

NextEra Energy Transmission New York, Inc.

(NEETNY)

Empire State Line

(ESL)

Case 18-T-0499

Appendix I

Quality Control Plan

September 2020



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Attachment 1 – Steel Pole Installation Checklist

Attachment 2 – Empire State Line 345 kV Transmission Line Caisson Installation Specification

NEETNY will design, engineer and construct the Empire State Line (ESL) Project in accordance with applicable and published planning and design standards and best engineering practices of the New York Independent System Operator (NYISO), New York State Reliability Council, the Northeast Power Coordinating Council, the North American Electric Reliability Corporation and successor organizations. Additionally, NEETNY will design, engineer and construct Network Upgrade Facilities as defined in Attachment P of the NYISO's Open Access Transmission Tariff in accordance with its Interconnection Agreement(s) and all applicable planning and design standards and best engineering practices of the Connecting Transmission Owners.

The Quality Control Plan is divided into three main areas of responsibility: (1) Design, (2) Construction, and, (3) Materials.

Design QA

- 1) NEETNY has a Construction Supervisor and Quality Assurance Inspector that is responsible for field inspection of the construction plans including staking, survey, alignment and component installation to ensure construction compliance and conformance;
- 2) NEETNY's Quality Assurance Inspector will establish check points and where appropriate, hold points for signoff;
- 3) The Quality Assurance Inspector will schedule and attend all construction progress meetings; and,
- 4) Approved changes/revisions will be tracked via Construction Contractor required red-line markups and shall produce final As Built drawings and documentation.

Construction QA

- 1) Construction oversight personnel will monitor all aspects of construction for conformance with the Environmental Management and Construction Plan (EM&CP) and Detailed Design IFC. The following positions will make up the base staff:
 - a. Construction Supervisor(s)/Chief Inspector(s)
 - b. Quality Assurance Inspector
 - c. Safety Inspector
 - d. Environmental Monitor
 - e. Agricultural Inspector
- 2) Upon inspection, NEETNY staff will report issues or verification of assigned checkpoints in their areas of responsibility to the Chief Inspector for inclusion in NEETNY's monthly report.

- 3) Major construction materials testing and quality including concrete, reinforcement steel, culvert pipe and backfill will be the responsibility of the Quality Assurance Inspector.

A checklist has been developed to track conformance with the above considerations (Attachment 1). This checklist is part of NEETNY's standard for quality control during installation.

Materials QA

Materials QA is divided into two key areas: (1) Shop Inspection/Shop QA Conformance, and (2) Field Receiving/Inspection.

- 1) Shop Inspection/Shop QA Conformance – NEETNY purchases major materials from thoroughly vetted vendors. Major components will have conformance reports from the vendor's QA program. NEETNY will have material vendors complete a qualification process which includes reviewing a vendor's QA program prior to approving them for procurement.
- 2) Steel Poles and Anchor Bolts - Because steel poles and anchor bolts are custom fabricated, they will be inspected in the shop for conformance using the vendor's QA Program previously approved by NEETNY's procurement division.
- 3) Major Components - Major Components such as conductor/wire and insulators will receive vendor shop QA verification via required conformance reports from the vendor. Test reports for conductor, OPGW and PHGW will also be provided by the vendor.
- 4) Material Availability - At least 14 days prior to construction, NEETNY shall file a report with the Secretary of the Commission confirming that all required construction materials are available. For purposes of this paragraph, an item of construction material is available: (i) if it is located at a marshalling yard, (ii) if it is in a NEETNY warehouse or other routine NEETNY inventory stocking location, or (iii) if it is on order from a vendor with a scheduled delivery date prior to the time scheduled for its use in the Project.
- 5) Field Receiving/Inspection – All materials will be inspected and accounted for upon delivery at the Project Site before transfer of responsibility to the Construction Contractor. Transmission hardware/framing materials provided by the contractor will receive the same accountability inspection as NEETNY provided materials. Following receipt of poles and components at the storage yard, the assigned construction staff shall verify that the quantities of materials received are identical to those provided with the manufacturer's fabrication drawings before transferring accountability to the Construction Contractor.

Reporting

- 1) Field Review Reports - During construction, Field Review Reports will be completed weekly by the Construction Management Team for inspections of Design, Construction and Materials. The Field Review Reports will be compared to the quality documents from each vendor. NEETNY shall provide Department of Public Service (DPS) Staff, New York State Department of Environmental Conservation, and New York State Electric & Gas Corporation with weekly status reports transmitted by electronic mail summarizing construction and indicating construction activities and locations scheduled for the following 14 days.

Within 10 business days following completion of each Quality Control Audit, NEETNY will provide to DPS Staff, a report of such audit that includes: (i) a description of the audit results, particularly with respect to results identifying that one or more structures or components NEETNY purchased for the Project did not conform to the specification for structures or components described in the approved EM&CP; and (ii) any notes pertinent to the subject matter of such audit made at audit meetings by NEETNY personnel and/or contractors who performed the audit.

If any Quality Control Audits conducted by NEETNY identifies that one or more structures or components NEETNY purchased for installation in the Project do not conform to the specification for structures and components described in the approved EM&CP, NEETNY shall: (i) provide written notification to the Secretary within not more than 72 hours of NEETNY's discovery of such non-conformity; and (ii) a description of the steps NEETNY will take to correct the non-conformity, including whether any components must be dismantled and returned to the manufacturer and a detailed estimate of construction costs and expected delays resulting from the non-conformity.

