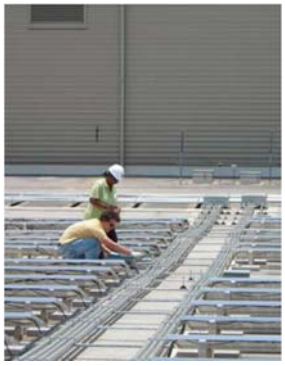
RFP Appendix A.1 (Solar)

PACIFICORP

Solar Photovoltaic Renewable Resource Technical Specification

2016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Contents

Acronyms and Abbreviations

AC	alternating current
A	ampere
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
CPT	control power transformer
DC	direct current
DR	Distributed Resources
EL	electroluminescence
EN	European Standard
EPS	Electric Power System
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
kW	kilowatt
kWh	kilowatt hour
LPS	lightning protection system
mil	unit of measurement for length (thousandth of an inch)
MW	megawatt
MW_{AC}	megawatt alternating current
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
O&M	operation and maintenance
PCB	polychlorinated biphenyl
PCC	Point of Common Coupling
PV	photovoltaic
PVC	polyvinyl chloride
PVEL	PV Evolution Labs

QA/QC	quality assurance/quality control
SCADA	supervisory control and data acquisition
SCCR	short-circuit current rating
SPD	surge protection devices
SWPPP	Storm Water Pollution Prevention Plan
TÜV	Technischer Überwachungsverein
UDOT	Utah Department of Transportation
UL	Underwriters Laboratories, Inc.
V	volt
V_{AC}	volts alternating current
V_{DC}	volts direct current
VDE	association for electrical, electronic, and information technologies

List of Appendices to Appendix A

A-1	Not Used
A-2	Interconnection Agreement
A-3	Permit-Matrix
A-4	Not used
A-5	Project One-line Drawing and Layout
A-6	Division of Responsibility
A-7	Owner Standards and Specifications
A-8	PVSYST Performance Summary Report
A-9	Product Data Input Supply Forms
A-10	Plant Performance Guarantee

Reference PacifiCorp Standards

RFP Appendix A-7 contains the following Owner standards that apply to this specification:

01. Attachment 1A Project Document Formatting and Requirements.
02. Attachment 1B Project Document Deliverables.
03. Computer Aided Design (PacifiCorp Energy) General AutoCAD/Drafting Standards (Specification DCAP876).
04. a) 04.1 Substation Equipment Power Transformers, ZS-001 and b) 04.2 Two-Winding Distribution Transformer, ZS-102.
05. Material Specification ZS 061, Electrical Equipment-Insulating Oil.
06. Material Specification ZS 065, Wind, Ice, and Seismic Withstand.
07. Material Specification ZS 066, Contaminated-Environment Protection.
08. Procedure SP-TRF-INST, Transformer Receiving, Installation and Testing.
09. Asset Management Form 006F, Meter and Relay Equipment Memorandum.
10. PacifiCorp Engineering Handbook, Part 6B.5 Fence Application and Construction.
11. PacifiCorp Engineering Handbook, Part 6B.6 Substation Grounding.
12. PacifiCorp Protective Relaying Standard, Document Number: GEN-ENG-RELAY-0001.
13. PacifiCorp Protective Relaying Standard, Arc Flash Hazard Standard, Document: GEN-ENG-RELAY-0002.
14. PacifiCorp Protective Relaying Standard, “Relay Current Transformer (CT) & Potential Transformer (PT) Insulation Integrity Test,” Document: GEN-ENG-RELAY-0003.
15. PacifiCorp Protective Relaying Standard, “Thermal Plant Protective Relay Maintenance and Testing-PRC-005,” Document: GEN-ENG-RELAY-1003.
16. PacifiCorp Protective Relaying Standard, “Relay Testing & Commissioning Checklist.”
17. PacifiCorp Protective Relaying Standard, “Relay Installation Procedure,” Document: GPCP-EQPMNT-INST.
18. PacifiCorp Protective Relaying Standard, “Current Transformer Installation Procedure (Relay),” Document: GPCP-CT-INST.
19. PacifiCorp Protective Relaying Standard, “Current Transformer Installation Form (Relay),” Document: GPCP-CT-INST.
20. PacifiCorp Substation High-Voltage Warning Signs, SG-001.
21. PacifiCorp Transformer Commissioning Requirements.

Technical Specification

This is Appendix A - Solar Photovoltaic Resources 2016 – Technical Specification, which will subsequently become a contract document, as a supplement to the TURNKEY ENGINEERING, PROCUREMENT AND CONSTRUCTION AGREEMENT ("The Agreement"). Capitalized terms used and not defined herein have the meanings given in the Agreement unless the context requires otherwise.

