that adequate room and slack is allowed for splicing.
14. Clamp or snub each cable and tie for proper support at each terminal connection and splice so that strain on the cable is not transmitted to the terminal connection or splice.

19.3.02 CABLE FIREPROOFING

- A. Fireproof all 13.8-kV cables at all conduit openings.
- B. Wrap fireproofing tape tightly around cable spirally in half-lapped wrapping with coated side towards cable.
- C. Over-wrap fireproofing tape with glass cloth electrical tape entire length in random wrap.
- D. Extend tapes one inch into ducts.

19.3.03 CABLE IDENTIFICATION

- A. Mark all cables with cable circuit and phase identification tags specified in PART 2 above.
- B. Securely fasten cable identification tags to cables at each end of tag holder with self-locking nylon ties, in visible locations at each termination and at intermediate pull boxes, manholes, trenches or other points of access.

19.3.04 CABLE TERMINATIONS

- A. Perform cable phase identification and phasing tests before initiation of terminating activities.
- B. Perform "megger" insulation resistance test on each cable to ground prior to terminating. Record temperature, humidity, duration of test and voltage for each test and submit to OWNER. Use 2500 volt motor-operated megger.
- C. Minimum acceptable megger reading is 10 megohms.
- D. Make further tests to isolate problem if specified test values are not met.
- E. Replace cable installation with new cable if required insulation resistance cannot be obtained.
- F. Complete termination in accordance with manufacturer's instructions.
- G. Ground all cable shields to grounding conductor.

19.3.05 TESTING CABLES

- A. New Cables.

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1. Test all sections of cables.
2. Conduct a high potential (HI POT) dc test at NETA specified values for 15 consecutive minutes. Record leakage current with time.

19.3.06 FIELD QUALITY CONTROL

- A. Coordinate installation and final testing with the OWNER. Notify the OWNER at least 48 hours in advance of testing. Provide OWNER the opportunity to witness any and all tests. Submit all test results to the OWNER within 36 hours of the test.
- B. Except where noted otherwise, the following tests may be performed by the Contractor or by an independent testing firm regularly employed in the testing of medium-voltage cables.
 1. DC high-potential (Hi-Pot) testing shall be performed by an independent testing firm.
- C. Tests shall be performed for all medium-voltage cable installed by this project.
- D. Tests shall be performed after making up splices and terminations, but before landing cable run at either source or load, and before electrical circuitry has been energized except as noted below:
 1. If desired, cables may be tested prior to making up splices and termination. However, such tests shall not replace the need to fully test the cable assembly after termination. Test voltages used prior to termination shall not exceed the cable manufacturer's recommended limits.
 2. Thermographic imaging of cable connections shall be performed after all other tests are complete and cable has been energized.
- E. Required calibrated test equipment includes an Ohmmeter, an Insulation Resistance Tester (Megger), Low-Resistance Meter, and thermographic imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C. Other needed equipment includes a tape measure, ambient thermometer, and ambient humidity indicator.
- F. Perform inspections and tests in accordance with NETA ATS 2003 7.3.3.
- G. Perform Visual and Mechanical Inspection per NETA ATS 7.3.3.1 and the following:
 1. Perform Visual and Mechanical Inspection at each end of cable and at any exposed transitional area.
 - a. Thermographic surveys of bolted connections are to be performed with cables energized. Where test conditions cannot be achieved, obtain Engineer approval for deviation.
- H. Perform Electrical Tests per NETA ATS 7.3.3.2 and the following.
 1. For all tests where voltage is applied, after the test set is removed, attach a shorting or drain device for the same duration that voltage was applied, in order to bleed off charge.
 2. Perform a Shield-Continuity Test, NETA ATS 7.3.3.2.3., on each power cable.
 - a. Jumper the conductor to the shield drain at the far end of the cable.
 - b. At the near end, measure the resistance of the shield drain to the conductor.

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- c. Deduct the conductor direct-current resistance per NEC Table 8, if desired.
 - d. Shielding shall exhibit continuity of less than ten ohms per 1000 feet of cable.
 - e. At the far end, remove the conductor to shield drain jumper.
- 3. Perform an Insulation-Resistance Test on each power cable per NETA ATS 7.3.3.2.2.
 - a. Use a megohmmeter with a voltage output of at least 2500 volts, but not higher than the -kV rating of the cable.
 - b. Insulation shall demonstrate resistance of greater than 15M Ω for 15-kV cables.
- 4. Correct deficiencies and retest to demonstrate compliance.

END OF SECTION 19

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SECTION 20 SUBSTATION STEEL STRUCTURES

SECTION 20 - PART 1 - GENERAL

20.1.01 SECTION INCLUDES

- A. Steel substation structures, miscellaneous steel components, anchor bolts, nuts, and washers.

20.1.02 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Design structural steel to support equipment and bus insulators supplied in accordance with Equipment Arrangement Drawings.
- B. Deflection Limitations:
 - 1. NEMA SG-6, Part 36, except that differential deflections between structures (as projected to the bus level) to be compatible with bus fittings furnished under Section 22.
- C. Design structural steel to withstand short circuit forces as calculated by Formula IV-1 in RUS Bulletin 65-1 with a short circuit reduction factor of 1.0 (no reduction). The three-phase symmetrical short circuit currents to be used in this Formula are as follows:
- D. Design Allowables: AISC Specifications.

20.1.03 QUALIFICATIONS

- A. Fabricator: Company specializing in performing the work of this Section with minimum 5 years documented experience.
- B. Design structures and their connections under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Florida.

20.1.04 SUBMITTALS

- A. Submit the following in accordance with provisions of Section 4.
 - 1. Shop Drawings:
 - a. Indicate sizes, dimensions, and locations of structural members.
 - b. Include details of bolted connections.
 - c. Indicate welded connections with AWS A2.0 welding symbols and net weld lengths.
 - d. Plan and section drawings.
 - e. Steel details.
 - f. Erection details.
 - g. Anchor bolt plan and detail drawings.
 - h. Identify rigid and slip bus connections.
 - 2. Manufacturer's mill certificate certifying that steel meets or exceeds specified requirements.

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3. Certified test reports including chemical analysis and physical tests.
4. Design Calculations: Complete, checked, and P.E. stamped calculations showing for each structure the design assumptions and loading conditions. P.E. to be registered in the State of Florida For each loading condition, provide forces and moments, stresses, and deflections. If a loading condition is not considered controlling for the design of a particular structure, provide documented evidence to that effect. Calculations to be neat and well organized with a table of contents.
5. Foundation Load Tabulation: As part of the design calculations, tabulate the maximum loads the structures impose on the foundations in orthogonal directions oriented about the major axis of each structure. Tabulation to be on both a per bare plate and a per structure or per frame basis. Tabulation to include all loading conditions applicable to each structure unless it has been clearly shown in the design calculations that a particular loading condition will not control structure and foundation design. Clearly indicate foundation loads which include overload factors.

SECTION 20 - PART 2 - PRODUCTS

20.2.01 GENERAL MATERIAL REQUIREMENTS

- A. Structural Steel Members: ASTM A36 or A572, Grade 50.
- B. Structural Tubing: ASTM A500, or ASTM A501.
- C. Pipe: ASTM A53, Grade B.
- D. Bolts, Nuts, and Washers: ASTM A325 galvanized to ASTM A153.
- E. Locknuts: Type MF or Palnut, galvanized.
- F. Anchor Bolts: ASTM A307, galvanized on the projected portion of the bolt plus six inches minimum.
- G. Welding Materials: AWS D1.1; type required for materials being welded.
- H. Touch-up Primer for Galvanized Surfaces: Zinc rich type.

20.2.02 FABRICATION

- A. Manufacture all structural and miscellaneous steel to the dimensions required by Buyer or Engineer approved shop drawings.
- B. In accordance with the applicable portions of the AISC Code, the AISC Specification and AWS D1.1.
- C. Qualifications of welders and welding procedures and operations as prescribed in AWS D1.1.
- D. Ease all exposed edges by grinding, or other suitable means, to eliminate all sharp edges and corners prior to galvanizing.
- E. Match existing structure type for each Substation.

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SECTION 20 - PART 3 - EXECUTION

20.3.01 WELDING

- A. In accordance with AWS D1.1.
- B. Use shielded-arc welding process.
- C. Keep residual shrinkage stresses to a minimum.
- D. Stress relieving treatment not required.
- E. Use only welding process and welding operators qualified in accordance with AWS Qualifications Procedure.
- F. No welding in the field will be permitted.

20.3.02 DETAILING AND FABRICATING

- A. In accordance with AISC:
 - 1. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
 - 2. Code of Standard Practice.
 - 3. Specification for Structural Joints using ASTM A 325 or A 490 bolts.

20.3.03 MARKING

- A. Place erection mark on each member or shop assembly of members.
- B. Stamp 1/2-inch letters or numerals into metal before galvanizing, or stamp with waterproof ink after galvanizing.

20.3.04 DRILLING

- A. All required holes for mounting equipment, grounding equipment bases, equipment bases, clamping ground wires from equipment to ground mat and mounting lighting fixtures, as required, shall be shop drilled before galvanizing.
- B. No drilling in the field will be permitted without written approval of the Engineer.

20.3.05 CLEANING AND FINISHING

- A. After shop work is completed and accepted, remove all foreign substances including slag and spatter from welded areas.
- B. Galvanize all plates and shapes in accordance with ASTM A 123 and anchor bolts in accordance with ASTM A 153 after material is fully fabricated.
- C. Take precautions against embrittlement, warpage and distortion in accordance with ASTM A 143 and ASTM A 384.
- D. Prevent warping of members which cannot be dipped in one operation.
- E. Material with sharp bends or kinks will be rejected.

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- F. After galvanizing, remove excess spelter from all holes.
- G. Reroll or press all plates and shapes warped during galvanizing.
- H. Redip or apply a coating of repair paint to material with defective galvanizing as directed by the Buyer or Engineer.
- I. When repair is authorized, wipe damaged area with clean rags saturated with mineral spirits or xylene followed with hand wire brushing. Reclean with solvent and apply one heavy brush coat of zinc rich galvanizing repair paint.
- J. All material with defective galvanizing after being dipped twice will be rejected.
- K. Furnish two gallons of zinc rich paint for field touch-up and repair of galvanized surfaces.

20.3.06 INSPECTING AND TESTING

- A. Inspection and tests of materials by the OWNER at the mill will be waived.
- B. Upon request, the CONTRACTOR shall furnish the OWNER sample coupons for independent testing by a laboratory approved by ASTM. The OWNER may witness taking of samples.
- C. Defective materials:
 - 1. Replace as required by the OWNER.
 - 2. Correct in the field as required by the OWNER.
- D. The CONTRACTOR shall bear all costs of all chemical analyses, physical tests and furnishing of all certified reports.
- E. Acceptance of materials or waiving of inspection does not relieve the CONTRACTOR of its responsibility.

END OF SECTION 20

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SECTION 21 SUBSTATION STRUCTURES ERECTION

SECTION 21 - PART 1 - GENERAL

21.1.01 SECTION INCLUDES

- A. Incidental structural shapes and plates.
- B. Materials required for erection.
- C. Erection of steel framing.

21.1.02 QUALITY ASSURANCE

- A. Perform Contract work in accordance with the specifications of the American Institute of Steel Construction (AISC); in particular, provisions of the "Code of Standard Practice for Steel Buildings and Bridges," and the "Specification for Design, Fabrication and Erection of Structural Steel for Buildings, latest editions.
- B. Construct structure joints in accordance with the "Specification for Structural Joints using ASTM A325 or A490 Bolts."

SECTION 21 - PART 2 - PRODUCTS

21.2.01 INCIDENTAL STRUCTURAL SHAPES AND PLATES:

- A. Conform to the requirements of ASTM A36.
- B. Exposed surfaces are to be galvanized in accordance with ASTM A123.

21.2.02 MATERIALS REQUIRED FOR ERECTION

- A. Provide all miscellaneous materials required for erection of steel structures on site, including but not limited to the following:
 - 1. Miscellaneous steel framing required for support and bracing of steel during erection.
 - 2. Minor steel components not specifically indicated on drawings as being furnished by this Contract, including shim stock, spacer steel plates, and similar materials.

SECTION 21 - PART 3 - EXECUTION

21.3.01 GENERAL REQUIREMENTS

- A. Erect framing and accessories in accordance with this Section and the referenced publications of the American Institute of Steel Construction, unless otherwise specified.
- B. Notify the Engineer when shop errors or damaged members are found.
- C. Do not erect any structure on concrete foundations that have cured for less than 7 days. If high temperatures are consistently less than 45 degrees during the previous 7-day period, allow at least 14 days curing before erection.

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- D. Align and set baseplates level. No grout shall be used, but shims up to 0.25 inch total may be used to level baseplates.

21.3.02 ERECTION OF STEEL FRAMING

- A. Do not ream or flame cut for correction of mismatched holes due to fabrication errors. Drill bolt holes, if a minor amount of holes are discovered missing. Major errors shall be brought to the attention of the Owner.
- B. A reasonable amount of drilling will be allowed and expected. Erection shall include the punching and reaming a moderate quantity of holes. A moderate quantity shall be defined as not exceeding one-half of one percent (0.5%) of the total holes required for the erection of the structures and equipment.
- C. Repair damage to prime coats.
- D. Assemble bolted connections as shown on the steel fabricators shop drawings. ASTM A325 bolts shall be pre-tensioned with load indicator washers, or by the "turn-of-the-nut" method.
- E. Project bolts not less than $\frac{1}{8}$ -inch or more than $\frac{3}{8}$ -inch beyond the locknut when assembled.

END OF SECTION 21

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SECTION 22 SUBSTATION EQUIPMENT

SECTION 22 - PART 1 - GENERAL

22.1.01 SECTION INCLUDES

- A. Identification signs.
- B. Static Protection.
- C. Group-Operated Air Break Switches.
- D. Circuit Switchers.
- E. Switch Operator Platforms.
- F. Hardware.
- G. Owner-Furnished Instrument Transformers.

22.1.02 RELATED WORK

- A. Section 21 - Substation Structures Erection.

22.1.03 QUALITY ASSURANCE

- A. Perform all Work in accordance with the requirements of the National Electrical Safety Code and National Electrical Code.

22.1.04 SUBMITTALS

- A. Identification Signs:
 - 1. Manufacturer's information showing all signs, mounting equipment and details of the installation. Include material properties of the signs furnished, including surface and backing plate manufacture.

SECTION 22 - PART 2 - PRODUCTS

22.2.01 PHASE IDENTIFICATION SIGNS

- A. Furnish signs of porcelainized enamel, 5 by 5 inches in size with 4 inch high letters:
 - 1. Red background, white letter "A".
 - 2. White background, black letter "B".
 - 3. Blue background, white letter "C".
- B. Furnish signs as manufactured by Seton Name Plate Corporation.
- C. Provide mounting holes in each corner of galvanized enamel signs and fit holes with brass or cadmium-plated zinc eyelets with 1/4-inch ID holes.

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- D. Mount Phase ID tags on the terminator bracket for each circuit.

22.2.02 STATIC PROTECTION

- A. Contractor shall review the existing substation static protection and install additional protection as required.

22.2.03 GROUP-OPERATED AIR BREAK SWITCHES

- A. Manufacturer: Cleveland Price or USCO.
- B. Type: All live parts shall be copper, silver plated contacts, and porcelain insulators.
- C. Ratings:
 - 1. Nominal voltage 69-kV:
 - a. Maximum kV: 72.5
 - b. BIL: 350-kV
- D. Accessories:
 - 1. Grounding strap and clamps for attachment to the vertical operating shaft. Strap to be braided copper wire, tinned, at least 18 inches long with two 9/16 inch holes at one end for attachment to the station grounding system.
 - 2. Switch blade position indicator located near operator.
 - 3. Provision for padlocking in either OPEN or CLOSED position.
 - 4. Operator: Manual.
- E. Shipping Requirements:
 - 1. Switches shall be assembled, with insulators, and fully adjusted before shipment.

22.2.04 CIRCUIT SWITCHERS

- A. Principal ratings and electrical characteristics:
 - 1. Nominal voltage: 13.8-kV
 - 2. Maximum kV: 15-kV
 - 3. BIL: 110-kV
 - 4. Type: outdoor, 3-pole
- B. Components:
 - 1. Terminals: 4-pole NEMA pads.
 - 2. Mechanism housing:

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- a. Weatherproof.
- b. Doors: vertically hinged with provisions for padlocks.
- c. Conduit entrance: removable, gasketed bottom plate, field drilled.
- d. Provide space heaters, thermostatically controlled.
3. Operating mechanism and auxiliaries:
 - a. Type: motor-compressed spring.
 - b. Closing mechanism: 125 VDC closing coil.
 - c. Tripping mechanism: 125 VDC closing coil, type DC shunt trip.
4. Operations counter.
5. "Charged" and "Discharged" indicators for stored-energy mechanism.

22.2.05 LOAD BREAK INTERRUPTER SWITCHES

- A. Air interrupter switches shall be group operated of the stored energy type, 3 pole single throw, utilizing a direct acting spring charged mechanism for both closing and opening functions. Switch mechanisms shall be operable externally from the front of the cubicle and shall be equipped with a quick-make/quick break mechanism to open and close the switch independent of the speed with which the operating handle is moved.
- B. Air interrupter switches shall have main and arcing contacts and be designed to provide maximum endurance for load interrupting and fault closing. The arcing contacts shall be spring loaded on break and shall be last in last out. Operation shall be in an arc chute designed to assist in interruption, and liberate no appreciable gases on interruption.
- C. Main switch blades shall be of electrolytic ally pure cold rolled copper. All contact points shall be heavily silver plated on blades.
- D. Each switch shall include operator with removable handle and operator position indicator. Provide provision for padlocking the switch in the open or closed position. The operator shall be located in such a manner to avoid interference with opening the adjacent or lower cubicle door with the switch in the opened or the closed position.

22.2.06 SWITCH OPERATOR PLATFORMS

- A. Provide grounding platforms for each switch operator location.
- B. Size: 3-foot x 4-foot.
- C. Fabricate from bar grating.
- D. Hot-dip galvanize after fabrication.
- E. Provide provisions for connecting grounding strap.

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22.2.07 HARDWARE

- A. Furnish terminal connectors complete with bolts, nuts, lockwashers and washers for all station equipment.
- B. Furnish corrosion-resistant hardware.
- C. Non-ferrous hardware:
 - 1. Silicon bronze for connecting copper to copper or copper to galvanized steel.
 - 2. Aluminum alloy 2024-T4 anodized bolts and 6061-T6 nuts for connecting aluminum to aluminum or aluminum to galvanized steel.
 - 3. Stainless steel for connecting aluminum to copper.
- D. Ferrous hardware: Hot-dipped galvanized, free of excess zinc; do not recut after galvanizing.

SECTION 22 - PART 3 – EXECUTION

22.3.01 GENERAL SIGN INSTALLATION PROCEDURE

- A. Install fence signs using aluminum tie wire minimum #12 gauge.
- B. Perform all required drilling and tapping of steel.

END OF SECTION 22

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SECTION 23 CONDUIT AND JUNCTION BOXES

SECTION 23 - PART 1 - GENERAL

23.1.01 SECTION INCLUDES

- A. Electrical conduit, hardware, and junction boxes.

23.1.02 RELATED WORK

- A. Section 21 - Substation Structures Erection.
- B. Section 24 - Substation Control Wiring - 600 VAC.

23.1.03 QUALITY ASSURANCE

- A. Perform all Work in accordance with the requirements of the National Electrical Safety Code and National Electrical Code.

23.1.04 SUBMITTALS

- A. Manufacturers' literature indicating conduit and hardware to be used on the project.

SECTION 23 - PART 2 - PRODUCTS

23.2.01 RIGID CONDUIT

- A. Provide zinc-coated rigid galvanized steel with fully threaded connections, unless otherwise specified.

23.2.02 FLEXIBLE CONDUIT

- A. Provide material of continuous lengths of spirally wound, galvanized steel strip with successive convolutions securely interlocked and with synthetic moisture-proof and oil-proof gray jacket extruded over lining.
- B. Furnish in same size as rigid conduit to which it connects.
- C. Provide material as manufactured by Anaconda Sealtite, Type U.A.

23.2.03 POLYVINYL CHLORIDE (PVC) CONDUIT

- 2.02 Schedule: 40 (For concrete encased & direct buried applications).
- 2.03 Manufacturer: Carlon or approved equal.
- 2.04 Above grade conduit shall have UV protection.

23.2.04 CONDUIT HARDWARE

- A. Couplings and Connectors:
 - 1. Rigid conduit connectors to be hot dipped galvanized, as manufactured by Appleton or approved equal.

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2. Flexible conduits to be zinc-coated or similar protection, as manufactured by Appleton. Provide Type ST or approved equal.
- B. Fittings and Covers:
 1. Type: Schedule 40 PVC.
 2. Provide gaskets and a weatherproof installation on outdoor units.
 3. Provide units manufactured by Carlon (PVC) or approved equal.
- C. Locknuts:
 1. Provide extra-heavy galvanized steel for sizes ½-inch to 2-inches.
 2. Provide galvanized malleable iron for 2½-inches and larger.
 3. Provide units manufactured by Thomas and Betts.
- D. Bushings:
 1. Provide malleable iron, cadmium-plated for sizes ½-inch to 1¼-inches conduit.
 2. Phenolic, insulating type for 1¼-inches and larger conduit shall be used.
 3. Grounding, insulated type shall be used for conduit entering cable trays and junction boxes.
 4. Provide units manufactured by O-Z Manufacturing Company.
- E. Conduit Straps:
 1. Provide units of malleable iron, two-hole, hot-dipped galvanized.
 2. Provide straps manufactured by Thomas and Betts or Steel City.
- F. PVC Hardware:
 1. Carlon or approved equal.

23.2.05 JUNCTION BOXES

- A. Junction boxes shall be Stainless Steel, NEMA type 4 rated.
- B. Furnish and install conduit from junction boxes to above grade equipment.
- C. Equip junction boxes with non-locking handle assembly, Hoffman No. C-WHNL.
- D. VT junction box: Hoffman No. C-SD24248SS6 with CP2424 back plate or equal:
 1. Furnish and install four (4) 3-pole, 600 volt fuse block with 15 ampere fuses.
 2. Furnish and install four (4) 12-point terminal block, GE type EB25.
 3. Furnish copper ground bus with a minimum of 6 threaded holes complete with washer head screws.

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4. Install vent in bottom of junction box.
- E. Lighting junction boxes: Hoffman No. L-HC302515SS6 with LP3025 back plate or equal.
 1. Install at each location, where substation lighting is needed.
 2. Furnish and install one 12-point terminal block, GE type EB25.
 3. Install vent in bottom of junction box.

Section 23 - PART 3 - EXECUTION

23.3.01 CONDUIT INSTALLATION REQUIREMENTS

- A. Install conduit and hardware in locations shown on Contract Drawings, and as required by the applicable sections of NESC and NEC.
- B. Make rigid conduit union joints with standard galvanized unions.
- C. Running threads shall not be permitted.
- D. Use bushings where conduit enters cabinets, pull boxes, and panels.
- E. Permanent identification shall be installed on each end of all conduit terminations.
- F. Ground all metal conduits to station ground.

23.3.02 JUNCTION BOX INSTALLATION

- 2.05 Install junction boxes in location shown on Contract Drawings.
- 2.06 Providing mounting hardware.
- 2.07 Ground all junction boxes to station ground.
- 2.08 Drill and modify steel structures to accommodate boxes.
- 2.09 Mounting of junction boxes to outdoor structures shall be accomplished by aluminum or stainless steel unistrut. Vertical and horizontal adjustments of box shall be possible without re-drilling. Mounting height shall be 4-feet 0-inches.
- 2.10 Ensure waterproof conduit penetrations.

END OF SECTION 23

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SECTION 24 SUBSTATION CONTROL WIRING - 600 VAC

SECTION 24 - PART 1 - GENERAL

24.1.01 SECTION INCLUDES

- A. 600 volt wire conductor requirements.
- B. Insulation requirements.
- C. Jacketing and shielding.
- D. Identification
- E. Manufacturer
- F. Accessories
- G. General requirements.
- H. Installation requirements.
- I. Splicing procedures.
- J. Protection, labeling, and installation requirements.

24.1.02 RELATED WORK

- A. Section 21 - Substation Structures Erection.
- B. Section 23 - Conduit and Junction Boxes.

24.1.03 QUALITY ASSURANCE

- A. Perform all Work in accordance with the requirements of the National Electrical Safety Code and National Electrical Code.
- B. Meet the requirements of the latest ICEA Standards Publications, to which the references contained herein apply unless otherwise stated.

24.1.04 SUBMITTALS

- A. Manufacturer's literature indicating wiring, jacketing, insulation materials, shielding materials, terminal blocks and connectors to be used on the project.

SECTION 24 - PART 2 - PRODUCTS

24.2.01 CONDUCTOR

- A. Copper, Class B Stranded per ASTM 8.

24.2.02 INSULATION REQUIREMENTS

- A. Ethylene-propylene rubber in accordance with ICEA S-95-658/NEMA WC70.

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B. Flame-, moisture- and chemical-resistant for installation in conduit; also for direct burial.

C. Insulate all wire and cable according to the following:

<u>Operating Voltage</u> (volts)	<u>Insulation Level</u> (volts)
0–600	600

D. Insulation thickness for 600 volt insulation level shall be as follows:

1. Minimum of 30 mils for single-conductor and multiple-conductor cables with a jacket.
2. Minimum of 45 mils for single-conductor cables without a jacket.

24.2.03 JACKETING AND SHIELDING

A. Jacketing to be in accordance with UL 1277.

24.2.04 IDENTIFICATION

A. Identification for multiple-conductor cable to be in accordance with ICEA, Method 1, Table E1 for power circuits, E2 (color sequence without white and green) for control and status circuits, and numbered pairs for analog circuits.

24.2.05 MANUFACTURER

A. Okonite or approved equal.

24.2.06 ACCESSORIES

A. Power cable connectors:

1. Design and size all wire, cable, equipment and bus terminals for the specific cable or bus being connected.
2. Use solderless, pressure type constructed of high strength, noncorrodible metal designed to furnish high pull-out strength and high conductivity joints.
3. Include connectors with rated current carrying capacity equal to or greater than the cable being connected and with silver- plated contact surfaces for copper conductors with 500 MCM capacity or greater.
4. Furnish items manufactured by Burndy, Thomas and Betts or American Pamcor.

B. Control cable connectors:

1. For all control, alarm and instrumentation wiring, use pressure grip solderless lugs of the ring-tongue type. Spade lugs will not be permitted.
2. Design for the specific size and type of conductor being connected.
3. Use only ratchet-type compression tooling as recommended by the manufacturer.

C. Terminal blocks:

1. Use for terminations of cable in equipment furnished under Contract or in other equipment where additional terminal blocks are required by the Contract Drawings.

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2. For power circuits, use General Electric Type EB5 molded-base type terminal blocks rated 600 volts ac with barriers between terminals, with terminal marking strips and rated at least 20 amperes.
 3. For control circuits and potential transformer terminal block use GE type EB-25 or approved equal.
 4. For all current circuits use 6-point short-circuiting terminal blocks Penn Union, Style 6006 or GE Type EB-27.
- D. Cable supports:
1. Support vertical runs of cable in conduit at boxes and at terminations in equipment with conduit type cable supports. Use O-Z, Kellum or Klein's woven basket type grips where required.
 2. Provide supports at terminations of cable in equipment where not provided by the equipment manufacturer, as required to eliminate strain on the connection.
- E. Cable tags:
1. All cable and wire tags will be permanent type, metal or composition with nylon or similar ties.
 2. All identification will be etched or indented in tags in a permanent manner.
 3. Tags shall be yellow/black or white/black, 1½-inches diameter.
 4. Manufacturer: Seton Name Plate Corporation.

SECTION 24 - PART 3 - EXECUTION

24.3.01 GENERAL REQUIREMENTS

- A. Furnish and install hangers, supports, cable grips, clamps, clamping blocks, marking tags, insulating tape and compounds, solder flux and connectors as required.
- B. Provide split rubber protectors on cable tray edges at all points where cables lay on the edges.
- C. Enclose all conductors in conduit, conduit fittings, suitable conduit bodies, boxes or cabinets, conduit banks, manholes, handholes, pullboxes or terminal boxes, wireways or trays.
- D. Install cable and wiring continuously between terminal points without intermediate splices or taps.
- E. Cable or tie together single-conductor cables of each individual circuit in all equipment, each box and manhole at intervals not exceeding 6 feet with wire-wraps. Do not tie circuits together at terminal points.
- F. Adequately clamp, snub and tie for proper support at each terminal block or connection so all strain on the cable will not be transmitted to the terminal connections.

24.3.02 INSTALLATION REQUIREMENTS

- A. Remove all sharp corners and pull a clean, dry, tight-fitting rag through all conduit immediately before installing wire and cable.

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- B. Do not kink wire and cable or permit cuts and abrasions in insulation or protective covering during installation.
- C. Leave a sufficient length of wire and cable at all ends to make connections conveniently to equipment and devices.
- D. Use a swivel connection for pulling conductors of No. 2 AWG size and larger.
- E. Do not exceed the pulling tension values recommended by the cable manufacturer.
- F. Pull with gradual and uniform stresses.
- G. If a lubricant is needed to aid in pulling, use only material approved by the cable manufacturer.
- H. Do not bend wire and cable to a radius smaller than recommended by the manufacturer.
- I. Remove and replace all wire and cable damaged during installation.
- J. Ensure cables are neat and parallel in entrance box and cable trays.
- K. Neatly coil spare conductors in a length equal to that of the longest single conductor and place at each end of all multiple conductor cable.

24.3.03 SPLICING PROCEDURES

- A. Splicing is not permitted except with written permission from the OWNER.

24.3.04 PROTECTION, LABELING, AND INSTALLATION REQUIREMENTS

- A. Protect all wire and cable to prevent the entrance of moisture during and after installation. Duct seal all conduits.
- B. Mark all cables at each end, at points of entrance to and exit from cable trench, in hand-holes and manholes where used, and in additional places where directed using cable tags per 24.2.06.E.
- C. For each conductor terminated by the CONTRACTOR, identify using heat shrink labeling system as manufactured by Kroy, Model TubeMarker 600 or equivalent. Labels shall be applied per manufacturer's instructions.
- D. Color code all lighting circuits in accordance with the National Electrical Code.
- E. Support all wire and cable with approved cable grips at approximately 40' intervals for vertical runs in conduit, 25' intervals if suspended to or between trays, and 75' intervals for inclined runs.
- F. Ground the shielding of all communication and signal cable at one end only. Do not ground at both ends.

END OF SECTION 24

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SECTION 25 MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR ASSEMBLY

SECTION 25 - PART 1 - GENERAL

25.1.01 SUMMARY

- A. Section includes furnishing, testing, delivery, and field assembly of outdoor, walk-in, metal-clad switchgear assemblies for both Stock Island Generation Facility Substation & Big Pine Substation containing:
 - 1. Circuit breakers.
 - 2. Protective relay and control equipment.
 - 3. Station battery system.
 - 4. Station service transformer.
 - 5. AC/DC panels.
 - 6. Instrument transformers.

25.1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. C37 Series, Power Circuit Breakers.
 - 2. C37 Series, Protective Relays.
 - 3. C39.1, Switchboard Instruments.
 - 4. C57 Series, Dry-Type Transformers.
 - 5. C62.11, Metal Oxide Surge Arresters.
 - 6. C57.13, Instrument Transformers.
 - 7. Z358.1, Emergency Eyewash and Shower Equipment.
- B. Insulated Cable Engineers' Association (ICEA):
 - 1. ICEA, Specifications for Wire and Cable.
- C. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE, Requirements for Short Circuit Withstand.
 - 2. IEEE 48, High-Voltage Alternating Current Cable Terminations.
 - 3. IEEE 484, Recommended Practice for Installation of Large Storage Batteries.
 - 4. IEEE 450, Recommended Practice for Maintenance, Testing and Replacement of Large Storage Batteries.

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- D. National Electrical Code (NEC):
 - 1. Current Rating of Control Wiring.
- E. National Electrical Manufacturers Association:
 - 1. NEMA SG4, Power Circuit Breakers.
 - 2. NEMA SG5, Power Switchgear Assemblies.
 - 3. NEMA SG6, Power Switching Equipment.
 - 4. NEMA SG2, High Voltage Fuses.

25.1.03 SYSTEM DESCRIPTION

- A. General
 - 1. Design, manufacture, and test in accordance with this Section and applicable sections of standards listed in Article 1.02. in effect at the Issue Date of this Section.
- B. Design Requirements
 - 1. Switchgear Enclosure:
 - a. Outdoor 15-kV class, metal-clad, single aisle, weatherproof with stainless steel walls and roof, as described herein.
 - b. Provide with two-tier vertical sections with circuit breakers and auxiliary equipment, located in the lower section and provisions for installation of future circuit breakers in the upper section.
 - c. Provide with battery section, including battery, charger, AC and DC auxiliary panels.
 - d. Single protected aisle for operating area.
 - e. Standard design and manufacture.
 - f. Provide with standard circuit breaker compartments to house horizontal draw-out breakers.
 - g. Factory assemble, prewire and pretest.

25.1.03 SUBMITTALS

- A. Provide in accordance with Section 4.
- B. Product Data: Catalogs and cut sheets.
- C. Shop Drawings:
 - 1. Switchgear enclosure:
 - a. Outline showing general arrangement, legend, floor plan, anchor details, and overall arrangement of switchgear and cabinet lineups.

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- b. Arrangement drawings of each section and cabinet showing the physical location and arrangement of all devices, terminal blocks, and power and control cable entrance areas.
 - c. Installation diagrams showing anchoring method.
 - 2. Bill of material.
 - 3. Nameplate.
 - 4. AC schematic (three-line) and DC schematic diagrams for all relaying, metering, and control circuits including power transformer and circuit switcher. Typical diagrams are not acceptable. Assign wire numbers on each diagram so each segment of circuit can be identified on internal and interconnection wiring diagrams.
 - 5. Individual internal wiring and interconnection diagram for each circuit breaker and auxiliary cubicle. Typical drawings are not acceptable. Prepare wiring diagrams as follows:
 - a. Use separate wiring diagram for each cubicle and cabinet.
 - b. Provide 3-inch clear margin on all sides of drawing for Seller's and Buyer's external cabling information.
 - c. Show relative physical arrangement and terminal locations of devices and terminal blocks.
 - d. Use terminal address system at origins and destinations of actual wiring. Tabular format wiring lists are not acceptable.
 - e. Use same wire numbers as assigned on schematic diagrams.
 - f. Show wiring between units for Seller-installed interconnection wiring. Indicate wire numbers at terminal blocks, designate wire groupings with routing code, and note drawing on which cable run is terminated.
 - 6. For each type of current transformer:
 - a. Excitation and ratio correction factor curves for each secondary ratio.
 - b. Resistance of current transformer secondary and connection leads for each ratio.
 - c. Actual current ratio and turn ratio for each tap.
 - d. Mechanical and thermal short time (one second) ratings.
 - 7. For each type of voltage transformer:
 - a. Ratio correction factor and phase angle curves.
 - b. Accuracy ratings at all standard burdens.
 - c. Thermal rating.
- D. Quality Assurance/Control Submittals.
 - 1. Design Data.

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2. Certified circuit breaker design test report for Design Tests listed in ANSI C37.09.
3. Certified AC switchgear assembly design test report for Design Tests listed in ANSI C37.20 and NEMA SG5.
4. Certified protective relay design test report for surge withstand capability.
5. Test Reports: Certified ratio and phase angle test reports for each type of metering accuracy current and voltage transformer.

25.1.04 DELIVERY, STORAGE AND HANDLING

- B. Deliver equipment F.O.B. to the Project Site. Project locations are subject to special limitations including bridges as required by FDOT. Contractor shall be responsible for arranging, paying freight and shipping, and handling equipment between factory and site.

25.1.05 MAINTENANCE

- A. Extra Materials
 1. Make interchangeable with and same material and workmanship as, corresponding original part.
 2. Deliver with switchgear assembly to Project Site.
 3. Materials or parts:
 - a. One 2,000 ampere spare circuit breaker interchangeable with main and feeder breakers.
 - b. Two 1,200 ampere circuit breaker spare interrupter bottle.
 - c. Two dozen switchboard indicating lamps.
 - d. Two indicating lamp pullers.
 - e. Four color caps of each color for indicating lamps.
 - f. Four resistors and lamp sockets for each type of indicating lamp.
 - g. One case ANSI 70, Light Gray touchup paint in aerosol cans.
 - h. Two sets spare fuses for voltage transformers and station service transformers.

SECTION 25 - PART 2 - PRODUCTS

25.2.01 ELECTRICAL EQUIPMENT HOUSING

- A. Structure:
 1. Furnish outdoor metal-clad compartmented switchgear assembly with single protected operating/equipment aisle.
 2. Furnish continuous weatherproof structure consisting of sloped roof, access doors at each end of operating/equipment aisle, and cubicle rear entry doors. Include awnings over personnel doors.

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3. Electrical Equipment Housing shall be constructed of a minimum of 11 gauge steel. This includes all exterior walls and roof, ceiling, all entrance doors and all cubicle doors. Design shall utilize either welded or bolted construction. Seams between adjoining panels and sections of the walls and roof shall be continuous-seam welded under inert gas to prevent impurities in the welds or shall be gasketed and bolted together to form a weatherproof structure. All welding personnel shall be properly trained and certified.
4. Provide Electrical Equipment Housing with rigid, welded, self-supporting structural base of adequate strength for handling and with capability of being installed on a foundation not completely level. Structural steel base shall be provided using welded structural I-beams and or steel channels. The base shall have a minimum height of 6 inches and shall be continuous-seam welded to the walls around the entire perimeter. The base shall have adequate strength to minimize deflection to no greater than $1/360^{\text{th}}$ of the unsupported span between and on either side of each lifting point when the housing is lifted at the four lifting points. The structural steel base shall be hot-dipped galvanized. The underside of the structural steel base shall be given a zinc rich primer followed by a coat of bitumastic undercoating for corrosion resistance purposes. The steel base shall include ventilation with varmint guards to prevent condensation build-up under switchgear.
5. The Electrical Equipment Housing shall be capable of withstanding the forces associated with shipping, as well as the process of loading and unloading, without permanent deformation. Lifting provisions for the Electrical Equipment Housing shall be fabricated from heavy structural steel that is integrally welded into the roof and structure of the enclosure. Each shipping section and its contents shall be capable of being lifted from the top using cables and hooks attached to the lifting provisions. Lifting from the base or the use of spreader bars for lifting shall not be required. Lifting provisions shall be positioned so as to balance the load.
6. The roof shall have a minimum slope of $1/4''$ per foot to allow moisture runoff. The Electrical Equipment Housing shall be capable of withstanding the specified loads plus loads due to all other equipment that may hang from the roof without permanent deformation or loss of waterproof capabilities. Adequate stiffening must be provided to support all loads. All external bolted seams shall be gasketed, caulked, and completely covered by roof caps. Building shall include gutters and downspouts.
7. The floor shall be fabricated from minimum $1/4''$ thick plate welded to the base and structural members. Provide adequate stiffening members to support the specified required loads with a deflection of no greater than $1/360^{\text{th}}$ of the distance between the floor stiffening members. Prior to shipment, the floor shall receive a finish coat of skid resistant epoxy paint.
8. Access to cable compartments shall be by full height, hinged doors. Bolted panels are not permitted. Each door must be of tamperproof construction without any external hardware. Doors shall utilize stainless steel butt hinges, welded to the door and enclosure door frame, with stainless steel hinge pins. The hinge shall not be visible or accessible when the door is closed. A $3/4''$ wide continuous rain gutter shall be provided on the sides and top of each door opening. A double return flange shall be provided on the door to assure that the door is square and flat. Door gasketing shall be installed inside the double return flange and make contact with external flange of the rain gutter. A heavy duty three point latching mechanism with stainless steel operating handle, that is capable of being padlocked, shall be provided on each door. The three point latching mechanism shall utilize heavy duty solid aluminum tubes with nylon rollers at the top and bottom to hold the door firmly shut without damaging the door frame surface. Power cable termination compartment doors shall have filters, top and bottom, to allow free flow of ventilating air. Filters shall be enclosed by externally mounted boxes that allow changing of filters without requiring access to high voltage compartments. Downward facing louvers shall be provided on both the filter box and door to prevent entrance of wind driven rain or snow into the interior of the enclosure. Filter boxes shall have drain holes at the bottom to allow any moisture that

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enters the filter box to flow down the exterior door surface. Exterior doors shall include a door stop to hold the door in the fully opened position.