- 2) Non-conformance Field Report - If a Contractor installs materials, structures or components that do not conform to the specifications to those described in the EM&CP, NEETNY will, within 30 days after becoming aware of such incident, prepare and deliver to DPS Staff a summary report detailing the incident, the steps to be taken to rectify the mistake, the material and labor costs associated with rectifying the incident and the manner in which such costs will be accounted for separate from NEETNY's Project costs.
- 3) Shop Inspection Report – Upon award of the steel pole fabrication, NEETNY will supply the vendor's Quality Control documents to DPS Staff. The inspection plan will ensure conformance with the fabrication contract and the fabricator's approved Quality Control Plan at a prescribed frequency.

Steel Pole Structures and Anchor Bolts

The vendor, following their Quality Control Plan will review each steel pole and associated anchor bolt cluster for the following:

- 1) Straightness
- 2) Welding
 - a. Performed in conformance with industry standards
 - b. Executed per approved vendor drawings
- 3) Dimensions of all steel pole elements conform to approved vendor drawings
- 4) Steel pole elements configured per the approved vendor drawings
- 5) Steel pole finish is per the contract documents
- 6) Anchor bolt clusters furnished per approved vendor anchor bolt drawings

To ensure the quality of materials used for steel pole structure fabrication and associated foundations, the vendor shall submit mill testing reports for the steel used to fabricate all elements of the steel pole structure and associated anchor bolt clusters. Lastly, the steel pole vendor shall be required to submit calculations and fabrication drawings bearing the seal of a Professional Engineer licensed in the State of New York.

Concrete

The Construction Contractor will select the concrete supplier. The Empire State Line 345 kV Transmission Line Caisson Installation Specifications are presented in Attachment 2.

Reinforcing Steel

The procurement of reinforcing steel shall be the responsibility of the Construction Contractor with the exception of anchor bolts which will be provided by NEETNY.

Conductor/Wire

All conductor shall be in conformance with industry standards and good practice prior to shipment to the material storage yard. The vendor will provide the following minimum information to demonstrate compliance:

- 1) Upon request, formal documentation of conformance with all applicable American Society for Testing and Materials (ASTM) Standards and the vendor's manufacturing Quality Control Plan. Optical ground wire (OPGW) will also include end to end optical quality verification reports.
- 2) Formal documentation of conformance with all reel sizes and dimensions.

OPGW reels will receive an additional Construction QA field check by NEETNY before they are installed. Each reel will receive an end to end light continuity check prior to stringing. The same verification will be made as splicing progresses.

All stringing operations will be tested and installed in accordance with the latest revision of the applicable publications and standards of the following organizations:

- 1) National Electrical Safety Code (NESC)
- 2) American Society for Testing and Materials (ASTM)
- 3) Underwriters' Laboratories, Inc. (UL)
- 4) Insulated Power Cable Engineers Association (IPCEA)
- 5) National Electrical Manufacturers Association (NEMA)
- 6) Institute of Electrical and Electronics Engineers (IEEE)
- 7) American National Standards Institute (ANSI)
- 8) National Fire Protection Association (NFPA)
- 9) Environmental Protection Agency (EPA)
- 10) Local and State Electrical Codes
- 11) National Board of Fire Underwriters
- 12) National Electrical Code (NEC)

During stringing, the wires shall be handled to avoid kinking, birdcaging or scraping that could cause damage to the strands. At the end of each working day, the wire shall be safely secured. If it becomes necessary to leave the wire in the stringing blocks before sagging due to a sudden change in the weather or an equipment breakdown, the wire shall be left at a sag greater than that indicated in the sag chart for the highest temperature anticipated before sagging will occur. The wire shall be clear of the ground and safe for pedestrians or vehicle traffic passing by, especially on downhill spans and at guard structures.

The Construction Contractor shall limit the minimum bending radius of the optical ground wire in accordance with the manufacturer's recommendations.

The conductors shall typically be installed through the controlled tension method by means of single bull wheel-type tension stringing equipment, such that the reel supports are stationary and the conductors are pulled directly into the sheaves, with lead lines, without touching the ground or any other objects unless an alternate method is approved by NEETNY. The equipment and methods used for stringing the conductors shall be such that the conductors will not be damaged or persons injured.

The conductor shall be pulled from the top of the reels and threaded through the tensioner, entering and leaving on the top of the bullwheels, with the conductor entering on the left side and leaving on the right side of the bullwheels when facing the direction of the pull.

Maximum stringing tension for the optical ground wire will be provided by NEETNY with the sag and tension data.

The minimum wire sag during tension stringing shall at all times be a value greater than those specified in the sag tables. The conductor shall not be allowed to touch the ground, fences or other objects. Should the conductor contact the ground, other objects or become abraded during the stringing operation, it shall be lowered, wiped clean and closely inspected by the construction foreman.

The tension in the conductor being pulled from the reels to the tensioner shall be the minimum possible to prevent the wire from touching the ground or birdcaging.