A-1 Introduction and Contractor Responsibilities

Contractor shall provide all required services and materials for the successful completion of the Plant. Contractor's responsibilities shall include environmental permitting, design, engineering, procurement of equipment, Site preparation work, foundations, installation of all equipment, bulk material and commodities supply, and Site finishing work. Contractor also shall deliver project management, construction management, commissioning and startup, and testing of work, all as described in this document including all referenced appendices and standards which will subsequently become a contract document.

Contractor shall construct all roads, foundations, electrical systems, control systems, monitoring systems, communications, ancillary structures, storage facilities, security systems, and fencing, and shall erect and commission the photovoltaic (PV) system in the locations and orientations set forth in the Site plan and Site layout drawings and in accordance with this document, and all related specifications that relate thereto.

Installation of the PV system shall be by a recognized, experienced Contractor in accordance with federal, state, local, and utility specifications and requirements and in accordance with the Utah Office of Energy Development. The electrical installation of the PV system shall be performed in accordance with the same requirements. The work shall be performed by an electrical contractor licensed in the state where the project will be constructed. The work shall be performed by a licensed solar photovoltaic contractor who has obtained written approval by the department of licensing (in the state where the project will be constructed) for the installation of solar PV systems. Contractor shall provide comprehensive onsite construction management for the Plant and shall commission the Plant. Contractor shall manage, supervise, inspect, and furnish all labor, equipment, materials, temporary structures, temporary utilities, products, and services related to the foregoing, all on a turnkey basis.

Contractor shall perform the Work in accordance with the following:

a. In a manner that is sufficient, complete, and adequate in all respects necessary for the Plant to successfully achieve Final Acceptance by the Guaranteed Final Acceptance Date.

b. In conformance with the professional standards, skill, expertise, and diligence of design and construction of professionals regularly involved in utility-grade, utility-scale, grid-connected solar PV power projects in the United States.

c. In compliance with the terms of the contract documents, the operating guidelines, the Utility's interconnection requirements (**RFP Appendix A-2 – Interconnection Agreement**), and all applicable laws, standards, and permits.

d. Approved as to form, use, and content by all government authorities and private entities authorized to administer or enforce any building, electrical, or construction code or standard whose approval of the final design of the Plant, or any portion thereof, is necessary for the construction, operation, or interconnection of the Plant.

A-1.1 Performance Characterization

The predicted PV system performance estimate must be provided in **RFP Appendix A-8** and is based on the performance characterization data in **RFP Appendix C-1** or **C-2**. The predicted PV system performance information that is to be provided shall include the PVSyst report, the 12X24 output in an Excel format, and an 8760 output in an Excel format. Contractor shall guarantee the energy performance of the Plant as set forth in **RFP Appendix A-10**.

A-1.2 Permitting

Contractor shall apply for and obtain all permits and authorizations necessary for construction of the Plant, as per the attached permitting matrix (**RFP Appendix A-3**). Copies of all applicable permits will be provided to Owner within 5 business days after they are obtained or completed.

A-1.3 Construction and Installation

Prior to beginning construction, Contractor shall provide a comprehensive onsite construction management plan for the construction of the Plant in accordance with all applicable laws and policies and Health, Safety, and Environmental Plans of the Contractor. No later than 15 days prior to initial Site mobilization, Contractor shall prepare and submit such Plans to Owner. Contractor shall also provide Owner with an evaluation and appropriate documentation of the safety record for any licensed Subcontractor that will be performing work on the Plant.

Contractor shall assemble, construct, and install with its own labor forces and/or with Subcontractors labor, tools, and equipment necessary to complete the Plant, including the following Works:

- Site preparation, including but not limited to drainage required by the civil engineering plan, and remove excess debris
- Coordination with Owner when trenching is performed
- Direct current (DC) cabling and combiner and junction boxes
- Alternating current (AC) trenching and cabling
- Inverters, switchgear, and transformers and accompanying supports and/or concrete pads
- Perimeter security fencing (described in section A-3.9 Security)
- Security lighting

- Installation of the monitoring system, meteorological station, and revenue grade metering

Contractor shall provide all utilities necessary during construction, including but not limited to electricity, water, toilets, fuel and communications. Contractor shall be responsible for all costs associated with construction power. The following sections and associated appendices describe the scope of work and technical specification for the Plant.

A-2 Site and Plant Description

Contractor shall, at its own cost and expense, design, engineer, procure, construct, test, and start up a utility scale PV solar system with a design output as stated in its proposal.