9. Design operating/equipment aisle to accommodate circuit breaker removal and normal maintenance operations. Minimum aisle width shall be of sufficient width to allow two power circuit breakers to pass side-by-side conveniently. Lights shall be installed such that a breaker located in the upper cubicle may be removed without removing the light.
10. Adequate space shall be provided for convenient operation and maintenance of batteries, battery charger, power circuit test panel and other accessory equipment. The aisle space and work areas shall not be less than shown on the bid drawings.
11. Electrical Equipment Housing shall include full height, hinged, gasketed, outward swing personnel doors with ventilating louvers. Personnel doors shall have a keyed, lockable handle on the exterior and a panic bar inside, so that the door can be opened from the inside, even when locked. Panic hardware shall be satin aluminum clear anodized finish and right hand reverse bevel. All entrance doors shall be provided with pneumatic door closures.
12. All cable entry openings shall have a removable 1/8" thick aluminum plate bolted over the opening.
13. Undercoat all metal surfaces contacting concrete pad.

B. Finish:

1. The exterior of the Electrical Equipment Housing walls and roof shall be stainless steel. Any sections or portions that cannot be stainless must be pre-approved by OWNER. Exterior Finish, shall be painted Devco Paints color number 4W18-2 or equal. Exterior finish shall be designed to withstand the environmental conditions of the site specified. All metal surfaces shall be chemically cleaned and treated to provide a bond between primer, paint, and metal surfaces to prevent the entrance of moisture and the formation of rust under the paint film. Finish shall be resistant to chalking and degradation due to ultra-violet radiation, acid rain, snow, ice, temperature extremes, and blowing sand. Exterior finish shall be capable of passing a 5% salt spray resistance test for a minimum of 1,500 hours without failing. Proof of capability shall be provided in the form of independent testing laboratory on samples of the proposed protective coating system.
2. Interior aisle walls and ceiling shall be painted ANSI 61 Gray.
3. Interior floor shall be painted ANSI 70 Gray.

C. Insulation:

1. Electrical Equipment Housing shall be insulated to provide temperature controlled interior environment. Areas requiring insulation include doors, walls, and ceilings. Insulation material shall be flame retardant, fiberglass fiber reinforced foam board, with reflective aluminum foil vapors on both sides. All insulation shall be protected from physical damage by minimum 16 gauge steel cover panels. Insulation shall have the following minimum thermal ratings:
 - a. Ceiling R-30
 - b. Walls R-19
 - c. Floors R-11

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D. Heating/Ventilation:

1. Provide sufficient ventilation of gases from battery area to prevent accumulation of an explosive mixture exceeding a 1 percent concentration. Use forced ventilation, if necessary, to meet this requirement.
2. Provide sufficient HVAC in the Enclosure to maintain temperature within electronic equipment operating range.

E. Fire Protection:

1. Provide a minimum of two smoke detectors in the electrical equipment housing with relay contacts. Contacts shall stop pressurization and/or HVAC system and activate an alarm. Alarm shall be wired to Programmable Automation Controller.
2. Provide hand held, wall mounted U.L. rated fire extinguishers mounted near each entrance door.

F. Utilities:

1. Provide workspace to included batteries, battery rack, charger, AC/DC Panels, transfer switch(es), eyewash station, and any additional equipment as specified.
2. Design enclosure with built-in, enclosed wireways to accommodate all interconnection wiring between cubicles, without need for exterior conduit systems. Wireway shall be 6" x 6", with removable covers, and shall extend around the perimeter of the electrical equipment housing.
3. Interior lighting shall be dual tube UL listed fluorescent light fixtures with 0 degree Fahrenheit ambient temperature rated ballast, protective plastic tube sleeves and wire guard. The lighting shall provide a minimum of 30 foot-candles of illumination at any point three feet above the floor. A three way light switch and duplex grounding receptacle shall be located at each personnel door. Additional receptacles shall be provided as indicated on the bid drawings.
4. A 70 watt high pressure sodium vapor light shall be located on the outside above each personnel door. These lights shall be controlled by common photoelectric cell.
5. An emergency exit light shall be located on the inside above each personnel door. These lights shall be self contained continuously charged battery powered.

G. Accessories:

1. Provide 60" wide by 48" deep lift-up drawing table and drawing storage rack.
2. Provide a circuit breaker test cabinet with 'open' and 'closed' pushbuttons, indicating lights, and cable with test plug located on the aisle wall across from the switchgear or as indicated on the bid drawings.
3. Provide telephone and facilities for connection to local telephone company service line.

H. Battery Charger:

1. Type: Exide MCR Series AT10, sized for specified application.
2. Rating: DC output from a 240 vac, 60 Hz source and equipped with an alarm assembly with local LED's and summary relay contacts for AC failure, DC failure, High Volts DC, Low Volts DC, and positive and negative ground fault.

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- I. Battery Cells:
 - 1. Type: Liberty Series 1000, sealed lead acid.
 - 2. Rating: 125 volts, sized for load.
 - 3. Provide with all connectors including across-aisle inter-rack connectors or aisles as required by mounting arrangement, and mount on racks suitable to best use of available space, including consideration of normal maintenance.
 - 4. Provide fungus proofing (tropicalization).
- J. Battery Racks:
 - 1. Sized and designed for specified battery and application.
 - 2. Furnish two-tier or three-tier racks, assembled in conformance with ANSI, IEEE and the rack manufacturer's instructions.
 - 3. Provide complete battery enclosure as indicated in the bid drawings.
 - 4. Clearance: minimum of 4 inches clearance from walls or equipment.
 - 5. Finish with two coats of acid resistant paint.
- K. Emergency Eye and Face Wash Station:
 - 1. Self-contained, gravity-operated, simple and quick-to-use portable unit complete with drain hose, mounting bracket, bacteriostatic additive, and test log card.
 - 2. Spray action with continuous flow of wash solution for 15 minutes at rate greater than 0.4 gpm.
 - 3. Sixteen gallon capacity, constructed of FDA polyethylene.
 - 4. Wall-mounted with included mounting bracket(s).
 - 5. SEI-certified and shall meet ANSI Z358.1-1991.
 - 6. Model No. 90320 by Sellstrom Manufacturing, or approved equal.
- L. Panelboards:
 - 1. Construction: in accordance with requirements of Federal Specification W-P-115a, and applicable industry standards.
 - 2. Enclosure: 12 gauge sheet steel, with front access doors and wire gutters at the top, bottom, and sides.
 - 3. DC Panelboard:
 - a. Provide a 225 ampere main, 250 vdc, 22 kA interrupting with plug-in type branch circuit breakers.
 - b. Provide 225 amp, two-pole, 250 vdc main circuit breaker.

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- c. Provide a minimum of 36 two-pole, 60 A frame, 250 vdc branch circuit breakers. Size, ratings, and quantities as indicated in the bid drawings.
- 4. AC Panelboard:
 - a. Provide minimum 225 amp main breaker, 120/240 volts, one-phase, three-wire AC station service, 22 kA interrupting capacity.
 - b. Provide a minimum of 42 single-pole branch circuit breaker capacity. Size, ratings, and quantities as indicated in the bid drawings.
 - c. Provide a minimum of 3 unused two-pole, 30 A breakers.
 - d. Provide a minimum of 4 unused single-pole 20 amp breakers.
- 5. Air circuit breakers:
 - a. Sizes: self-contained, plug-in type, non-interchangeable trip elements effectively sealed to prevent tampering, sized as required for intended load in accordance with applicable standards.
 - b. Tripping elements: thermally-operated, inverse-time-limit type, non-tripping on normal momentary overload, but ensuring adequate circuit protection in conformance with NEC standards.
 - c. Operating mechanism: capable of trip-free operation on abnormal overloads and short circuits, with quick make, quick break contact movement during manual or automatic operation.
 - d. Contacts: non-welding, silver alloy, with arc-quench protection.
 - e. Automatic tripping: clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions.
- 6. Provide copper neutral bar of same capacity as the buses equipped with solderless-type connectors and provisions for grounding, and mounted as required in the panel box.
- 7. Lugs: solderless-type of suitable capacity for incoming line loads.
- 8. Cabinets: surface or flush-type as required at particular locations, with hinged doors and trim, steel front and boxes of gauge conforming to NEC, galvanized after fabrication and finished with manufacturer's standard coats of paint. Provide typed directory on inside of door.

25.2.02 METAL-CLAD SWITCHGEAR

- A. Principal ratings, electrical characteristics and features.
 - 1. Continuous current:
 - a) Main bus 2,000 A
 - b) Feeder breaker positions 1,200 A
 - 2. Rated short circuit current 20 kA, rms
 - 3. Rated close and latch current 52 kA

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4.	Rated maximum voltage	15-kV
5.	Nominal voltage class	13.8-kV
6.	Operating voltage	13.8-kV
7.	Basic Impulse Level (BIL)	95-kV
8.	Low frequency (1 min.) withstand voltage	36-kV

25.2.03 CIRCUIT BREAKERS

A. Breaker Principal ratings and electrical characteristics.

1.	Nominal voltage class	13.8-kV
2.	Rated maximum voltage	15-kV
3.	Voltage range factor (K)	1.3
4.	Operating voltage	13.8-kV
5.	Continuous current, feeders	1,200 A
6.	Max. symmetrical interrupting capability	37 kA, rms, min.
7.	Three second short time current carrying capability kA, rms, min.	37
8.	Closing and latching capability	52 kA
9.	Capacitive Current Switching Duty per ANSI C37.06-2000	630 A (1200 Amp bkr) 1000 A (2000 Amp bkr)
10.	Interrupting time	3 cycles max.
11.	Low frequency (1 min.) withstand voltage	36-kV, rms
12.	Basic Impulse Level (BIL)	95-kV
13.	Closing mechanism operation	125 VDC
14.	Tripping mechanism operation	125 VDC

B. Manufacturer:

1. Cutler Hammer.

C. Circuit Breaker Features:

1. Interrupters: Vacuum
2. Auxiliary switch contacts: Provided so that at least four "a" and four "b" contacts are unassigned after all connections are made. Arrange so contacts operate in both CONNECT and TEST positions.

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3. Provide manual means for tripping.
 4. Provide trip free and non-pumping operation.
 5. Provide contact erosion indicator.
 6. Provide anti-condensation heaters, permanently wired to the 120 volt auxiliary power source through fuses or circuit breakers in each metal-clad unit. Apply heaters at half-rated voltage and install perforated metal heater guards.
- D. Circuit breaker compartments: Closed door draw-out design, with CONNECT and TEST/DISCONNECT positions.
1. All of the circuit breakers shall be 15-kV class, 3-pole, and electrically and mechanically trip free with a 20 kA interrupting rating. Each circuit breaker shall be equipped with one 4-stage auxiliary switch in addition to the auxiliary contacts required for normal circuit breaker control and operation. The circuit breaker element shall be stored energy type, 125 VDC close, charge, and trip.
 2. Protective front covers shall be provided on the circuit breaker element to prevent access to the operating mechanism or live parts when the circuit breaker is in the connected position.
 3. All circuit breakers shall be vacuum interrupter, horizontal draw-out type, provided with self-aligning, line-side and load-side disconnecting devices. Each breaker shall be provided with a motor-charged spring, stored energy-operating mechanism. The stored energy mechanism shall be charged normally by a universal electric motor and in emergency or maintenance situations, by a manual handle.
 4. The primary disconnecting fingers shall be silver plated and retained to the primary contacts with individual leaf springs. The secondary disconnecting contact shall be a silver-plated, multi-contact plug. The plugs shall automatically engage the housing sockets in the breaker operating position.
 5. Circuit breakers of the same ratings and control voltages shall be completely interchangeable. This shall be demonstrated at the switchgear manufacturer's factory with the specific breakers for this project being inserted and tested in each cell.
 6. The breaker front panel shall be a grounded steel barrier that effectively isolates the instrument and control compartments. The front panel shall have the following control and indication features:
 - a. Breaker open-close indication.
 - b. Closing springs charged-discharged indication.
 - c. Operations counter.
 - d. Manual trip-close push buttons.
 7. Switchgear shutters shall be permanently marked to indicate the "Bus" or "Feeder" side primary stationary disconnects. Phase markings shall also be included.
 8. The circuit breaker shall be mechanically interlocked to coordinate with the requirements outlined in applicable ANSI standards.

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9. Manual operating devices for racking the circuit breaker elements in and out of their cubicle shall be provided.
10. An extension jumper with secondary disconnects shall be provided for each switchgear assembly so that the circuit breaker and the circuit breaker's operation may be checked with the element outside of the circuit breaker cubicle.

25.2.04 SWITCHGEAR BUS SYSTEMS

- A. Bus bars will be electrical grade copper having the specified continuous current rating as limited by ANSI standards to temperature rise and documented by design tests. All joints will be silver plated and have at least two bolts per joint using plated steel hardware. All bus connections will be rated to carry the full frame size continuous current of the associated breaker. Bus bars will be braced to withstand the magnetic stresses developed by currents equal to the power circuit breaker momentary and interrupting ratings.
- B. Orient all three phase bus so they are arranged A-B-C left to right when facing front of equipment, A-B-C from top to bottom in vertical plane, and A-B-C from front to back where applicable.
- C. Tapering of bus systems is not permitted.
- D. Install in a compartment separate from the other wiring, and extended to each end for future expansion.
- E. Provide with removable compartment covers.
- F. Lexan sleeving shall be used for insulating the bus. Insulating boot coverings over the joints shall match the color of the bus sleeving and comply with the ANSI foil test.
- G. A full length, bare, silver-plated ground copper bus shall be provided and installed near the bottom of the unit line-up. It shall be 1/4 by 3 inches minimum in cross-section. In the feeder breaker units, provision shall be made for attachment of a NEMA 2-hole ground lug. The ground bus shall be securely bonded to the frame of each unit and shall have provision for grounding the entire assembly at each exterior end of the lineup. Extension provisions similar to those of the power buses shall be provided. Extend into the power cable entrance compartment of each unit and equip with a clamp connector for 4/0 -500 kcmil copper cable.
- H. All bus and live part supports shall be high-strength electrical grade wet process porcelain or cycloaliphatic epoxy having a BIL rating of 95-kV and shall be supported on 1/4" minimum GPO-3 polyester fiberglass sheets.

25.2.05 CONTROL POWER TRANSFORMER

- A. Fuses for Control Power Transformers shall be draw-out and key-locked with a secondary breaker to prevent access with the secondary breaker closed. Primary connections to the transformers shall be insulated and enter the compartment through porcelain or cycloaliphatic epoxy bushings. They shall be self-aligning, and shall have silver to silver contact surfaces. When moved to a full out position, the CPT fuses and/or windings shall be automatically connected to a ground stud. Control Power Transformer shall be sized to supply all equipment load requirements in the Electrical Equipment Enclosure and an additional 25-kVA capacity for equipment external to the enclosure. Secondary rating shall be 120/240 volt, single phase.
- B. Control Power Transformer Type: dry-type, manufacturer's standard.
- C. Power Fuse Type: high voltage current limiting.

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25.2.06 VOLTAGE TRANSFORMERS

- A. Each set of voltage transformers and their primary fuses shall be mounted in separate steel compartments. Primary connections to the transformers shall be insulated and enter the compartment through porcelain or cycloaliphatic epoxy bushings. Each set of voltage transformers and fuses shall be mounted on the tilt out steel carriage which will be capable of disconnecting the transformer fuses from their voltage source and removing them from the structure. This removing mechanism shall be so arranged that full access to the transformers cannot be accomplished until the fuses are disconnected from the structure and grounded. When moved to a full out position, the transformer fuses and VT windings shall be automatically connected to a ground stud. Primary contacts shall be insulated from the structure by porcelain or cycloaliphatic epoxy supports, shall be self-aligning, and shall have silver to silver contact surfaces. VT's shall be of the ratio indicated on the contract drawings and shall comply with ANSI C57.13.
- B. Fuse Type: high voltage current limiting type fuses.
- C. Impulse level: not less than 110-kV.
- D. Total number and location: As indicated on one-line diagram.
- E. Accuracy class: 0.3 for standard burdens of W, X, Y and Z ratings. Maximum ratio and phase angle errors when carrying full secondary burdens shall not exceed ANSI standard classifications.
- F. Fuse secondary circuits with dual element cartridge fuses mounted in barrier type fuse holders.

25.2.07 CURRENT TRANSFORMERS

- A. Type: dry, 600 volt insulation, 5 ampere secondary's.
- B. Impulse level: 10-kV full wave.
- C. Thermal and mechanical capabilities: at least equal to that of circuit breakers.
- D. Total number and location: As indicated on one-line diagram.
- E. Ratio: As indicated on one-line diagram.
- F. Metering accuracy: 0.3 using standard burdens of B-0.1, 0.2, and 0.5. Verify that accuracy will meet 0.3 class with actual connected meters and wiring.
- G. Relaying accuracy: C400 minimum.
- H. Wire all taps directly to shorting type terminal blocks.

25.2.08 SURGE ARRESTERS

- A. Type: substation class, metal oxide, mounted in each feeder breaker termination compartment.
- B. Rating: 8.4-kV nominal, MCOV.
- C. Connection to ground bus: 4/0 AWG copper conductor.
- D. Connection to breaker terminals: 4/0 AWG copper, 15-kV insulated cable.

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25.2.09 CABLE TERMINATORS

- A. Install in main and feeder breaker termination compartments of size and quantity indicated in these specifications.
- B. Provide slip-on terminators for use with 1/C, copper, 133 percent EPR insulated, shielded, jacketed cables:
 - 1. Rating: 15-kV, 110-kV BIL.
 - 2. Type: heat shrinkable, stress control, with insulation tubing, stress relief mastic, and heat activated sealant and solderless ground braid.
- C. Cable supports: sized to withstand maximum short circuit stresses specified for the switchgear assembly
- D. Connections: removable flexible braided copper connector links and hardware for transformer cable connections.
- E. Grounding: connect stress cones with ground braid termination.

25.2.10 WIRING

- A. Each switchboard line up shall be completely assembled, wired, and tested at the factory, including all buses, connections, insulators, cleats, terminals, and terminal blocks.
- B. Mount all relays, instruments, bases and equipment involving three-phase circuits so they are arranged A-B-C left to right when facing front of equipment, A-B-C from top to bottom in vertical plane, and A-B-C from front to back where applicable.
- C. All wireways shall be sized to provide a minimum of 40 percent spare capacity.
- D. All secondary wiring shall be 600 volt, type SIS stranded switchboard wire, No. 12 AWG or larger. It shall be UL Listed, Type VW-1, 90°C, tinned copper and provided with a permanent wire marking system identifying the "from-to" wire designation at each end of the wire. These designations shall match the wiring diagram.
- E. Current transformer secondary circuits shall be No. 10 AWG minimum.
- F. Use multi-strand Class K hinge wire where door opening requires bending in service.
- G. Connect power circuits to separate power terminal blocks.
- H. Connect current and voltage transformer leads to accessible terminal blocks before wiring to relaying, metering, or control devices.
- I. Provide an ungrounded two-wire, 125 VDC control bus integral with each switchgear cubicle.
- J. Provide 120 VAC supply bus integral with each switchgear cubicle.
- K. Secondary wiring shall be neatly formed, firmly secured, and terminated in approved molded-type terminal blocks conveniently located with respect to shipping splits and control conduit terminals.
- L. Terminal blocks shall be mounted such that the wires to them can be grouped and formed together in as neat and workmanlike manner. A sufficient number of terminal connections including 20

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percent of spare terminals shall be provided.

- M. Terminal blocks shall be GE type EB-25 or approved equal. Shorting blocks, type EB-27 or approved equal, shall be provided for current transformers. All terminal blocks shall be furnished with marking strips.
- N. Terminal blocks shall be mounted on brackets so that the blocks are oriented at a 45 degree angle with the cubicle side walls.
- O. Two-pole, pull-out disconnecting fuse blocks (with fuses) to be provided for each breaker to protect trip and close circuits and for control and auxiliary power circuits.
- P. All terminations shall be made with short-shank, non-insulated, ring-tongue terminal connectors. Crimp using AMP "Certicrimp" hand tools. There shall be a maximum of two conductors per terminal stud.
- Q. Provide the following alarm points to Programmable Automation Controllers:
 - 1. Building Door Open
 - 2. Building Temperature
 - 3. Building Fire
 - 4. Loss of Station Service
 - 5. Battery Charger
 - 6. Battery Hydrogen

25.2.11 ARC PROTECTION RELAY

- A. Provide and install arc detection relaying and all associated sensor fiber equipment. Relay shall protect all metal-clad compartments. Relay shall operate on light and current.

25.2.12 PROTECTIVE RELAYS

- A. Manufacturer: Schweitzer Engineering Laboratories.

25.2.13 INSTRUMENT, CONTROL, AND SELECTOR SWITCHES

- A. Manufacturer: Electros witch Series 24.

25.2.14 REMOTE TERMINIAL UNIT

- A. Manufacturer: Novatech Orion 5R or later version.

25.2.15 SATELLITE-SYNCRONIZED CLOCK

- A. Manufacturer: Arbiter Systems.

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25.2.16 MISCELLANEOUS COMPONENTS

- A. Provide black laminated plastic composition bevel edged nameplates with permanent white engraved lettering. Fasten to panel using small round head stainless steel screws. Install inside cubicle and cabinets with cement.
- B. Provide low drain, switchboard Light Emitting Diode (LED) type indicating lamp assemblies with integrally mounted resistor, complete with bulb and color cap, and suitable for AC or DC operation as necessary.

25.2.17 ACCESSORIES

- A. Provide special tools required for proper maintenance, testing and inspection of the metal-clad equipment.
- B. Provide crank for manually charging the stored energy closing mechanism.
- C. Provide 1,200 ampere grounding and test device.
- D. Provide lever for racking breakers to and from the connected positions.
- E. Provide two test plugs for each type of relay, test switch and meter.

25.2.18 SOURCE QUALITY CONTROL

- A. Assemble, adjust and complete manufacturer's routine production tests on each item of electric equipment in accordance with ANSI C37 and NEMA standards.
 - 1. Install each circuit breaker in its assigned unit after switchgear is fully assembled.
 - 2. Check each circuit breaker for correct operation of shutters, interlocks, auxiliary contacts, racking mechanisms, and ease of installation and withdrawal.
 - 3. Check the complete assembly for alignment and fit of enclosure panels, bus connections and clearances.
 - 4. Perform dielectric tests on wiring in accordance with referenced standards.
 - 5. Perform point-to-point circuit continuity tests.
 - 6. Check control switches for proper contact operation.
 - 7. Check device markings, nameplate markings, conductor identification and meter and instrumentation scales.
 - 8. Functionally test all AC and DC control circuits to verify proper operation. Simulate operation by applying AC currents and voltages to CT and VT circuits, and DC voltages to control circuits. Demonstrate proper operation of all circuits.

25.2.19 MANUFACTURER'S FIELD SERVICES

- A. Visually inspect Goods upon delivery. Prior to the Buyer accepting delivery, provide a written report to the Buyer and the Engineer itemizing any damage incurred.

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1. Verify operation of all equipment, breakers, AC and DC panels, battery charger, annunciator, air conditioning, heater, exhaust fans, AC outlets, exterior and interior lights, emergency lights, and light circuits.
 - a. Megger, Ratio, and Polarity test all CTs.
 - b. Additional tests as determined by the manufacturer.

END OF SECTION 25

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SECTION 26 SUBSTATION GROUNDING

SECTION 26 - PART 1 - GENERAL

26.1.01 SECTION INCLUDES

- A. Ground wire, ground rods, and connectors related to substation grounding.

26.1.02 RELATED WORK

- A. Section 11 - Excavation, Trenching, and Backfilling.

26.1.03 QUALITY ASSURANCE

- A. Perform all work in accordance with the requirements of the National Electrical Safety Code and National Electrical Code.

26.1.04 SUBMITTALS

- A. Manufacturers' literature indicating materials to be used on the project.

SECTION 26 - PART 2 - PRODUCTS

26.2.01 GROUND WIRE

- A. Use conductors of bare, soft-drawn or soft-annealed copper wire in accordance with ASTM B3, and tinned per ASTM B246.
- B. Class B stranding in accordance with ASTM B8 in sizes No. 1/0 AWG and larger.

26.2.02 GROUND RODS

- A. Furnish copper-clad steel or copper alloy sectional rods.
- B. Size: 3/4-inches by 10-feet.
- C. Provide rods as manufactured by Copperweld or ITT Blackburn.

26.2.03 CONNECTORS

- A. Below grade connections shall be CADWELD.
- B. Above grade connections shall be bolted.

SECTION 26 - PART 3 - EXECUTION

26.3.01 INSTALLATION REQUIREMENTS

- A. Owner will inspect all below grade connections prior to backfilling. Contractor will be required to uncover and reinstall all below-grade grounding that is covered before inspection by Owner.
- B. Protect all parts of grounding system against damage during construction. Observe provisions for temporary grounds as required by applicable safety codes.

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- C. Thoroughly clean surfaces of wire to be part of an electrical connection with steel wool, wire brush or emery cloth, if necessary.
- D. Thoroughly dry all surfaces before applying grounding electrodes or connectors.
- E. Route ground wire along the webs of columns and beams where possible for maximum physical protection.
- F. Do not use hold-down or foundation bolts for ground connections.
- G. Remove non-conductive protective coating and paint from the threads and contact surfaces of equipment ground pads, conduits and fittings before attaching grounding connection.
- H. Connect ground wire to conduit with clamps, straps or grounding bushings manufactured for this purpose.
- I. Ground all metallic conduits entering cable trenches.
- J. Do not run a ground cable through a metallic conduit.
- K. Do not run a ground cable through a hole or other opening in magnetic material.
- L. Drive ground rods vertically into the ground. Drilling and jetting are not acceptable methods. Drive rods into unexcavated portion of the earth where possible; where rods must be installed in excavated areas, drive rods into earth after the compaction of the backfill is completed.
- M. Separately ground all metal isolated from ground or not grounded through mechanical connection to other grounded equipment.
- N. Provide separate ground to panelboards, switchboard panels and other structure-mounted equipment.
- O. Ground the substation fence.
- P. Provide the following transformer grounds using soft-annealed or soft-drawn copper conductor:
 - 1. Single conductor to transformer neutral bushing using 500 kcmil copper.
 - 2. Two tank grounds in diagonally opposite corners at the base of the transformer using 500 kcmil copper.
 - 3. Single conductor for each voltage class of arrester looped through the grounding stud of each arrester and tied to the ground grid in two separate locations using 4/0 AWG copper.
- Q. Ground all frames and housings of electrical equipment, supporting structures, and fence.
- R. Ground grid conductors shall be located at a depth of 18 inches below the finished grade.
- S. No part of the ground grid shall be located within a foundation.
- T. Field measurements of the grounding system resistance and step & touch voltages shall be made and compared against the design values. The grounding system shall be modified as required to meet the design requirements.

END OF SECTION 26

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SECTION 27 SUBSTATION CALIBRATION AND TESTING

SECTION 27 - PART 1 - GENERAL

27.1.01 SECTION INCLUDES

- A. General Requirements.
- B. Contractor's Responsibility During Testing.
- C. Specific Tests and Checks Required.
- D. Miscellaneous Services During Startup.

27.1.02 RELATED WORK

- C. Section 21 - Substation Structures Erection.

27.1.03 QUALITY ASSURANCE

- A. Unless specifically noted to the contrary, furnish all equipment, materials, labor and testing in accordance with applicable sections of latest revisions of the following:
 - 1. Manufacturer's instructions.
 - 2. National Electric Testing Association (NETA).
 - 3. Institute of Electrical and Electronics Engineers (IEEE).
 - 4. American National Standards Institute (ANSI).
 - 5. National Electrical Manufacturers Association (NEMA).
 - 6. Insulated Cable Engineers Association (ICEA).
 - 7. Occupational Safety and Health Administration (OSHA).
 - 8. American Society for Testing and Materials (ASTM).
- B. If there are conflicts between listed codes and standards, Engineer will decide which codes and standards are applicable.

27.1.04 SUBMITTALS

- A. Record all test data on forms approved by Owner and submit test data in report form (six copies) to the Engineer.
- B. Manufacturer's tolerances for test data of Contractor furnished equipment.

27.1.05 QUALIFICATIONS

- A. Contractor shall have a 5-year record of satisfactory performance, shall have experience in testing comparable to the requirements of this Section and shall have successfully tested 3 projects similar in scope within the last 5 years.

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- B. Personnel assigned to the testing shall be experienced in high voltage electric power equipment testing and be familiar with the test equipment to be used and with safety rules, regulations and practices; or they shall work under the immediate and continuous supervision of a person who meets these qualifications.

SECTION 27 - PART 2 - PRODUCTS - NOT USED

SECTION 27 - PART 3 - EXECUTION

27.3.01 CONTRACTOR'S RESPONSIBILITY DURING TESTING

- A. Determine that all equipment is operational within industry and manufacturer's tolerances, is installed in accordance with design specifications, and is suitable for energization.
- B. Furnish, install and maintain all tools, material, test connections and power.
- C. Furnish all personnel and standby labor required for testing and adjusting all electrical facilities and their component parts.
- D. Provide adequate protection to all personnel during tests.
- E. Test equipment to be used shall be capable of testing to within industry and manufacturer's tolerances, with accuracy traceable to the National Bureau of Standards. The testing organization shall have a formal instrument calibration program.
- F. Avoid overstressing the equipment under test, or other equipment connected to it, in any way.
- G. Unless specifically waived, perform tests in presence of the Owner or its representative.
- H. Perform tests so as to assure installation is sound and will function as intended.
- I. Advise Owner immediately of any discrepancy or failure of a device on test. Failures which are corrected by minor adjustment need not be so reported but must be noted in test report.
- J. Correct all wiring errors found and make minor adjustments to equipment as required to enable it to pass tests.
- K. Record all test information on forms to be approved by Engineer.

27.3.02 SPECIFIC TESTS AND CHECKS REQUIRED

- A. Equipment tests:
 - 1. Instrument Transformers:
 - a. Ratio and Polarity Test.
 - 2. Grounding grid:
 - a. Visual inspection.
 - b. Connection resistance (2 point method).
 - c. Grid resistance to remote ground (fall-of-potential method).

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3. Control Building - Perform all functional tests recommended by the manufacturer for the:
 - a. Battery system.
 1. Visual and Mechanical Inspection.
 - i. Inspect for physical damage and evidence of corrosion.
 - ii. Check intercell bus link integrity.
 - iii. Confirm that installation complies with drawings and specifications.
 2. Electrical Tests - Refer to ANSI/IEEE Standard 450 (lead) or ANSI/IEEE Standard 1106 (nickel-cadmium).
 - i. Measure bank charging voltage and each individual cell voltage.
 - ii. Measure electrolyte specific gravity and visually check fill level.
 - iii. Verify proper charging rates from charger during recharge mode.
 - iv. Verify individual cell acceptance of charge during recharge mode.
 3. Test Values
 - i. Compare measured values to manufacturer's specifications.
 4. Verify proper operation of the battery charger in accordance with the manufacturer's recommendations.
 - i. Check operation of indicating meter and calibrate if necessary.
 - ii. Check generation of alarms.
 - iii. Verify proper charging voltage.
 - iv. Verify proper supply voltage connection.
 - b. Building emergency lights:
 1. Verify proper operation and charging of each light assembly.
 - c. Ventilation systems:
 1. Verify proper operation of building HVAC unit.
 2. Verify proper operation of battery ventilator.
6. Relay Panels
 - a. Check each terminal connection for tightness.
 - b. Verify proper installation of shorting provision in test switches and test blocks.
 - c. Verify proper operation of all electrically operated switches.

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7. Power Transformers:
 - a. Perform the following tests:
 - 1) Inspect physical and mechanical condition.
 - 2) Verify that cooling fans and pumps operate correctly.
 - 3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with NETA ATS 1995.
 - 4) Verify correct liquid level in all tanks and bushings.
 - 5) Verify that positive pressure is maintained on nitrogen-blanketed transformers.
 - 6) Perform specific inspections and mechanical tests as recommended by manufacturer.
 - 7) Verify correct equipment grounding.
 - b. Electrical Tests:
 - 1) Perform insulation-resistance tests, winding-to-winding and each winding-to-ground with test voltage in accordance with NETA ATS 1995. Test duration shall be for ten minutes with resistances tabulated at 30 seconds, one minute, and ten minutes. Calculate polarization index.
 - 2) Perform a turns-ratio test on all no-load tap-changer positions and all load tap-changer positions. Verify that tap setting is as specified. Verify that winding polarities are in accordance with nameplate.
 - 3) Perform insulation power-factor/dissipation-factor tests on all windings and correct to 20° Celsius in accordance with test equipment manufacturer's instructions.
 - 4) Perform power-factor/dissipation-factor tests (or hot collar watts-loss tests) on bushings and correct for 20° Celsius in accordance with test equipment manufacturer's instructions.
 - 5) Measure resistance of each high voltage winding in each no-load tap-changer position. Measure resistance of each low-voltage winding in each load tap-changer position, if applicable.
 - 6) If core ground strap is accessible, measure core insulation resistance at 500 VDC.
 - 7) Perform vacuum bottle integrity test (over potential), if applicable, across each vacuum bottle with the contacts in the open position in strict accordance with manufacturer's published data. DO NOT EXCEED MAXIMUM VOLTAGE STIPULATED FOR THIS TEST.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

c. Test Values:

- 1) Bolt-torque levels shall be in accordance with NETA Standards unless otherwise specified by the manufacturer.
- 2) Insulation-resistance values at one minute should not be less than values recommended by NETA. Resistance values shall be temperature corrected in accordance with NETA.
- 3) The polarization index should be compared to previously obtained results.
- 4) Turns ratio test results shall maintain a normal deviation between each voltage step and shall not deviate more than 1/2-percent from the calculated voltage ratio.
- 5) Maximum winding insulation power factor/dissipation factor of liquid-filled transformers corrected to 20°C shall be in accordance with manufacturer's specifications.
- 6) Consult manufacturer if winding-resistance test results vary more than 1 percent from test results of adjacent windings.

B. System and Functional Tests:

1. After station has been energized and load placed on substation, perform an infrared scan at night of all high voltage equipment and connections. Provide report detailing procedure, areas inspected, load conditions during test and photographs or thermograms of areas tested.
2. Perform insulation resistance (Meggar) test on all 600V cables (control, status, AC, DC, CT, VT).

27.3.03 MISCELLANEOUS SERVICES DURING STARTUP

A. Equipment Protection:

1. After equipment has been tested and checked for operation, the Contractor shall be responsible for proper protection of the equipment to make sure that subsequent operation and testing of other equipment and systems does not disturb, damage, or otherwise interfere with the functional capability of the equipment.

END OF SECTION 27

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

SECTION 28 RECENT SOIL REPORTS FOR INFORMATION

SECTION 28 - PART 1

28.1 Big Pine Substation

SECTION 28 - PART 2

28.2 Stock Island Generation Facility Substation 1995

SECTION 28 - PART 3

28.3 Stock Island Generation Facility Substation 2005

END OF SECTION 28

September 10, 1999

The Utility Board of The City of Key West
Engineering Department
1001 James Street
Key West, Florida 33040

Attention: Mr. Dave Gerstenkorn, P.E.
Project Engineer

Re: Subsurface Exploration and
Foundation Evaluation
Big Pine Key Substation Expansion
Proposed Building Expansion
Auxiliary Equipment, and
Pipe Support Foundations
Big Pine Key, Florida

PSI Project No. 397-95102

Dear Mr. Gerstenkorn:

Professional Service Industries, Inc. has conducted a subsurface exploration and foundation evaluation for the proposed building expansion, auxiliary equipment, and pipe support foundation structures to be constructed within the premises of the existing Big Pine Key Substation in Big Pine Key, Florida. Our services were provided in accordance with PSI Proposal No. 397-993, dated July 21, 1999. Authorization for our services was provided by The Utility Board of The City of Key West through a Purchase Order No. 003969 dated August, 1999.

A summary of our findings and recommendations for the proposed structures is provided in the Executive Summary section of this report. The results of this exploration, together with our recommendations for the foundation design and site preparation, are to be found in the accompanying report.

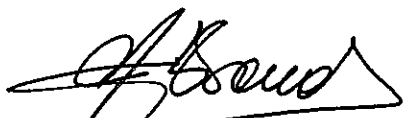
The Utility Board of The City of Key West
Engineering Department
PSI Project No. 397-95102

Often, during design and construction of a project, questions arise concerning the subsurface conditions. PSI would be pleased to continue its role as Geotechnical Engineer during the project implementation.

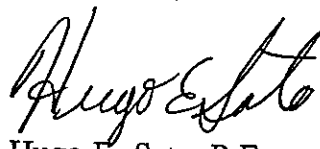
We appreciate the opportunity to work with you on this project. Please do not hesitate to contact the undersigned if you have any questions or if you need additional information.

Sincerely,

PROFESSIONAL SERVICE INDUSTRIES, INC.



Mustapha A. Abboud, E.I.
Project Geotechnical Engineer



Hugo E. Soto, P.E.
Senior Geotechnical Engineer
Florida Registration No. 36640

MAA/HES/ec

cc: Addressee (3)
File (1)



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1.0 EXECUTIVE SUMMARY

Exploration and evaluation of the subsurface conditions have been made at the site for the proposed Big Pine Key Substation expansion structures to be constructed within the premises of the existing Big Pine Key Substation facility in Big Pine Key, Florida. Test borings have been drilled and the samples of materials recovered from the borings have been visually examined and classified. The data have been carefully evaluated in light of the project information provided to us.

The results of the exploration and evaluation indicate that the subgrade conditions at the site lend themselves for support of the proposed structures employing shallow foundations; however, given the near coastal setting of the project site and the potential effect of hurricane storm surge using a shallow foundations, a deep foundation system is required for support of the structures. Drilled shafts is a suitable deep foundation system for support of the structures and one that offers good support to axial loads. The site stratigraphy and our recommendations for foundation design and related construction are summarized below.

- The test boring locations (B-1 through B-3) are mantled by six (6) to eight (8) inch layer of granular fill materials consisting of limerock with fine sand. Underlying the fill, a three (3) to four (4) inch layer of sandy silt was encountered at borings B-2 and B-3. Below the fill and silt is a deposit of moderately well to weakly cemented limestone formation that persisted to the maximum depths explored of 40 feet.
- The proposed structures may be supported on drilled shafts which are socketed three (3) feet into the moderately well cemented limestone formation existing at about 0.5 to 1.0 foot below existing ground surface. An allowable compression capacity of 30 tons can be achieved using 18-inch diameter drilled shafts.
- Ground floor slabs may be constructed as conventional slab-on-grade and can bear on compacted structural fill.
- The owner/designer should not rely solely upon the executive summary and must read and evaluate the entire contents of this report prior to utilizing our engineering recommendations in the preparation of design and construction documents.



2.0 INTRODUCTION

2.1 Authorization

This report presents the results of a subsurface exploration and foundation evaluation for the proposed building expansion, auxiliary equipment and pipe support foundation structures to be constructed within the premises of the existing Big Pine Key Substation in Big Pine Key, Florida. Our services were provided in accordance with PSI Proposal No. 397-993, dated July 21, 1999.