The brakes for the tension stringing equipment shall be controlled by a manual mechanical device designed so that the desired tension will be held as long as the brakes are set. Hydraulic controlled devices will be acceptable if approved by NEETNY. The pulling tension shall not pre-stress the conductors. The maximum pulling tension shall not exceed 50% of the initial sagging tensions for each line conductor. The cable pullers, tensioners and pulling lines shall have an adequate margin of capability over this figure as approved by NEETNY. The pulling line and conductor shall be attached to a pulling board with a freely rotating ball bearing swivel. Particular care shall be taken at all times to prevent any loosening of strands and to ensure that the conductors do not become kinked, twisted or abraded in any manner.

A construction inspector shall be present at all long spans and road crossings during the pulling process to verify the conductor does not contact the ground. Should the conductor touch the ground during stringing and sagging operations, the operation should be stopped as to allow for provisions to assure that the conductor no longer touches the ground during stringing and sagging. Before being completely strung and sagged, the portion that has touched the ground should be inspected for burring, defacing or other damage. If damage has occurred, then it should be immediately repaired to the satisfaction of NEETNY. If the damage is minor, wire may be sanded down to prevent audible noise and signal interference.

If the conductors are damaged in any way, the Construction Contractor shall immediately repair or replace the damaged sections as directed by NEETNY. Slightly damaged or abraded sections may be repaired by dressing with a fine emery cloth. NEETNY's Construction Supervisor shall make the determination of the level of damage to the conductor and the appropriate measures to be taken to repair the segment. Damage shall be defined as any deformity or foreign matter on the surface of the conductor that can be detected by sight or touch and cannot be completely removed without affecting the original geometry and surface condition of the wire. Damage includes, but is not limited to, nicks, scratches, abrasions, kinks, compressions, basketing, birdcaging, popped-out strands or broken strands.

Insulators

All insulators procured for the ESL Project shall conform to NEETNY transmission standards and provided by pre-approved bidders.

Vendors shall be required to provide documentation upon request of batch conformance with ANSI 29.2 and the applicable version of ANSI 52 strength rating. This documentation would be provided to the Construction Superintendent prior to shipment of the materials to NEETNY's material storage yard.

Transmission Line Hardware/Framing Materials

All materials, other than poles, wire and insulators, furnished in association with the Project shall be provided by the Construction Contractor based on an approved list by supplier provided by NEETNY. Inspections will occur upon receiving at NEETNY's Material Storage Yard for quantity and quality before being inventoried by the Construction Contractor.

Attachment 1

Steel Pole Installation Checklist

1A. Environmental Checklist

1B. Foundation Checklist

1C. Pole Installation Checklist

1D. Conductor Installation Checklist

1A. Environmental Checklist

Structure Environmental Checklist

Structure Number	Verify compliance with all environmental; wildlife and SWPPP Requirements including dewatering practices	Verify environmental, wildlife and cultural avoidance areas are clearly demarcated within work areas.	Verify any oil and hazardous material is properly stored and labeled, fueling and repair is not in wetland areas and secondary containment is installed.	If necessary; verify mats or wide tracks are used to prevent ruts in wetlands.	Verify adequate drainage in right of way; and that the installation of any culverts is to specifications.	Verify right of way access points are identified and installed to specifications and maintained to avoid trackout.	Verify clearing is per specifications (ex: width of right of way; time of year restrictions)
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Structure Number	Verify compliance with all environmental; wildlife and SWPPP Requirements including dewatering practices	Verify environmental, wildlife and cultural avoidance areas are clearly demarcated within work areas.	Verify any oil and hazardous material is properly stored and labeled, fueling and repair is not in wetland areas and secondary containment is installed.	If necessary; verify mats or wide tracks are used to prevent ruts in wetlands.	Verify adequate drainage in right of way; and that the installation of any culverts is to specifications.	Verify right of way access points are identified and installed to specifications and maintained to avoid trackout.	Verify clearing is per specifications (ex: width of right of way; time of year restrictions)
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1B. Foundation Checklist

1C. Pole Installation Checklist

1D. Conductor Installation Checklist

Attachment 2

Empire State Line 345 kV Transmission Line Caisson Installation Specification



EMPIRE STATE LINE 345 kV TRANSMISSION LINE CAISSON INSTALLATION SPECIFICATION

Revision A

PRELIMINARY – NOT FOR CONSTRUCTION

Project No.: 13666-003

55 East Monroe Street
Chicago, IL 60603-5780 USA
312-269-2000
www.sargentlundy.com



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1.0 GENERAL

This specification covers the technical and performance requirements for furnishing all necessary equipment and material (steel reinforcement, concrete, grout, etc.) and performing all operations required for the complete installation of concrete drilled piers for NextEra Energy Resources, LLC (OWNER).

It is not the intent of this specification to outline all technical requirements, nor to set forth the requirements adequately covered by the applicable codes, standards, specifications, and federal, state and local regulations. The CONTRACTOR shall meet the requirements of this specification and the applicable federal, state and local regulations.

CONTRACTOR shall perform work only per OWNER approved procedures.

1.1 Scope

1.1.1 This Specification covers furnishing of materials and installation of concrete and reinforcing steel for structure foundations per approved foundation drawings furnished by OWNER or OWNER's engineer.

1.1.2 Where specifications and reference documents conflict, the Engineer shall make the final determination of applicable document.

1.2 References

Unless otherwise noted, the latest revision of the following reference standards shall apply to this Section.