Except as otherwise expressly provided in the Agreement, Owner is not responsible for providing any material, labor, or services of any kind during Contractor's execution of the Work. Contractor is fully responsible for all development, permitting, engineering, procurement, construction, interconnection coordination, and startup and testing activities, and shall deliver a complete, operational, and reliable turnkey Plant to Owner. Contractor shall provide electrical and structural engineered drawings stamped by an engineer certified in the state where the project will be constructed, materials and equipment, installation of PV modules, installation of electrical systems including inverters, electrical connection to the existing electrical infrastructure, and construction of mounting structures on which the PV modules are installed. Contractor shall provide comprehensive onsite construction management for the Plant and shall commission the Plant. Contractor shall manage, supervise, inspect, and furnish all labor, equipment, materials, temporary structures, temporary utilities, products, and services related to the foregoing, all on a turnkey basis.

A-3 Design and Engineering

Contractor shall design and engineer the Plant in accordance with prudent utility practices, with the professional standards, skill, expertise, and diligence of design and construction of professionals regularly involved in utility-grade, utility-scale, grid-connected solar PV power projects for public utilities in the United States. The design must conform to the requirements and conditions of all applicable permits and laws, be in compliance with the operating guidelines, and meet the Owner specifications.

Contractor is responsible for all engineering for the Plant. All design drawings, specifications, and calculations shall be signed by a professional engineer-of-record in the in the state where the project will be constructed. The Agreement provides for submission to Owner of complete design drawings, data, and documents for review and comment. These engineered design drawings, data, and documents must be submitted to Owner for review and comment before construction is to begin.

Contractor is responsible for ensuring that all components are installed above the 100-year flood plain (inverter stations, substation, supervisory control and data acquisition [SCADA] system, Security System, control building, PV modules, tracker motors, switchgear, transformers, combiner boxes, etc.). The Contractor is responsible for ensuring that all PV modules and combiner boxes are installed above the maximum snow height.

Any third-party study or independent engineering reviews (such as the geotechnical study and corrosion study) shall be provided to Owner.

A-3.1 Engineering Design Package

Based on the review of the Plant Site and infrastructure, Contractor shall design (or have designed by consulting engineers) a Plant (including all layout, civil, electrical, and structural components) that will produce the required electricity and that is capable of being operated in a safe, normal, reliable, and continuous manner as required by the contract documents at all operating conditions and modes specified below. The system design shall comply with all applicable laws and regulations and applicable permits. Owner may utilize a third-party or independent engineering consultant to perform technical reviews. Studies prepared by the Contractor's third-party consultants shall be provided to the Owner for review.

The Engineering Design Package shall include all items required in **Appendix A-7.2 Attachment 1B – Project Document Deliverables**, and shall include:

- Studies related to the project, such as the geotechnical engineering report and the lightning protection study
- Schematic and preliminary designs
- Design calculations
- All drawings including mechanical, electrical, structural, civil, and construction drawings (Site plans, schematic single lines, and detail drawings)
- Project schedule
- Product description information
- Bill of Materials
- Equipment details, descriptions, and specifications
- Layout of equipment

The Engineering Design Package shall be provided prior to commencement of construction.

A-3.2 Site Layout, Maps, Line Drawings

Prior to beginning construction or procuring equipment, Contractor shall submit to Owner Site layout design drawings, data, and documents for review. The design shall include a vehicle access road to provide maintenance, cleaning, and public safety access with a 30-year service life (assuming regular maintenance) that shall comply with state and local county surface requirements.

The contractor shall plan and execute construction of earthwork methods to control surface drainage from cuts and fills and prevent erosion and sedimentation in compliance with the Storm Water Pollution Prevention Plan (SWPPP).

A-3.3 Structural Engineering

Contractor shall design the PV arrays' mounting systems, foundations, and piers, as well as any equipment pads and buildings on the Site. The designs shall be based on the

requirements of applicable codes, standards, and permits, and the information/specifications provided by the module, inverter, transformer, switchgear, racking/tracking structures, and all other vendors.

A-3.3.1 Geotechnical Analysis

Geotechnical analysis shall be provided by Contractor and performed by a qualified geotechnical engineering firm. The results of the analysis shall be used when designing the foundations for the structures on the Site.