Authorization to perform this exploration and evaluation was provided by The Utility Board of The City of Key West, through a Purchase Order No. 003969 dated August 3, 1999.

2.2 Purpose

The purpose of this geotechnical study was to evaluate the subsurface and groundwater conditions at the site and to recommend a type and depth of foundation system suitable for support of the proposed structures as well as to provide criteria for the architects and engineers to use in preparing the foundation design.

2.3 Scope

The scope of this study included subsurface exploration, field testing, engineering analysis and evaluation of the foundation materials.

The scope of services did not include an environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements which appear in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.



2.4 General

The general analysis of the foundation conditions reported herein is considered sufficient in detail and scope to form a reasonable basis for the foundation design. The recommendations submitted for the proposed structures are based on the available subsurface information and the design details furnished.

If there are any revisions to the plans for the proposed structures, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be retained to determine if changes in the foundation recommendations are required. If PSI is not retained for these functions, PSI will not be responsible for the impact of those conditions on the performance of the proposed structures.

3.0 PROJECT DESCRIPTION

Based on the information provided, we understand that the proposed project will involve the construction of a one-story building expansion; 20 by 20 feet in footprint area, the construction of an auxiliary equipment structure; 30 by 14 feet in footprint area, and pipe support column foundations within the premises of the existing Big Pine Key Substation in Big Pine Key, Florida. We also understand that due to the setting of the project site in a coastal construction zone subject to seasonal hurricane activities, the proposed structures are to be supported on a deep foundation system socketed a minimum of 3 feet into the natural rock formation.

We also understand based on the structural plans provided to us, the existing structures are supported on a deep foundations comprising of 36-inch drilled shafts with ten feet embedment below existing grades.

The unit transformer will be about 140,000 pounds; however, structural information has not been provided to us regarding the building expansion and pipe supported columns; therefore, we are assuming that column and wall loads for the structures do not exceed 120 kips and 5 kips per lineal foot, respectively. In addition, we are assuming that the slab floors will be constructed as conventional slab-on-grade with loads not exceeding 250 pounds per square foot (psf).



We have been provided with the following drawings:

- 1- Boundary of Topographical Survey
(Showing proposed boring locations and structures footprints)
Prepared by: Frederick H. Hildebrandt
Provided by: The Utility Board of The City of Key West
Dated: May 7, 1999
Scale: 1" = 20'
- 2- Set of Foundation Plans (DWG Nos. 41, 64 & 68)
(Showing existing facility structure foundations)
Prepared by: CE Maguire, Inc.
Provided by: The Utility Board of The City of Key West
Dated: February 1985 (DWG No. 41) and
March 1983 (DWG Nos. 64 & 68)

Based on the information provided, the existing ground surface elevation in the construction area ranges approximately between +5 and +8 feet (NGVD). A finished grade elevation of about +10.0 (NGVD) feet is planned for the proposed construction. Thus, the site will be raised 2.0 to 5.0 feet above existing grade prior to foundation construction.

4.0 DESCRIPTION OF SITE

4.1 Site Location

The site for which this subsurface exploration has been made is within the property of the existing Big Pine Key Substation Facility located in the northwest quadrant of Country Road and Eduardo Road in Big Pine Key, Florida. We have appended a Site Vicinity Map which identifies the location of the site with respect to existing streets and landmarks. This map is presented on Sheet 1 in the Appendix.



4.2 Site Conditions

The site conditions were observed by a representative of PSI on August 24, 1999. The subject expansion areas are mantled with limerock fill and scattered grass located within the fenced premises of the Big Pine Key Substation. No standing water was observed at the site.

The truck mounted drilling equipment used for the subsurface exploration did not experience any difficulty in moving around the site.

5.0 FIELD EXPLORATION

The field exploration to evaluate the engineering characteristics of the foundation materials included reconnaissance of the project site, drilling of the test borings, performing Standard Penetration Tests and recovering split spoon samples. Water level measurements were recorded in each of the test borings after their completion.

Three (3) Standard Penetration Test (SPT) borings were drilled for the project. SPT Borings B-1 through B-3 were drilled within the footprint area of the proposed building expansion and auxiliary equipment. The borings were extended to depths of 40 feet below the existing ground surface. The boring locations were selected by The Utility Board of The City of Key West and PSI. These locations are shown on the Boring Location Plan (Sheet 2) provided in the Appendix. The procedures used for drilling, sampling, and conducting field tests and measurements are also discussed in the Appendix. After completion of the test borings, the drill holes were backfilled with excavated soil and the site was cleaned as required.



6.0 SUBSURFACE CONDITIONS

6.1 General

Subsurface materials encountered in the borings have been visually examined and classified and are described on the boring logs presented in the Appendix. The results of the Standard Penetration Tests and water level observations are also presented on the boring logs.

Representative samples of the materials recovered from the borings were placed in sample jars. They are now stored in the laboratory for further analysis if desired. Unless notified to the contrary, all samples will be disposed of after 60 days.

The stratification of the profile components as shown on the boring logs represents the subsurface conditions at the actual boring locations. Variations may occur within a short distance from the borings. Lines of demarcation represent the approximate boundary between the types of materials encountered, but the transition may be gradual, or not clearly defined.

It is to be noted that, whereas the test borings are drilled and sampled by experienced drillers, it is sometimes difficult to record changes in stratification within narrow limits.



6.2 Soil/Rock Conditions

The test boring locations (B-1 through B-3) are mantled by six (6) to eight (8) inch layer of granular fill materials consisting of limerock with fine sand. Underlying the fill, a three (3) to four (4) inch layer of sandy silt was encountered at borings B-2 and B-3. Below the fill and silt is a deposit of moderately well to weakly cemented limestone formation that persisted to the maximum depths explored of 40 feet.

A detailed description of the soil interlayering is provided on the boring logs given in the Appendix. The Standard Penetration Test N-values are used to evaluate the relative density of granular soils. The correlation of penetration resistance with relative density is presented in the Appendix.

6.3 Groundwater Conditions

Groundwater levels were measured in the open boreholes upon completion of the drilling and sampling activities. The water levels measured in the borings ranged from 3.9 to 4.3 feet below existing ground surface. However, please note that groundwater levels fluctuate as a function of tides, barometric conditions and rainfall. Under normal tidal barometric and rainfall conditions, we expect that the groundwater table may rise by one (1) foot or slightly more above the level determined in the borings. During severe hurricane storms, it is conceivable that the groundwater table may be at final grades.

7.0 FOUNDATION EVALUATION

The subsurface conditions of the site lend themselves to support of the building expansion, auxiliary equipment structure and pipe supporting columns employing shallow/mat foundations. We understand that a deep foundation system is required given the near coastal setting of the site, and the potential effects of hurricane storm surge when using a shallow foundation system. The principal effect of hurricane storm surge is scour, which can lead to the undermining of ground supported facilities (such as foundations), and hydrodynamic forces which can induce both lateral and uplift loads upon a structure.



In lieu of a ground supported shallow/mat foundations, we recommend that the structures be supported on drilled shafts which utilize the moderately well cemented limestone formation existing at depths ranging from 6 to 12 inches below the existing ground surface at the time of the field exploration. Drilled shafts will provide good support to axial loads imposed by the structures and be resistant to undermining. Design criteria for the drilled shafts are provided in the following section of the report.

8.0 FOUNDATION RECOMMENDATIONS

8.1 Drilled Shaft Foundation Design

We recommend that the proposed structures be supported on drilled shafts which are socketed into the limestone formation that exists at depths ranging from of 6 to 12 inches below the existing site grade. Drilled shafts socketed into the limestone will mobilize their resistance principally in side shear (i.e. a combination of mechanical interlock and chemical bond) that is developed over the length embedded in the carbonate rock formation.

The following table summarizes our recommendations for minimum rock penetration and embedment to develop the axial compression capacities for this type of pile.

DRILLED SHAFTS
Summary of Allowable Axial Capacities

DIAMETER (INCHES)	ALLOWABLE COMPRESSION CAPACITY (TONS)	ALLOWABLE UPLIFT CAPACITY (TONS)	ALLOWABLE LATERAL CAPACITY (TONS)	MINIMUM ROCK PENETRATION (FEET)
18	30	15	2	3

Note: The shaft embedments below final grades will be dependent on the thickness of the layer of fill added to bring the site to its final grades. We estimate the total shaft embedment length could be up to 8 feet.



The design capacity refers to dead and normal live loads and may be increased by 25 percent for total loads, including wind forces. The above pile capacity is a function of stresses mobilized in the subsurface materials only. Structural stresses developed in the pile cross section may impose a more severe limitation on the pile capacity and should be verified. Total and differential settlements of the pile supported structure should be minimal.

8.2 Foundation Settlement

Based on the compression loads to be imposed on the foundation by the proposed structures we estimate that the total settlement for the drilled shafts will be less than one-half (1/2) of an inch.

9.0 CONSTRUCTION CONSIDERATIONS

9.1 Site Preparation

Initial site preparation in the construction area should consist of the stripping of the existing grass and any unsuitable material existing at the site. After stripping, the surface soils should then be densified prior to the placement of the fill needed to achieve the finished grades.

9.2 Drilled Shaft Installation

The stratigraphic profile of the site consists of limerock fill and fine sand underlain by 3 to 4 inches of sandy silt followed by the limestone formation to the terminal depth of exploration. It has been our experience that drilled shaft construction in this profile using the wet method of installation does not require the use of temporary casing; however, slurry might be required in order to preserve the stability of the fill layer which will bring the site to its final grades as part of the site preparation prior to drilled shaft construction.



We recommend that the slurry level (if required during construction) be maintained at the ground surface. We also recommend that the properties of the slurry be maintained within the ranges presented below:

Recommended Drilling Slurry Properties

Property	Test Method	Range of Results @ 20° C
Viscosity	Marsh cone funnel	28 to 40 seconds
PH	pH indicator paper strips	8 to 11
Density	Mud density balance	70 to 75 pcf

We recommend that the mineral slurry be premixed with clean water prior to introduction into the shaft excavations. The premixing of the drilling slurry may be done in either a slurry tank or in a pit excavated in the project area.

The mineral slurry should be slowly circulated and screened of all coarse fragments. The entire shaft excavation should be filled with a uniform suspension that prevents the accumulation of coarse cuttings at the bottom. A bailing bucket should be used to remove any residual cuttings in the shaft bottoms that are not removed by slurry circulation.

Concrete placement should be done using the wet method of installation. The concrete should be placed continuously utilizing a tremie pipe or a concrete pump. A 4000 psi compressive strength concrete with a 7 to 9-inch slump is generally used and has been found to achieve acceptable results. During the concrete placement, displaced slurry and the drill cuttings should be allowed to overflow into an excavated pit. Pumping of the slurry from the shaft during concrete placement should not be allowed.



The concrete head in the tremie pipe should always exceed the fluid or slurry level in the drilled shaft. Initial concrete placement should be performed with the tremie pipe within two inches of the shaft bottom. The tremie should remain always embedded in the fresh concrete until concrete placement has been completed. Concrete placement using pumped concrete should be performed in a similar manner.

We recommend that a geotechnical engineer familiar with the subsurface conditions of the site monitor the installation of the drilled shafts. The monitoring is essential to verify that the shafts are installed properly to meet both the design criteria and the design intent.

9.3 In-Situ Densification of Soils

Compaction of the in-place granular fill in the proposed structure footprints plus a five (5)-foot wide perimeter extending beyond the outer lines of the structure areas, where practical, should be accomplished with a self-propelled vibratory roller which imparts a dynamic force of not less than 20,000 pounds. To minimize the effects of compaction induced vibrations on adjacent existing structures, the compaction operation should be limited to a maximum distance of 25 feet from the existing structures. The maximum drum roller weight to be used between five (5) to 25 feet from the existing structures should be limited to four (4) tons. For distances of less than five (5) feet, walk behind vibratory sled or rollers should be used. Compaction of the bearing surface using this equipment should continue until no further vertical settlement of the surface is visually discernible.



9.4 Structural Fill and Backfill

Proper control of the placement and compaction of new fills for the project should be exercised by a representative of the Geotechnical Engineer. The fill materials should be placed in lifts not exceeding 12 inches in loose thickness. Each lift should be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density near the optimum moisture content as determined by ASTM D-1557. Fill to be compacted with a vibratory plate or a small walk behind vibratory roller should be placed in lifts not exceeding six inches in loose thickness.

It is imperative that any fill supporting slab-on-grade structures be placed, compacted and tested in accordance with the specifications of this report in order to adequately support the footing and floor slab loads. The tests should be performed by a qualified soils technician working under the supervision of a Geotechnical Engineer in accordance with appropriate ASTM procedures. Any fill indicating less than the recommended relative compaction should be recompacted until the required density is obtained prior to the placement of subsequent lifts or concrete for substructures.

The engineered fill should be free of organic matter and consist of granular material containing less than 12 percent passing the U.S. Standard No. 200 mesh sieve. The fill material may be composed of either clean sands or crushed limerock. The crushed limerock should have no particle size in excess of three inches. Structural fill should have a Unified Soil Classification System designation of GP, GW, SW, GP-GM, GW-GM, SW-SM or SP-SM.



9.5 Groundwater Control

Based on the water level measurements made during the drilling operations, dewatering will probably not be required for site preparation and drilled shaft construction. If required, however, groundwater can generally be lowered one to two feet by pumping from barrel sumps located in perimeter ditches or pits. All sump inlets should be located outside the bearing areas to avoid loosening the surrounding soils. The groundwater level should be maintained at least one foot below the bottom of any excavations made during construction and two feet below the surface upon which vibratory compaction operations are conducted.

10.0 GENERAL CONDITIONS

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein, have been presented after being prepared in accordance with general accepted professional practice in the field of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

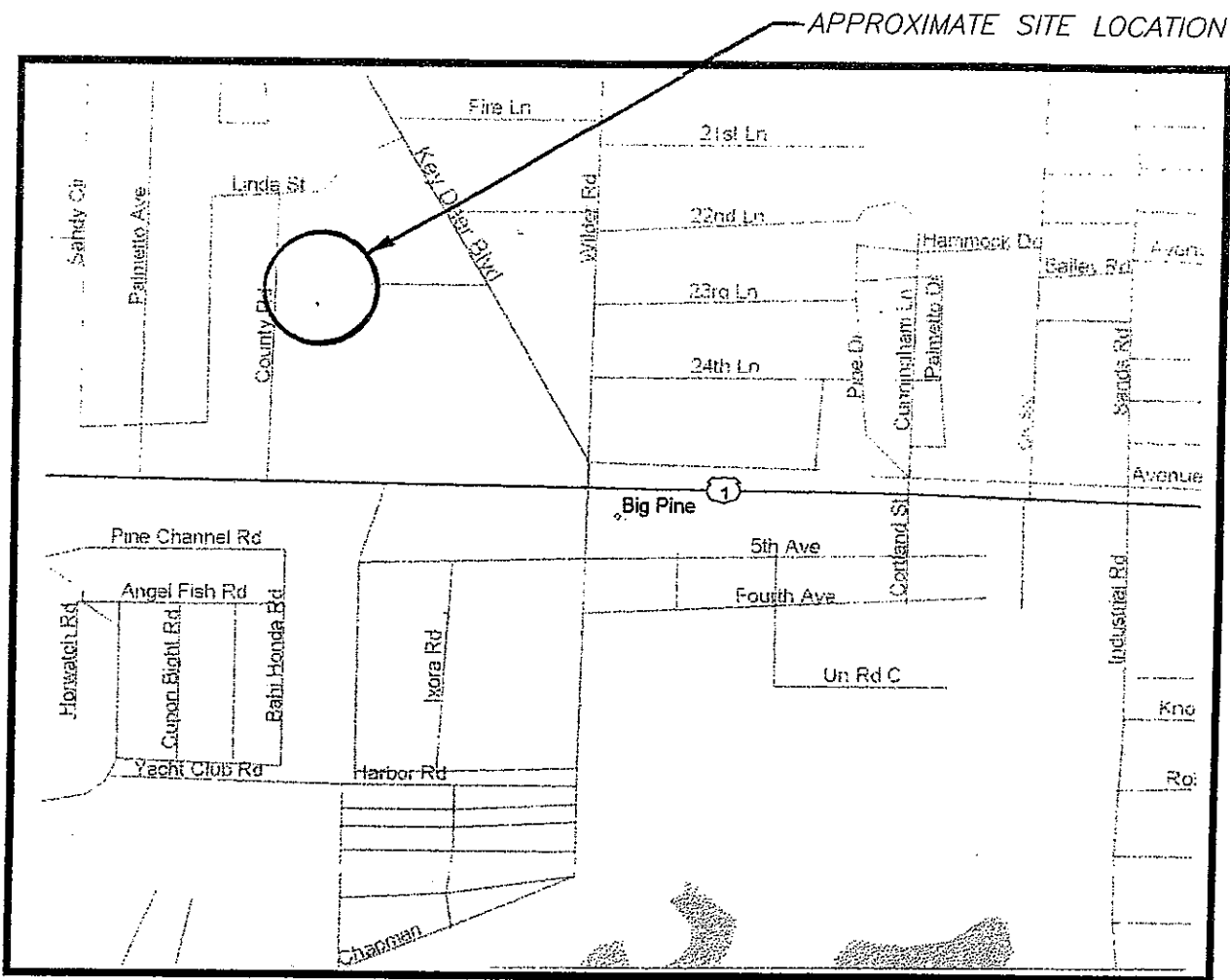
After the plans and specifications are complete, it is recommended that PSI be provided the opportunity to review the final design and specifications, in order to verify that the earthwork and foundation recommendations are properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations.

This report has been prepared for the exclusive use of The Utility Board of The City of Key West for the specific application to the proposed construction.



APPENDIX





REFERENCE: MICROSOFT EXPEDIA STREETS 98
SCALE: NOT TO SCALE

SITE VICINITY MAP

GEOTECHNICAL SERVICES
BIG PINE KEY ELECTRIC SUB-STATION EXPANSION

BIG PINE KEY, FLORIDA

DATE: AUG 99 SHEET 1 PROJ. NO: 397-95102

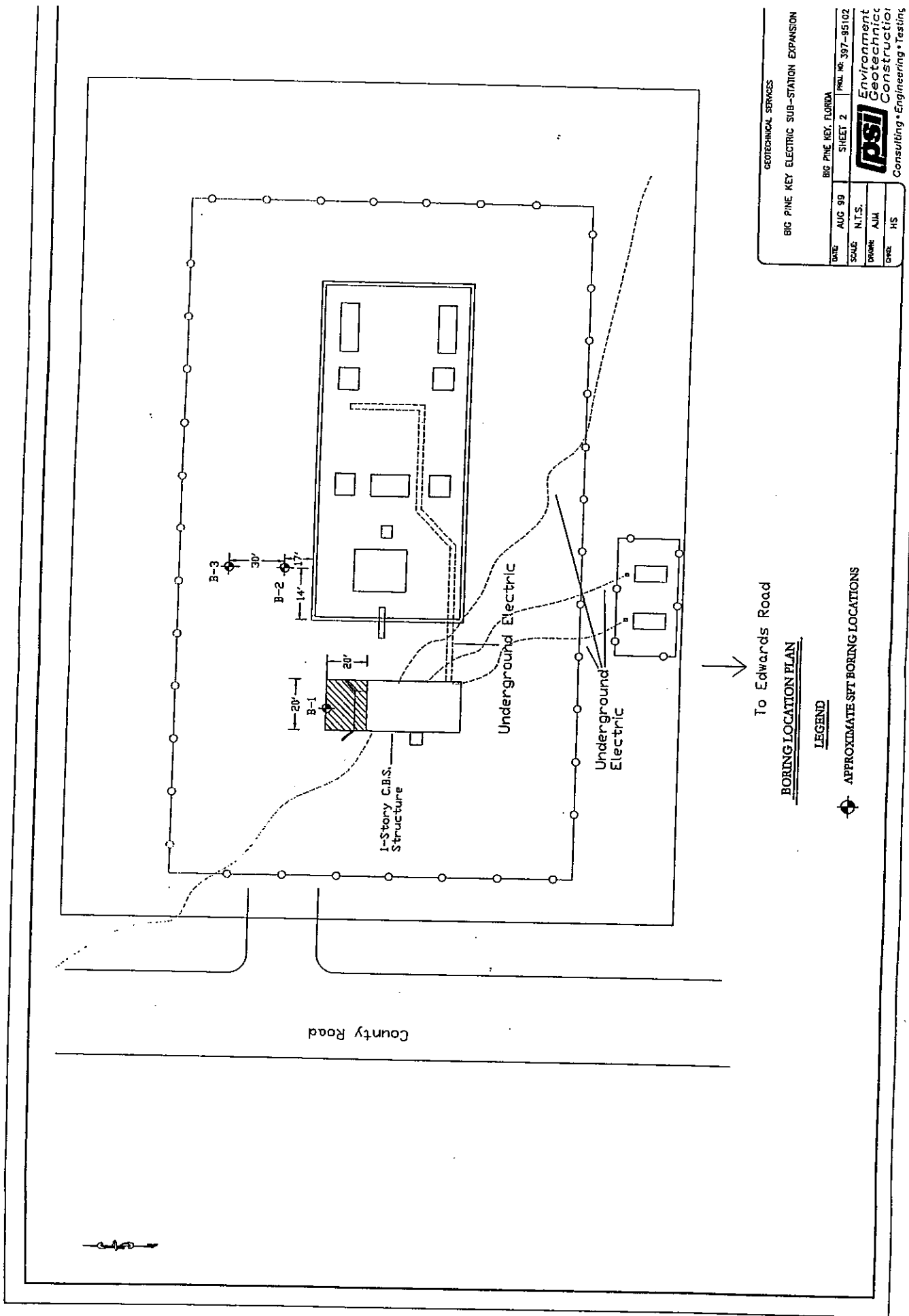
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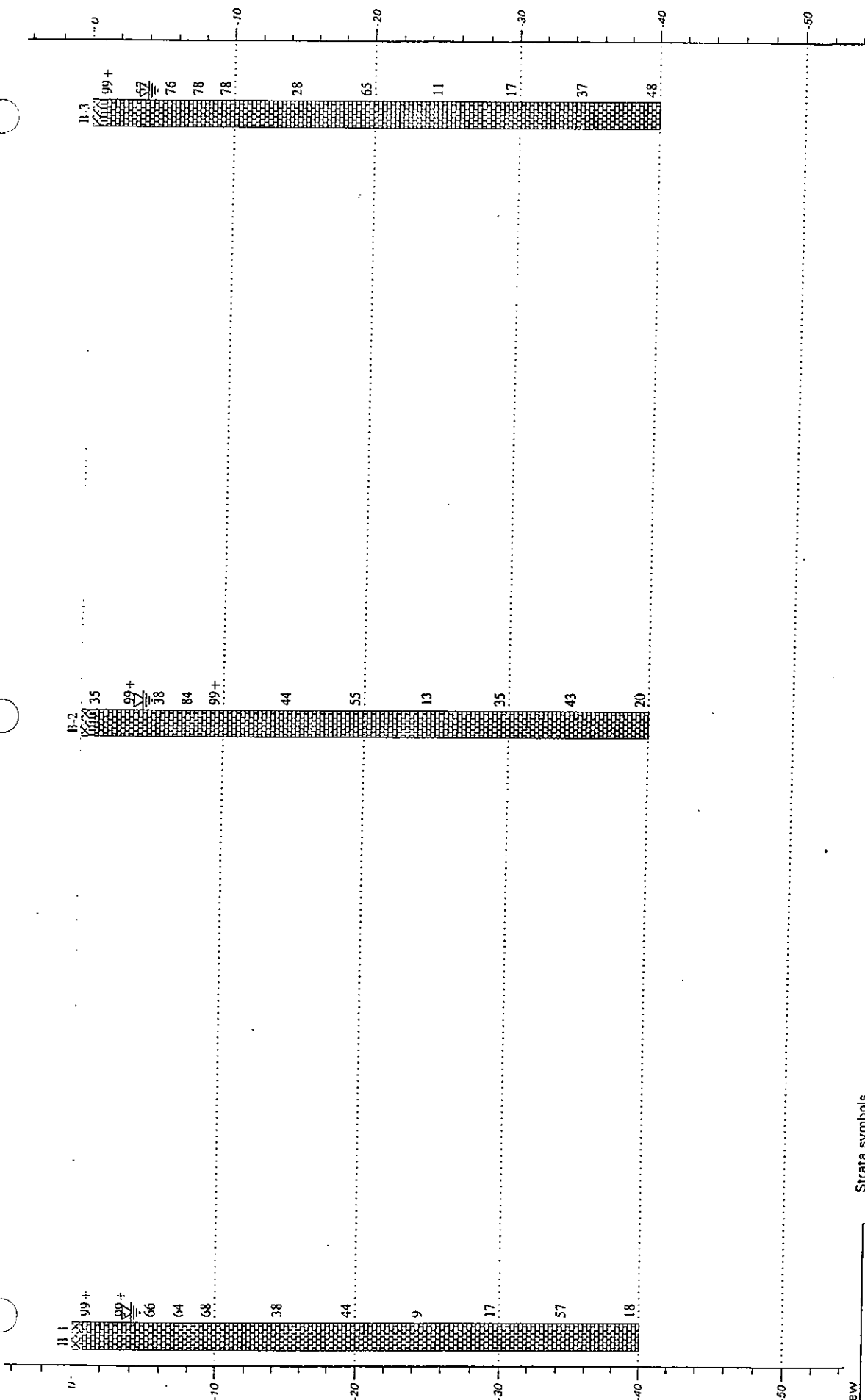
DRAWN: A.J.M.

CHKD: H.S.

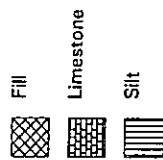


Environmental
Geotechnical
Construction
Consulting • Engineering • Testing





Strata symbols



PROFESSIONAL SERVICE INDUSTRIES, INC.
GENERALIZED SOIL PROFILE

HORIZONTAL SCALE: 1" = (unproportionally)
VERTICAL SCALE: 1" = (unproportionally)
DRAWN BY/APPROVED BY: AJM/MAA
DATE DRAWN: 9/10/1999

Big Pine Key Substation Expansion

Big Pine Key, Florida

PROJECT NO. 397-95102

FIGURE NUMBER

1

LOG OF BORING NO. B-1

Big Pine Key Substation Expansion

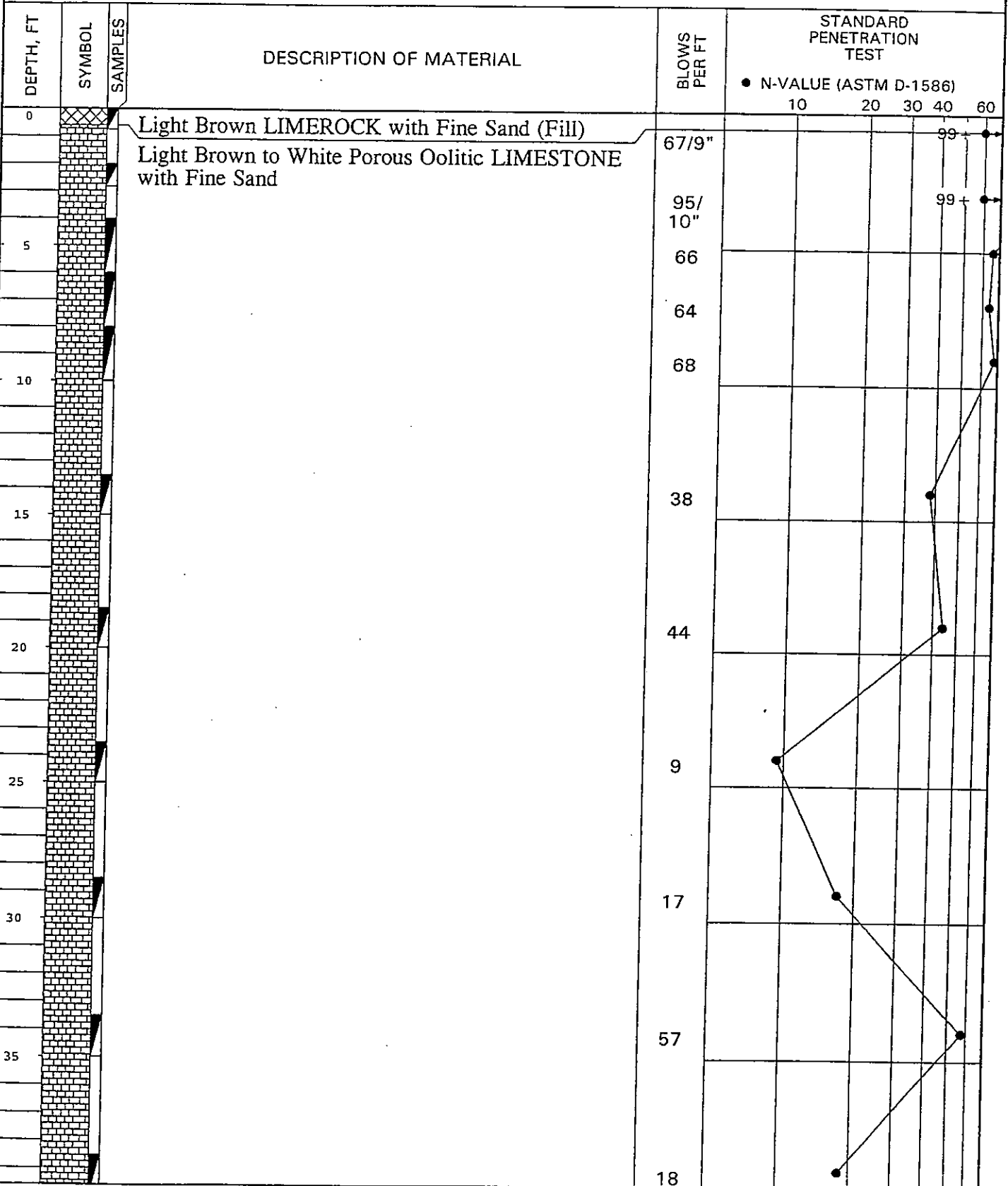
Big Pine Key, Florida

Client: The Utility Board of Key West

Project Number: 397-95102

Type: 2" Split Barrel

Location: See Attached Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8/24/99

IN BORING: 4.1'

LOGGED BY: OC

Big Pine Key Substation Expansion

Client: The Utility Board of Key West

Type: 2" Split Barrel

Location: See Attached Boring Location Plan

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8/24/99

IN BORING: 4.1'

LOGGED BY: _____ OC

KEYS Bid #12-T1 Specifications for
EPC of Dynamic Var Compensation
(DVC-Statcom System)

PROFESSIONAL SERVICE INDUSTRIES INC

LOG OF BORING NO. B-2

Big Pine Key Substation Expansion

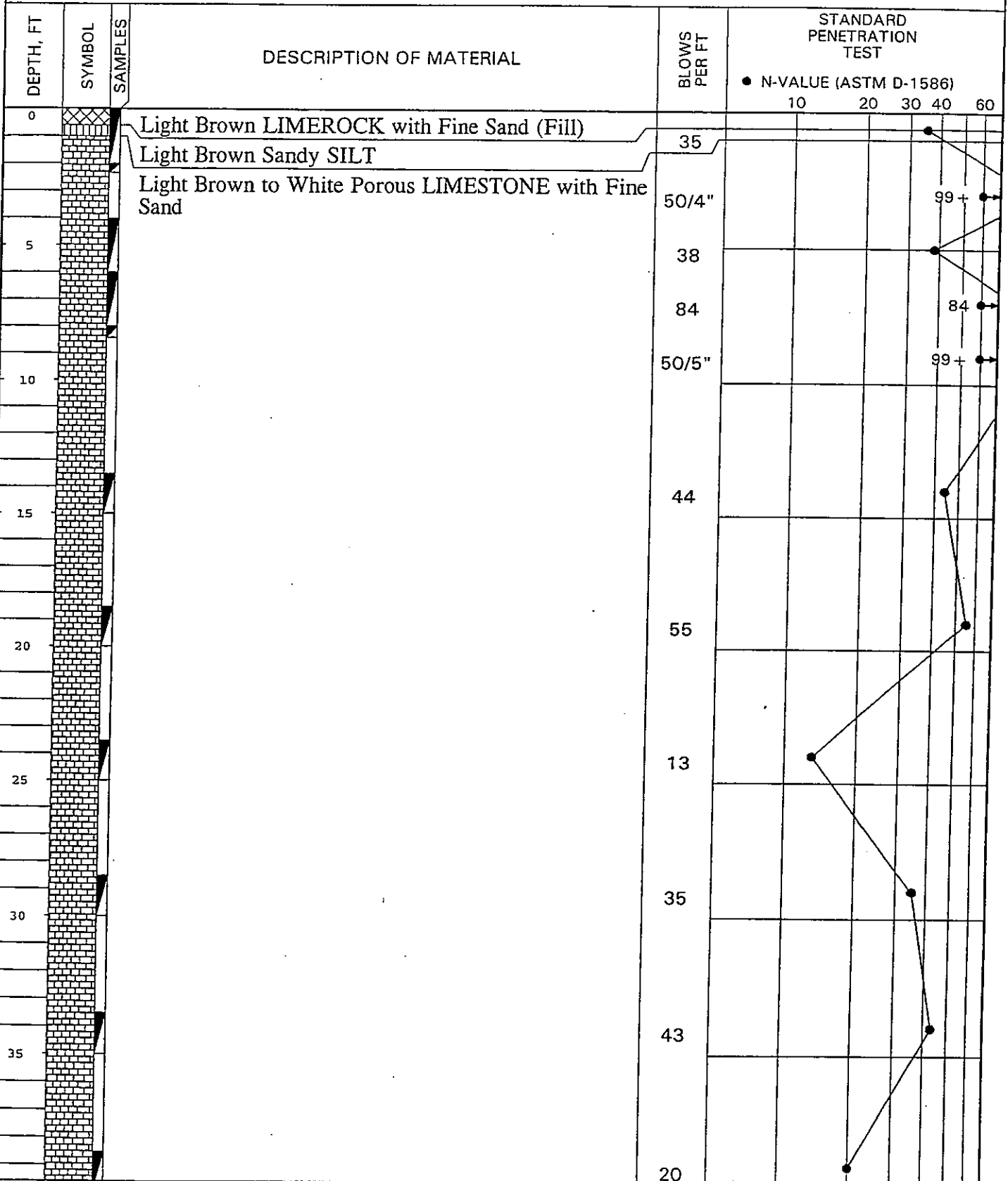
Big Pine Key, Florida

Client: The Utility Board of Key West

Project Number: 397-95102

Type: 2" Split Barrel

Location: See Attached Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8/24/99

IN BORING: 4.3'

LOGGED BY: OC

Big Pine Key Substation Expansion

Location: See Attached Boring Location Plan

KEYS Energy Services

LOG OF BORING NO. B-3

Big Pine Key Substation Expansion

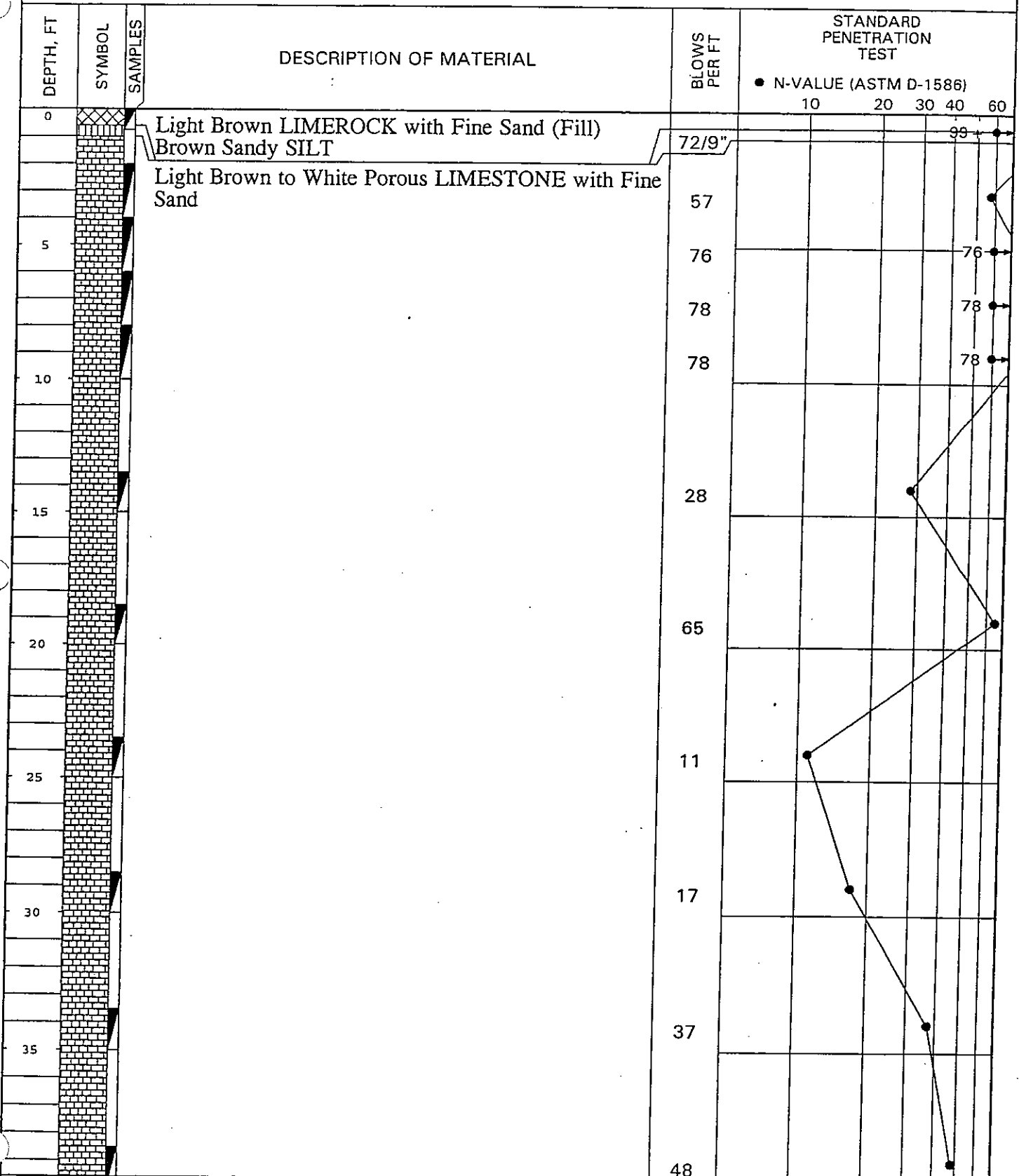
Big Pine Key, Florida

Client: The Utility Board of Key West

Project Number: 397-95102

Type: 2" Split Barrel

Location: See Attached Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8/25/99

IN BORING: 3.9'

LOGGED BY: OC

LOG OF BORING NO. B-3

Big Pine Key Substation Expansion

Big Pine Key, Florida

Client: The Utility Board of Key West

Project Number: 397-95102

Type: 2" Split Barrel

Location: See Attached Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST					
					● N-VALUE (ASTM D-1586)					
					10	20	30	40	50	60
40			Light Brown to White Porous Oolitic LIMESTONE with Fine Sand							
			End of Boring							
45										
50										
55										
60										
65										
70										
75										

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8/25/99

IN BORING: 3.9'

LOGGED BY: OC

CORRELATION OF PENETRATION RESISTANCE WITH
RELATIVE DENSITY OF GRANULAR SOILS

RELATIVE DENSITY	STANDARD PENETRATION TEST BLOWS/FT. (N-VALUE)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Over 50



DRILLING AND SAMPLING PROCEDURES

The test borings were performed with a drilling rig equipped with a rotary head. The drill holes were advanced by the use of a high speed rollercone bit, with bentonite drilling fluid being pumped through the drill rods to remove the cuttings and to stabilize the side walls and bottom of the hole. Representative samples were obtained by the use of split-barrel sampling procedures in general accordance with the procedures for "Penetration Test and Split-Barrel Sampling of Soils" (ASTM D-1586).