American Society for Testing and Materials (ASTM):

- A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- A706 Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
- C31 Making and Curing Concrete Test Specimens in the Field.
- C33 Concrete Aggregates.
- C39 Compressive Strength of Cylindrical Concrete Specimens.
- C40 Organic Impurities in Fine Aggregates for Concrete.
- C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- C94 Ready-Mixed Concrete.
- C143 Slump of Hydraulic-Cement Concrete.
- C150 Portland Cement.
- C172 Sampling Freshly Mixed Concrete.
- C192 Making and Curing Concrete Test Specimens in the Laboratory.
- C231 Air Content of Freshly Mixed Concrete by the Pressure Method.
- C233 Air-Entraining Admixtures for Concrete.
- C260 Air-Entraining Admixtures for Concrete.
- C309 Liquid Membrane-Forming Compounds for Curing Concrete.
- C494 Chemical Admixtures for Concrete.

- C595 Blended Hydraulic Cements.
- C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- C989 Slag Cement for Use in Concrete and Mortars.
- C1064 Temperature of Freshly Mixed Hydraulic-Cement Concrete.
- C1077 Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
- C1260 Potential Alkali Reactivity of Aggregates.
- C1293 Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
- D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).
- D4253 Maximum Index Density of Soils Using a Vibratory Table.
- D4254 Minimum Index Density of Soils and Calculation of Relative Density.

American Concrete Institute (ACI):

- 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- 232.2 Use of Fly Ash in Concrete.
- 301 Structural Concrete.
- 304 Guide for Measuring, Mixing, Transporting and Placing Concrete.
- 305.R Specification for Hot Weather Concreting.
- 306.R Standard Specification for Cold Weather Concreting.
- 308 Recommendations for Curing Concrete.
- 309 Guide for Consolidation of Concrete.
- 336.1 Construction of Drilled Piers
- 347 Guide to Formwork for Concrete.

American Petroleum Institute (API):

- 13A Specification for Drilling-Fluid Materials.

1.3 Definitions

1.3.1 Allowable Bearing Pressure - The vertical pressure per unit area that may be applied to the soil at the level of the shaft bottom.

1.3.2 Bearing Stratum - The layer(s) of soil or rock that support the shaft and loads imposed on it. Bearing elevation is the proposed depth of the base of each shaft, as noted on Drawings, accounting for minimum embedment and rock socket into competent rock.

- 1.3.3 Casing - Cylindrical steel tube, lowered into the excavated hole to protect workmen and observers. Protects walls of excavation from collapse or cave-in and soil and water from the excavation during drilling and concrete placement.
- 1.3.4 Pumping of Concrete- "Underwater-Type Concrete" is conveyed by pressures through rigid pipe or flexible hose and discharged directly to bottom of shaft through slurry or under water. Pressure is applied by piston pumps, pneumatic compressed air, or squeeze pressure pumps in accordance with ACI 336.1.
- 1.3.5 Rock Excavation - Defined as all material encountered in excavating drilled shafts which cannot be removed with a conventional earth auger and requires rock auger, core barrel, boulder roter, or hand labor using air-powered tools and/or other special excavation procedures. Refusal of the earth auger shall be defined as a penetration rate equal to, or less than, 1/10 ft. per minute period using a drill rig, or as otherwise approved, providing its maximum continuous torque and its maximum downward force ("crowd").
- 1.3.6 Slurry - Method of advancing drilled shaft hole where bentonite (sodium montmorillonite in accordance with API 13A) or anionic polymer is mixed with clean water or water within shaft to produce a slurry mixture capable of maintaining the stability of shaft walls and bottom in potentially caving and/or water-bearing soils.
- 1.3.7 Tremie - Method of placing concrete, if permitted by Engineer, for "Underwater-Type Concrete" through a rigid pipe or flexible hose. Concrete is placed by means of gravity flow or drop through the interior of the pipe, the lower end of which is kept immersed in fresh concrete.

1.4 Submittals

- 1.4.1 Pre-construction submittals shall include, but not limited to, the following items. OWNER shall approve items below prior to the start of construction:
- 1.4.1.1 Concrete mix design
- Mix proportions
 - Historic test data (within last 365 days)
 - When Historic data is not available a trial batch shall be tested in laboratory prior to approval
- 1.4.1.2 Steel reinforcement cage schedule, details and erection drawings
- 1.4.1.3 Grouts and curing agents
- 1.4.1.4 CONTRACTOR's experience
- 1.4.1.5 Proposed drilled shaft rig name, model number, maximum continuous torque rating (ft-lb), maximum downward force ("crowd"), proposed earth and rock auger attachments, and proposed special techniques and equipment. Submittals shall reflect any Contractor modifications that affect the torque and crowd ratings