FIELD TESTS AND MEASUREMENTS

Penetration Tests - During the sampling procedure, standard penetration tests (SPT) were performed at pre-determined intervals to obtain the standard penetration value (N) of the soil. The standard penetration value (N) is defined as the number of blows of a 140 pound hammer, falling thirty (30) inches, required to advance the split-barrel sampler one (1) foot into the soil. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows are recorded for each of three (3) successive increments of six (6) inches penetration. The "N" value is obtained by adding the second and third incremental numbers.

Groundwater Level Measurements - Groundwater level depths were obtained during the test boring test operations. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. Seasonal variations, tidal conditions, temperature, land-use, and recent rainfall conditions may influence the depths to the groundwater.

Ground Surface Elevations - Ground surface elevations at the test boring locations were not provided. Therefore, all references to depth of the various strata and materials encountered, are from existing grade at the time of drilling.



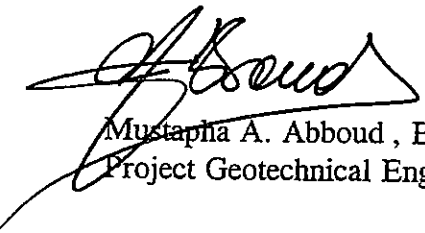
The Utility Board of The City of Key West
Engineering Department
PSI Project No. 397-95102

Often, during design and construction of a project, questions arise concerning the subsurface conditions. PSI would be pleased to continue its role as Geotechnical Engineer during the project implementation.

We appreciate the opportunity to work with you on this project. Please do not hesitate to contact the undersigned if you have any questions or if you need additional information.

Sincerely,

PROFESSIONAL SERVICE INDUSTRIES, INC.



Mustapha A. Abboud, E.I.
Project Geotechnical Engineer



Hugo E. Soto, P.E.
Senior Geotechnical Engineer
Florida Registration No. 36640

MAA/HES/ec

cc: Addressee (3)
File (1)



REPORT OF SUBSURFACE EXPLORATION

AND FOUNDATION EVALUATION

FOR

**PROPOSED COMBUSTION TURBINE,
AUXILIARY EQUIPMENT AND MONOPOLE TOWER
STOCK ISLAND, FLORIDA**

PREPARED FOR

UTILITY BOARD OF THE CITY OF KEY WEST

PSI PROJECT NO. 397-55093

August 28, 1995

Utility Board of the City of Key West
1001 James Street
Key West, Florida 33040

Attention: Mr. Dave Gerstenkorn
Planning Resource Engineer

Re: Subsurface Exploration and
Foundation Evaluation
Proposed Combustion Turbine,
Auxiliary Equipment and Monopole
Tower
Stock Island, Florida

PSI Project No. 397-55093

Dear Mr. Gerstenkorn:

Professional Service Industries, Inc. has conducted a subsurface exploration and foundation evaluation for the proposed combustion turbine, auxiliary equipment and monopole tower to be constructed at the Stock Island Generating Plant in Stock Island, Florida. Our services were provided in accordance with our proposals for subsurface exploration (PSI Proposal No. 397-255) dated July 7, 1995, and July 24, 1995 and (PSI Proposal No. 397-263) dated August 2, 1995.

A summary of our findings and recommendations is provided in the Executive Summary section of this report. The results of this exploration, together with our recommendations for the foundation design and site preparation, are to be found in the accompanying report.

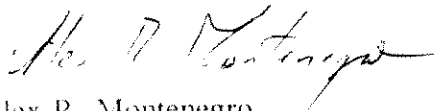
Utility Board of the City of Key West
August 28, 1995

Often, during design and construction of a project, questions arise concerning the subsurface conditions. PSI would be pleased to continue its role as Geotechnical Engineer during the project implementation.

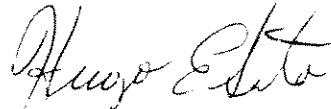
We appreciate the opportunity to work with you on this project. Please do not hesitate to contact the undersigned if you have any questions or if you need additional information.

Sincerely,

PROFESSIONAL SERVICE INDUSTRIES, INC.



Alex R. Montenegro
Project Geotechnical Engineer



Hugo E. Soto, P.E.
Senior Geotechnical Engineer
Florida Registration No. 36640

ARM/HES/TJT/em

cc: Addressee (3)
File (1)



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1.0 EXECUTIVE SUMMARY

Exploration and evaluation of the subsurface conditions have been made at the site for the proposed combustion turbine, auxiliary equipment and monopole tower to be constructed at the Stock Island Generating Plant in Stock Island, Florida. Test borings have been drilled and the samples of materials recovered from the borings have been visually examined and classified. The data have been carefully evaluated in light of the project information provided by Mr. Dave Gerstenkorn of the Utility Board of the City of Key West.

The results of the exploration and evaluation indicate that the subgrade conditions of the site do not lend themselves to support of the equipment employing a mat foundation because of the low strength and high compressibility of a silt layer existing between depths of 4 to 8 feet below grade. Safe use of a mat foundation will necessitate that the surface fill that covers the site and the underlying weak fine grained soils be exchanged for well compacted granular fill. However, we understand that a deep foundation system is preferable to support the equipment. Augercast piling is the most suitable deep foundation for support of the turbine and auxiliary equipment and one that offers good support to axial loads imposed by the structures. With regard to the 100-foot monopole tower, the most suitable deep foundation for this structure is a drilled shaft foundation (caisson). The site stratigraphy and our recommendations for foundation design and related construction are summarized below.

- The test boring locations are mantled by 4 to 6 feet of granular fill materials. The fill materials consist of limerock with fine sand. Underlying the fill materials are very soft silts which continue to a depth of 8 feet. A two foot layer of silty fine sand was encountered beneath the fill at two boring locations and was followed by the soft silts to a depth of 8 feet. Below the silts is a deposit of weakly to well cemented limestone that continues to the maximum depth explored.
- Foundations for the turbine and auxiliary equipment may be supported on augercast piles which are socketed into the well cemented limestone existing at about 8 feet below ground surface. The following allowable capacities are recommended:



AUGERCAST PILES

Summary of Allowable Compression Capacities

Diameter (Inches)	Allowable Compression Capacity (Tons)	Minimum Rock Penetration (Feet)	Minimum Depth from Existing Ground Surface (Feet)
14	25	7	14
14	32	9	16
14	40	11	18

The allowable compression capacities presented above considers the affects of negative skin friction developed by the new fill.

We have evaluated a 72-inch diameter drilled shaft (caisson), placed at different depths, to support the proposed tower loads. The shaft depths evaluated ranged from 15 to 30 feet below existing ground surface. Based on the moment, compression load and lateral load imposed on the foundation by the proposed tower, we estimate that the total settlement and lateral deflection for a 72-inch diameter shaft installed at 20 feet below the existing ground surface will be less than 1/4.



2.0 INTRODUCTION

2.1 Authorization

This report presents the results of a subsurface exploration and foundation evaluation for the proposed combustion turbine, auxiliary equipment and monopole tower to be constructed at the Stock Island Generating Plant in Stock Island, Florida. Our services were provided in accordance with our proposal for Subsurface Exploration (PSI Proposal No. 397-255) dated July 12, 1995 and July 24, 1995 and (PSI Proposal No. 397-263) dated August 2, 1995.

Authorization to perform this exploration and evaluation was provided by Mr. Anthony F. Niles of the City Electric System by way of a purchase order No. 710268 dated July 25, 1995.

2.2 Purpose

The purpose of this geotechnical study was to evaluate the subsurface and groundwater conditions at the site and to recommend a type and depth of foundation system suitable for the proposed structures as well as to provide criteria for the architects and engineers to use in preparing the foundation design.

2.3 Scope

The scope of this study included subsurface exploration, field testing, engineering analysis and evaluation of the foundation materials.

The scope of services did not include any environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements which appear in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.



2.4 General

The general analysis of the foundation conditions reported herein is considered sufficient in detail and scope to form a reasonable basis for the foundation design. The recommendations submitted for the proposed structures are based on the available subsurface information and the design details furnished.

If there are any revisions to the plans for the proposed structures, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be retained to determine if changes in the foundation recommendations are required. If PSI is not retained for these functions, PSI will not be responsible for the impact of those conditions on the performance of the structure.

3.0 PROJECT DESCRIPTION

Based upon the information provided by Mr. Dave Gerstenkorn of the Utility Board of the City of Key West, we understand that the project will involve the installation of a combustion turbine, auxiliary equipment and a monopole tower at the Stock Island Generating Plant Site. The auxiliary equipment will consist of the following:

- One Unit Transformer
- One Generator Auxiliary Cab
- One Generator Cab
- One Control Cab
- One Inlet Air Housing

The unit transformer will be supported on a isolated 8 feet by 12 feet reinforced concrete mat foundation while the remaining equipment and the combustion turbine will be supported on one reinforced concrete mat foundation with approximate plan dimensions of 7 feet by 92 feet.



Structural information provided to us indicates that uplift loads are not required and that the anticipated gravity loads are as follows:

Combustion Turbine	192,000 lbs.
Unit Transformer	73,200 lbs.
Generator Auxiliary Cab	25,700 lbs.
Generator Cab	178,000 lbs.
Control Cab	30,500 lbs.
Inlet Air Housing	45,000 lbs.

The monopole tower is in the preliminary design phase and no information regarding structural loads is available at this time. However, for purposes of our evaluation, we have assumed a 70 foot monopole antenna tower, with maximum loads as follows:

Overturning Moment:	22,500 kip-inches
Total Shear:	30 kips
Total Compression Load:	20 kips

We were provided with the following drawing for our use:

- Plot Plan Electrical Plan
Proposed Site Plan Stock Island Generating Plant
Prepared by: City Electric System Engineering Department
Dated: July 26, 1995

Based on the information provided by Mr. Dave Gerstenkorn, the existing ground surface elevation in the construction area is approximately 3.5 feet MSL (Mean Sea Level). A finished grade elevation of 9.0 feet MSL (Mean Sea Level) is planned for the proposed construction. Thus, the site will be raised 5.5 feet above existing grade to meet the project specific requirements.



4.0 DESCRIPTION OF SITE

4.1 Site Location

The site for which this subsurface exploration has been made is within the property of the Stock Island Generating Plant located on the west side of Front Street in Stock Island, Florida. We have appended a Vicinity Map which identifies the location of the site with respect to existing streets and landmarks. This map is presented in the Appendix.

4.2 Site Conditions

The site conditions were observed by a representative of PSI on August 5, 1995. Currently the subject area is vacant and covered by limerock fill and bituminous asphalt. The topography of the site was observed to be relatively flat. No standing water was noted at the site.

The truck mounted drilling equipment used for the subsurface exploration did not experience any difficulty in moving around the site.

5.0 FIELD EXPLORATION

The field exploration to evaluate the engineering characteristics of the foundation materials included reconnaissance of the project site, drilling of the test borings, performing Standard Penetration Tests and recovering split spoon samples. Water level measurements were recorded in each of the test borings after their completion.



Five (5) Standard Penetration Test (SPT) borings were drilled for the project. SPT Boring B-1 was drilled at the monopole tower while B-2 through B-5 were drilled within the footprint area of the proposed combustion turbine and auxiliary equipment. The borings were extended to depths ranging from 40 to 45 feet below the existing ground surface. The borings were marked and drilled at the locations selected by a representative of the Utility Board of the City of Key West. These locations are shown on the Boring Location Plan provided in Appendix "A". The procedures used for drilling, sampling, and conducting field tests and measurements are also discussed in the Appendix. After completion of the test borings, the drill holes were backfilled with excavated soil and the site was cleaned as required.

6.0 SUBSURFACE CONDITIONS

6.1 General

Subsurface materials encountered in the borings have been visually examined and classified and are described on the boring logs presented in the Appendix "A". The results of the Standard Penetration Tests and water level observations are also presented on the boring logs.

Representative samples of the materials recovered from the borings were placed in sample jars. They are now stored in the laboratory for further analysis if desired. Unless notified to the contrary, all samples will be disposed of after 60 days.

The stratification of the profile components as shown on the boring logs represents the subsurface conditions at the actual boring locations. Variations may occur within a short distance from the borings. Lines of demarcation represent the approximate boundary between the types of materials encountered, but the transition may be gradual, or not clearly defined.

It is to be noted that, whereas the test borings are drilled and sampled by experienced drillers, it is sometimes difficult to record changes in stratification within narrow limits.



6.2 Stratigraphy

The test boring locations are mantled by 4 to 6 feet of granular fill materials. The fill materials consist of limerock with fine sand. Underlying the fill materials are very soft silts which continue to a depth of 8 feet. A two foot layer of silty fine sand was encountered beneath the fill at two boring locations and was followed by the soft silts to a depth of 8 feet. Below the silts is a deposit of weakly to well cemented limestone that continues to the maximum depth explored.

Standard Penetration Resistance Values (N-values) in the fill ranged from 14 to 38 blows per foot. N-values in the silt materials ranged from 2 to 3 blows per foot while those in the fine sand soils varied from 2 to 5 blows per foot. Blow counts in the limestone were between 4 and 60 blows per foot.

6.3 Groundwater Conditions

Groundwater levels were measured in the open boreholes upon completion of the drilling and sampling activities. The water levels measured in the borings ranged from 3.0 to 3.5 feet below existing ground surface. However, please note that groundwater levels fluctuate as a function of tides, barometric conditions and rainfall. Under normal tidal barometric and rainfall conditions, we expect that the groundwater table may rise by 1 foot or slightly more above the level determined in the borings. During severe hurricane storms, it is conceivable that the groundwater table may be at grade.

7.0 FOUNDATION EVALUATION

The subsurface conditions of the site do not lend themselves to support of the turbine and auxiliary equipment employing mat foundations because of the low strength and high compressibility of the soft silt existing between depths of 4 to 8 feet below grade. While wholesale removal of these materials and subsequent replacement with clean granular fill or lean concrete may be considered to allow a shallow foundation system to be employed, we understand that a deep foundation system is preferable to support the turbine and equipment.



In addition, given the near coastal setting of the site, design of the project components must consider the potential effects of hurricane storm surge when using a shallow foundation system. The principal effect of hurricane storm surge is scour, which can lead to the undermining of ground supported facilities (such as foundations), and hydrodynamic forces which can induce both lateral and uplift loads upon a structure.

In lieu of a ground supported mat foundations, we recommend that the foundations for the turbine and auxiliary equipment be supported on piling which utilize the weakly to well cemented limestone existing at a depth of 8 feet below grade as their bearing stratum. Piling will provide good support to axial loads imposed by the structures and be resistant to undermining. While a variety of piles may be considered for this purpose, we believe that pressure grouted auger piling (augercast piles) will provide the most cost effective deep foundation for the project and recommend their use for support of the turbine and auxiliary equipment.

While a variety of deep foundation types may be considered for the tower, we recommend that a drilled shaft (caisson) be used in order to accommodate the anchor bolt cage for the monopole.

Design criteria for the augercast piles and a drilled shaft are provided in the following section of the report.

In the absence of any filling, we expect that the site will experience areal subsidence of the order of 1 to 2 inches over a 40 to 50-year period owing to secondary compression settlement of the silt layer. Fills placed to raise site grades will serve to increase the magnitude of settlement due to primary consolidation and possible additional secondary compression. The additional settlement will be approximately one-inch. The effects of the long-term settlement upon on-grade structures, underground utilities and pipes must be evaluated.



8.0 FOUNDATION RECOMMENDATIONS

8.1 Combustion Turbine and Auxiliary Equipment

8.1.1 Augercast Pile Design

We recommend that the foundations for the turbine and auxiliary equipment be supported on augercast piles which are socketed into the limestone formation which exists at a depth of 8 feet below the site grade. Augercast piles where are socketed into the limestone will mobilize their resistance principally in side shear (i.e. a combination of mechanical interlock and chemical bond) that is developed over the length embedded in the carbonate rock formation.

The following table summarizes our recommendations for minimum rock penetration and embedment to develop the axial compression capacities for this type of pile.

AUGERCAST PILES

Summary of Allowable Compression Capacities

Diameter (Inches)	Allowable Compression Capacity (Tons)	Minimum Rock Penetration (Feet)	Minimum Depth from Existing Ground Surface (Feet)
14	25	7	14
14	32	9	16
14	40	11	18



The design capacity refers to dead and normal live loads and may be increased by 25 percent for total loads, including wind forces. The above pile capacity is a function of stresses mobilized in the subsurface materials only. Structural stresses developed in the pile cross section may impose a more severe limitation on the pile capacity and should be verified. Total and differential settlements of the pile supported structure should be minimal.

8.2 Monopole Antenna Tower

8.2.1 Drilled Shaft Foundation Design

Drilled shafts are foundations which most efficiently support structures which are subjected to high overturning moments and lateral forces. We have analyzed a 72-inch diameter shaft embedded at depths ranging from 15 to 30 feet below existing ground surface to support the monopole tower. The shaft diameter is dictated by the diameter of the steel plate located at the bottom of the anchor bolts' cage, the diameter of the structural steel bars and the associated clearances required. For the subject tower foundation the minimum shaft diameter required is 72-inches.

The lateral load capacity for a 72-inch diameter drilled shaft was evaluated using the computer program "L-PILE". We assumed drilled shafts of variable lengths below the ground surface. The shaft top was considered to have a free end.

The 28-day compressive strength of the concrete considered in our analysis was 4000 psi. The lateral load was assumed to act at the shaft head. The results of the analysis are shown in Appendix "B".

The monopole antenna shaft is required to have a compressive capacity of 20 kips and a lateral capacity of 30 kips. It must also resist an overturning moment of 25,500 kip-inches.



We recommend that a 72-inch diameter drilled shaft for the monopole antenna be founded in the limestone formation soils at a depth of 20 feet below existing ground surface with a minimum penetration of 12 feet into the limestone formation.

Based on the moment and lateral load imposed for the foundation by the proposed tower we estimate that the total lateral deflection of the head of the 72-inch diameter shaft, installed to 20 feet below the ground surface, will be less than 1/4 inch. The output information from the program "L-PILE" and the graphic results of the lateral analysis are presented in Appendix "B".

The following tables summarize our recommendations for compression and lateral load capacities for this type of foundation.

DRILLED SHAFT CAPACITIES

100-Foot Monopole Antenna Tower (20-Foot Embedment) (Minimum 12 feet into the limestone formation)

Drilled Shaft Diameter (inches)	Allowable Axial Compression Capacity (Kips)	Allowable Design Lateral Capacity (*) (Kips)
72	> 100	31

(*) Estimated lateral deflection will be less than 1/4 inch.

3.2.2 Drilled Shaft Settlement

Based on the compression loads to be imposed on the foundation by the proposed tower we estimate that the total settlement for the 72-inch diameter shaft, installed to a depth of 20 feet, will be less than 1/4 inch.



9.0 CONSTRUCTION CONSIDERATIONS

9.1 Augercast Pile Installation

Recommendations for augercast pile installation are presented hereafter.

- We recommend that the piles be spaced at least 2.5 pile diameters center-to-center to minimize pile capacity reduction caused by group effects. A placement tolerance with respect to the design center of 3 inches should be specified for group piles and 1 inch for isolated piles unless more stringent construction positioning is required. Out-of-plumbness for the piling should be limited to 2 percent maximum.
- The 28-day compressive strength of the grout used in the piles should be at least 5000 pounds per square inch (psi).
- In order to provide some assurance that the piles are constructed with a continuous cross section, a full-length steel reinforcing bar or cage should be installed at the center of each pile immediately after grouting. Centralizers should be attached to individual bars at the third points.
- Piles subject to uplift due to wind load must be provided with adequate reinforcing steel throughout their entire length.

9.2 Drilling and Grouting

Augercast piles are constructed by rotating a hollow-stem continuous flight auger into the ground until the planned tip depth or termination criterion are achieved. At the termination depth, a grout with high fluidity is pumped under pressure into the hole through the hollow stem auger. As long as pressure is observed in the line, the auger is slowly withdrawn and the augercast shaft is constructed.



Grout volumes, possibly up to 1 1/2 times the theoretical pile volume, may be required for proper pile installation. A minimum grout factor of 1.15 should be specified for the piles. The grout factor is defined as the actual volume of grout pumped into the pile divided by the theoretical volume of the drilled hole.

After achieving the desired depth, a positive grout pressure should be observed prior to initiating withdrawal of the auger. A continuous fluid return consisting of slurry and then grout at the top of the hole is the best indication that the desired pressure head is being achieved.

The auger should be withdrawn slowly so that a positive grout pressure is maintained in the hole at all times during auger withdrawal. If the withdrawal of the auger becomes erratic, grout pressure suddenly drops, or if the grout is interrupted, the auger tip should be reinserted at least 5 feet below the level where the grouting operation was disrupted prior to resuming withdrawal of the auger.

The installation of adjacent piles located within 4 feet of each other on the same working day is not recommended at this site due to the potential existence of inter-connected pores or cavities in the limestone formation. We recommend that adjacent piles located within 4 feet not be installed until the initial grouted pile has set overnight.

Some subsidence of fresh grout may occur in the top of the piles. This subsidence is in-part a result of the weight of the grout column "pushing" laterally into pores in the limestone layer. We anticipate that subsidence will occur within a period of approximately two hours following the grouting operation. If subsidence occurs while the pile grout is in a fluid state, we recommend that the pile be immediately filled with fresh grout to the proper cutoff elevation. We recommend that a pile grout subsidence of up to 8 inches be considered acceptable. Grout should not be pumped into the piles when it is older than 90 minutes from the time it was batched.

Prior to actual installation of the piles, the contractor should demonstrate that the materials and equipment proposed for use are capable of installing the production piles. The contractor should provide an accurate method of determining the depth and alignment of the auger.



9.3 Augercast Pile Monitoring

The successful augered cast-in-place pile installation will in large part depend upon the expertise of the contractor and the techniques he uses. Because of the possibility of soil intrusions during auger withdrawal and nonvertical or "dog-leg" piles, the job specifications must be carefully prepared and continuous inspections made of the installation. Full-time inspection must be maintained during installation to monitor depths and the amount of grout pumped versus the rate of auger withdrawal. The full-time monitoring of pile installation will provide a degree of assurance that continuous piles of the proper cross-section are being constructed.

We recommend that the grout pump should be calibrated prior to initiation of production pile installation. At least one set of six 2-inch cubes or 3 inch diameter x 6 inch high grout cylinders should be made for each day of pile installation.

9.4 Test Pile Program

A full-scale compression load test should be performed on a prototype pressure grouted auger pile to provide information on load-settlement response and confirm that the design capacity can be achieved. The tests should be performed in accordance with ASTM D-1143 and the South Florida Building Code. The standard loading method prescribed in ASTM D-1143 should be used as it will more closely replicate pseudostatic loading of the piles by the structure than will the quick-load procedure.

9.5 Drilled Shaft Installation

We recommend that the wet method of construction or casing be used for the drilled shafts. Slurry required to preserve the stability of the side walls should be maintained at the ground surface. We recommend that the properties of the slurry be controlled within the ranges presented below.



Recommended Drilling Slurry Properties

Property	Test Method	Range of Results @ 20° C
Viscosity	Marsh cone funnel	28 to 40 seconds
pH	pH indicator paper strips	8 to 11
Density	Mud density balance	70 to 75 pcf

We recommend that the mineral slurry be premixed with clean water prior to introduction into the shaft excavations. The premixing of the drilling slurry may be done in either a slurry tank or in a pit excavated in the project area.

The bentonite slurry should be slowly circulated and screened of all coarse fragments. The entire shaft excavation should be filled with a uniform suspension that prevents the accumulation of coarse cuttings at the bottom of the shaft. A bailing bucket should be used to remove any residual cuttings in the shaft bottoms that are not removed by bentonite slurry circulation.

Concrete placement should be done using the wet method of installation. The concrete should be placed continuously utilizing a tremie or a concrete pump. A 4000 psi compressive strength concrete with a 7 to 9-inch slump is generally used and has been found to achieve acceptable results. During the concrete placement, displaced slurry and the drill cuttings should be allowed to overflow into an excavated pit. Pumping of the slurry from the shaft during concrete placement should not be allowed.



9.6 Site Preparation

Initial site preparation in the construction area should consist of the stripping of the existing asphalt. If pipes, connecting the equipment, or underground utilities are placed and are susceptible to settlement, in this case we recommend that the subgrade after stripping be proofrolled to aid in the detection of weak subgrade soils lying immediately below existing grades. The surface soils should then be densified prior to the placement of the fill needed to achieve the finished grade.

9.7 Proofrolling

We recommend that the surface of the existing fill soils be proofrolled with a large diameter, self-propelled vibratory compactor. The area to be subjected to proofrolling should include the construction footprint area plus a minimum 5 foot wide extended perimeter zone. The vibratory compactor should have a static drum weight of about 4 tons and should be capable of exerting a minimum dynamic force of 20 tons. Each section of stripped grade should be subject to multiple, overlapping (minimum of 20 percent overlap) coverages of the roller as it operates at its maximum vibrational frequency and a travel speed of no more than 1.5 piles per hour. Rolling should continue until no further settlement of the subgrade or fill surface is visually discernible. In no case should any areas of the subgrade receive less than 5 complete passes with the roller.

Pumping, weaving, cracking and other unusual distortion of the surface under the weight of the roller will be indicative of buried pockets of soft soil which should be removed and replaced with engineered fill. If instability of the fill surface is not observed during proofrolling, then the existing fill can be left in-place.



9.8 In-Situ Densification of Soils

The surface soils in the construction area should be densified with the same equipment used for proofrolling. The in-situ soils should be compacted to 95 percent of the Modified Proctor maximum dry density determined per ASTM D-1557, to a depth of least 12 inches below the subgrade. Frequent wetting of the subgrade may be necessary during the rolling operations to prevent drying and loosening of the upper 6 to 12 inches of soil.

9.9 Engineered Fill and Backfill

Proper control of the placement and compaction of new fills for the project should be exercised by a representative of the Geotechnical Engineer. The fill materials should be placed in lifts not exceeding 12 inches in loose thickness. Each lift should be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density near the optimum moisture content as determined by ASTM D-1557. Fill to be compacted with a vibratory plate or a small walk behind vibratory roller should be placed in lifts not exceeding six inches in loose thickness.

It is imperative that any fill supporting slab-on-grade structures be placed, compacted and tested in accordance with the specifications of this report in order to adequately support the footing and floor slab loads. The tests should be performed by a qualified soils technician working under the supervision of a Geotechnical Engineer in accordance with appropriate ASTM procedures. Any fill indicating less than the recommended relative compaction should be recompacted until the required density is obtained prior to the placement of subsequent lifts or concrete for substructures.



The engineered fill should be free of organic matter and consist of granular material containing less than 10 percent passing the U.S. Standard No. 200 mesh sieve. The fill material may be composed of either clean sands or crushed limerock. The crushed limerock should have no particle size in excess of three inches and have a Unified Soil Classification System designation of GP or GW.

9.10 Groundwater Control

Based on the water level measurements taken during our drilling operations, dewatering will probably not be required for excavations less than 3 feet deep. If required, however, groundwater can generally be lowered one to two feet by pumping from barrel sumps located in perimeter ditches or pits. All sumps inlets should be located outside the bearing areas to avoid loosening the surrounding soils. The groundwater level should be maintained at least one foot below the bottom of any excavations made during construction and two feet below the surface of any vibratory compaction operations. In areas where deeper groundwater drawdown or control is required, or where more positive groundwater control is desired for prolonged periods, a single-stage, fully-sanded vacuum wellpoint system may be required.

10.0 GENERAL CONDITIONS

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein, have been presented after being prepared in accordance with general accepted professional practice in the field of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.



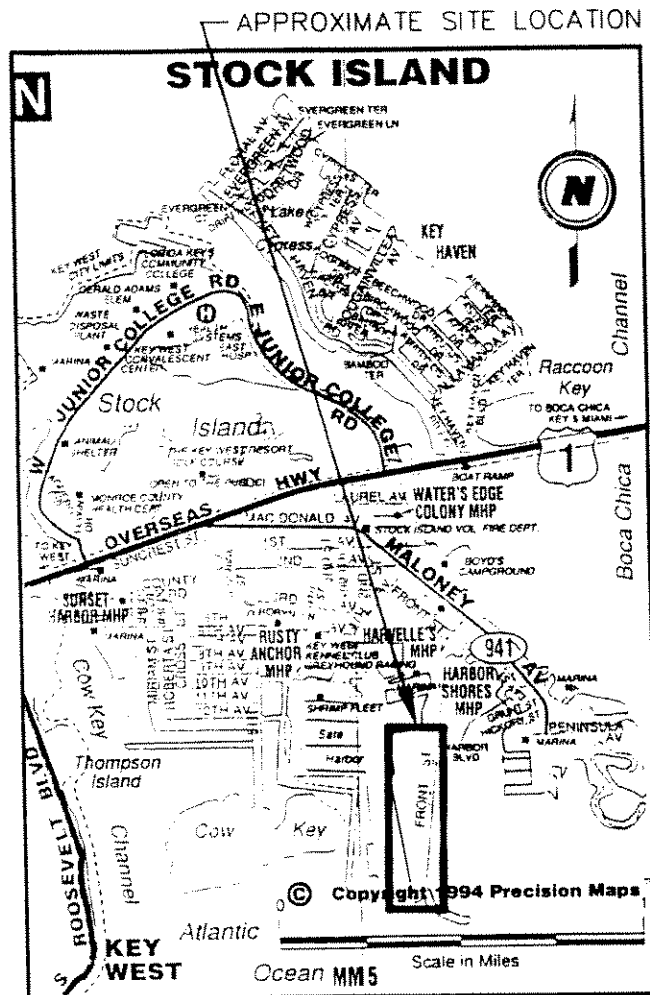
After the plans and specifications are complete, it is recommended that PSI be provided the opportunity to review the final design and specifications, in order to verify that the earthwork and foundation recommendations are properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations.

This report has been prepared for the exclusive use of the Utility Board of the City of Key West for the specific application to the proposed construction.



APPENDIX "A"





REFERENCE: PERCISION MAPS "MAP OF FLORIDA KEYS"
 ISSUED: 1994
 SCALE: N.T.S.

VICINITY MAP



SITE VICINITY MAP
**PROPOSED COMBUSTION TURBINE AND
 AUXILIARY EQUIPMENT AT STOCK ISLAND**
 STOCK ISLAND, FLORIDA

psi ENVIRONMENTAL
 GEOTECHNICAL
 CONSTRUCTION

DRAWN	KEK	SCALE	NOTED	PROJ. NO.	397-55093
CHECKED	ARM	DATE	AUG 95	SHEET	1

LOG OF BORING NO. B-1

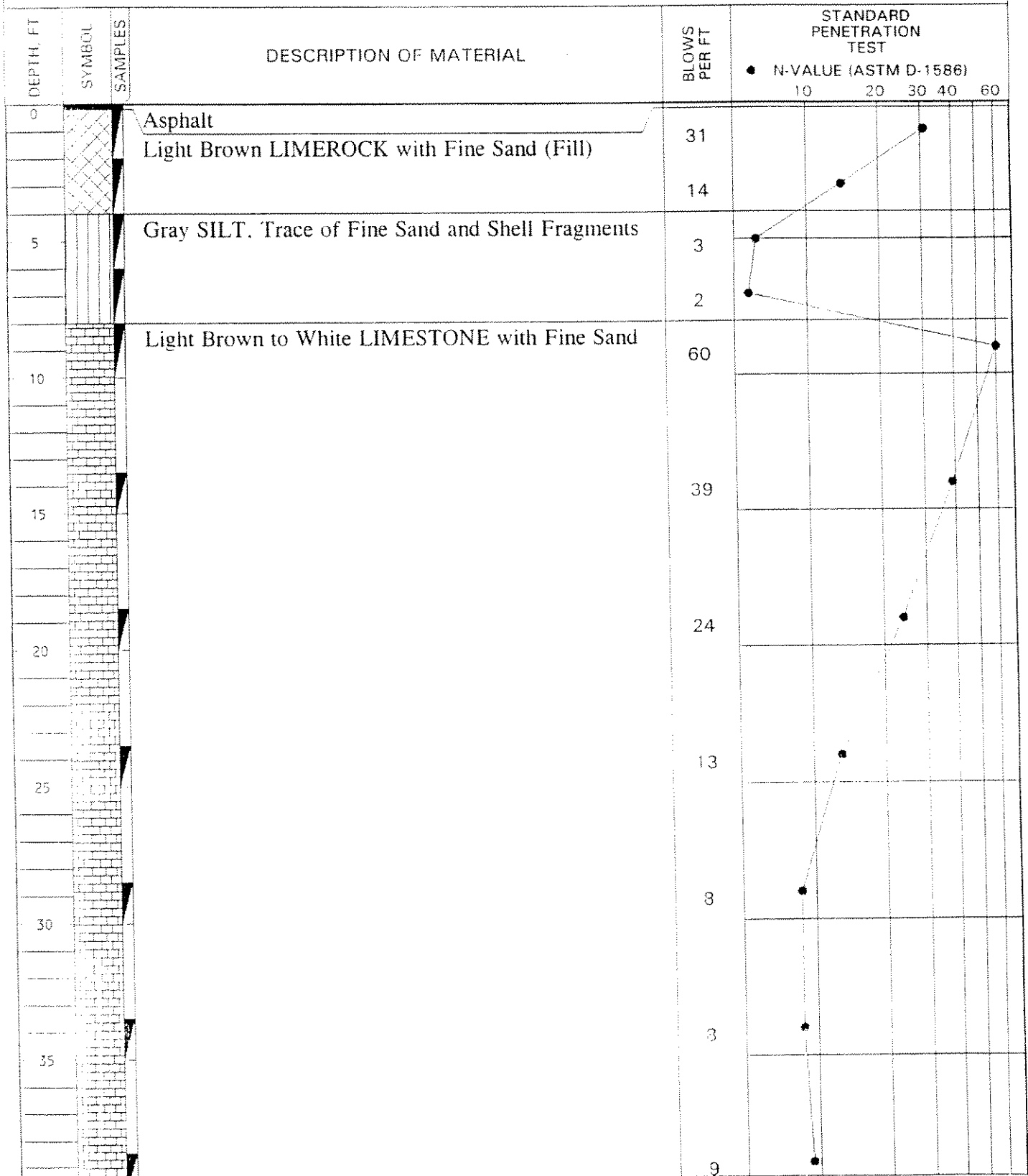
Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8-4-95

IN BORING: 3' - 6"

LOGGED BY:

J. Rivero

LOG OF BORING NO. B-1

Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST					
					● N-VALUE (ASTM D-1586)					
					10	20	30	40	50	60
40			End of Boring							
45										
50										
55										
60										
65										
70										
75										

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8-4-95

IN BORING: 3' - 6"

LOGGED BY: J. Rivero

LOG OF BORING NO. B-2

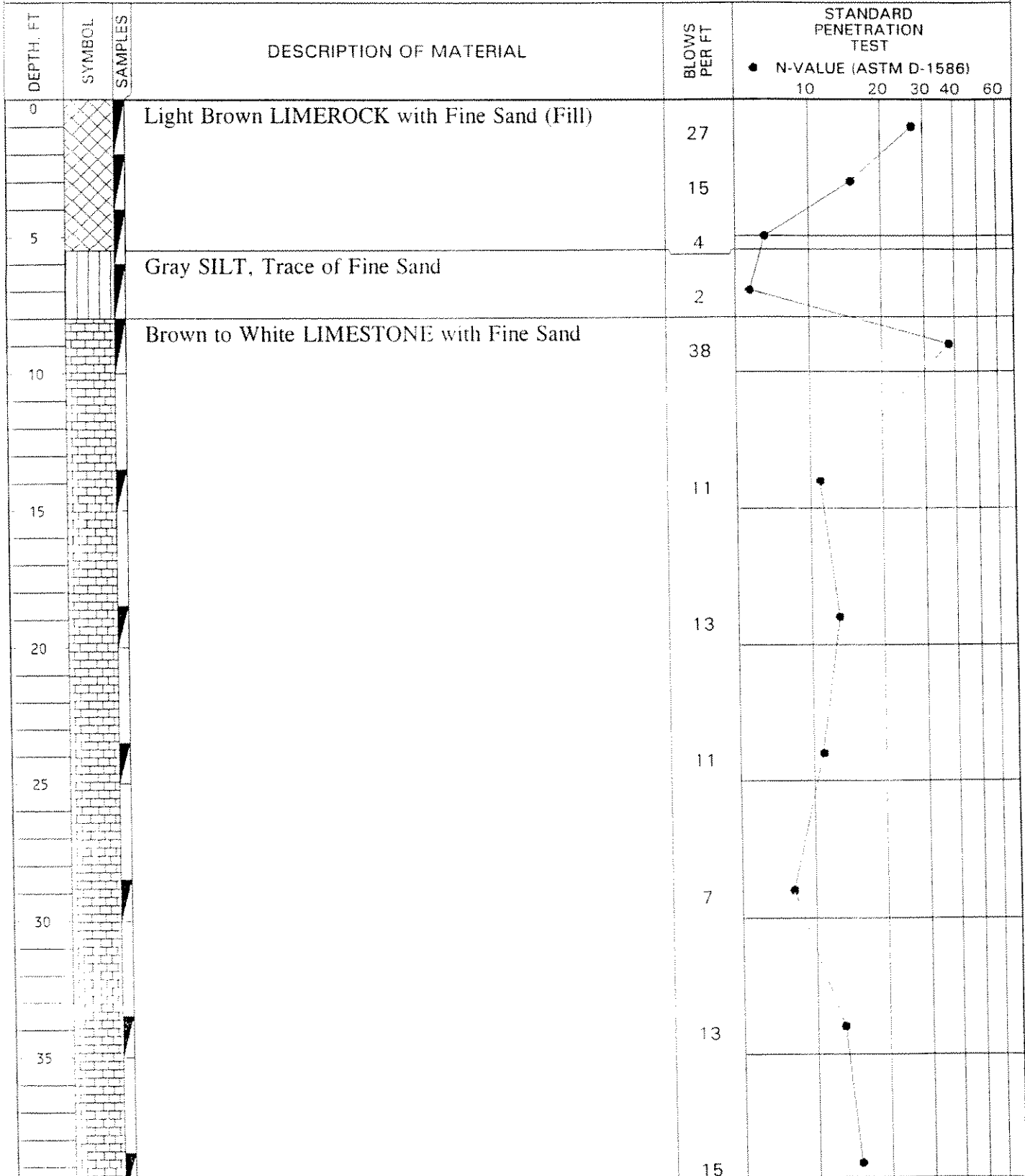
Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8-4-95

IN BORING: 3' - 2"

LOGGED BY: J. Rivero

LOG OF BORING NO. B-2

Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST					
					● N-VALUE (ASTM D-1586)					
					10	20	30	40	50	60
40			End of Boring							
45										
50										
55										
60										
65										
70										
75										

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8-4-95

IN BORING: 3' - 2"

LOGGED BY: J. Rivero

LOG OF BORING NO. B-3

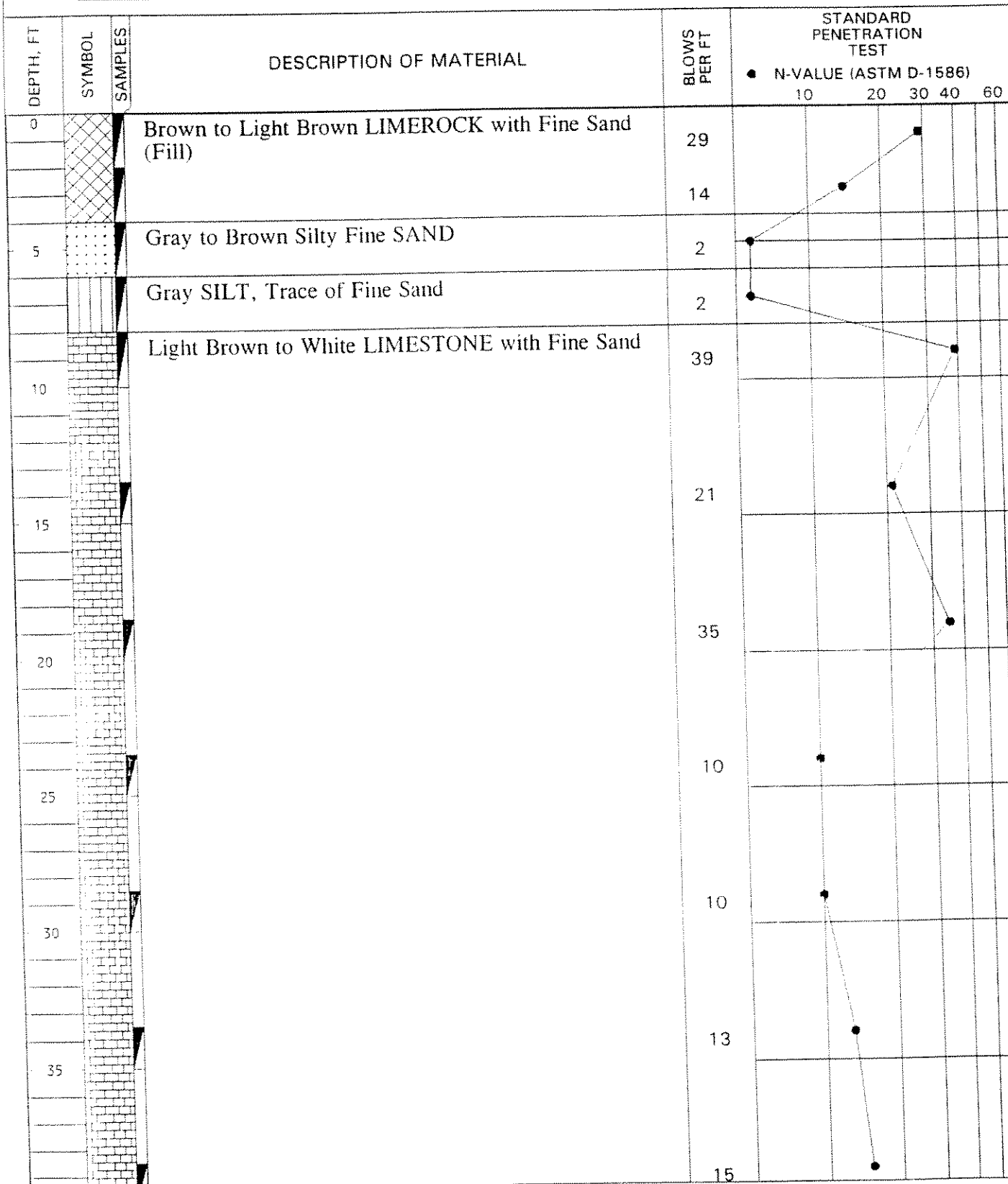
Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION: _____

DATE: 8-4-95

IN BORING: 3' - 2"

LOGGED BY: J. Rivero

LOG OF BORING NO. B-3

Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST					
					● N-VALUE (ASTM D-1586)					
					10	20	30	40	50	60
40			End of Boring							
45										
50										
55										
60										
65										
70										
75										

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8-4-95

IN BORING: 3' - 2"

LOGGED BY: J. Rivero

LOG OF BORING NO. B-4

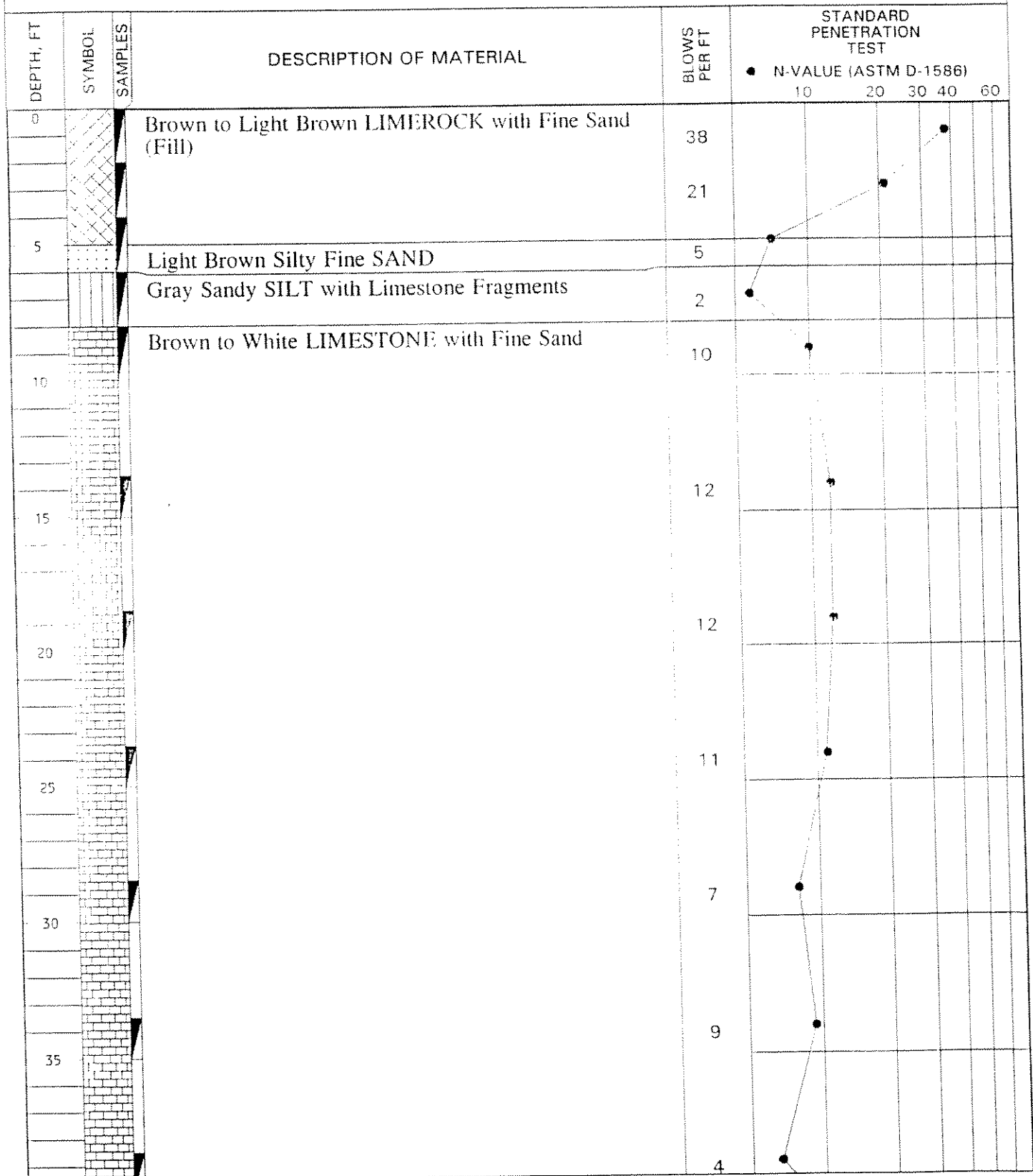
Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan



COMPLETION DEPTH: 45 feet

DEPTH TO WATER

ELEVATION:

DATE: 8-4-95

IN BORING: 3' - 0"

LOGGED BY: J. Rivero

LOG OF BORING NO. B-4

Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST					
					● N-VALUE (ASTM D-1586)					
					10	20	30	40	50	60
40										
45			End of Boring	21						
50										
55										
60										
65										
70										
75										

COMPLETION DEPTH: 45 feet

DEPTH TO WATER

ELEVATION: _____

DATE: 8-4-95

IN BORING: 3' - 0"

LOGGED BY: J. Rivero

LOG OF BORING NO. B-5

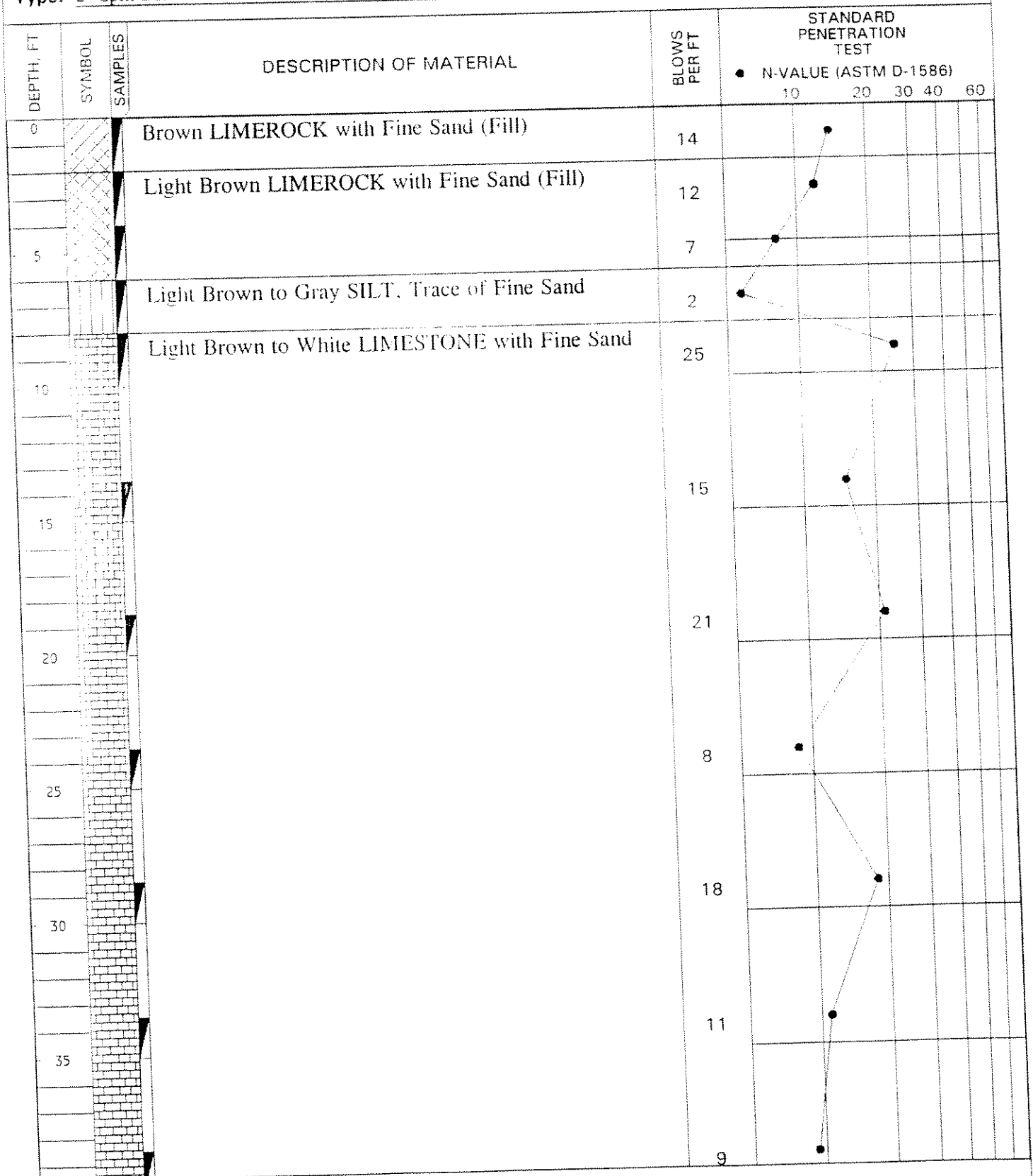
Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8-5-95

IN BORING: 3' - 1"

LOGGED BY: J. Rivero

LOG OF BORING NO. B-5

Proposed Combustion Turbine, Auxiliary Equipment & Monopole Tower
Stock Island, Florida

Client: Utility Board of the City of Key West

Project Number: 397-55093

Type: 2" Split-Barrel

Location: See Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST					
					● N-VALUE (ASTM D-1586)					
					10	20	30	40	50	60
40			End of Boring							
45										
50										
55										
60										
65										
70										
75										

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION:

DATE: 8-5-95

IN BORING: 3' - 1"

LOGGED BY: J. Rivero

CORRELATION OF PENETRATION RESISTANCE WITH
RELATIVE DENSITY OF GRANULAR SOILS

RELATIVE DENSITY	STANDARD PENETRATION TEST BLOWS/FT. (N-VALUE)
Very Loose	0 - 4
Loose	5 - 9
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50



DRILLING AND SAMPLING PROCEDURES

The test borings were performed with a drilling rig equipped with a rotary head. The drill holes were advanced by the use of a high speed rollercone bit, with bentonite drilling fluid being pumped through the drill rods to remove the cuttings and to stabilize the side walls and bottom of the hole. Representative samples were obtained by the use of split-barrel sampling procedures in general accordance with the procedures for "Penetration Test and Split-Barrel Sampling of Soils" (ASTM D-1586).

FIELD TESTS AND MEASUREMENTS

Penetration Tests - During the sampling procedure, standard penetration tests (SPT) were performed at pre-determined intervals to obtain the standard penetration value (N) of the soil. The standard penetration value (N) is defined as the number of blows of a 140 pound hammer, falling thirty (30) inches, required to advance the split-barrel sampler one (1) foot into the soil. The sample is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows are recorded for each of three (3) successive increments of six (6) inches penetration. The "N" value is obtained by adding the second and third incremental numbers.

Water Level Measurements - Water level depths were obtained during the test boring and percolation test operations. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. Seasonal variations, tidal conditions, temperature, land-use, and recent rainfall conditions may influence the depths to the groundwater.

Ground Surface Elevations - Ground surface elevations at the test boring and exfiltration locations were not provided. Therefore, all references to depth of the various strata and materials encountered, are from existing grade at the time of drilling.



APPENDIX "B"