- 1.4.1.6 Detailed procedures for each anticipated method of construction - dry and uncased, temporary casing, slurry, or other procedure including:
- a. Sequence of excavation, rebar cage placement, concrete placement, and placement of embedded items such as anchor bolts.
 - b. Methods to prevent segregation of concrete during placement.
 - c. Methods to prevent caving, if necessary.
 - d. Equipment and procedures for cleanout of bottom of drilled shaft and walls of rock socket.
 - e. Procedures for supporting rebar cage during concrete placement, including type, size and material construction of spacers to be used.
 - f. Procedures for supporting anchor bolts, direct embedded poles or other embedded items.
 - g. Procedures for and sequence of, installation and removal of telescoped temporary casing.
 - h. Procedures for emergency cold joint construction in the event concrete placement is unexpected interrupted
- 1.4.2 Construction submittals shall include, but not limited to, the following:
- 1.4.2.1 Concrete mix data from batches
- a. Slump
 - b. Maximum aggregate size
 - c. Fine aggregate – sieve analysis, fineness modulus, soundness, reactivity, deleterious substances
 - d. Coarse aggregate – sieve analysis, soundness, reactivity, deleterious substances
 - e. Air Content
 - f. Admixture Content
 - g. Water Cement Ratio
 - h. Cement and Fly Ash Content
- 1.4.2.2 Concrete cylinder test reports with a minimum of the following information:
- a. Project name
 - b. Cylinder location (Structure number)
 - c. Dimensions of test cylinder.
 - d. Cylinder identification.
 - e. Date cast.
 - f. Date to be tested
 - g. Slump.
 - h. Entrained air content.
 - i. Supplier.
 - j. Truck number
 - k. Ticket number
 - l. Dispensing time

- m. Sampling time.
 - n. temperature at time of placement
 - o. Concrete temperature at time of placement
 - p. Amount of water added at site.
- 1.4.2.3 Laboratory test reports of material for use in concrete.
- 1.4.2.4 Drilled Shafts: Submit at the completion of each day, drilled shaft construction logs
- a. Identification number.
 - b. Shaft dimensions.
 - c. Ground surface elevation.
 - d. Bottom of concrete elevation.
 - e. Top of concrete elevation.
 - f. Description of soils encountered during drilling and the depths at which transitions occur.
 - g. Bearing layer description.
 - h. Nature and location of obstructions.
 - i. Water conditions during drilling and concrete placement.
 - j. Amount of unclassified excavation.
 - k. Amount of rock excavation and length of rock socket, if required.
 - l. Method of construction - dry and uncased, temporary casing, slurry, or other.

2. Material Requirements

2.1 Reinforcing Steel

- 2.1.1 All main bars shall be deformed bars and conform to ASTM A615 or ASTM A706, Grade 60.
- 2.1.2 All ties shall be deformed bars and conform to ASTM A615 or ASTM A706, Grade 60. Spiral lateral reinforcement providing the equivalent steel area of the specified size and spacing of the ties to comply with the design may be substituted in drilled piers.
- 2.1.3 Fabrication of steel bars shall conform to ACI 315. Bars with kinks or bends not called for in the drawings shall not be used. The use of heat to bed or straighten reinforcing steel shall not be permitted.
- 2.1.4 All rebar shall have mill certifications.

2.2 Concrete

- 2.2.1 The 28 day strength of concrete shall at minimum be 4,000 psi.
- 2.2.2 Maximum slump range shall be 5", plus or minus 1" for regular concrete placed using the dry-hole method. For concrete placed using the wet (tremie) method, maximum slump range shall be 8", plus or minus 1". Unless approved by OWNER prior to concrete placement.
- 2.2.3 Cement

- 2.2.3.1 Portland Cement shall conform to ASTM C150, Type I or II.
- 2.2.3.2 Shall be no less than 60% by mass of the total cementitious material.

2.2.4 Fly Ash

- 2.2.4.1 Conform to ASTM C618, Class C or F.
- 2.2.4.2 Limited to a maximum of 25% by mass of the total cementitious material.

2.3 Aggregate

- 2.3.1 Conform to ASTM C33.
- 2.3.2 Maintain fine aggregate free of ice, frozen lumps, dirt, etc.
- 2.3.3 Blast furnace slag will not be permitted.

2.4 Mixing Water

Only potable water shall be used unless otherwise approved by OWNER. If non-potable water is approved all testing shall be at the cost of the CONTRACTOR. Water shall be tested according to ASTM C1602.

2.5 Admixtures

All admixtures shall be approved by OWNER prior to use.

2.5.1 Water Reducing Type

- 2.5.1.1 Conform to ASTM C494, Type A or D.
- 2.5.1.2 High range water reducing shall conform to ASTM C494 Type F or G
- 2.5.1.3 Conform to manufacturer's recommendations for use.
- 2.5.1.4 Technical assistance of the manufacturer's field representative shall be furnished upon request.

2.5.2 Air-Entraining Type

- 2.5.2.1 Conform to ASTM C260.
- 2.5.2.2 Air Entrainment shall be 5% ± 1%
- 2.5.2.3 Conform to manufacturer's recommendations for use.
- 2.5.2.4 Technical assistance of the manufacturer's field representative shall be furnished upon request.
- 2.5.2.5 Testing of air-entraining admixtures shall conform to ASTM C233.

2.6 Mixing

- 2.6.1 All concrete material shall be batched by weight.
- 2.6.2 Method of determining amount of moisture shall be approved by OWNER and shall be deducted from the amount of mixing water added to the mix.

- 2.6.3 Concrete delivered to the jobsite shall be mixed in route. Mixing shall conform to ASTM C94. Maximum of 90 minutes are allowed from the time the concrete truck leaves the batching place (supplier) to pouring concrete at the job site.