100-FOOT MONOPOLE ANTENNA TOWER, STOCK ISLAND, FLORIDA
72-INCH DIAMETER SHAFT 20-FOOT EMBEDMENT

```
*****
*   PROGRAM LPILE  4.0                               *
*   (C) COPYRIGHT ENSOFT, INC., 1993                  *
*   ALL RIGHTS RESERVED                               *
*   -----                                           *
*                                                     *
*               Prepared for                          *
*                                                     *
*   PROFESSIONAL SERVICE INDUSTRIES, INC.            *
*   1675 Lee Road                                     *
*   Winter Park, FL 32789                             *
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*   Program to be used only by Licensee               *
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PROGRAM LPILE Version 4.0
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ALL RIGHTS RESERVED

PROPOSED COMBUSTION TURBINE, AUXILIARY EQUIPMENT AND MONOPOLE TOWER

UNITS--ENGLISH UNITS

INPUT INFORMATION

THE LOADING IS STATIC

PILE GEOMETRY AND PROPERTIES

PILE LENGTH = 240.00 IN

2 POINTS

X	DIAMETER	MOMENT OF INERTIA	AREA	MODULUS OF ELASTICITY
IN	IN	IN**4	IN**2	LBS/IN**2
.00	72.000	.132D+07	.407D+04	.350D+07
240.00	72.000	.132D+07	.407D+04	.350D+07

SOILS INFORMATION

X AT THE GROUND SURFACE = .00 IN
 SLOPE AT THE GROUND SURFACE = .00 DEG.

4 LAYER(S) OF SOIL

LAYER 1
 THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
 X AT THE TOP OF THE LAYER = .00 IN
 X AT THE BOTTOM OF THE LAYER = 42.00 IN
 MODULUS OF SUBGRADE REACTION = .900D+02 LBS/IN**3

LAYER 2
 THE SOIL IS A SAND - P-Y CRITERIA BY REESE ET AL, 1974
 X AT THE TOP OF THE LAYER = 42.00 IN
 X AT THE BOTTOM OF THE LAYER = 48.00 IN
 MODULUS OF SUBGRADE REACTION = .600D+02 LBS/IN**3

LAYER 3
 THE SOIL IS A SOFT CLAY
 X AT THE TOP OF THE LAYER = 48.00 IN
 X AT THE BOTTOM OF THE LAYER = 96.00 IN
 MODULUS OF SUBGRADE REACTION = .300D+02 LBS/IN**3

LAYER 4
 THE SOIL RESPONSE IS DEFINED BY INPUT P-Y CURVES
 X AT THE TOP OF THE LAYER = 96.00 IN
 X AT THE BOTTOM OF THE LAYER = 360.00 IN
 MODULUS OF SUBGRADE REACTION = .000D+00 LBS/IN**3

DISTRIBUTION OF EFFECTIVE UNIT WEIGHT WITH DEPTH 8 POINTS

X, IN	WEIGHT, LBS/IN**3
.00	.73D-01
42.00	.73D-01
42.00	.85D-01
48.00	.85D-01
48.00	.89D-01
96.00	.89D-01
96.00	.89D-01
360.00	.89D-01

DISTRIBUTION OF STRENGTH PARAMETERS WITH DEPTH 8 POINTS

X, IN	C, LBS/IN**2	PHI, DEGREES	E50
.00	.000D+00	.330D+02	-----
42.00	.000D+00	.330D+02	-----
42.00	.000D+00	.330D+02	-----
48.00	.000D+00	.330D+02	-----
48.00	.347D+01	.000	.200D-01
96.00	.347D+01	.000	.200D-01
96.00	.000D+00	.000D+00	-----
360.00	.000D+00	.000D+00	-----

INPUT P-Y CURVES 1 CURVES, 4 POINTS ON EACH

X, IN	Y, IN	P, LBS/IN
96.00	.00	.00
	.03	6400.00
	.17	8000.00
	7.20	8000.00

BOUNDARY AND LOADING CONDITIONS

LOADING NUMBER 1

BOUNDARY-CONDITION CODE	=	1
LATERAL LOAD AT THE PILE HEAD	=	.292D+05 LBS
MOMENT AT THE PILE HEAD	=	.224D+08 IN-LBS
AXIAL LOAD AT THE PILE HEAD	=	.168D+05 LBS

FINITE-DIFFERENCE PARAMETERS

NUMBER OF PILE INCREMENTS	=	20
DEFLECTION TOLERANCE ON DETERMINATION OF CLOSURE	=	.100D-03 IN
MAXIMUM NUMBER OF ITERATIONS ALLOWED FOR PILE ANALYSIS	=	100
MAXIMUM ALLOWABLE DEFLECTION	=	.72D+03 IN

OUTPUT CODES

ROUTPT = 1
 NPYOP = 0
 INC = 1

OUTPUT INFORMATION

LOADING NUMBER 1

BOUNDARY CONDITION CODE	=	1
LATERAL LOAD AT THE PILE HEAD	=	.292D+05 LBS
MOMENT AT THE PILE HEAD	=	.224D+08 IN-LBS
AXIAL LOAD AT THE PILE HEAD	=	.168D+05 LBS

X	DEFLECTION	MOMENT	SHEAR	SOIL REACTION	TOTAL STRESS	FLEXURAL RIGIDITY
IN	IN	LBS-IN	LBS	LBS/IN	LBS/IN**2	LBS-IN**2
*****	*****	*****	*****	*****	*****	*****
.00	.125D+00	.224D+08	.292D+05	.000D+00	.614D+03	.462D+13
12.00	.111D+00	.227D+08	.285D+05	-.120D+03	.624D+03	.462D+13
24.00	.979D-01	.230D+08	.265D+05	-.211D+03	.633D+03	.462D+13
36.00	.855D-01	.233D+08	.236D+05	-.277D+03	.641D+03	.462D+13
48.00	.739D-01	.236D+08	.210D+05	-.149D+03	.648D+03	.462D+13
60.00	.630D-01	.238D+08	.192D+05	-.147D+03	.655D+03	.462D+13

X	DEFLECTION	MOMENT	SHEAR	SOIL REACTION	TOTAL STRESS	FLEXURAL RIGIDITY
IN	IN	LBS-IN	LBS	LBS/IN	LBS/IN**2	LBS-IN**2
*****	*****	*****	*****	*****	*****	*****
72.00	.528D-01	.241D+08	.175D+05	-.144D+03	.661D+03	.462D+13
84.00	.434D-01	.243D+08	.158D+05	-.140D+03	.666D+03	.462D+13
96.00	.348D-01	.244D+08	-.238D+05	-.646D+04	.671D+03	.462D+13
108.00	.269D-01	.237D+08	-.984D+05	-.598D+04	.651D+03	.462D+13
120.00	.198D-01	.221D+08	-.161D+06	-.439D+04	.607D+03	.462D+13
132.00	.133D-01	.198D+08	-.205D+06	-.296D+04	.546D+03	.462D+13
144.00	.748D-02	.172D+08	-.233D+06	-.166D+04	.473D+03	.462D+13
156.00	.218D-02	.143D+08	-.245D+06	-.485D+03	.393D+03	.462D+13
168.00	-.267D-02	.113D+08	-.245D+06	.594D+03	.312D+03	.462D+13
180.00	-.717D-02	.839D+07	-.232D+06	.159D+04	.233D+03	.462D+13
192.00	-.114D-01	.572D+07	-.207D+06	.254D+04	.160D+03	.462D+13
204.00	-.155D-01	.342D+07	-.171D+06	.344D+04	.975D+02	.462D+13
216.00	-.194D-01	.162D+07	-.124D+06	.432D+04	.483D+02	.462D+13
228.00	-.233D-01	.436D+06	-.674D+05	.519D+04	.160D+02	.462D+13
240.00	-.272D-01	.000D+00	.000D+00	.605D+04	.414D+01	.462D+13

OUTPUT VERIFICATION

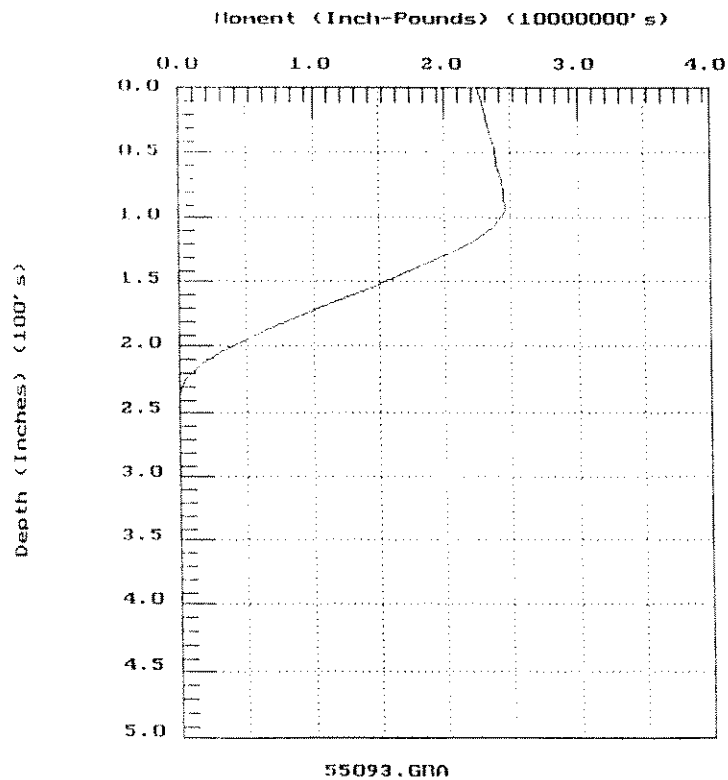
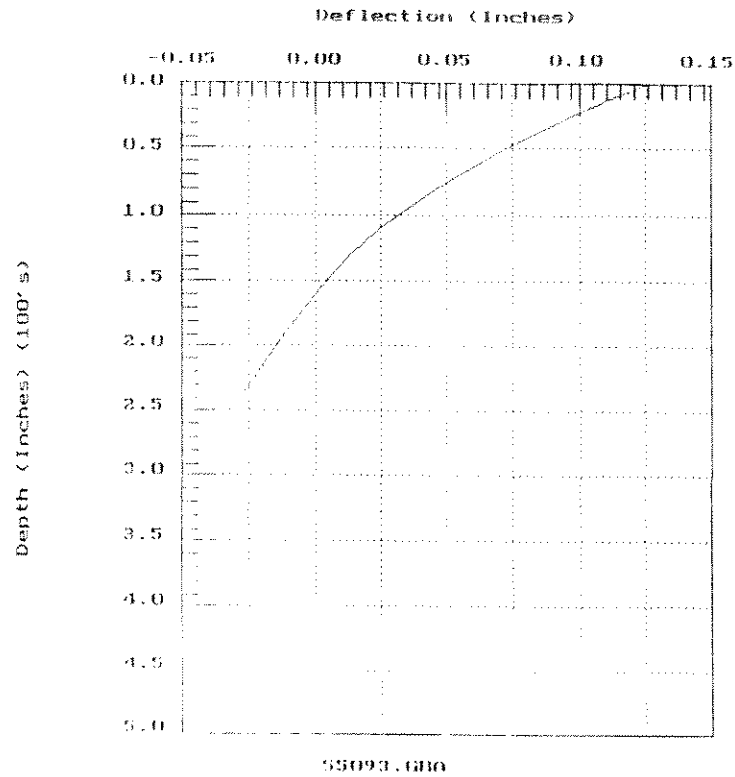
THE MAXIMUM MOMENT IMBALANCE FOR ANY ELEMENT = .132D-05 IN-LBS
 THE MAX. LATERAL FORCE IMBALANCE FOR ANY ELEMENT = .672D-07 LBS

OUTPUT SUMMARY

PILE-HEAD DEFLECTION = .125D+00 IN
 COMPUTED SLOPE AT PILE HEAD = .118D-02
 MAXIMUM BENDING MOMENT = .244D+08 LBS-IN
 MAXIMUM SHEAR FORCE = -.245D+06 LBS
 NO. OF ITERATIONS = 14
 NO. OF ZERO DEFLECTION POINTS = 1

S U M M A R Y T A B L E

BOUNDARY CONDITION	BOUNDARY CONDITION	AXIAL LOAD LBS	PILE HEAD DEFLECTION IN	MAX. MOMENT IN-LBS	MAX. SHEAR LBS
BC1	BC2	.1684D+05	.1247D+00	.2445D+08	-.2454D+06



PROJECT NAME

**Proposed Combustion Turbine,
Auxiliary Equipment & Monopole Tower
Stock Island, Florida**

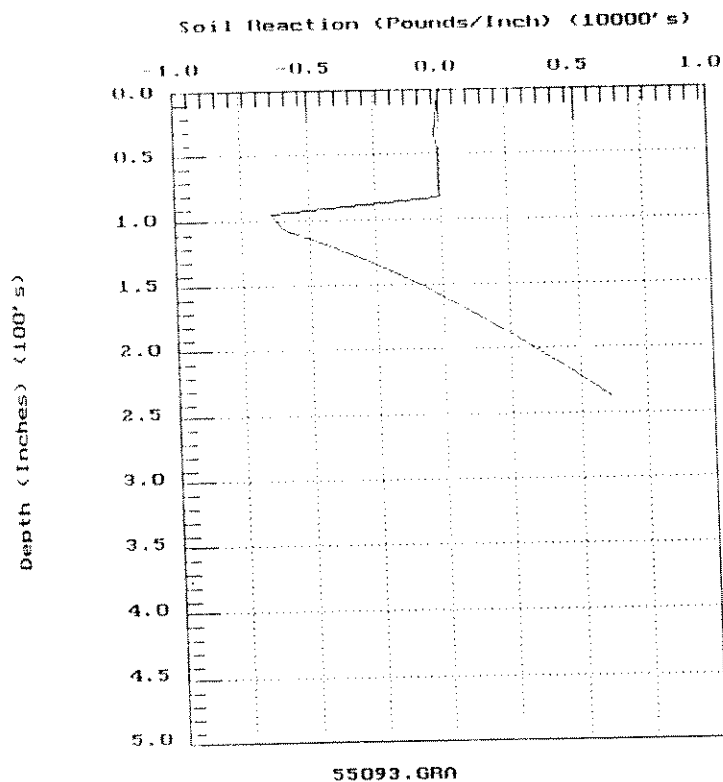
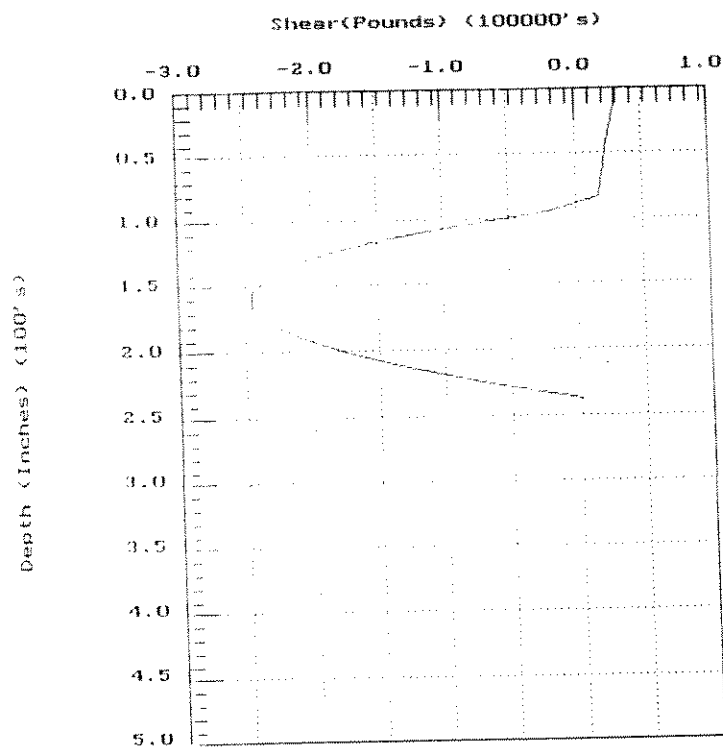
**LATERAL SHAFT CAPACITY
72-IN. SHAFT DIAMETER**

PROJECT NO

397-55093

DATE

AUGUST/1995



PROJECT NAME

**Proposed Combustion Turbine,
Auxiliary Equipment & Monopole Tower
Stock Island, Florida**

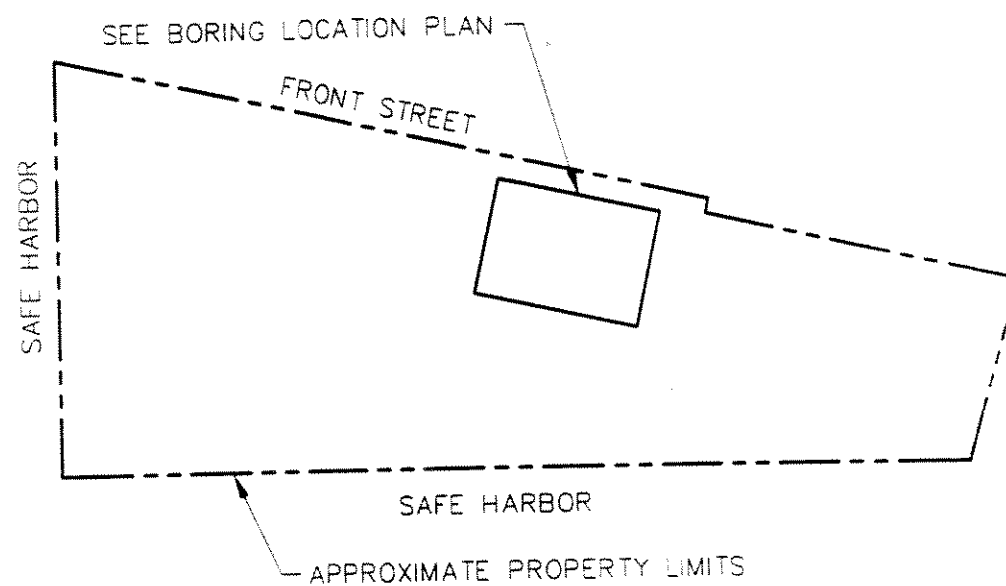
**LATERAL SHAFT CAPACITY
72-IN. SHAFT DIAMETER**

PROJECT NO

397-55093

DATE

AUGUST/1995



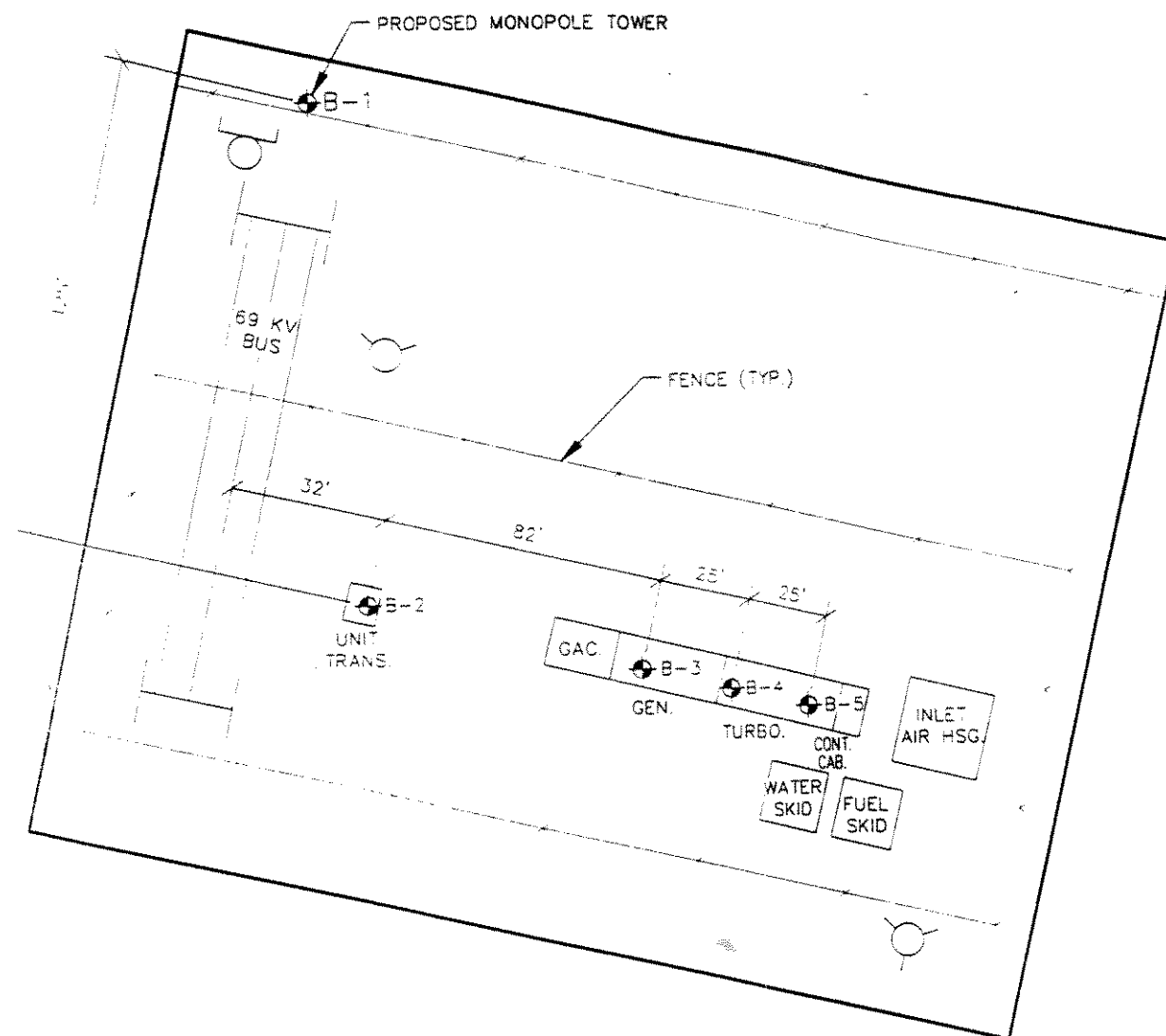
SITE LOCATION PLAN

SCALE: N.T.S.



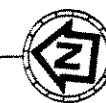
LEGEND

◆ Approximate SPT boring location



BORING LOCATION PLAN

SCALE: N.T.S.



DRAWN	CDT
CHECKED	ARM
APPROVED	ARM
SCALE	NOTED

GEOTECHNICAL SERVICES PROPOSED COMBUSTION TURBINE AND AUXILIARY EQUIPMENT AT STOCK ISLAND STOCK ISLAND, FLORIDA		
ENVIRONMENTAL GEOTECHNICAL CONSTRUCTION		
DATE	AUG 95	PROJ. NO. 397-55093
		SHEET 2

REPORT OF

GEOTECHNICAL ENGINEERING SERVICES

FOR

PROPOSED COMBUSTION TURBINE

STOCK ISLAND, FLORIDA

PREPARED FOR

UTILITY ENGINEERING CORP.

PREPARED BY

PROFESSIONAL SERVICE INDUSTRIES, INC.

PSI PROJECT No. 397-55112
UEC JOB No. 012464

AUGUST 12, 2005

August 12, 2005

Utility Engineering Corp
1515 Arapahoe Street, Tower 1, Suite 700
Denver, CO 80202

Attention: Mr. Erik McElwain, P.E.
Project Manager

Re: Report of
Geotechnical Engineering Services
Proposed Combustion Turbine
Stock Island, Florida
PSI Project No. 397-55112
UEC Job No. 012464

Dear Mr. McElwain:

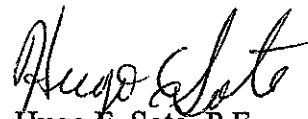
Professional Service Industries, Inc. (PSI) has conducted a geotechnical engineering study in connection with the subject project. Our services were provided in general accordance with PSI Proposal No. P-397-550134 dated July 7, 2005. Authorization to perform our services was provided by means of a Utility Engineering Consultants Agreement, dated July 28, 2005.

A summary of our findings and recommendations is provided in the Executive Summary section of this report. The results of the subsurface exploration program, together with our recommendations for the foundation system, related construction and site preparation are presented in the accompanying report. We appreciate the opportunity to provide our services to Utility Engineering Corp. on this project. Please do not hesitate to contact the undersigned if you have any questions about the report or if you need additional information.

Sincerely,

PROFESSIONAL SERVICE INDUSTRIES, INC.


Drew Badri, E.I.
Project Geotechnical Engineer


Hugo E. Soto, P.E.
Principal Consultant
Florida Registration No. 36440

DB/HES/ec

cc: Addressee (5)
File (1)

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APPENDIX

Sheet 1:	Site Vicinity Map
Sheet 2:	Boring Location Plan
Sheet 3:	Generalized Subsurface Profile
	Logs of Borings
Table 1:	Summary of Soil Resistivity Testing
	Drilling and Sampling Procedures, Field Tests and Measurements
	Schematics of Usual Open-Hole Percolation Test

1.0 EXECUTIVE SUMMARY

The proposed development will consist of a combustion turbine and auxiliary units at the subject site in Stock Island, Florida. The site currently exists as an open parcel of land with predominant exposed soil cover. Paved driveways were also observed within the property. The site stratigraphy and our recommendations for foundation design/ construction are summarized below.

1. PSI performed five (5) Standard Penetration Test (SPT) borings to depths of 40 and 45 feet below existing grade. Additionally, resistivity testing was performed at nine (9) locations at the subject site.
2. The results of the borings performed for the study indicate the subsurface conditions to generally consist of a layer of fill material comprising mainly of limerock and fine sand, with trace amounts of silt and PVC fragments. With the exception of boring BH-4, the fill material was underlain by a stratum of soft compressible material (sandy silt/silty sand) ranging in thickness from 2.0 to 7.5 feet (in the depth interval 6.0 to 13.5 feet below existing grade). The sandy silt/silty sand and fill materials were in turn underlain by a stratum of natural limestone formation to the maximum boring termination depth of 45 feet below existing grade.
3. Groundwater was observed in the borings at depths ranging from 2.0 to 3.7 feet below existing grade at the time of the measurement.
4. The results of the subsurface exploration and analysis indicate that due to the presence of soft compressible sandy silt/silty sand layers, unacceptable settlements are anticipated under the relatively high loads to be imposed by the planned structures. Therefore, the soils will not provide safe support to shallow foundations. We consider pressure grouted augercast piles to be the most cost effective/technically reliable means of foundation support.
5. PSI recommends that the combustion turbine and associated auxiliary structures be supported on 14 or 16-inch diameter augercast piles with pile lengths ranging from 19 to 24 feet below existing grade. Depending on the rock penetration/diameter the allowable compression capacities are estimated to range from 35 to 80 tons. Allowable uplift capacities would be approximately one half the compression capacities.

The owner/designer should not rely solely upon the executive summary and must read and evaluate the entire contents of this report prior to utilizing our engineering recommendations in the preparation of design and construction documents.

2.0 INTRODUCTION

Professional Service Industries, Inc. (PSI) has conducted a geotechnical engineering study in connection with the subject project. Our services were provided in general accordance with PSI Proposal No. P-397-550134 dated July 7, 2005.

2.1 Authorization

Authorization to perform our services was provided by means of a Utility Engineering Consultants Agreement, dated July 28, 2005. Furthermore, a Purchase Order (# 0124640001) dated August 2, 2005 was also furnished by Utility Engineering Corp. on this project.

2.2 Purpose

The purpose of this exploration was to evaluate the general subsurface (soil/rock) and groundwater conditions at the site, to recommend the most feasible type of foundation system(s) for the proposed structures, and to provide criteria for the architects and engineers to use in preparing the foundation design and related construction.

2.3 Scope

The scope of work included coordination of field activities, site reconnaissance, boring layout, underground utility clearance, resistivity testing, drilling/sampling borings, performing engineering analyses and providing recommendations for use in site preparation and foundation design.

The scope of our services did not include any environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements which appear in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

2.4 General

The general analysis of the subsurface conditions reported herein is considered sufficient in detail and scope to form a reasonable basis for the foundation design. The recommendations submitted for the construction of the proposed structures are based on the available subsurface information and the design details furnished.

If there are any revisions to the plans for the proposed structures, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be retained to determine if changes in the foundation recommendations are required. If PSI is not retained for these functions, PSI will not be responsible for the impact of those conditions on the performance of the proposed structures.

3.0 PROJECT DESCRIPTION

Based on the information provided by Mr. Erik McElwain, P.E., Project Manager with Utility Engineering Corp, it is our understanding that the proposed development will consist of a combustion turbine and auxiliary units mounted on a reinforced concrete mat.

At this time, PSI has not been supplied with any structural information. However, from our experience with similar developments, PSI has assumed that primarily gravity loads will be imposed by the proposed structures and the maximum allowable compression load will be approximately 200,000 lbs.

The recommendations presented in this report are based on the assumption that there are no adverse impacts to the soil and groundwater at this site. If this is not the case, please inform PSI so that we may revisit and possibly amend/revise the recommendations presented in this report.

4.0 DESCRIPTION OF SITE

4.1 Site Location

The subject site is located in Stock Island, Florida. We have appended a Site Vicinity Map which identifies the location of the study area. This map is presented on **Sheet 1** of the Appendix.

4.2 Site Conditions

At the time of our subsurface exploration the property consisted of a vacant parcel of land with a predominant exposed soil cover. The grades at the site appeared to be relatively flat. No standing water was observed at the site during our subsurface exploration program. Our truck mounted drilling equipment did not encounter any mobility constraints within the site.

5.0 FIELD EXPLORATION

5.1 General

The field exploration program to evaluate the engineering characteristics of the subsurface materials included reconnaissance of the project site, clearing underground utilities, drilling borings, performing Standard Penetration Tests, soil resistivity testing and recovering split-spoon samples. Water level measurements were recorded in each borehole after its completion.

5.2 Standard Penetration Test Borings

Five (5) Standard Penetration Test (SPT) borings were drilled at the project site. The SPT borings were extended to depths of 40 and 45 feet below the existing grade. The locations of the SPT borings were provided by Mr. Erik McElwain, P.E., Project Manager with Utility Engineering Corp. The approximate boring exploration locations are shown on the Boring Location Plan on **Sheet 2** of the Appendix. The procedures used for drilling, sampling, plus conducting field tests and measurements are also discussed in the Appendix.

The test locations were marked in the field by a representative of PSI utilizing normal taping procedures. They are presumed to be accurate to within a few feet. After completion of the test borings, the boreholes were backfilled with excavated material and the site was generally cleaned up, as required.

5.3 Soil Resistivity Testing

Soil resistivity testing was requested within the proposed Combustion Turbine location. Testing was performed using an AEMC Instruments Digital Ground Resistance Tester Model 4500 and the Wenner four point method. Resistivity test results are tabulated and presented in **Table 1** in the **Appendix**.

6.0 SUBSURFACE CONDITIONS

6.1 General

Subsurface materials encountered in the borings were visually observed and classified, and are described on the boring logs and Generalized Subsurface Profile Sheets in the Appendix. Included with the boring logs and profiles are the results of the Standard Penetration Tests and water level observations. Jar samples of the materials recovered from the borings are now stored in our office for further analysis if desired. Unless notified to the contrary, all samples will be disposed of after 60 days.

The subsurface stratification shown on the boring logs and generalized profile represents subsurface conditions at the actual boring locations. Variations may occur within a short distance from the borings. The stratification lines presented on the boring logs represent approximate boundaries between successive materials encountered, but the actual transition may be gradual, or not clearly defined.

It is to be noted that, whereas the test borings were drilled and sampled by experienced drillers, it is sometimes difficult to record changes in stratification within narrow limits.

6.2 Soil/Rock Conditions

The results of the borings performed for the study indicate the subsurface conditions to generally consist of a layer of very loose to medium dense fill material comprising mainly of limerock and fine sand, with trace amounts of silt and PVC fragments. With the exception of boring BH-4, the fill material was underlain by a stratum of soft compressible material (sandy silt/silty sand) ranging in thickness from 2.0 to 7.5 feet (in the depth interval 6.0 to 13.5 feet below existing grade). The sandy silt/silty sand and fill materials were in turn underlain by a stratum of weakly to moderately cemented natural limestone formation to the maximum boring termination depth of 45 feet below existing grade.

A detailed description of the subsurface profile components is presented on the boring logs in the Appendix. Sheet 3 of the Appendix, presents a generalized subsurface profile that was prepared using the results of the SPT borings.

6.3 Groundwater Conditions

Groundwater levels were measured in the open boreholes upon completion of the drilling and sampling operations. The water levels measured in the borings, ranged from 2.0 to 3.7 feet below the existing ground surface. It should be noted that groundwater levels will fluctuate as a function of tidal changes, rainfall, and the infiltration rate of the soil. We recommend that the contractor determine the actual levels at the time of construction to determine potential groundwater impact on the construction procedure.

In storm surge conditions and following extreme rain events, the water table may be at or above the existing ground surface.

7.0 EVALUATION

We have evaluated the use of, both, shallow and deep foundations for the support of the proposed structures. Our analysis for the use of shallow foundations assuming the proposed loads noted earlier, and considering the sandy silt/silty sand which underlies the site, which is considered highly compressible, indicated the potential for excessive total and differential settlements. Therefore, a shallow foundation system is not recommended. To reduce settlement to an acceptable level, a deep foundation system is recommended, (i.e., driven piles, augercast piles or drilled shafts).

Locally, the most economical deep foundation system consists of pressure grouted augercast piles. As an added advantage, this system generates the least amount of vibrations during installation while still providing resistance to lateral and uplift forces. Detailed installation and monitoring recommendations for the construction of augercast piles are included in later sections of this report. Foundations may be constructed after the site preparation recommendations presented in this report have been implemented.

Drilled shafts are another type of deep foundation system that can be used to support the superstructure loads. This type of deep foundation system can sustain significantly higher loads (compression, tension, lateral) than augercast piles as their diameters are much higher. However, they are typically more expensive than augercast piles and will produce large volumes of soil and drilling mud spoil. PSI can provide recommendations for this type of foundation system, if requested.

8.0 RECOMMENDATIONS

8.1 Augercast Piles

Augercast piles (pressure-grouted) are considered the most appropriate type of deep foundation system for the support of the proposed structures. The capacity of those piles is essentially developed in side shear (skin friction) between the periphery of the grouted pile and the layers of rock or/and sand through which the piles penetrate. Our analysis consisted of determining a pile capacity for a specific pile size and socket length.

The structures can be supported on either 14 or 16-inch diameter augercast piles with the allowable capacities and minimum pile tip depths as outlined in the following table:

Summary of Augercast Pile Capacities

AUGERCAST PILE DIAMETER (INCHES)	MINIMUM ROCK PENETRATION (FEET)	MINIMUM PILE TIP DEPTH BELOW EXISTING GRADE (FEET)	ALLOWABLE COMPRESSION CAPACITY (TONS)	ALLOWABLE UPLIFT CAPACITY (TONS)
14	5	19	35	17
	10	24	70	35
16	5	19	40	20
	10	24	80	40

A safety factor of 2 against exceeding the ultimate unit skin friction values in the subsurface layers was used in our pile capacity calculations. The pile capacity recommended previously is controlled by stresses developed in the subsurface materials only. Allowable stresses for the selected pile section may impose more stringent restrictions on pile capacity and should be checked by the structural engineer. The structural engineer should determine the minimum compressive strength for the grout in accordance with applicable building code requirements.

The design capacity refers to dead and normal live loads and may be increased by 25 percent for total loads, including wind forces.

The following table presents recommended soil/rock design parameters for lateral pile capacity analyses.

Summary of Soil/Rock Design Parameters for Lateral Pile Capacity Analyses

MATERIAL TYPE	SPT "N" RANGE (bpf)	APPROXIMATE SOIL UNIT WEIGHT		ANGLE OF INTERNAL FRICTION ϕ (deg)	ALLOWABLE SHEAR STRENGTH S_u (psf)	HORIZONTAL SUBGRADE MODULUS	
		γ_{moist} (pcf)	γ_{sat} (pcf)			k_{moist} (pci)	k_{sat} (pci)
FILL	0 – 10	100	110	30	-	25	20
	10 – 30	105	115	32	-	90	60
SANDY SILT	0 – 10	95	105	-	500	-	-
SILTY SAND	0 – 10	100	110	30	-	25	20
LIMESTONE	0 – 10	105	115	30	-	25 **	20 **
	10 – 20	115	125	-	3000 *	-	-
	20 – 50	125	135	-	5000 *	-	-

Note:

- 1 *. Limestone shear strength estimated by the method proposed by McMahan (1988). PSI recommends that lateral behavior of Limestone strata with an average blow count above 10 bpf be modeled by the p-y method proposed by Reese, et al.
- 2 **. Limestone layers with blow counts equal to or less than 10 bpf, should be modeled as granular soil.

8.2 Settlement Potential

For an augercast pile supported system, the settlement of the structures is anticipated to be one inch or less, with differential settlements not exceeding one half inch. Settlement movement will primarily occur as a result of elastic compression in the limestone layers and will occur almost immediately with the application of load.

9.0 CONSTRUCTION CONSIDERATIONS

9.1 General

Site preparation for the proposed structures should consist of removal of below grade utilities, construction debris and any unsuitable materials (if encountered). The site should then be backfilled to the proposed final grades (if required) as per recommendation presented in Section 9.2 of the report.

9.2 Structural Fill and Backfill

Proper control of the placement and compaction of new fills for the project should be exercised by a representative of the geotechnical engineer. The fill materials should be placed in lifts not exceeding 12 inches in loose thickness. Each lift should be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density near the optimum moisture content as determined by ASTM D-1557. Fill to be compacted with a vibratory plate tamper or a small walk behind vibratory roller should be placed in lifts not exceeding six inches in loose thickness.

It is imperative that any fill supporting mats/slabs be placed, compacted and tested in accordance with the specifications of this report in order to adequately support the slab loads. The tests should be performed by a qualified soils technician working under the supervision of a geotechnical engineer in accordance with appropriate ASTM procedures. Any fill indicating less than the recommended relative compaction should be recompacted until the required density is obtained prior to the placement of subsequent fill lifts or pouring concrete for substructures.

Structural fill should be free of organic matter and consist of granular material containing less than 12 percent passing the U.S. Standard No. 200 mesh sieve. The fill material may be composed of either clean sands and/or limerock. The fill material should have no particle size in excess of three (3) inches and have a Unified Soil Classification System designation of GP, GW, GP-GM, GW-GM, SP, SW, SP-SM or SW-SM.

Structural fill or backfill to be placed below the water table level should consist of an inorganic, non-plastic material, free of any man-made debris, limerock with a three (3) inch maximum particle size with ASTM (Unified) Soil Classification of GP or GW or FDOT 57 Stone.

9.3 Groundwater Control

The need for significant groundwater control is not anticipated for construction at this site. However, if required due to heavy rainfall conditions or temporarily perched water, such water can be controlled by pumping from sumps located in ditches or pits. Groundwater should be maintained at the following levels:

- At least one (1) foot below the bottom of any excavation made during construction operations and
- At least two (2) feet below the surface of any vibratory compaction operations.

The discharge from any dewatering system should be handled in accordance with current regulatory criteria.

9.4 Excavations

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. PSI is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

10.0 AUGERCAST PILE CONSTRUCTION CONSIDERATIONS

10.1 Augercast Pile Installation

Recommendations for augercast pile installation are presented hereafter.

- We recommend that the piles be spaced at least 2.5 pile diameters center-to-center to minimize pile capacity reduction caused by group effects. A placement tolerance with respect to the design center of 3 inches should be specified for groups of piles and one (1) inch for isolated piles unless more stringent construction positioning is required. Out-of-plumbness for the piling should be limited to two (2) percent maximum.
- The 28-day compressive strength of the grout used in the piles should be determined by the Structural Engineer in accordance with applicable building code requirements.
- In order to provide some assurance that the piles has been constructed with a continuous cross section a full-length steel reinforcing bar or cage should be installed at the center of each pile immediately after grouting. Centralizers should be attached to individual bars at the bottom and at third points.
- Piles subject to uplift due to wind load must be provided with adequate reinforcing steel throughout their entire length. Similarly, laterally loaded piles should be provided with adequate reinforcement.

10.2 Drilling and Grouting

Augercast piles are constructed by rotating a hollow-stem continuous flight auger into the ground until the planned tip depth or termination criterion is achieved. At the termination depth, a grout with high fluidity is pumped under pressure into the hole through the hollow stem auger. As long as pressure is observed in the line, the auger is slowly withdrawn up the hole and the augercast shaft is constructed.

Grout volumes of 1.5 times or greater than the theoretical pile volume, may be required for proper pile installation. A grout factor equal to or greater than that of the successful test piles should be obtained. The grout factor is defined as the actual volume of grout pumped into the pile divided by the theoretical volume of the drilled hole.

After achieving the desired depth, a positive grout pressure should be observed prior to initiating withdrawal of the auger. A continuous fluid return consisting of slurry and then grout at the top of the hole is the best indication that the desired pressure head is being achieved.

The auger should be withdrawn slowly so that a positive grout pressure is maintained in the hole at all times during auger withdrawal. If the withdrawal of the auger becomes erratic, grout pressure suddenly drops, or if the grout flow is interrupted, the auger tip should be reinserted at least five (5) feet below the level where the grouting operation was disrupted prior to resuming withdrawal of the auger.

The installation of adjacent piles located within four (4) feet of each other on the same working day is not recommended at this site due to the potential existence of inter-connected pores or cavities in the limestone layers. We recommend that adjacent piles located within four (4) feet not be installed until the initial grouted pile has set overnight.

Some subsidence of fresh grout may occur in the top of the piles. This subsidence is in-part a result of the weight of the grout column "pushing" laterally into pores in the limestone layer. We anticipate that subsidence will occur within a period of approximately two hours following the grouting operation. If subsidence occurs while the pile grout is in a fluid state, we recommend that the pile be immediately filled with fresh grout to the proper cutoff elevation. We recommend that a pile grout subsidence of up to eight (8) inches be considered acceptable. Grout should not be pumped into the piles when it is older than 90 minutes from the time it was batched.

Prior to actual installation of the piles, the contractor should demonstrate that the materials and equipment proposed for use are capable of installing the production piles. The contractor should provide an accurate method of determining the depth and alignment of the auger.

10.3 Augercast Pile Monitoring

Successful augercast pile installation is in large part dependent upon the expertise of the contractor and the techniques he uses. Because of the possibility of soil intrusions during auger withdrawal and nonvertical piles, the job specifications must be carefully prepared and continuous observations made of the installation.

Full-time observations must be maintained during installation to monitor depths and the amount of grout pumped versus the rate of auger withdrawal. The full-time monitoring of pile installation will provide a degree of assurance that continuous piles of the proper cross-section are being constructed.

We recommend that the grout pump should be calibrated prior to initiation of production pile installation. At least one (1) set of six (6), 2-inch cubes or three (3)-inch diameter by 6-inch high grout cylinders should be made for each of 50 cubic yards of grout.

10.4 Test Pile Program

Construction documents produced for the project should include provisions for a full-scale testing of each prototype pile used in the foundations. The drilling of these piles should be performed under the direct supervision of a geotechnical engineer from this office who is familiar with the subsurface conditions encountered at the site.

We recommend that at least one (1) static compression load test and one static tensile load test be performed for each prototype pile, for this project. The test piles should be subjected to full scale static compression load tests pursuant to the requirements of ASTM D1143 and the Florida Building Code under the direct supervision of a geotechnical engineer from this office. The reaction piles may be positioned at production pile locations.

The purpose of the test piles is to evaluate the load deformation behavior as well as the load distribution of this foundation element as compared to the production piles. Therefore, it is imperative that the cut off elevation of the test pile be the same as that of the production piles. Based on the results of the load tests the geotechnical engineer would then provide additional installation criteria (i.e. minimum grout factor, revised termination criteria, etc.) for the production piles, if necessary. Testing of the pile should include the standard method of loading to at least twice the compression design value.

11.0 GENERAL CONDITIONS

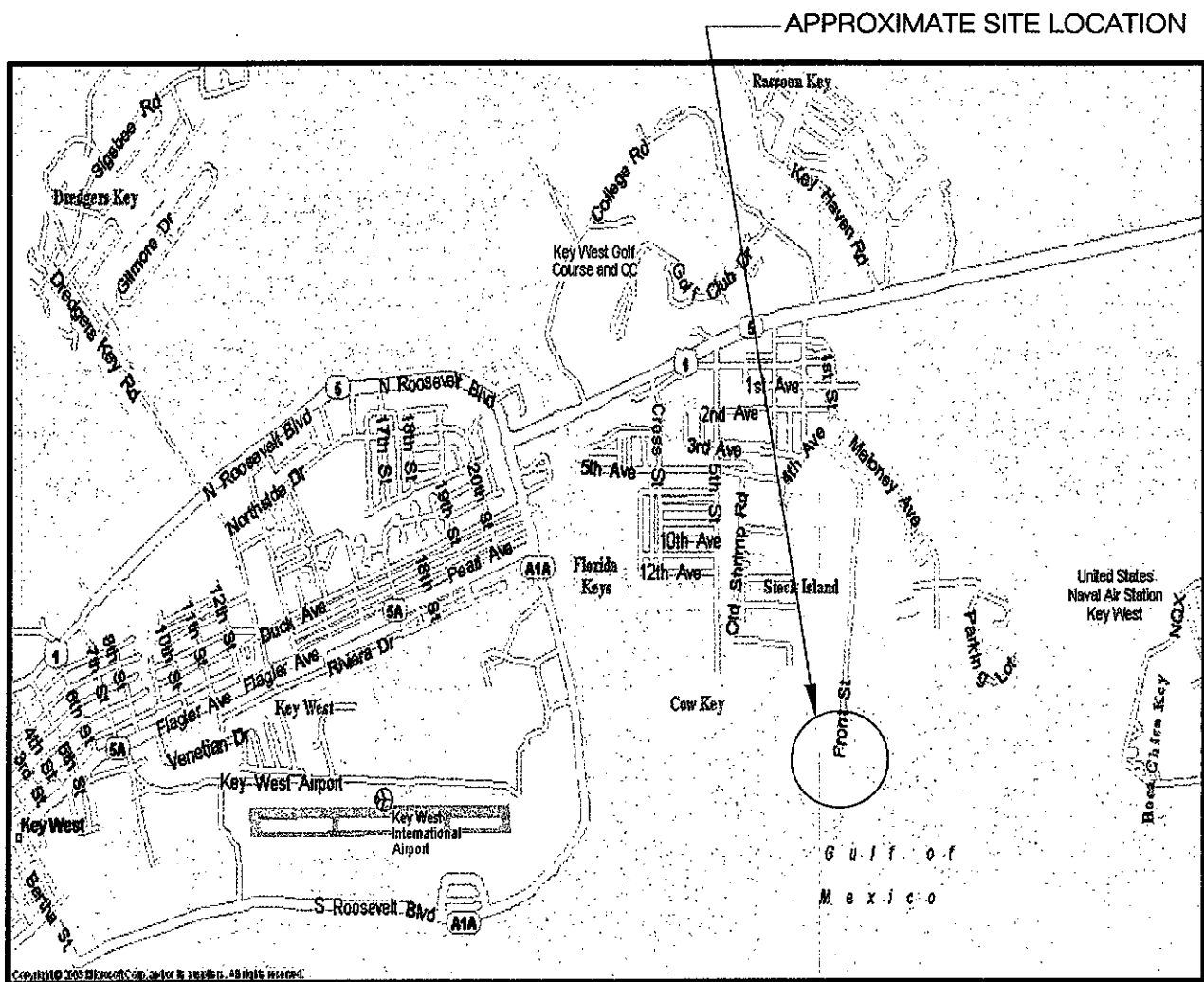
The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein, have been presented after being prepared in accordance with general accepted professional practice in the field of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

After the plans and specifications are complete, it is recommended that PSI be provided the opportunity to review the final design and specifications, in order to verify that the earthwork and foundation recommendations are properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations.

This report has been prepared for the exclusive use of Utility Engineering Corp, and their design consultants for the specific application to the construction of the proposed Combustion Turbine in Stock Island, Florida.

APPENDIX





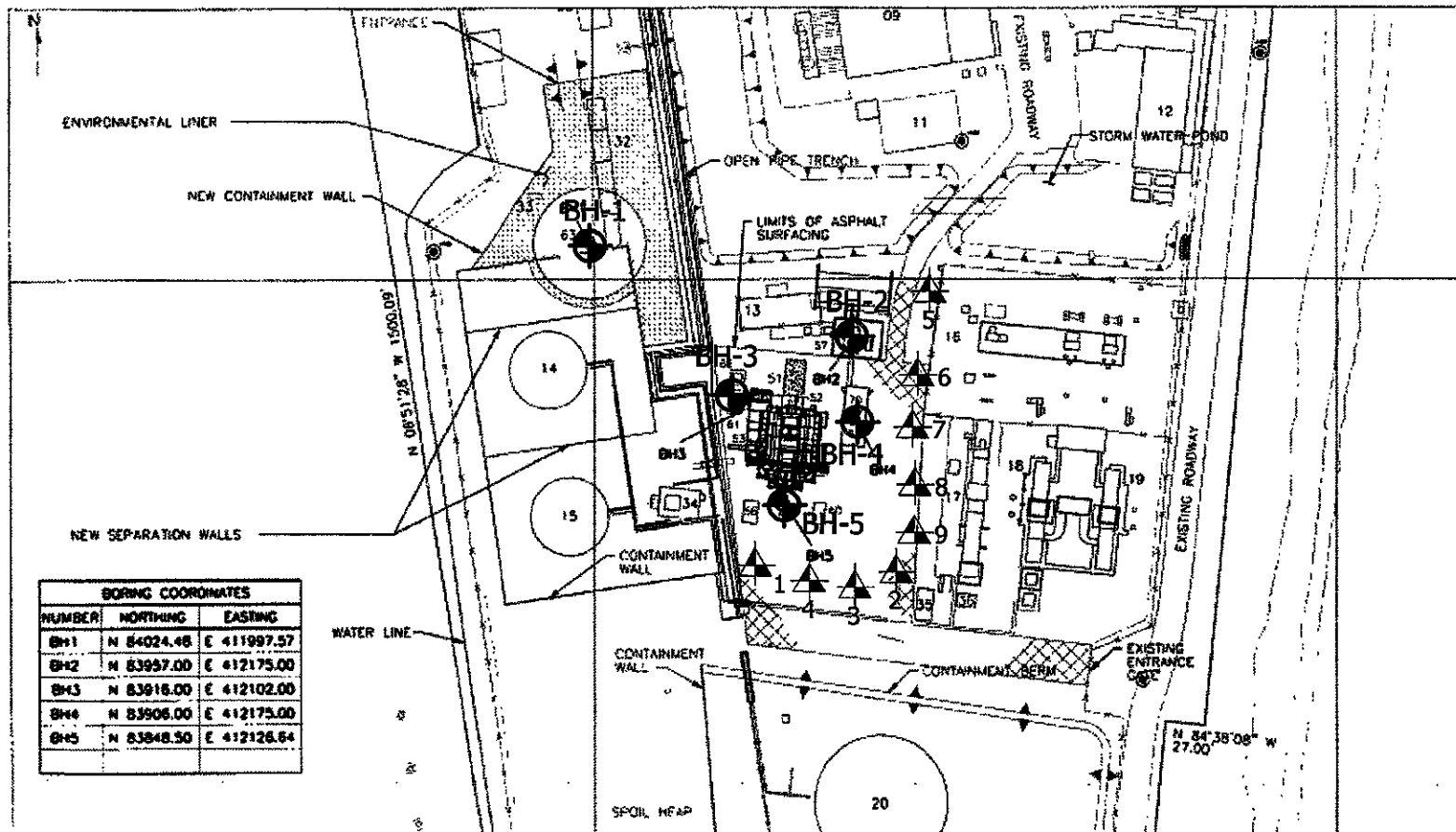
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SCALE: NOT TO SCALE

SITE VICINITY MAP

GEOTECHNICAL ENGINEERING SERVICES

PROPOSED COMBUSTION TURBINE
STOCK ISLAND, FLORIDA

DATE:	08/08	SHEET #1	PROJ. NO: 397-55112
SCALE:	N.T.S.		
DRAWN:	DB		
CHKD:	DB		



BORING COORDINATES		
NUMBER	NORTHING	EASTING
BH-1	N 84024.48	E 411997.57
BH-2	N 83957.00	E 412175.00
BH-3	N 83916.00	E 412102.00
BH-4	N 83906.00	E 412175.00
BH-5	N 83848.50	E 412126.64

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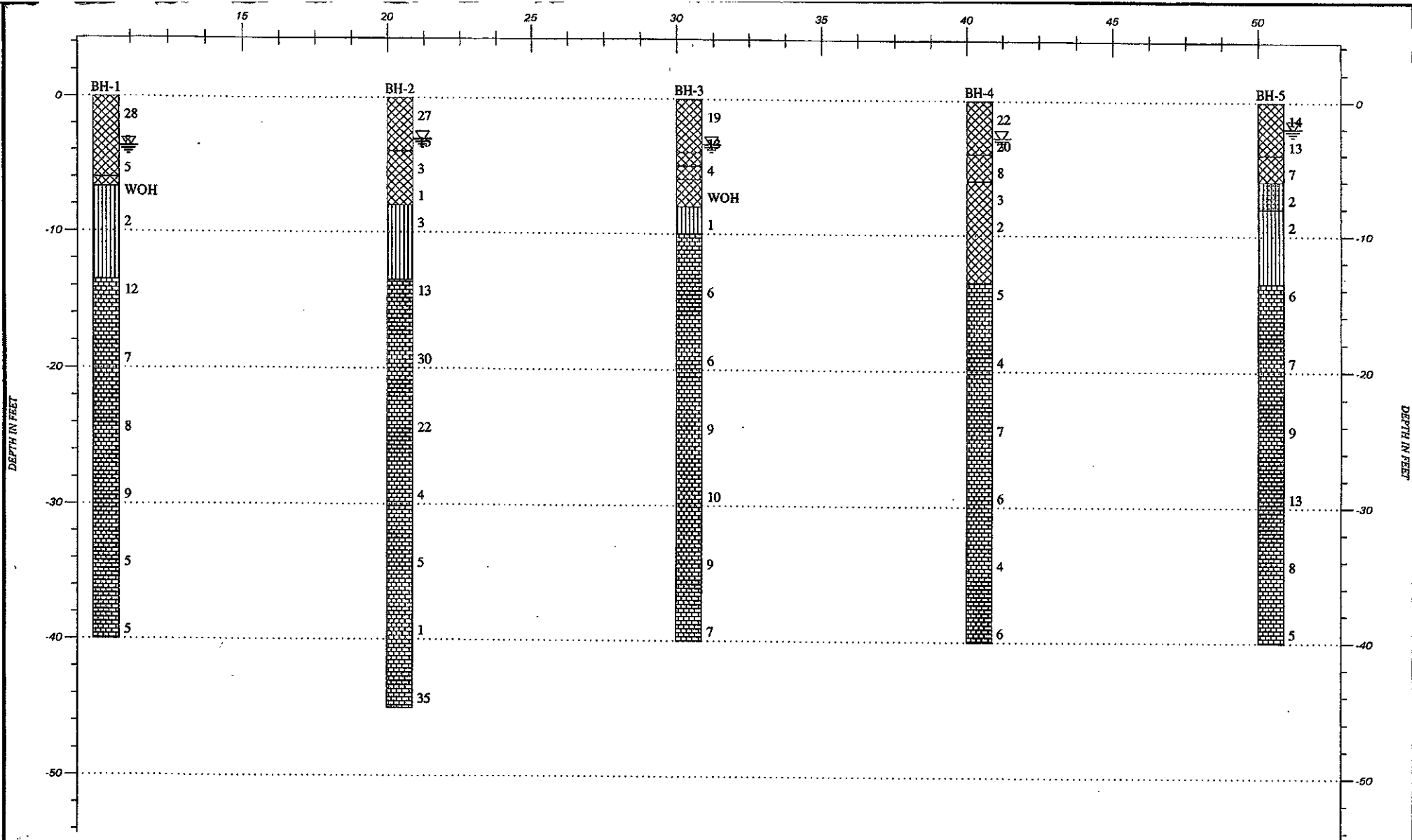
LEGEND



APPROXIMATE SPT BORING LOCATION (#5)



APPROXIMATE SOIL RESISTIVITY TESTING LOCATION (#9)



Strata symbols

-  Fill
-  Silt
-  Limestone
-  Silty sand

PROFESSIONAL SERVICE INDUSTRIES, INC.
GENERALIZED SOIL PROFILE

HORIZONTAL SCALE: 1"=(proportional)	DRAWN BY/APPROVED BY EC/DB	DATE DRAWN 8/11/2005
VERTICAL SCALE: 1"=(proportional)	Proposed Combustion Turbine Stock Island, Florida	
PROJECT NO. 207 55110		SHEET NUMBER KEYS Energy Services

LOG OF BORING NO. BH-1

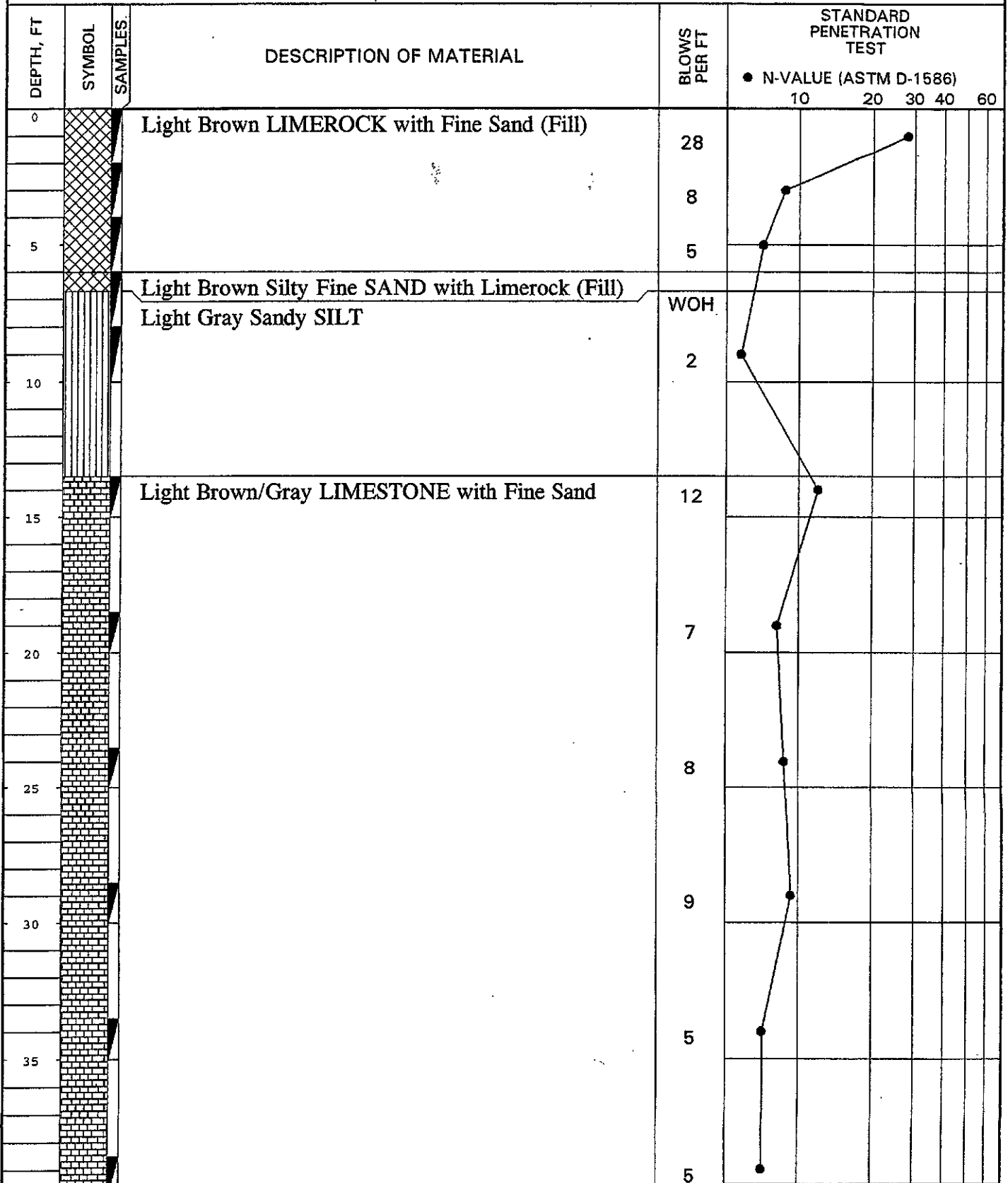
Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/04/05

IN BORING: 3.7'

LOGGED BY: D.C.

Proposed Combustion Turbine
Stock Island, Florida

Project Number: 397-55112

Location: See Attached Boring Location Plan

COMPLETION DEPTH: 40 feet DEPTH TO WATER ELEVATION: 0
DATE: 08/04/05 IN BORING: 3.7' LOGGED BY: D.C.

LOG OF BORING NO. BH-2

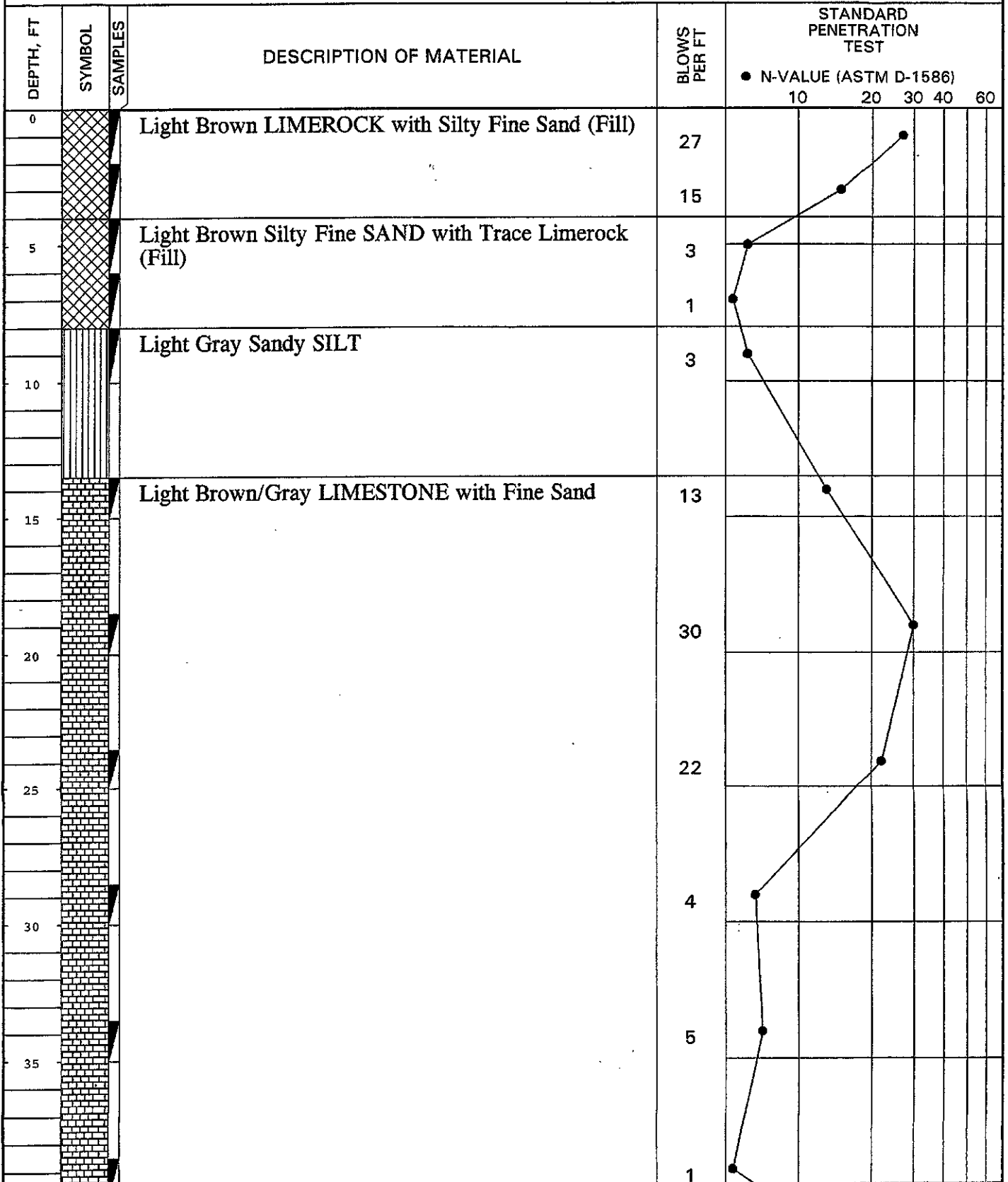
Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan



COMPLETION DEPTH: 45 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/03/05

IN BORING: 3.1'

LOGGED BY: D.C.

LOG OF BORING NO. BH-2

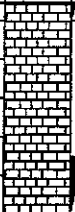
Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST					
					● N-VALUE (ASTM D-1586)					
					10	20	30	40	50	60
40			Light Brown/Gray LIMESTONE with Fine Sand	35						
45			End of Boring							
50										
55										
60										
65										
70										
75										

COMPLETION DEPTH: 45 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/03/05

IN BORING: 3.1'

LOGGED BY: D.C.

LOG OF BORING NO. BH-3

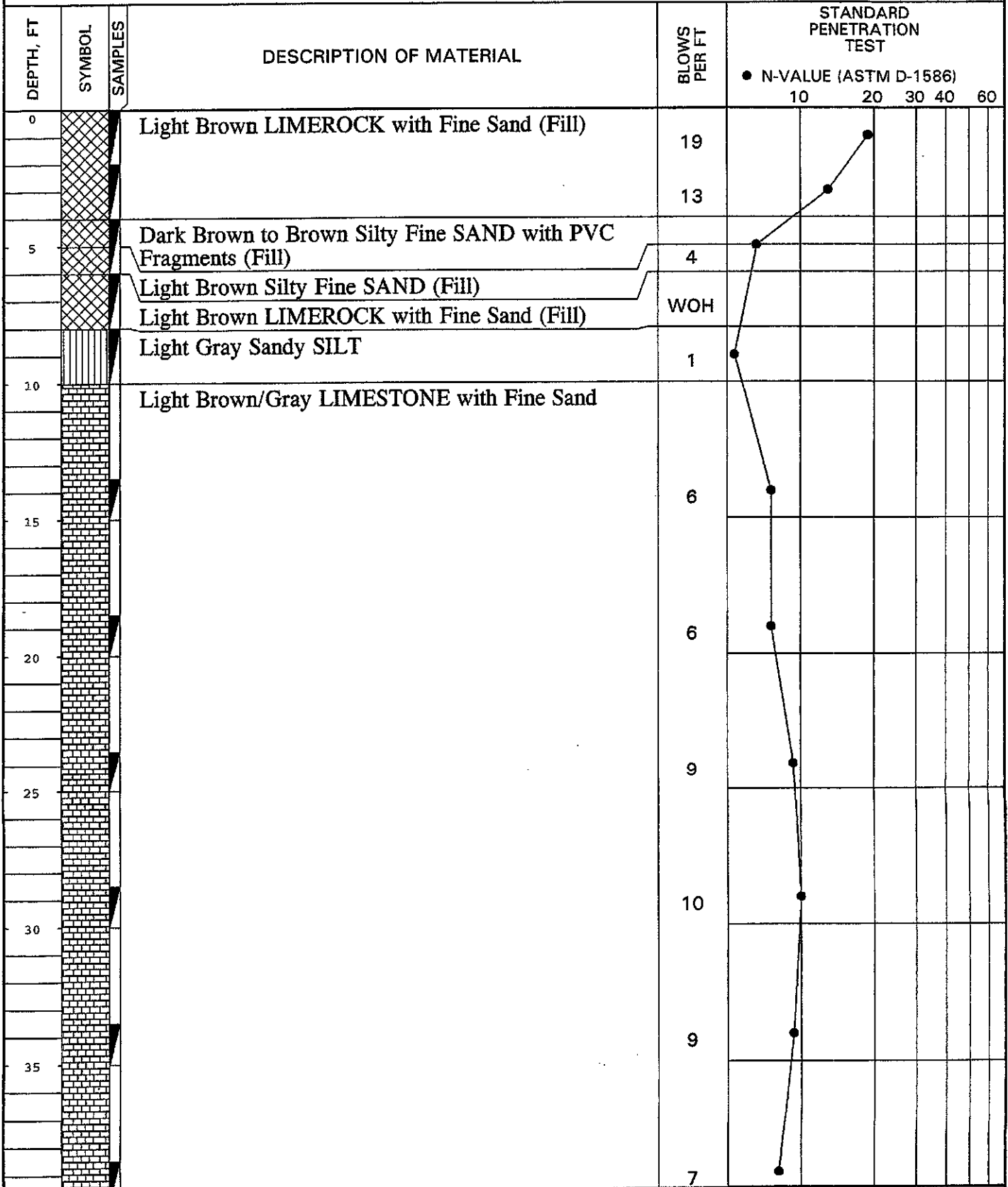
Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/04/05

IN BORING: 3.4'

LOGGED BY: D.C.

LOG OF BORING NO. BH-3

Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST				
					● N-VALUE (ASTM D-1586)				
					10	20	30	40	60
40			Light Brown/Gray LIMESTONE with Fine Sand End of Boring						
45									
50									
55									
60									
65									
70									
75									

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/04/05

IN BORING: 3.4'

LOGGED BY: D.C.

LOG OF BORING NO. BH-4

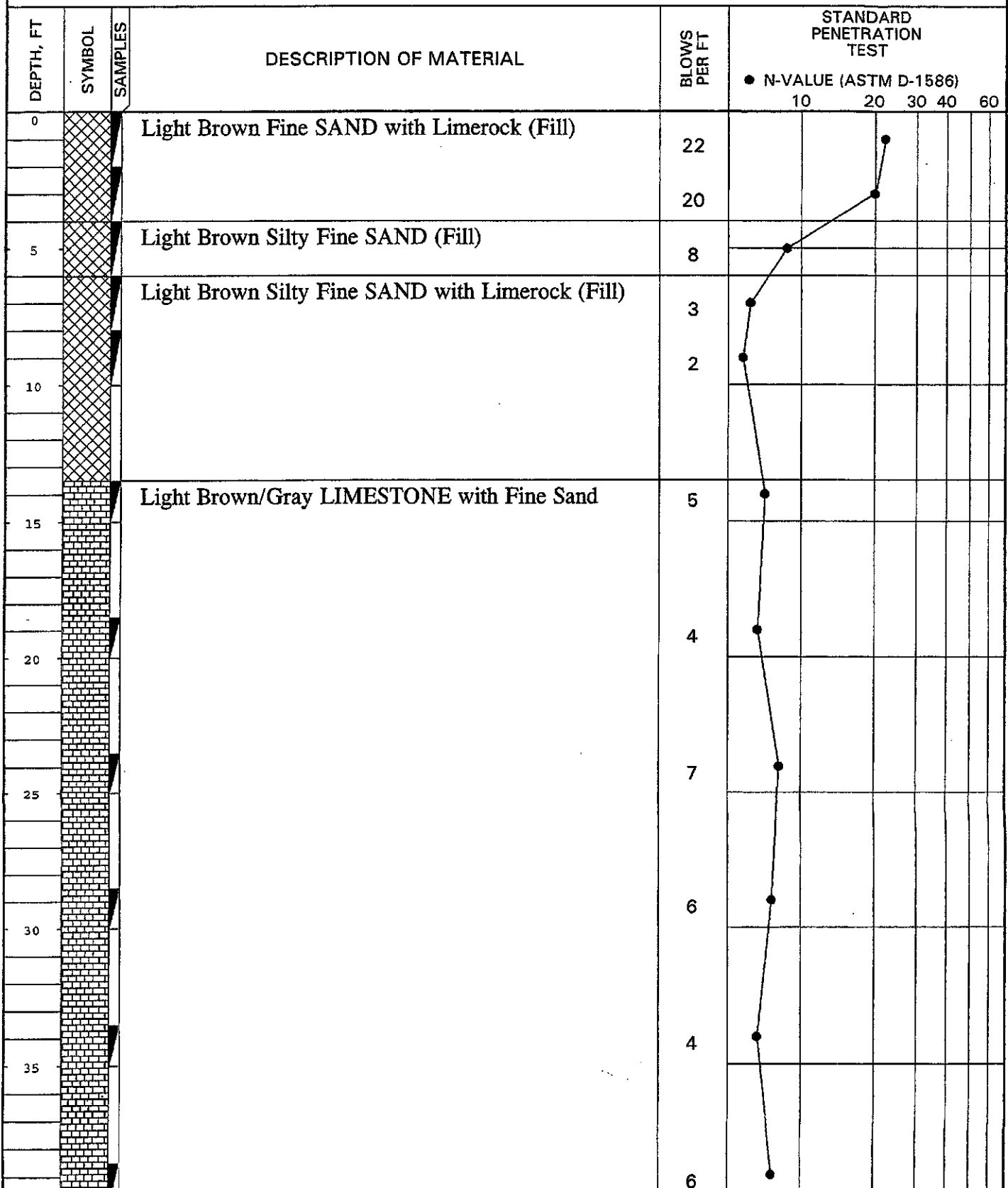
Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan



COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/03/05

IN BORING: 2.8'

LOGGED BY: D.C.

LOG OF BORING NO. BH-4

Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST				
					● N-VALUE (ASTM D-1586)				
					10	20	30	40	60
40			Light Brown/Gray LIMESTONE with Fine Sand						
			End of Boring						
45									
50									
55									
60									
65									
70									
75									

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/03/05

IN BORING: 2.8'

LOGGED BY: D.C.

LOG OF BORING NO. BH-5

Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST					
					● N-VALUE (ASTM D-1586)					
					10	20	30	40	60	
0			Light Brown LIMEROCK with Fine Sand (Fill)	14						
				13						
5			Light Brown Fine SAND with Trace Limerock (Fill)	7						
			Light Brown Silty Fine SAND	2						
			Light Brown Sandy SILT	2						
10										
			Light Brown/Gray LIMESTONE with Fine Sand	6						
15										
				7						
20										
				9						
25										
				13						
30										
				8						
35										
				5						

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/04/05

IN BORING: 2.0'

LOGGED BY: D.C.

LOG OF BORING NO. BH-5

Proposed Combustion Turbine
Stock Island, Florida

Client: Utility Engineering Corp

Project Number: 397-55112

Type: 2" Split-Barrel

Location: See Attached Boring Location Plan

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	STANDARD PENETRATION TEST				
					● N-VALUE (ASTM D-1586)				
					10	20	30	40	60
40			Light Brown/Gray LIMESTONE with Fine Sand						
			End of Boring						
45									
50									
55									
60									
65									
70									
75									

COMPLETION DEPTH: 40 feet

DEPTH TO WATER

ELEVATION: 0

DATE: 08/04/05

IN BORING: 2.0'

LOGGED BY: D.C.

**TABLE 1: SOIL RESISTIVITY TESTING
 PROPOSED COMBUSTION TURBINE
 STOCK ISLAND, FLORIDA
 PSI PROJECT NO. 397-55112**

PSI Project Name : FMPA STOCK ISLAND, FLORIDA
Engineer in Charge : DB
Test Completed By : BB
Test Instrument : EEMC Model 4500 Digital Earth Resistance Tester
Serial Number : 05H45221
Date Last Updated: 8/11/2005
Calculation : Resistivity (Ohms-cm) = 191.5 x probe spacing (ft) x R (Ohms Reading)

Location	1.5 (ft)	Resistivity (Ohms-cm)	2.5 (ft)	Resistivity (Ohms-cm)	4.0 (ft)	Resistivity (Ohms-cm)	10.0 (ft)	Resistivity (Ohms-cm)
1	6.1	1752.2	13.3	6367.4	7.7	5898.2	6.2	11873.0
2	5.5	1579.9	12.9	6175.9	5.8	4442.8	5.6	10724.0
3	7.3	2096.9	7.8	3734.3	7.3	5591.8	9.9	18958.5
4	4.4	1263.9	3.5	1675.6	7.8	5974.8	16.6	31789.0
5	5.6	1608.6	10.3	4931.1	6.5	4979.0	6.7	12830.5
6	7.0	2010.8	8.4	4021.5	8.8	6740.8	11.3	21639.5
7	7.60	2183.10	8.80	4213.00	8.30	6357.80	9.4	18001.0
8	6.20	1780.95	6.60	3159.75	1.80	1378.80	7.2	13788.0
9	5.00	1436.25	6.70	3207.63	5.40	4136.40	5.9	11298.5



CORRELATION OF PENETRATION RESISTANCE WITH
RELATIVE DENSITY OF GRANULAR SOILS

RELATIVE DENSITY	STANDARD PENETRATION TEST BLOWS/FT. (N-VALUE)
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

DRILLING AND SAMPLING PROCEDURES

The borings were performed with a drilling rig equipped with a rotary head. The drill holes were advanced by the use of a high speed rollercone bit, with bentonite drilling fluid being pumped through the drill rods to remove the cuttings and to stabilize the side walls and bottom of the hole. Representative samples were obtained by the use of split-barrel sampling procedures in general accordance with the procedures for "Penetration Test and Split-Barrel Sampling of Soils" (ASTM D-1586).

FIELD TESTS AND MEASUREMENTS

Penetration Tests - During the sampling procedure, Standard Penetration Tests (SPT) were performed at pre-determined intervals to obtain the standard penetration value (N) of the soil. The standard penetration value (N) is defined as the number of blows of a 140 pound hammer, falling thirty (30) inches, required to advance the split-barrel sampler one (1) foot into the soil. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows are recorded for each of three (3) successive increments of six (6) inches penetration. The "N" value is obtained by adding the second and third incremental numbers.

Water Level Measurements - Water level depths were obtained during the boring operations. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. Seasonal variations, tidal conditions, temperature, land-use, and recent rainfall conditions may influence the depths to the groundwater.

Ground Surface Elevations - Ground surface elevations at the boring locations were not provided. Therefore, all references to depth of the various strata and materials encountered, are from existing grade at the time of drilling.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

SECTION 29 DRAWINGS

SECTION 29 - PART 1

29.1 M-688 System One Line.

SECTION 29 - PART 2

29.2 BP-1, Big Pine One Line.

SECTION 29 - PART 3

29.3 BP-2, Big Pine Layout.

SECTION 29 - PART 4

29.4 SIPS-1, Stock Island Generation Facility Substation One Line.

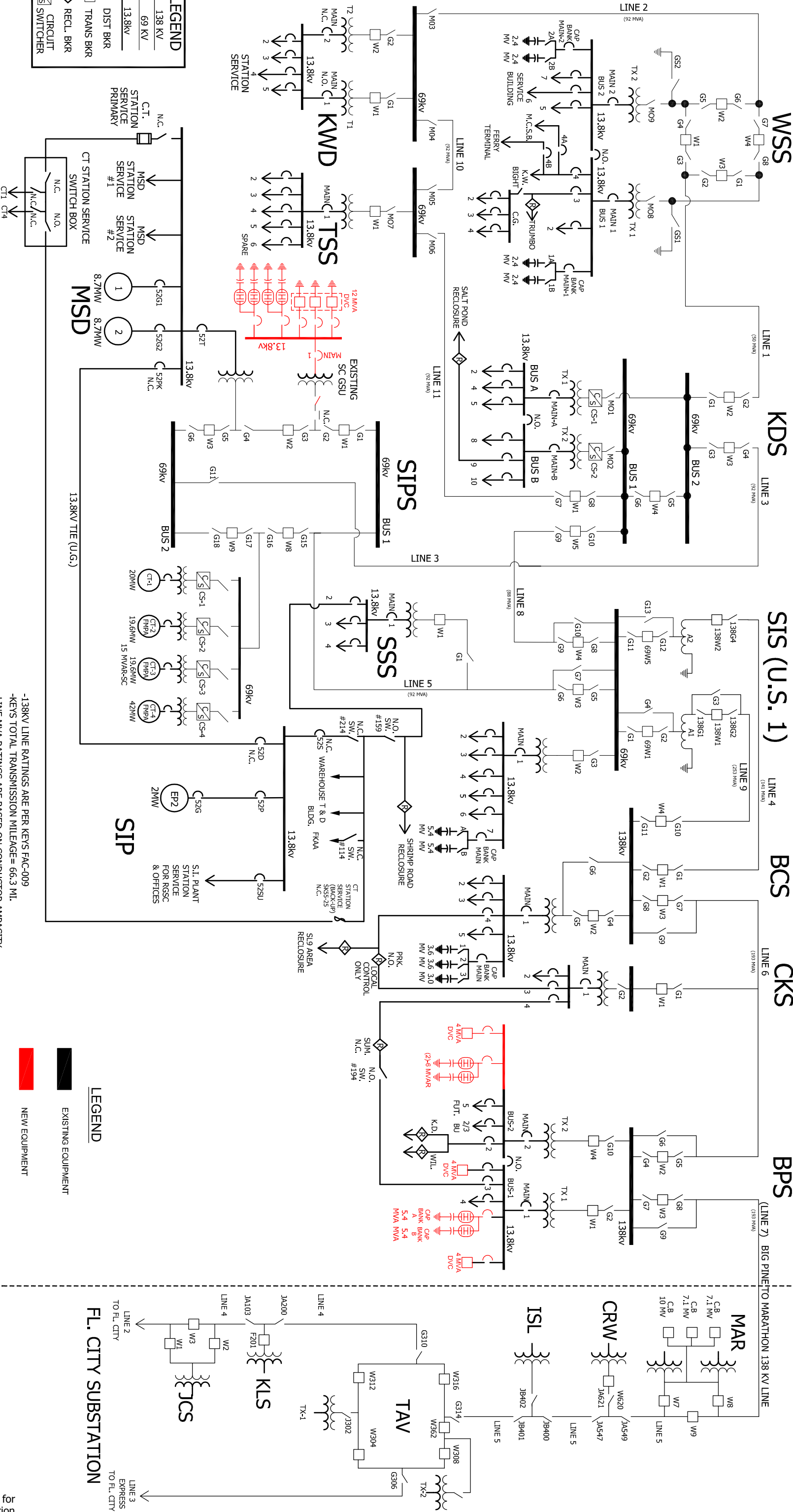
SECTION 29 - PART 5

29.5 SIPS-2, Stock Island Generation Facility Substation Layout.

SECTION 29 - PART 6

29.6 M-729, Typical Duct Bank.

END OF SECTION 29



-138KV LINE RATINGS ARE PER KEYS FAC-009
-KEYS TOTAL TRANSMISSION MILEAGE= 66.3 MI.
-LINE MVA RATINGS ARE BASED ON CONDUCTOR AMPACITY.
-DERATING WILL OCCUR IF VOLTAGE AND STABILITY ARE NOT WITHIN RANGE.

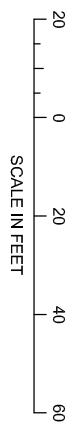
REDRAWN FROM KEYS ENERGY SERVICES
DRAWING NAME: M-688. LAST REVISION 8/27/2010

* ADDED NOTE THAT FEEDER 4 AT KWD IS STATION SERVICE

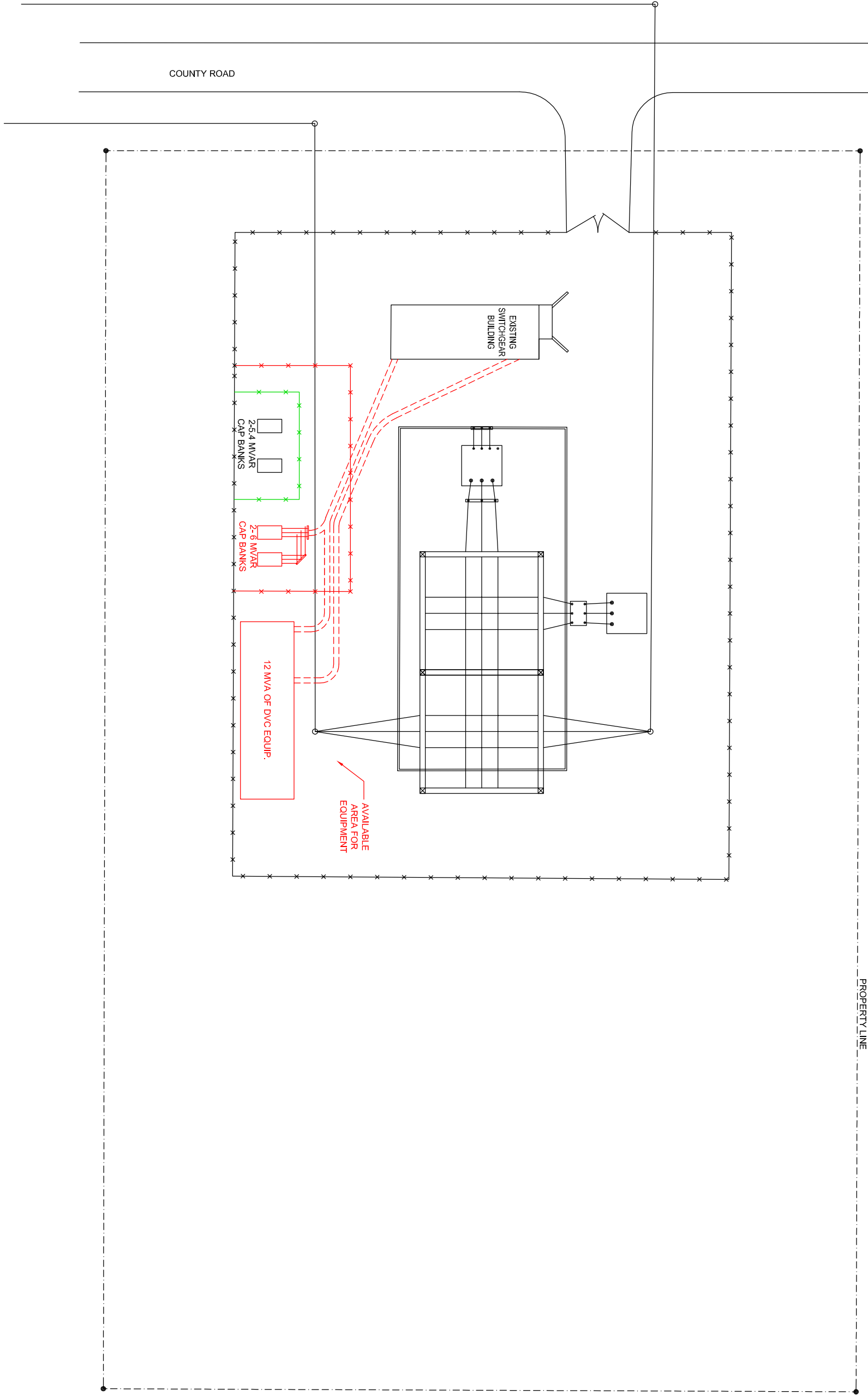
DESIGNED				AWS			
DRAWN				AWS			
ISSUED FOR BIDDING				CONSTRUCTION			
REVISION DESCRIPTION							
REV	DATE	CHKD	APPD				
0	3-30-11						

KEYS Bid #12-11 Spec
EPC of Dynamic Var Co
(DVC-Starcom System)



REV	DATE	CHKD	APPD	REVISION DESCRIPTION	DESIGNED	ISSUED FOR BIDDING ONLY NOT FOR CONSTRUCTION		 R.W. Beck 1000 Legion Place, Suite 1100 Orlando, FL 32801 (407) 422-4911 An SAIC Company	KEYS ENERGY SERVICES BIG PINE SUBSTATION ELECTRICAL EQUIPMENT PLAN	PROJECT NUMBER:
										SHEET 1 OF 1
										DRAWING NUMBER:

KEYS Bid #12-11 Specifications for
EPC of Dynamic Var Compensation
(DVC-Statcom System)



LEGEND

-  UNDERGROUND DUCT BANK
-  EXISTING EQUIPMENT
-  NEW EQUIPMENT
-  EQUIPMENT TO BE REMOVED UNDER THIS CONTRACT

DESIGNED	AWS
DRAWN	AWS

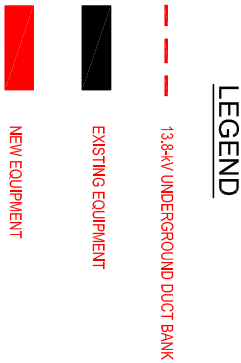


An SAIC Company

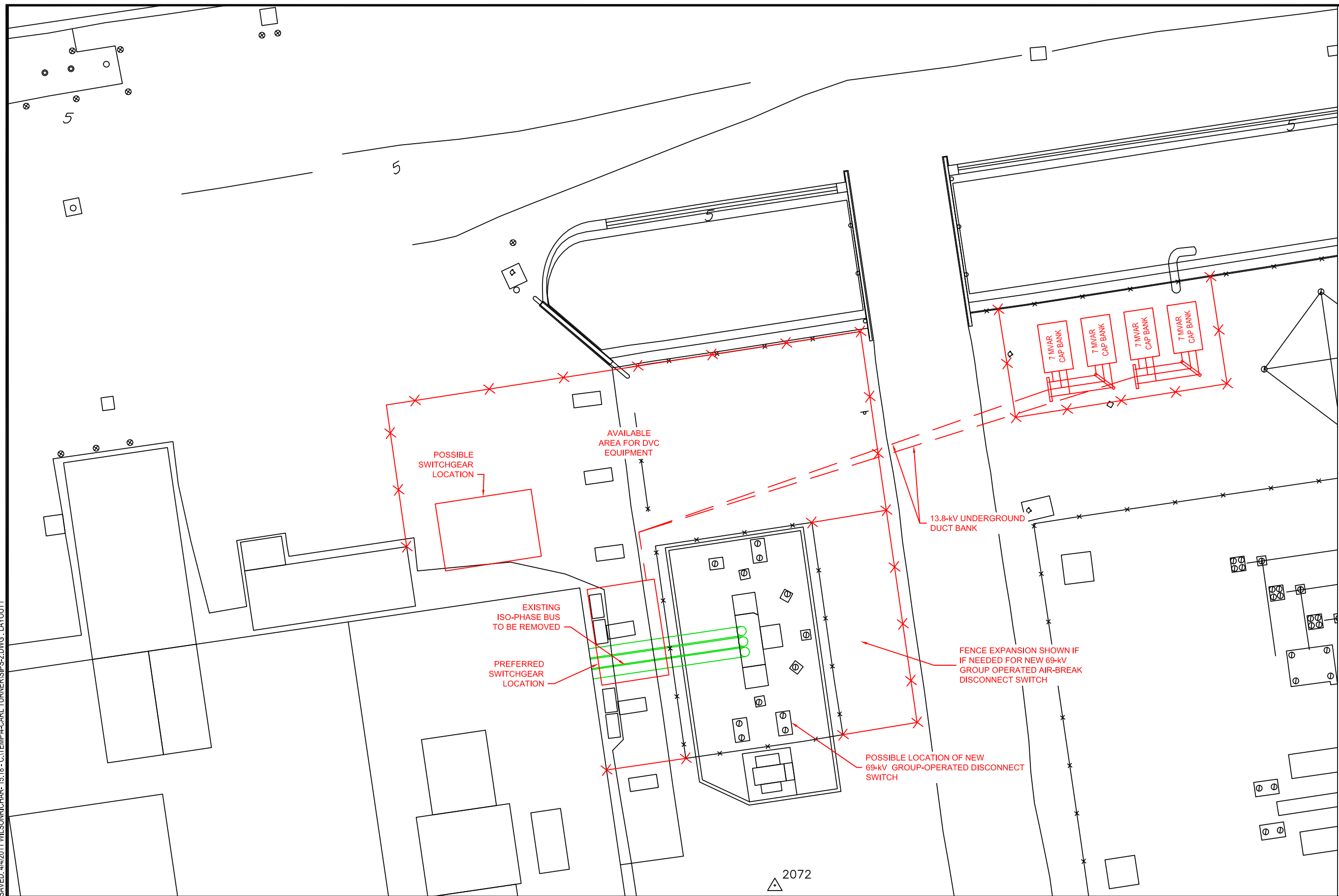
KEYS ENERGY SERVICES
STOCK ISLAND SUBSTATION
CONCEPTUAL ONE-LINE DIAGRAM

PROJECT NUMBER:	
SHEET OF:	1 1
DRAWING NUMBER:	SIPS-10

KEY: Bid #12-11 Specialties
 REP of Dynamic Var Control
 (DVC-Starcom System)



PLOT: 4/4/2011 WILSONRICHAR-15:18 - C:\TEMP\4-CARL TURNER\SIPS-2.DWG - LAYOUT1

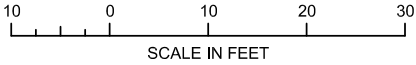


LEGEND

- EXISTING EQUIPMENT
- NEW EQUIPMENT
- EQUIPMENT TO BE REMOVED UNDER THIS CONTRACT

DESIGNED	AWS
DRAWN	AWS
DATE	
KEYS Bid #12-11 Specifications for BIDDING	
REV of Dynamic Var Compensation (DVC System)	
REVISION DESCRIPTION	

ISSUED FOR
BIDDING ONLY
NOT FOR
CONSTRUCTION



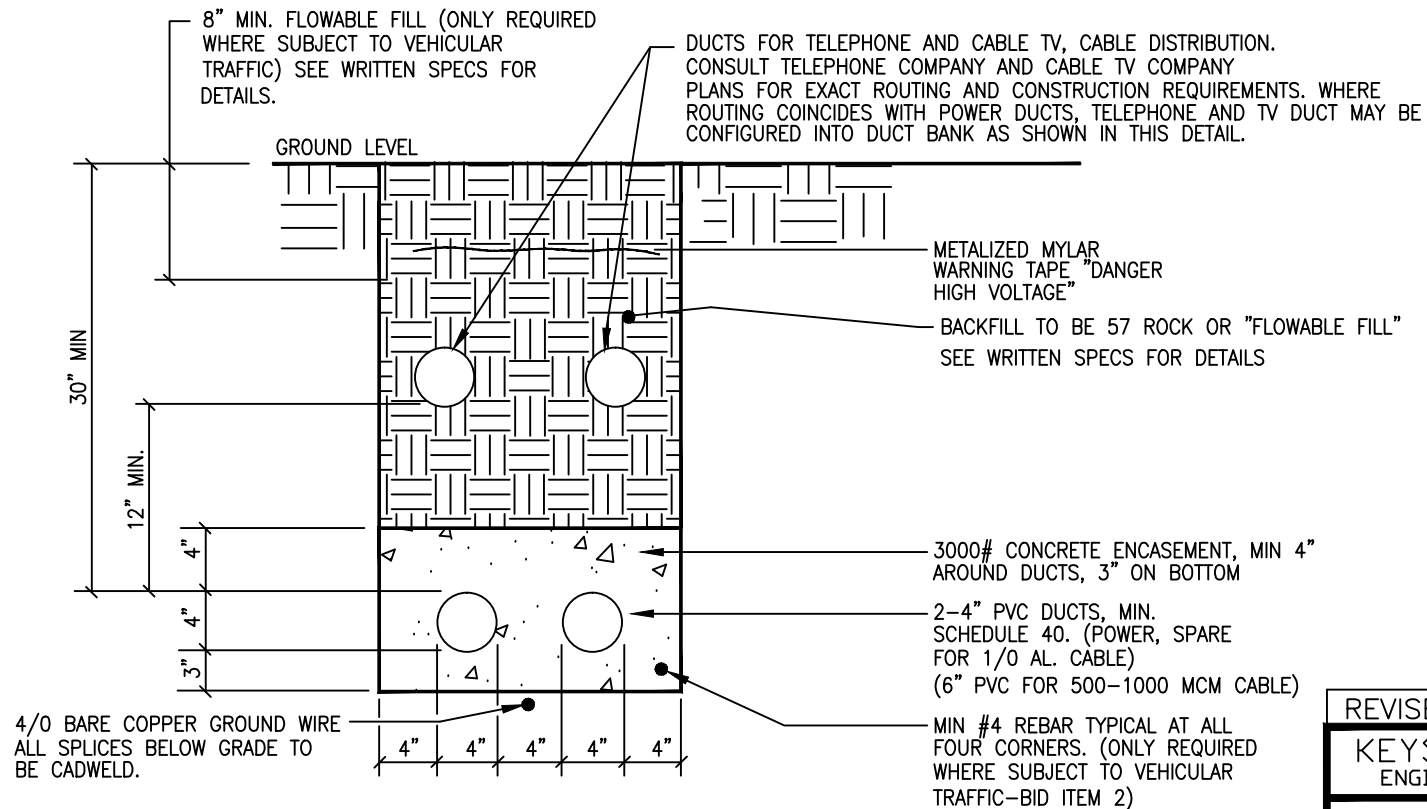
R.W. Beck
1000 Legion Place, Suite 1100
Orlando, FL 32801
(407) 422-4911

KEYS ENERGY SERVICES
STOCK ISLAND SUBSTATION
ELECTRICAL EQUIPMENT PLAN

PROJECT NUMBER:	
SHEET OF:	1 1
DRAWING NUMBER:	SIPS-2.0

KEYS Energy Services

HIGH VOLTAGE TRENCH



TYPICAL UNDERGROUND
HIGH VOLTAGE
DUCT BANK CROSS SECTION

SCALE: NONE

REVISED 2-28-06 RVS	
KEYS ENERGY SERVICES ENGINEERING DEPT. KEY WEST FL.	
UNDERGROUND SPECIFICATIONS	
DESIGNED BY: D. FINIGAN	
APPROVED BY:	
DATE: 1-01	
DRAWN BY: VIN SMITH	
SCALE: NONE	SHEET 1 OF 2



M-729

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

KEYS ENERGY SERVICES **GENERAL TERMS & CONDITIONS**

ADDITIONS/DELETIONS

KEYS reserves the right to add or delete any item from this bid or resulting contract when deemed to be in the best interest of KEYS.

ALTERATIONS IN PROPOSAL

Except as otherwise provided herein, Proposals which are conditional in any way, or which contain erasures or interlineations not authenticated as provided herein, or which contain items not called for, items not in conformity with applicable laws, changes, additions, recapitulations, alternative Proposals, or any other modifications of the Proposal forms which are not specifically called for in the Contract Documents, will be rejected as not responsive unless specifically agreed to in writing by KEYS. Erasures, interlineations or other corrections shall be authenticated by affixing in the margin immediately opposite the correction, the handwritten initials of each person executing the Proposal.

APPLICABLE LAW

This Contract shall be interpreted in accordance with the law of the State of Florida.

ASSIGNMENT

No contract awarded under these terms, conditions, and specifications, may be sold, transferred or assigned in full or part without the written permission of KEYS. Such written permission shall not relieve the Contractor from its obligations and liabilities.

ATTORNEY FEES

The prevailing party in any litigation or mediation relating to the contract shall be entitled to recover its reasonable attorney fees and costs from the other party for all matters, including, but not limited to, appeals.

BASIS OF AWARD

A. The award will be made by KEYS on the basis of the Proposal from the lowest responsive* responsible**, Bidder which, in KEYS' sole and absolute judgment, will best serve the interest of the KEYS.

B. KEYS reserves the right to accept or reject any or all Proposals, and to waive any informalities and irregularities in said Proposal.

*Responsive Bidder: Any person, firm, or corporation submitting a bid for the work contemplated whose bid form is complete and regular, free of excisions or special conditions and has no alternative bids for any item unless requested in the technical specifications.

**Responsible Bidder: Any person, firm, or corporation submitting a bid for the work contemplated who maintains a permanent place of business, has adequate manpower and equipment to do the work properly and within the time limit that is established, has adequate financial status to meet his obligations contingent to the work and has a history of performance of like contracts (acceptable to the KEYS).

C. Evaluation: The lowest evaluated price shall be determined from an analysis which assesses the impact of the contract price, operational and maintenance costs.

BID BOND/CERTIFIED CHECK

Each proposal should be accompanied by a Bid Bond or Certified Check payable to the UTILITY BOARD OF THE CITY OF KEY WEST in an amount not less than five (5%) percent of the amount of the proposal as security.

BID PROPOSAL PRICING

All bid proposals must remain firm for 120 days minimum.

BIDDER QUALIFICATIONS

If a pre-bid meeting is held, please provide the following information at that time. If no pre-bid meeting is held, please provide this information in your bid response.

CITY/COUNTY LICENSING

For the term of the contract, Contractor shall maintain City of Key West and Monroe County licenses and/or other requirements to work within the City or County limits. The contractor should provide KEYS with a copy of all licenses.

COMPLETENESS OF PROPOSAL

A. Each Bidder shall respond to all items on Proposal Page. When quoting on all items including optional items, bidders shall insert the words "No Bid" in the space provided for any item for which no offer is made. Failure to do so may result in the Proposal being rejected as not responsive.

B. KEYS will consider alternative, additive, or deductive options with no initial pricing.

C. Each Proposal shall include specific acknowledgment of receipt of all Addenda issued during the bidding period. Failure to do so may result in the Proposal being rejected as not responsive.

D. Each Bidder shall furnish information relating to its experience, facilities, personnel, material, equipment and business as is required by the Proposal form. Failure to do so may result in the Proposal being rejected as not responsive.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

- E. Additional technical data furnished by a Bidder, but not required by the Request for Proposal (RFP), may at KEYS' option be considered a part of the Proposal to the extent that it is supplementary to, is consistent with and not contrary to the RFP.

CONTACT REFERENCES

KEYS contact for bidding requirements and technical specifications: Supervisor of Purchasing, susan.ham@keysenergy.com.

CONTRACT DURATION

The duration of the base contract shall be for ten (10) months from the date of execution by the Utility Board through June of 2012. KEYS reserve the right to cancel this contract without cause with 30 days written notice and with cause within 10 days.

CONTRACT CHANGES

No changes, over the contract period, shall be permitted unless prior written approval is given by the Utility Board of the City of Key West, Florida. No Contractor shall assign the contract or any rights or obligations there under without the written consent of KEYS. In the event of such approved subcontracting, the Contractor agrees to provide KEYS with written documentation relative to the Subcontractor(s) employed in this contract.

CONTRACT COMPLIANCE

All contracts are subject to the terms and conditions of the Fair and Accurate Credit Transactions Act of 2003. The said provisions and compliance therewith are expressly made part of the contract and are binding covenants on the party contracting with KEYS.

CONTRACTOR LIABILITY

In the event of default by the Contractor, KEYS reserves the right to utilize the next lowest Bidder as the new Contractor. In the event of this occurrence, the next lowest Bidder, if it wishes the award, shall be required to provide the bid items at the prices as contained on its proposal or bid for this specification.

CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall be responsible for all loss, damage, vandalism, theft, etc. for all equipment, tools, materials, etc. left on the job site.
- B. Contractor shall be responsible for maintaining the site in a clean condition during installation. Contractor and KEYS at which time the site should be cleaned up will make a final walk down of the sites.
- C. Prior to completion of demobilization, Contractor shall remove all construction materials, waste, demolition debris, excess materials, temporary installation, etc. that have not been specifically turned over and accepted by KEYS.
- D. Contractor shall be responsible for any and all costs for clean up of oil or gasoline spills which result from his equipment or from any work performed as part of this contract.
- E. Permit violations or environmental damage caused by the Contractor shall be mitigated or repaired by the Contractor, at the Contractor's expense, to the satisfaction of the governing authority citing such damage.
- F. Items discussed in this section are not intended to be all-inclusive of Federal, State, and Local Laws and Regulations. Information is provided as anticipated minimum requirements. Contractor shall be familiar and comply with all requirements of applicable laws and regulations.
- G. The Contractor will assume total responsibility for materials, delivery to/from job site, installation, and testing of system.

DELIVERY

- A. Delivery, inspection and acceptance - delivery, inspections and acceptance will be at destination, F.O.B. Key West as specified in the RFP, KEYS Warehouse, unless otherwise provided. Until delivery and acceptance and after any rejections, risk of loss will be on the Vendor, unless loss results from negligence of KEYS.
- B. Notwithstanding the requirements for any KEYS inspection and test contained in the specifications applicable to this proposal, except where specialized inspections or tests are specified for performance solely by KEYS, the Contractor shall perform or have performed the inspections and tests required to substantiate that the supplies and services provided under this proposal conform to the drawings, specifications and proposal requirements listed herein, including if applicable, the technical requirements for the manufacturer's part numbers specified herein.
- C. Delivery of Excess Quantities – The Contractor is responsible for the delivery of each item quantity within allowable variations, if any. If the Contractor delivers and KEYS receives quantities of any item in excess of the quantity called for (after considering any allowable variations of quantity) such excess quantities will be treated as being delivered for the convenience of the Contractor. KEYS may retain such excess quantities without compensating the interests herein. Quantities in excess, will at the option of KEYS, either be returned at the Contractor's expense, or retained and paid for by KEYS at the contract unit price.
- D. Deliveries – In the event of failure to deliver material of the quality or within the time specified, KEYS may cancel the order and buy elsewhere. The Contractor will be responsible for any cost differences encountered in the procurement of materials. Failure of KEYS to exercise this option with respect to any installment shall not be deemed a waiver with respect of future installments, if any.
- E. Delivery tickets – All shipments under this agreement shall be accompanied with delivery tickets, or packing slips, in triplicate, which shall contain the following minimum information: name of supplier, purchase order number, date of order, date of delivery

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

or shipment, itemized list of supplies or services furnished, quantity, unit price, and extension of each line item. Upon delivery, the Warehouse will retain a copy of the related delivery ticket.

- F. Inspection, Acceptance and Title – Inspection and acceptance will be at destination, unless otherwise provided. Title and risk of loss or damage to all items shall be the responsibility of the contract supplier until accepted by KEYS in writing.

ENTIRE AGREEMENT

The terms, specifications and/or drawings included in a duly executed contract will constitute the entire agreement between the parties. No modification or waiver of terms of this agreement shall be binding, unless in writing, signed by a duly authorized representative of KEYS.

ERROR IN BID CALCULATION

In the event there is a mathematical error in the bid, KEYS will recalculate using the line items and correct the total.

EXECUTION OF PROPOSAL

If a Proposal is made by a partnership, it shall contain the name and address of each partner and shall be executed in the partnership name, followed by the handwritten signature of a partner authorized to execute the Proposal for the partnership. If a Proposal is made by a corporation, it shall be executed in the name of the corporation, followed by the handwritten signature of an officer authorized to execute the Proposal for the corporation, and the printed or typewritten designation of the office he holds in corporation. Another partner of the partnership or official of the corporation shall attest to the authority of the person executing the Proposal. KEYS may require any Bidder to furnish certified copies of extracts of the minutes of meetings of the governing body of the Bidder authorizing execution of the Proposal and Contract Documents.

FORCE MAJEURE

KEYS shall not be liable in any way to the contractor as a result of an event, circumstance or act of a third party that is beyond a party's reasonable control (e.g. an act of God, and act of the public enemy, an act of a government entity, strikes or other labor disturbances, hurricanes, earthquakes, fires, floods, epidemics, embargoes, war and riots).

LITIGATION SEARCH

KEYS reserve the right to conduct a litigation search on contractor's history of past litigation.

LIQUIDATED DAMAGES

The Liquidated Damages shall be \$3,000.00 per day per system. The liquidated damage amount specified herein shall apply to damages and expenses the KEYS may incur as a result of a delay in completing the Scope of Work. The commencement date for Liquidated Damages will be 05/01/2012 for Stock Island Generation Facility Substation and 06/01/2012 for Big Pine Key Substation. Any problems conforming to this schedule shall be stated in the proposal. On these dates, the above-specified damages of \$3,000.00/day will commence.

MODIFICATION OF PROPOSAL

A modification of a proposal already received will be considered only if the modification is received prior to the time last announced for opening Proposals. All modifications shall be made in writing, executed and submitted in the same form and manner as the original proposal, fax or E-mail. Phone modifications will not be considered.

NOTICE TO PROCEED

KEYS will issue the successful bidder a Notice to Proceed after the following activities have been completed: 1) the Performance Bond and Insurance Certificates have been reviewed, 2) a Pre-Construction meeting has been held and issues regarding environmental, lien releases, payment procedures, safety, security, and use of sub-contractor notification were discussed. Two copies of this document will be provided. The successful bidder will be asked to complete the signature block on both documents and return one signed original document to acknowledge receipt of this notice.

OPENING PROPOSALS

At the time and place last announced for opening Proposals, each Proposal which has been received prior to the time last announced for opening Proposals, except those which have been properly withdrawn, will be publicly opened and read aloud, irrespective of any irregularities or informalities in such Proposals.

KEYS INSPECTIONS/MEETINGS

KEYS will make inspections and/or meetings as deemed necessary to ensure that all work is being performed in compliance with these specifications and guarantees.

PAYMENT

Payment will be made after acceptance of services and materials and within 30 days after receipt of invoice. KEYS will hold 10% retention until 30 days after project completion and final acceptance. The Contractor will complete and submit the provided Contractor's Request for Payment form, prior to any payment of draw request. The Contractor's request for payment shall be accompanied by a breakdown of material and labor associated with that particular request. KEYS does not pay service charges on late payments.

PENALTIES

KEYS reserves the right to increase or decrease quantities shown without penalties.

PERFORMANCE BOND

Within ten (10) days after the Contractor receives the Notice of Utility Board Approval and prior to the execution of the Contract, the Contractor shall furnish a Performance and Payment Bond in the form acceptable to KEYS, which form is included in the Contract Documents, with corporate Surety satisfactory to KEYS such bond shall insure the full and faithful performance of the Contract, including the payment of faithful performance of the Contract, including the payment of all obligations arising there under, and shall be in an amount equal to 100 percent of the Total Contract Amount unless otherwise provided in these specifications. Such bond shall further comply in all respects with the laws of the State of Florida.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

PERSONNEL

- A. The project supervisor must be capable of communicating fluently in English at all times.
- B. On a project, the foreman must be capable of communicating fluently in English.
- C. All employees of company must be United States Citizens or legally authorized to reside and work in the United States.
- D. KEYS may request at any time throughout the contract the following within eight (8) hours:
 - proof of citizenship for all employees
 - proof of employee's salary is at or above state and federal minimum requirements
 - proof of eligibility to legally work in the United States

POSTPONEMENT OF OPENING

KEYS reserves the right to postpone the date and time last announced for opening Proposals and such postponement may be made at any time prior to the time last announced for opening Proposals. KEYS will give written or telegraphic notice or post on DemandStar of any such postponement to each party to whom Contract Documents have been issued, followed by issuance of an Addendum confirming the changing of the announced date and time for opening Proposals.

PRICES

- A. All prices bid shall be firm unless the conditions of the RFP permit price escalation. If an escalation method or indices are specified, the Bidder shall indicate in its bid the specific items subject to escalation, and shall give the method and indices to be used in computing the amount thereof
- B. The vendor shall provide the proposal price in U.S. dollars only.

PROPOSAL GUARANTEE

- A. The Proposal Guarantee shall be the cashiers check or Bid Bond required in the Notice to Bidders. A bid bond or cashier's check in lieu of a surety bond in the amount of (five) 5% of the proposal shall be submitted with all proposals. This bid bond requirement is to be used as security and will be returned to bidder after KEYS enters into a Contract with the successful bidder. This (five) 5% shall be based on the total bid price. The bid bond or cashier's check shall be valid for a period of no less than 120 days after bid opening date.
- B. KEYS may reject all Proposals, and in such event, all cashiers checks and Bid Bonds will thereupon be returned to the Bidders.
- C. When a Proposal is accepted, all checks and Bid Bonds will thereupon be returned to the bidders, except for the approved proposal. The cashiers check or Bid Bond of the approved Bidder will be returned after completion of the requirements in the following paragraph.
- D. Within 10 days after delivery of Notice of Utility Board Approval, or such additional time as is allowed by KEYS, the Bidder shall furnish satisfactory Performance and Payment Bond, Insurance Certificate and Insurance Policies.

PUBLIC ENTITY CRIME CLAUSE

Any person submitting a bid or proposal in response to this invitation must execute the enclosed form **FOR 094, SWORN STATEMENT UNDER SECTION 287.133 (3) (a), FLORIDA STATUTES ON PUBLIC ENTITY CRIMES**, including proper check(s), in the space(s) provided, and enclose it with his bid proposal. If you are submitting as bid or proposal on behalf of dealers or suppliers who will ship commodities and receive payment from the resulting contract, it is your responsibility to see that copies of the form are executed by them and are included with your bid or proposal. Corrections to the form will not be allowed after the bid or proposal opening time and date. Failure to complete this form may result in immediate disqualification of your bid or proposal.

QUALITY ASSURANCE PROVISIONS

A system of test and inspection shall be used to insure receipt of the quality and quantity of material(s)/service(s) purchased. Material(s)/service (s) will be promptly inspected and any discrepancies from the purchase order and/or the supplier's invoice shall be reported immediately to the Director of Administration, Compliance & Internal Policies.

RELEASE OF LIENS

The Contractor is to furnish a release of liens for sub-contractual materials and labor prior to each payment. In addition, the Contractor is to furnish the standard form of "Statement Concerning Claims."

REJECTION

The Utility Board reserves the right to reject any or all proposals, to waive irregularities and informalities in any or all proposals, and to separately accept or reject any item, items, bid schedule or bid schedules of the proposal which the Utility Board deems to be in the best interest of the Utility Board.

RETAINAGE

A 10% retainage fee will be applied to all payment requests.

SAFETY / MAINTENANCE OF TRAFFIC (MOT)

Contractor is to provide all required Safety and Traffic Control equipment as required by FDOT, City of Key West, or Monroe County MOT. Personnel are required to be trained in MOT as required. Contractor is to provide copies of certification of MOT training.

SAFETY AND PROTECTION

Examination of existing facilities: After the Contract is awarded and before commencement of the work, Contractor and KEYS shall make thorough examination of all existing structures and facilities associated with the project.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

Safety requirements: Contractor shall do whatever work is necessary for safety and be solely and completely responsible for conditions of the job site, including safety of all persons (including employees) and property during the project period. This requirement shall apply continuously and not be limited to normal working hours.

Safety provisions shall conform to Federal and State Departments of Labor, Occupational Safety and Health Act (OSHA), and other applicable Federal, State, County, and Local Laws, Ordinances, Codes, requirements set forth herein, and regulations that may be specified in other parts of these specifications. Where these are in conflict, the more stringent requirement shall be followed. Contractor shall become thoroughly familiar with governing safety provisions and shall comply with the obligations set forth therein.

Contractor shall develop and maintain for the duration of the project, a safety program that will effectively incorporate and implement required safety provisions. The Contractor must furnish Keys Energy Services Environmental/Safety Officer with a written copy of Vendor's company Safety Program. Contractor shall appoint a qualified employee who is authorized to supervise and enforce compliance with the safety program.

KEYS duty to conduct review of the Contractor's performance is not intended to include a review or approval of the adequacy of Contractor's safety supervisor, safety program, or safety measures taken in, on, or near the site.

SCOPE OF WORK

While KEYS has tried to anticipate all Work required under and during the term of this contract, the parties understand and agree that the Work required herein may require without notice to the Contractor, the performance of Extra Work or the omission of Work previously required. KEYS may at any time and without notice to the Contractor, require changes in the scope of Work under this contract as KEYS may find necessary or desirable. Such changes may include the omission of Work previously required.

- A. KEYS shall notify the Contractor of the change in scope work via Change Order, which shall become part of the Contract Documents. If a Change Order directs Contractor to omit Work, the Contractor shall refrain from performing it.
- B. The Contractor shall perform Extra Work only pursuant to the issuance by KEYS of Change Order. Records of any Extra Work performed by contractor shall be reviewed daily by the Contractor and KEYS, duplicate copies of accepted records made and signed by both the Contractor or his representative and KEYS, and one (1) copy retained by each.