3.0 Testing

3.1 General

- 3.1.1 CONTRACTOR shall supply independent testing laboratory to perform all required material testing.
- 3.1.2 All testing shall be performed by certified technician in accordance with ASTM C1077
- 3.1.3 Test results of all production concrete and mix designs shall be supplied to OWNER.
- 3.1.4 OWNER shall have the right to observe all phases of concrete cylinder curing and testing.
- 3.1.5 Slump Tests shall conform to ASTM C143
- 3.1.6 Air content test shall conform to ASTM C231
- 3.1.7 Samples acquired for testing shall be cured according to ASTM C31
- 3.1.8 Laboratory will cure and test concrete cylinders conforming to ASTM C192 and C39, testing one cylinder at seven days and two at 28 days while holding one as a spare.
- 3.1.9 Air-entraining admixture shall be tested conforming to ASTM C233.

3.2 Pre-Construction

- 3.2.1 For trial batch mix design the laboratory shall make two concrete test cylinders using proposed water and two concrete test cylinders using potable water conforming to ASTM C192.
- 3.2.2 Laboratory trial batches shall be used to establish a water-cement ratio compression strength curve with at least three points, each representing the strength of a separate trial batch. At least one point shall be above and one below the strength required. Each point on the curve shall represent the average of at least three specimens tested at 28 days or an earlier age when approved by Purchaser's Representative.
- 3.2.3 A point on the water-cement ratio compressive strength curve shall be selected that will provide an average strength at least 1200 psi greater than the specified minimum strength.

3.3 Field

- 3.3.1 The CONTRACTOR's independent testing laboratory shall furnish test equipment, test cylinder molds, and trained personnel to perform all required field tests, make the required concrete test cylinders and deliver test cylinders to the testing laboratory selected by the Purchaser. The prescribed tests shall be made in the presence of or with the concurrence of the Purchaser.
- 3.3.2 Concrete sampling for tests and cylinder making shall be done conforming to ASTM C172.

- 3.3.3 Prepare test cylinders conforming to ASTM C31, with not less than one set of cylinders (four cylinders) from each concrete foundation or each 50 cubic yards or fraction thereof.
- 3.3.4 Temperature determination shall conform to ASTM C1064
- 3.3.5 Slump and Air Test results shall be furnished to the Testing Laboratory for inclusion in the Cylinder Test Reports.
- 3.3.6 All test data shall be provided to the OWNER.
- 3.3.7 After casting cylinders, each cylinder shall be identified with the following information:
 - a. Date and time prepared
 - b. Delivery ticket number.
 - c. Sequential cylinder numbers indicating structure number and cylinder number.
- 3.3.8 Should the statistical data indicate an unacceptable combination of average strength and standard deviation, Supplier shall take immediate corrective action.

4.0 EXECUTION

4.1 Excavation

- 4.1.1 The excavation required for the drilled pier shafts shall be made through whatever materials are encountered to the dimensions and elevations shown on the engineering design drawings.
- 4.1.2 Contractor shall verify the location of all underground conduits, piping, duct banks and utilities prior to starting drilling operation.
- 4.1.3 Excavate drilled shafts with an auger rig capable of drilling, as a minimum, the diameter and depth of foundations shown on the Drawings in the subsurface materials present. Rock excavation is not anticipated but may be encountered.
- 4.1.4 Provide hoisting equipment rated for personnel use, back-up lifeline, and boatswain's chair for downhole entry by personnel.
- 4.1.5 Keep the ground surface for a minimum of 2 feet from the edge of the excavation clean and level.
- 4.1.6 Dispose of materials removed from the excavation at an off-site location or as directed by the OWNER.
- 4.1.7 Prior to placing reinforcing steel and concrete, all silt, mud, loose material, and extraneous matter shall be removed from the excavation. The CONTRACTOR shall demonstrate that each pier excavation is free from such silt, mud, loose and extraneous material. All excavations shall be approved by the OWNER before concrete is placed.
- 4.1.8 No pier shall be excavated closer than 6 pier diameters to an existing drilled pier unless concrete placement in the existing pier has been completed for at least 24 hours.
- 4.1.9 All unattended excavations shall be covered with solid covers to maintain a safe workplace. Properly sized metal plates or heavy plywood sheeting may be used to meet this requirement. CONTRACTOR shall install bracing, sheathing, shoring, and covers as necessary to protect excavations as required for safety and to

conform to governing laws and regulations. The covers shall be anchored to prevent being dislodged and shall be clearly marked "Open Pit" and cordoned off with barricade tape or other suitable barriers. Any injury or damage resulting from any of CONTRACTOR's operations shall be the sole responsibility of the CONTRACTOR. Any footing excavation which is to be left open overnight shall receive prior approval of the OWNER.