SECURITY/BACKGROUND CHECK

Keys requires all bids to include a complete listing of employee names, valid driver's license and/or social security numbers of all individuals that will perform work at the various sites. In addition to the D.M.V. references, Keys will run mandatory felony and misdemeanor background checks due to security reasons. The successful bidder must expressly agree to the right for Keys to run the D.M.V. references and the various criminal history background checks. Please do not supply social security numbers and driver's license data until after the award has been made.

KEYS reserve the right to perform background checks during the entire duration of the contractual agreement. The contractor will advise KEYS immediately of any employee staff changes before they are permitted on-site. Non-compliance of security/background check portion of the bid specifications will result in rejection of the proposal or termination of awarded contractual agreement.

SEVERABILITY

If any of these General Terms & Conditions is determined to be invalid, illegal or enforceable, the remaining provisions of these General Terms & Conditions remain in full force to the extent permitted by law.

SUBCONTRACTORS

Each Bidder shall list on the Proposal form the name of each construction subcontractor who will furnish in excess of 10% of the Project. Failure to do so shall entitle KEYS, at its option, to reject the bid.

SUBMISSION OF PROPOSAL

It is the sole responsibility of each Bidder to deliver its Proposal to KEYS at the place designated for receiving Proposals and prior to the time for opening Proposals last announced to Bidders. Any Proposal received after the time last announced for opening Proposals may be retained by KEYS or returned to the Bidder, but such Proposal shall be rejected as not responsive.

TAX

The prices of materials set forth herein shall not include state sales tax or local option tax. KEYS is generally exempt from state sales tax, (sales tax number 04-00307-00-54), and local option tax. However; any purchases of materials (made by the contractor) for construction of new electrical transmission and distribution facilities are subject to state sales tax and local option tax.

TERMINATION OF CONTRACT

When deemed to be in the best interest of KEYS, any awards or contracts resulting from this specification may be cancelled by KEYS by the following means: 1) ten (10)-day written notice with cause; or 2) 30-day written notice without cause.

WARRANTY

- A. The Contractor warrants to KEYS that the Material and Equipment to be furnished under the Contract shall be designed and fit for the purpose specified when operated in accordance with the Contractor's specific operating instructions or, in the absence thereof, in accordance with generally accepted operating practices; free from defects in material, workmanship, and title; shall meet all specifications, including those relating to performance, contained or incorporated by reference in the Contract; and that the technical direction of installation on KEYS' premises when furnished by the Contractor shall be performed in a competent, diligent manner in accordance with generally accepted professional practices.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

- B. The foregoing warranties, except as to title, shall apply to defects or deficiencies occurring within a period of **1** years from Final Acceptance provided the same is not unreasonably delayed by the KEYS or others. If, however, during the above **1** year warranty period the Equipment is not available for operation due to a failure to meet such warranties, such time of unavailability shall not be counted as part of the warranty period. The condition of any field tests shall be mutually agreed upon, and the Contractor shall be notified of and may be represented at all tests that may be made.
- C. If the equipment and materials furnished hereunder does not meet the warranties specified above when it has normal and proper use and maintenance, KEYS shall promptly notify the Contractor and make the Equipment available for correction. The Contractor shall thereupon within a reasonable time correct all defects, including nonconformance with the Engineering Specifications, by either repairing or replacing any defective or damaged parts of the Equipment.
- The cost of Labor, Materials and Equipment components directly associated with such repair or replacement of the Equipment, including removal, loading and unloading, transportation to and from the repair site and reinstallation, shall be borne by the Contractor.
- D. Any repaired or replacement part furnished under the foregoing warranty shall carry warranties on the same terms as set forth above for **1** years from the date of its Final Acceptance.
- E. The Contractor shall obtain written warranties from its Subcontractors and suppliers of Materials, Labor and Equipment components where such warranties are obtainable and shall deliver the original warranties to KEYS.
- F. Neither the final payment, nor any other provision of the Contract, nor partial or entire use of the Material and Equipment by KEYS shall relieve the Contractor of liability with respect to the warranties referred to in the Contract or any other warranties, express or implied.

WITHDRAWAL OF PROPOSAL

Each Proposal shall constitute an offer to KEYS as outlined therein and shall be irrevocable after the time last announced for opening Proposals. Any Bidder may withdraw its Proposal by giving written notice to KEYS at the place such Proposals are to be received and at any time prior to the time last announced for opening Proposals. After the time last announced for opening Proposals and until execution of the Contract, no Bidder will be permitted to withdraw its Proposal for a period exceeding 120 days after the time last announced for opening Proposals.

INSURANCE SECTION

INDEMNITY AND INSURANCE REQUIREMENTS

By the signing of this contract and these indemnity and insurance requirements, the vendor agrees with the provisions shown below.

INDEMNITY

The Contractor shall indemnify, defend and hold harmless KEYS and their officers, partners, agents, employees and servants from and against any and all claims, judgments, liens, loss, damage, cost, charge or expense, including defense costs, court costs and attorneys' fees, whether direct or indirect, by reason of liability imposed by law or by bodily injuries, including death at any time resulting there from, sustained by any person or persons or on account of damages to property, including loss of use thereof, arising out of or in consequence of the performance of the Contract, whether such injuries to or death of persons or damages to property are due or are claimed to be due to operations, errors, omissions, or negligent acts of KEYS or any of their officers, partners, agents, employees or servants, excepting only such injuries or damages as shall have been finally determined to have resulted solely from errors, omissions or negligent acts of KEYS or of their officers, partners, agents, employees or servants or independent contractor directly responsible to KEYS. For this indemnity, the Utility Board of the City of Key West will pay the sum of ten dollars (\$10.00). The bidder shall add this amount (\$10.00) to their base bid proposal, which will be included in payment to firm.

INSURANCE REQUIREMENTS

The insurance provided by the Vendor pursuant to this Contract shall apply on a primary basis and any other insurance provided by KEYS shall be excess of and not contributory to the insurance provided by the Vendor.

During the term of this agreement, except as specifically provided herein, the Contractor shall provide and maintain, at his sole cost and expense, insurance in the following types and amounts to cover all work under this agreement, including that done by sub-contractors.

The Vendor shall not commence any work on the contract until he has provided KEYS with proof of coverage's required, in the form an original certified Certificate of Insurance properly signed by the authorized agent of the insurance company. The insurance company must be an eligible surplus lines company or a company authorized by the Florida State Department of Insurance to sell the specific insurance required or with respect to Workers' Compensation authorized as a group self-insurer by Florida Statute 440.57. The agent of the insurance company must be licensed to sell the insurance coverage's required under this contract. Without limiting any of the other obligations or liabilities of the Vendor, the following insurance coverage's with indicated limits of liability are mandatory under this contract. Those coverage's with no limits shown are not required.

VENDOR'S ENVIRONMENTAL IMPAIRMENT RESPONSIBILITY

- A. The Vendor acknowledges that the performance of this contract is, or may be, subject to Federal, State, and Local laws and regulations enacted for the purpose of protecting, preserving, or restoring the environment. The Vendor shall, at his sole cost, will be responsible for full compliance with any such laws or regulations.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

- B. The Vendor's performance under this contract shall include, but not be limited to:
- C. Performance in a manner to minimize disturbance of or damage to the environment.
- D. To the extent caused by the performance of this contract by or on behalf of the Vendor, the clean-up, repair or restoration of the environment to the extent required by any Federal, State, or Local laws or regulations.
- E. The Vendor shall be responsible for any fines, penalties, damage, or assessments made against the Vendor or KEYS resulting from the performance of this contract by or on behalf of the Vendor.
- F. The Vendor's obligation under paragraph B and C above shall survive the contract and shall not be limited in any manner by acceptances of final payments.

WORKERS COMPENSATION--EMPLOYER'S LIABILITY INSURANCE

Shall provide benefits consistent that will respond to all benefits as prescribed by Florida Statutes. To include employers Liability Insurance shall be provided in accordance with statutes of the Florida Workers Compensation Act, the Federal Longshore and Harbor Workers Act, Maritime including the Jones Act, Federal Employers Liability Act and any other applicable federal or state laws. Customarily provided under the standard Workers Compensation Policy shall provide the following limits:

•Each Accident	\$100,000.00
•Disease-Policy Limit	\$100,000.00
•Disease-Each Employee	\$100,000.00

COMMERCIAL GENERAL LIABILITY INSURANCE

This insurance shall cover those sources of liability which would be covered by the latest edition of the standard Commercial General Liability Coverage Form as published by the Insurance Services Office (ISO) as filed for use in Florida without the attachment of restrictive endorsements other than the elimination of medical payments and fire damage legal liability.

General Aggregate	\$2,000,000.00
Limit of Insurance per project	
Products/Completed Operation	\$2,000,000.00
(Coverage for 3 yrs. after contract completion)	
Personal & Advertising Injury	\$1,000,000.00
Each Occurrence	\$1,000,000.00
Other coverage required (Remove Policy Exclusions)	

_____ \$ _____

_____ \$ _____

_____ \$ _____

BUSINESS AUTOMOBILE POLICY

This insurance shall cover those sources of liability which would be covered by Part IV of the latest edition of the standard business auto policy form (ISO) as filed for use in Florida without attachments of restrictive endorsements. Coverage's shall include owned, non-owned, and hired autos.

The policy shall be endorsed to include coverage as required by Section 29 and 30 of the Motor Carrier Act of 1980 (MCS 90).

Each Occurrence Bodily Injury and Property Damage Liability Combined: \$1,000,000.

ADDITIONAL NAMED INSURED

The Utility Board of the City of Key West shall be included as an additional named insured for Comprehensive General Liability Form (ISO) and Business Automobile coverage's.

WAIVER OF SUBROGATION

The Contractor's Workers Compensation, Commercial General Liability and Business Automobile insurance shall include a Waiver of Transfer of RIGHTS OF Recovery against others to KEYS' (ISO Form). The Utility Board of the City of Key West must be named in the schedule for the specific project involved.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation
Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island
Generation Facility Substations

INSURANCE AGENT'S STATEMENT

I have reviewed the above requirements with the bidder named below. The following deductibles apply to the corresponding policy.

POLICY

DEDUCTIBLES

Liability policies are _____ Occurrence _____ Claims Made

Insurance Agency

Signature

BIDDERS STATEMENT

In consideration of this contract, if awarded, the Vendor agrees without reservation to the indemnification and insurance clauses herein and which will become a part of the contract, the signing of which confirms the Vendor's acceptance.

DATE _____ FIRM NAME _____

SUBMITTED BY: _____
Print / Title

SIGNATURE _____

WITNESS _____

NOTE: EACH BIDDER SHALL PROVIDE A COPY OF COMPLETED CERTIFICATE OF INSURANCE COMPLYING WITH THE AFOREMENTIONED INSURANCE REQUIREMENTS OR SIGN AND DATE ABOVE AGREEING TO PROVIDE SUCH INSURANCE UPON AWARD OF BID.

NOTICE: THIS SIGNATURE BLOCK PERTAINS TO AGREEMENT TO ENTIRE TERMS & CONDITIONS. FAILURE TO PERFORM ABOVE NOTED ACTION MAY RESULT IN NON-COMPLIANCE WITH THESE SPECIFICATIONS.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

DRUG-FREE WORKPLACE STATEMENT

Preference shall be given to businesses with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quality, and service are received by the State or by any political subdivision for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie bids will be followed if none of the tied vendors have a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

The undersigned vendor in accordance with Florida Statutes Section 287.087 hereby certifies that

_____ does:

(Name of Business)

1. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
2. Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
3. Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in Subsection 1.
4. In the statement specified in Subsection 1, notify the employees that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of Chapter 1893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
5. Impose a sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program if such is available in the employee's community, by any employee who is so convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

As the person authorized to sign the statement, I certify that this firm complies fully with the above requirements.

Print Name_____

Vendor's Signature_____

Date: _____

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SWORN STATEMENT PURSUANT TO SECTION 287.133(3)(a), FLORIDA STATUTES, ON PUBLIC ENTITY CRIMES

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted to _____
(print name of public entity)

by _____
(print individual's name and title)

for _____
(print name of entity submitting sworn statement)

whose business address is _____

and (if applicable) its Federal Employer Identification Number (FEIN) is _____

If the entity has no FEIN, include the Social Security Number of the individual signing sworn statement: _____

2. I understand that a "public entity crime" as defined in Paragraph 287.133(1)(g), Florida Statutes, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or of the United States, including, but not limited to, any bid or contract for goods or services to be provided to any public entity or an agency or political subdivision of any other state or of the United States and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, or material misrepresentation.

3. I understand that "convicted" or "conviction" as defined in Paragraph 287.133(1)(b), Florida Statutes, means a finding of guilt or a conviction of a public entity crime, with or without an adjudication of guilt in any federal or state trial court of record relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, nonjury trial, or entry of a plea of guilty or nolo contendere.

4. I understand that an "affiliate" as defined in Paragraph 287.133(1)(a), Florida Statutes, means:

- a. A predecessor or successor of a person convicted of a public entity crime; or
- b. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employee, members, and agents who are active in the management of an affiliate. The KEYShip by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

5. I understand that a "person" as defined in Paragraph 287.133(1)(e), Florida Statutes, means:

- a. any natural person or entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts for the

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with a public entity.

- b. The term "person" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in management of an entity.
6. Based on information and belief, the statement, which I have marked below, is true in relation to the entity submitting this sworn statement. (Please indicate which statement applies):

_____ Neither the entity submitting this sworn statement, nor any of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, nor any affiliate of the entity has been charged with the convicted of a public entity crime subsequent to July 1, 1989.

_____ The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, nor any affiliate of the entity has been charged with and convicted of public entity crime subsequent to July 1, 1989.

_____ The entity submitting this sworn statement, or one or more of its officers, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989. However, there has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing Officer, determined that is was not in the public interest to place the entity submitting this sworn statement on the convicted vendor list. (Attach a copy of the final order).

I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER FOR THE PUBLIC ENTITY IN PARAGRAPH ONE (1) ABOVE IS FOR THAT PUBLIC ENTITY ONLY AND, THAT THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND THAT I AM REQUIRED TO INFORM THE PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD AMOUNT PROVIDE IN SECTION 287.017, FLORIDA STATUTES FOR CATEGORY TWO OF ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

(Signature)

(Date)

STATE OF _____

COUNTY OF _____

PERSONALLY APPEARED BEFORE ME, the undersigned authority, _____
who, after first being sworn by me, affixed his/her signature in the space provided above on this _____ day
of _____ of 20_____.

NOTARY PUBLIC
My Commission Expires:
FOR-094

Revised: 11/01/02

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

PAYMENT & PROCEDURES FORMS

Partial-Progress Payments:

KEYS may require release of liens.

Contractor will submit the following documents:

- "Contractor's Request For Payment"
- "Sworn Statement Concerning Claims"
- "Release Of Lien"

A sample of each of these forms is attached.

"Contractor's Affidavit and Request for Payment": Form #FOR-216

Complete this form for work completed to date. Attach appropriate documentation to support this request. Retainage of not less than 10% will be deducted until final inspection by KEYS has been completed and all items are satisfactory. It must be signed by a corporate official, contain the raised corporate seal, be notarized and signed by the notary.

"Sworn Statement Concerning Claims": Form #FOR-213

The prime contractor must complete this form for each sub contractor. This must be done each time a request for payment is made. It must be signed by a corporate official, contain the raised corporate seal, be notarized and signed by the notary.

"Release Of Lien": Form #FOR-212

The prime contractor is responsible for obtaining and forwarding a release of lien for every sub contractor on the job. The release of lien must be unconditional and must contain a date from the sub contractor, which coincides with the date of the payment request. It must be signed by a corporate official, contain the raised corporate seal, be notarized and signed by the notary.

Final Payments:

Contractor is required to submit the following documents:

- "Contractor's Request For Payment"
- "Sworn Statement Concerning Claims"
- "Final Release Of Lien"
- "Contractor's Affidavit Of Contract Completion"

A sample of each of these forms is attached.

"Contractor's Affidavit and Request for Payment": Form #FOR-216

Complete this form. Attach appropriate documentation to support this request.

"Final Release Of Lien": Form #FOR-214

The prime contractor is responsible for obtaining and forwarding a final release of lien for every sub contractor on the job. The release of lien must be unconditional. It must signed by a corporate official, contain the raised corporate seal, be notarized and signed by the notary.

"Contractor's Affidavit Of Contract Completion": Form #FOR-215

The prime contractor must complete this form. It must signed by a corporate official, contain the raised corporate seal, be notarized and signed by the notary.

CONTRACTOR'S REQUEST FOR PAYMENT

TO BE COMPLETED BY CONTRACTOR:KEYS: UTILITY BOARD OF THE CITY OF KEY WEST PAYMENT NO: _____ DATE: _____

CONTRACTOR: _____ CONTRACT NO: _____ PAGE: _____ OF _____

PROJECT: _____ BID NO: _____

ESTIMATED CONTRACT: \$	PREVIOUSLY APPROVED: \$	THIS REQUEST: \$	TOTAL TO DATE: \$:	THIS REQUEST: \$	TOTAL TO DATE: \$
LESS RETAINED AMOUNT:					
SUBTOTAL:					
PLUS SALES TAX (INCLUDE TAX ON RETAINED AMOUNT WHEN APP.)					
SUBTOTAL:					
LESS TOTAL DEDUCTIONS:					
SUBTOTAL:					
LESS PREVIOUS PAYMENTS:					
PAYMENT REQUESTED:					

RETAINED AMOUNT DETAIL

%OF FIRST: _____

%OF BALANCE: _____

TOTAL: _____

SALES TAX DETAIL

TOTAL TO DATE: _____

LESS AMOUNT PAID: _____

PERIOD AMOUNT DUE: _____

WE HEREBY REPRESENT THAT THE ABOVE CONTRACTOR'S REQUEST IS A TRUE ESTIMATE OF WORK COMPLETED UNDER THE ABOVE CONTRACT TO DATE AND HEREBY RELEASE THE KEYS FROM ANY CLAIMS FOR MATERIALS OR LABOR FURNISHED OR EXPENSE INCURRED TO DATE WHICH IS NOT INCLUDED IN REQUESTS AND PAYMENT TO DATE, EXCEPT FOR INTEGRATED UNITS OF CONSTRUCTION PARTIALLY COMPLETED FOR WHICH NO REQUEST FOR PAYMENT HAS BEEN MADE.

CONTRACTOR: _____

BY: _____

Signature

DATE: _____

PRINT NAME: _____

TITLE: _____

**TO BE COMPLETED BY KEYS
PROJECT MANAGER**

AMOUNTS APPROVED

W.O.# _____

P.O.# _____

QUANTITIES VERIFIED

REQUEST VERIFIED

KEYS Project Manager/Date

Accountant & Financial Analyst Date

Supervisor –Purchasing –Date

KEYS' CONTRACT COORDINATOR USE ONLY:**NOTICE TO KEYS RECEIVED****RELEASE OF LIEN RECEIVED (Yes/No)**

SWORN STATEMENT CONCERNING CLAIMS: (Yes/No)

CONTRACTOR'S AFFIDAVIT OF CONSTRUCTION COMPLETION (Yes/No)

ROUTING: 1. Contractor 2. KEYS Project Manager 3. Finance/Budget 4. Purchasing 5. Finance/Accounts Payable

FOR-216

Revised: 04/19/04

**KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation
Systems (DVC-Statcom Systems) @ Big Pine Key &
Stock Island Generation Facility Substations**

UTILITY BOARD OF THE CITY OF KEY WEST
SWORN STATEMENT CONCERNING CLAIMS

PROJECT AND TITLE: _____

SUB -CONTRACTOR: _____

CONTRACT FOR: _____

CONTRACT DATE: _____ CONTRACT AMOUNT: \$ _____

To: Utility Board of the City of Key West ("Keys Energy Services")

Post Office Box 6100

Key West, Florida 33041

In response to your demand, the undersigned contractor or material man _____ submits
the following statement of account for: (Sub Contractor Name) _____.

Labor performed to date consists of the following:

_____.

Material furnished to date consists of the following:

_____.

Labor still to be performed consists of the following:

_____.

Material still to be furnished consists of the following:

_____.

Amount paid on account to date: \$ _____, Amount now due: \$ _____,
Amount to become due: \$ _____.

[Signature]

[Date]

The State of _____

County of _____

_____, being first duly sworn, deposes and states that _____ [he or she] is the lien holder named in
the forgoing statement of account; that _____ [he or she] has read the statement of account and has knowledge of its
contents; that the statements contained in the statement of account are true; and that the sum of \$ _____ as set
forth in the statement of account is due and owing to lien holder.

Contractor(s), who, being by me duly sworn, subscribed to the foregoing affidavit in my presence.

(Notary Public)

Print Name: _____

My Commission Expires: _____

FOR-213

Revised: 04/22/02

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

UTILITY BOARD OF THE CITY OF KEY WEST
RELEASE OF LIEN

PROJECT AND TITLE: _____

SUB -CONTRACTOR: _____

CONTRACT FOR: _____

CONTRACT DATE: _____ CONTRACT AMOUNT: \$ _____

To: Utility Board of the City of Key West ("Keys Energy Services")

Post Office Box 6100

Key West, Florida 33041

KNOW ALL MEN BY THESE PRESENTS:

That the undersigned, for and in consideration of payment of the sum \$ _____ and _____ (\$ _____) paid by _____ the prime contractor, receipt of which is hereby acknowledged, hereby releases and quit claims to The Utility Board of the City of Key West, the KEYS, all liens, lien rights, claims or demands of any kind whatsoever, which the undersigned now has or might have against the project on account of labor performed and/or material furnished by the undersigned in the construction of said project have been fully paid for.

In witness whereof, I have hereunto set my seal this ____ day of _____, 20 ____.

Witness:

_____ (SEAL)

_____ by _____

The State of _____

County of _____

_____, being first duly sworn, deposes and states that _____ [he or she] is the lien holder named in the forgoing statement of account; that _____ [he or she] has read the statement of account and has knowledge of its contents; that the statements contained in the statement of account are true; and that the sum of \$ _____ as set forth in the statement of account is due and owing to lien holder.

Contractor(s), who, being by me duly sworn, subscribed to the foregoing affidavit in my presence.

(Notary Public)

Print Name: _____

My Commission Expires: _____

FOR-212

Revised: 04/22/02

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

UTILITY BOARD OF THE CITY OF KEY WEST
****FINAL** RELEASE OF LIEN**

PROJECT AND TITLE: _____

SUB -CONTRACTOR: _____

CONTRACT FOR: _____

CONTRACT DATE: _____ CONTRACT AMOUNT: \$ _____

To: Utility Board of the City of Key West ("Keys Energy Services")

Post Office Box 6100

Key West, Florida 33041

KNOW ALL MEN BY THESE PRESENTS:

That the undersigned, for and in consideration of payment of the sum \$ _____ and _____ (\$ _____) paid by _____ the prime contractor, receipt of which is hereby acknowledged, hereby releases and quit claims to The Utility Board of the City of Key West, the KEYS, all liens, lien rights, claims or demands of any kind whatsoever, which the undersigned now has or might have against the project on account of labor performed and/or material furnished by the undersigned in the construction of said project have been fully paid for.

In witness whereof, I have hereunto set my seal this _____ day of _____, 20____.

Witness:

_____ (SEAL)

by _____

The State of _____

County of _____

_____, being first duly sworn, deposes and states that _____ [he or she] is the lien holder named in the forgoing statement of account; that _____ [he or she] has read the statement of account and has knowledge of its contents; that the statements contained in the statement of account are true; and that the sum of \$ _____ as set forth in the statement of account is due and owing to lien holder.

Contractor(s), who, being by me duly sworn, subscribed to the foregoing affidavit in my presence.

(Notary Public)

Print Name: _____

My Commission Expires: _____

FOR-214

Revised: 04/22/02

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

UTILITY BOARD OF THE CITY OF KEY WEST

KEYS ENERGY SERVICES

CONTRACTOR'S AFFIDAVIT OF CONTRACT COMPLETION

PROJECT AND TITLE: _____

CONTRACTOR: _____

CONTRACT FOR: _____

CONTRACT DATE: _____ CONTRACT AMOUNT: _____

CONTRACTOR'S AFFIDAVIT

I solemnly swear and affirm: That the work under the above named Contract and all amendments thereto have been completed in accordance with the requirements of said Contract; that all costs incurred for equipment, materials, labor, and services against the project have been paid; that no liens have been attached against the project; that no suits are pending by reason of work on the project under the Contract; that all Workmen's Compensation claims are covered by Workmen's Compensation insurance as required by law; that all public liability claims are adequately covered by insurance, and that the Contractor shall save, protect, defend, indemnify and hold the KEYSS harmless from and against any and all claims which arise as a direct or indirect result of any transaction, event or occurrence related to performance of the work contemplated under said Contract.

CONTRACTOR:

_____ (SEAL)

Title: _____

Date: _____

STATE OF _____

COUNTY OF _____

Personally appeared before me this _____ day of _____, 20____,
_____ known (or made known) to me to be the:

(KEYS)

(Partner)

(Corporate Officer-Title)

(Name of Contractor(s))

Contractor(s), who, being by me duly sworn, subscribed to the foregoing affidavit in my presence.

(Notary Public)

Print Name: _____

My Commission Expires: _____

Per attached Sworn Statement(s) Concerning Claims
FOR-215

Revised: 04/22/02

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

Proposal Page 1 of 2 KEYS BID #12-11

(Please type or print all information)

Pursuant to and in compliance with your advertisement for bids and other contract documents relating thereto, the undersigned bidder, having familiarized himself with the terms and conditions affecting the performance of the contract contained in the specifications, hereby proposes and agrees to perform within the contract documents, schedules, and specifications for the following amounts.

I. Contractor to provide the design, labor, material, installation, testing and commissioning for the Big Pine Site per the attached Specifications.

- a. Engineering and Design \$_____
- b. Material
 - i. Outdoor Capacitor Banks and Associated Equipment \$_____
 - ii. Dynamic Var Compensation Equipment \$_____
 - iii. Other Equipment \$_____
 - iv. Spare Parts \$_____
- c. Construction \$_____
- d. Training \$_____

Total Cost Item I

\$_____

II. Contractor to provide the design, labor, material, installation, testing and commissioning for the Stock Island Site per the attached Specifications.

- a. Engineering and Design \$_____
- b. Material
 - i. Outdoor Capacitor Banks and Associated Equipment \$_____
 - ii. Dynamic Var Compensation Equipment \$_____
 - iii. Control Building – Powerconn or Alternate (Specify if using an Alternate) \$_____
 - iv. Other Equipment \$_____
 - v. Spare Parts \$_____
- c. Construction \$_____
- d. Training \$_____

**KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation
Systems (DVC-Statcom Systems) @ Big Pine Key &
Stock Island Generation Facility Substations**

Proposal Page 2 of 2
KEYS BID #12-11

Total Cost Item II \$ _____

III. Mobilization and Demobilization \$ _____

IV. Optional 3 Year Extended Warranty - DVC components. \$ _____

TOTAL BID PRICE (Items I, II, III, and IV) \$ _____

INDEMNITY FEE (\$10.00): \$ _____

Bid Price in Words: _____

Company: _____

Telephone: _____ **FAX:** _____ **Email:** _____

Address: _____

Submitted by: _____
(Print)

(Signature)

Bid Bond Enclosed

or

Cashier's Check

_____ YES _____ NO AMOUNT \$ _____

*** KEYS reserves the right to accept and/or reject any proposal or any portion of a proposal. Bidder shall submit with the proposal any constraints, if any.

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

PROJECT TEAM MEMBERS

Design & Engineering Firm:

Name : _____
Address: _____

Email: _____
Cell Phone: _____
Business Phone: _____

Construction Contractor:

Company Name : _____
Address: _____

Contact Name: _____
Email: _____
Cell Phone: _____
Business Phone: _____

Material Supplier:

DVC:

Company Name: _____
Address: _____

Contact Name: _____
Email: _____
Business Phone: _____

Control Building:

Company Name: _____
Address: _____

Contact Name: _____
Email: _____
Business Phone: _____

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

EXCEPTIONS: ** ANY EXCEPTIONS MUST BE SUBMITTED ON THIS SHEET **

[illegible]

KEYS Bid #12-11 Specifications for EPC of Dynamic Var Compensation Systems (DVC-Statcom Systems) @ Big Pine Key & Stock Island Generation Facility Substations

STATEMENT OF NO BID
KEYS Bid #12-11

If you are not bidding on this service/commodity, please complete and return this form to:

KEYS Energy Services
Attn: Purchasing Dept.
6900 Front Street Extended
Key West, FL 33040

Failure to respond may result in deletion of Vendor's name from the qualified bidders list for KEYS Energy Services.

COMPANY NAME: _____

ADDRESS: _____

TELEPHONE: _____

SIGNATURE: _____

DATE: _____

We, the undersigned have declined to bid on _____ for the following reason(s):

- _____ Unable to meet insurance requirements.
- _____ Insufficient time to respond to the Invitation to Bid.
- _____ We do not offer this product or its equivalent.
- _____ Our product schedule would not permit us to perform.
- _____ Unable to meet specifications.
- _____ Unable to meet bond requirements.
- _____ Specifications unclear (explain below).
- _____ Other (specify below).

Remarks: _____