- 4.1.10 Excavation, where practicable, shall be dewatered before placing concrete.
- 4.1.11 If dewatering is required, a dewatering plan shall be prepared by the CONTRACTOR and provided to the OWNER no less than 7 days in advance for approval.
- 4.1.12 When soil stabilization is required the hole shall be opened as deeply as is possible, until the unstable strata are encountered. At this point premixed soil stabilizing solution (drilling mud) is introduced into the hole until the hole is full. Use of drilling mud shall be approved by OWNER prior to use. Normal bucket drilling procedures can then then carried out through the drilling mud. Care should be taken to prevent drastic surging of the mud when entering or leaving the hole so as to prevent sloughing or caving.
- 4.1.13 Drilled shafts which are over excavated without OWNER approval shall have the over excavation filled with unreinforced concrete, provided foundation does not require reinforcing steel for lateral or uplift loadings at depth, at CONTRACTORS expense. If loads on shaft require reinforcing steel, provide steel with adequate lap splice at CONTRACTORS expense.
- 4.1.14 Locate drilled shaft as indicated within the following tolerances. Deviations in excess of these tolerances shall be corrected at CONTRACTORS expense, including additional costs for engineering, redesign, and inspection:
- a. Centerline: Within 3" of surveyed location
 - b. Diameter: + 3", - 0"
 - c. Plumb: 1.0 percent of the length, 12.5 percent of shaft diameter whichever is less.
- 4.2 Temporary Steel Casing (if utilized)
- 4.2.1 The use of temporary steel casing for the protection of personnel, prevention of cave-ins, and displacement of earth shall be the responsibility of the CONTRACTOR.
- 4.2.2 Temporary steel casing shall be smooth and free of encrusted concrete for ease of removal
- 4.2.3 Steel casing shall be of sufficient diameter and wall thickness to prevent collapse or cave-in of the excavation and to prevent soil and water from entering the excavation during drilling, field observation, and concrete placement.
- 4.2.4 Casing extraction shall be a slow uniform rate.
- 4.2.5 If casing is required to be left in place permanently, prior permission is required from OWNER's engineer.
- 4.3 Anchor Bolts

- 4.3.1 Anchor bolts for tubular steel poles shall be accurately set as shown on the drawings. CONTRACTOR shall construct foundations using the templates provided by the manufacturer to locate the bolts in the correct rotation and spacing. The bolts shall be placed in the correct relationship to the bisector as indicated on manufacturer drawings. The bolts shall not interfere with the reinforcing cage when in place and an adequate space shall exist between the bolts and reinforcing cage. The CONTRACTOR shall construct adequate devices for holding the assembled bolts in the correct position during concreting.
- 4.3.2 The center of each steel pole bolt pattern shall be within 2" of its designed position.
- 4.3.3 Each anchor bolt shall be plumb within 1/4" from the top of each bolt to the bottom of each bolt
- 4.3.4 All anchor bolts position shall have a tolerance of $\pm 1/16$ " relative to one another without successive accumulation
- 4.3.5 The transverse axis of each pole shall not deviate from the bisector of the interior line angle or the angle specified on the steel pole data sheet by more than 12 minutes of arc.
- 4.3.6 Prior to placing concrete, CONTRACTOR shall verify that there is sufficient bolt projection to allow for any required plumbing of tubular steel pole during erection. Resulting both thread projection after plumbing and top nut tightening is to be at least one and one-half threads. Steel detail drawings are available from the OWNER to verify bolt setting and steel pole base plate thickness.
- 4.3.7 Wet setting of the anchor bolt cage is not permitted. Anchor bolt cage must be properly constructed and set prior to the installation of any concrete.

4.4 Reinforcing Steel

- 4.4.1 Column ties or spiral shall be tied at all intersections with longitudinal bars using no less than no.18 gauge annealed wire.
- 4.4.2 All reinforcing steel shall be of the proper size and length indicated and placed in the correct position.
- 4.4.3 No welding shall be performed on reinforcing steel (except that the top and bottom rows of ties for drilled shafts may be tack welded provided ties conform to ASTM A706).
- 4.4.4 Bars shall be spliced only as indicated or as approved by the OWNER.
- 4.4.5 Reinforcing cage shall be clean of dirt, rust, mill scale, form oil or bond reducing chemicals.
- 4.4.6 Supplier shall supply bracing required to ensure constructability of the reinforcing steel cage. Braces shall be located so they do not interfere with the placement or pumping of the concrete.
- 4.4.7 Provide spacers of sufficient design and material construction to maintain appropriate clearance from the side walls or casing and shaft bottom.
- 4.4.8 Prior to placement of concrete, center reinforcing cages in the drilled shaft excavation and suspend or tie them off in an approved manner to cutoff elevation.
- 4.4.9 CONTRACTOR shall notify OWNER 2 working days prior to reinforcement cage placement for inspect and approval.

4.5 Formwork

- 4.5.1 Form the drilled shaft with round forms with an inside diameter equal to the drilled shaft's nominal diameter. Forms shall restrain concrete without deformation or settlement. CONTRACTOR shall be responsible for structural adequacy of formwork.
- 4.5.2 Forms shall have a smooth interior surface and be treated with an approved oil or form-releasing agent prior to placement of reinforcing steel. Material shall not stain, cause injury to exposed concrete surfaces, or affect bonding of specified surface coatings.
- 4.5.3 Construct forms to be removable without marring concrete surface.
- 4.5.4 All form work shall conform to ACI 347.

4.6 Placing Concrete

- 4.6.1 Concrete placement shall be continuous and monolithic, with no construction joints.
- 4.6.2 Do not place concrete that has partially hardened or has been contaminated by foreign materials. Contaminated concrete shall be removed before completing pour.
- 4.6.3 Concrete shall be placed within 1 hour and 30 minutes after first introduction to water to cement and aggregate. Concrete which has partially set shall not be re-tempered but shall be discarded.
- 4.6.4 Placement of concrete shall follow ACI 336.1. If guided free-fall method is utilized concrete shall not come into contact with any reinforcement, anchor bolts, and hole sides to prevent segregation.
- 4.6.5 Concrete shall be vibrated the top 20 ft. Vibrators shall be penetrated to the bottom of the layer being placed and at least 6 inches into any previous placed layer. Do not drag vibrators through the concrete. Insert and withdraw vibrator slowly with the vibrator running continuously so that no hole will be left in the concrete.
- 4.6.6 Do not flow concrete from one location to another by use of a vibrator.
- 4.6.7 Do not use aluminum equipment to convey concrete.
- 4.6.8 Concrete placed through a slurry or under water shall be pumped with an approved concrete pump as follows:
 - a. Concrete shall be placed using a rigid pipe or flexible hose. Placement shall be started with the lower end of the pipe or hose sealed with a rubber gasketed wood plug with a line attached, or similar device, lowered to the bottom with the pipes or hose dry, plug shall be displaced by the concrete and retrieved from the work. The water shall be displaced as the concrete is placed and the end of the pipe or hose shall be kept embedded 2 to 5 feet in the concrete as the concrete is placed.
 - b. Should the end of the pipe or hose be accidentally pulled out of the concrete during the placement, the pour shall be immediately discontinued, and the pipe or hose withdrawn from the hole. The pipe or hose shall be resealed at the bottom and returned to the hole with the sealed end inserted into the concrete. Pouring may then be resumed.

- c. The cutoff point shown on the drawings shall be over poured. The excess concrete shall then be dipped out, and visual inspection made of the concrete at the top of the pour. If any contamination of the concrete is observed, it will be necessary to reinsert the pipe or hose a sufficient distance into the concrete and to continue pouring fresh concrete until the contaminated concrete has been replaced by uncontaminated concrete.

4.7 Slurry

- 4.7.1 Use of slurry shall be approved prior to use.
- 4.7.2 Slurry shall consist of a mixture of bentonite (sodium montmorillonite conforming to API 13A) or anionic polymer and water to produce a slurry of sufficient density to maintain stability of the shaft walls and bottom and to facilitate removal of coarser grained soils from the excavation.

4.8 Finishing and Repairs

- 4.8.1 Surface shall be troweled; this shall be done in a manner to produce even, uniform surfaces.
- 4.8.2 Finish shall have smooth appearance with brushed finish.
- 4.8.3 Repair as soon as forms have been removed and before liquid membrane forming compound is applied.
- 4.8.4 Repairs shall be made with Portland cement mortar or Five Star[®] Structural Concrete in accordance with ACI 301.
- 4.8.5 Compact mortar into depressions so that after curing, hole is filled and mortar is flush with surface. Use hammer and ramming rod for compacting the holes.
- 4.8.6 OWNER shall be notified of areas containing major defects or where reinforcing steel is exposed prior to determination of repair method.

4.9 Curing

- 4.9.1 Cure and protect concrete in accordance with the methods described in ACI 308.
- 4.9.2 Hot and Cold weather concreting shall follow sections 4.9 and 4.10, respectively.
- 4.9.3 Keep concrete surfaces continuously moist after placement for 14 days minimum if concrete contains fly ash. Otherwise cure for 7 days minimum.
- 4.9.4 Use potable water for curing.
- 4.9.5 Alternatively, a membrane-forming curing compound may be used. Spray the concrete surface with water immediately after forms are removed. Keep the surface moist until the curing compound is applied. The concrete should be allowed to reach a uniformly damp appearance with no free water on the surface and then application of the curing compound should be at once.

4.10 Hot Weather Concreting

- 4.10.1 When the temperature is 90 degrees F or above, or is likely to rise above 90 degrees F within the 24-hour period after concrete placement; or when there is any combination of high air temperature, low relative humidity and wind velocity which would impair concrete strength or quality, follow the recommendations of ACI 305.1.
- 4.10.2 Concrete shall have a maximum temperature of 85 degrees F during placement.
- 4.10.3 Dampen subgrade and forms with cool water immediately prior to placement of concrete.
- 4.10.4 Protect freshly placed concrete immediately after placement so that the rate of evaporation as determined by ACI 305.1 does not exceed 0.2-pound per square foot per hour.
- 4.10.5 Protect concrete with suitable insulation if rapidly decreasing nighttime temperatures occur, which would cause thermal shock to concrete placed during warm daytime temperatures.
- 4.10.6 Protect the concrete with temporary wet covering during any appreciable delay between placement and finishing.
- 4.10.7 During hot weather, make provision for shading or otherwise cooling the reinforcing steel and other embeds prior to and during concrete placement.

4.11 Cold Weather Concreting

- 4.11.1 When the temperature is 40 degrees F or is likely to fall below 40 degrees F during the 24-hour period after concrete placement, follow the recommendations of ACI 306.1 to prevent loss of concrete strength or quality.
- 4.11.2 Minimum temperature for concrete as mixed shall be as indicated on lines 2, 3 and 4 of Table 5.1 of ACI 306R. Maximum temperature for concrete as mixed shall be 15 degrees F greater than the corresponding minimum temperature.
- 4.11.3 Place and maintain concrete so that its temperature is never less than the temperature indicated on line 1 of Table 5.1 of ACI 306R. Maintain the required temperature for the time duration indicated in ACI 306R.
- 4.11.4 Monitor temperature of concrete in place at corners or edges of formwork as applicable.
- 4.11.5 Do not expose concrete to carbon monoxide or carbon dioxide fumes from heaters or engines. Oil or coke burning salamanders will not be permitted. Personnel shall be present at all times to maintain safe, continuous operation of heating system.
- 4.11.6 Control temperature and humidity of protected concrete so that excessive drying of concrete surfaces does not occur.