At a minimum, the following should be included in the analysis:

a. Review publicly available geotechnical information and reports. This may include soils and geologic maps and literature, photographs, hydroelectric reports, groundwater reports, and water well data.

b. Coordination and mobilization of the geotechnical services team for subsurface exploration of the Site. This should include working with the local utilities to mark any existing underground utilities (such as cables, gas lines, piping, etc.).

c. Study the Site to determine the presence of faults, ground fissures, and other potential geologic hazards that could affect the structural design and construction of the Plant.

d. Drilling or digging of exploratory borings and pits. The amount and depth shall be determined by the Contractor.

e. Performance of cone penetration tests. The amount and depth shall be determined by the Contractor.

f. Laboratory testing of collected soil samples from the borings and test pits. An evaluation of the in-place moisture content and dry density, gradation, plasticity, consolidation characteristics, collapse potential, expansivity, shear strength, resistivity, chloride content, sodium sulfate content, and solubility potential (total salts) should be conducted.

g. Analyze the corrosivity of the soil. Include a recommendation for the type of cement to be used in concrete foundations. Also include recommendations for corrosion protection for underground steel, including rigid metal conduit (such as the need for polyvinyl chloride [PVC] coating).

A detailed report shall be provided outlining the tasks performed and the results of the testing. Included in the report should be any recommendations for the foundation designs, structural support designs, corrosion protection for both underground steel and concrete, pile drive frequency, minimum pile size, and any geologic conditions that may prevent the development of the project. Specifically, an opinion on the viability of driven piles as the PV racking supports should be provided.

A-3.3.2 Environmental Loads

All structures on the Site need to be designed using environmental loads as specified in the American Society of Civil Engineers (ASCE) 7 code book *Minimum Design Loads for Buildings and Other Structures.* These include wind loads (Chapter 6), snow loads (Chapter 7), rain loads (Chapter 8), ice loads (Chapter 10), and earthquake loads (Chapter 11). Each structure on Site shall be grouped in Occupancy Category II as defined in

Table 1-1 of ASCE 7. The corresponding importance factor shall be used for each load calculation.

A-3.3.3 Racking/Tracking Foundations and Supports

All foundations and supports must be designed using the calculated environmental loads discussed above and soil properties provided in the geotechnical report. Foundations and supports shall meet the recommendations found in the geotechnical report. Foundations and supports shall be designed for a minimum 30-year lifetime, including all environmental factors and corrosion. Foundations and supports should be designed to withstand the impacts and contact pressure from the installation method (such as a vibratory hammer). Any damage to corrosion protection coatings during installation should be repaired. Foundations and supports, including any field-applied modifications (such as holes drilled), shall meet the requirements in section A-3.3.5 Corrosion Protection.

A-3.3.4 Equipment Pads

All equipment pads shall be located such that adequate personnel access is provided to such equipment. A minimum of 4 feet (or 1.5 meters) horizontal clearance from obstructions that would otherwise limit access to the equipment on the pad shall be provided around all equipment pads. The pads shall be sized sufficiently to allow safety and adequate working space around the equipment. The inverter stations, switchgear, substation (if applicable), and other buildings shall be elevated above the Federal Emergency Management Agency 100-year flood plain. The slope of the earthwork around the inverter stations and other equipment shall allow safe and ergonomic access to the equipment.

A-3.3.5 Corrosion Protection

Corrosion protection shall be utilized on the structures of the Plant. The type and amount shall depend on the selected materials of construction and conditions at the Site. A study of these conditions along with recommendations from the geotechnical report shall be used to design the corrosion protection.

The corrosion protection study shall be performed by a qualified corrosion expert and documented with references and calculations showing that the foundations, supports, racking, fasteners, and conduit shall meet a 30-year design life in aboveground and belowground conditions. If galvanized materials are used, field-applied zinc coatings shall meet American Society for Testing and Materials (ASTM) A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings. This standard contains minimum requirements for the material, surface preparation, and application process. For example, repairs to damage due to vibratory pile driving shall conform to ASTM A780.

It is preferred that all holes in structural members requiring galvanization shall have the holes drilled before the galvanization is applied. Should holes be drilled in the field, galvanizing shall be applied to the exposed steel as specified in ASTM A780. All field welds shall have a field-applied galvanization as specified in ASTM A780. For example, if torque tubes with a 3-mil (0.003-inch) hot-dip galvanization are to be welded in the field, a field-applied coating, such as hot stick repair, shall meet or exceed the original 3-mil coating thickness of the torque tube per ASTM A780 requirements.

Only steel bolts with pre-applied corrosion inhibitors or stainless steel bolts and fasteners shall be allowed in the entire mounting structure.

A-3.3.6 Single Axis Tracking Structures

In the event a tracking system is utilized, the system shall be designed using the environmental loads and the Occupancy Category as discussed in section A-3.3.2 Environmental Loads. The torque tubes, attachments, module mounting brackets, fastening hardware, foundations, and supports shall have a 30-year design life. Equipment shall have corrosion protection coatings as discussed in section A-3.3.5 Corrosion Protection.

A common feature of many trackers is the "stow" option during high winds. This feature will change the tracker's tilt to a more favorable angle to decrease the wind loads on the racking, supports, and foundations during high wind conditions. If a "stow" is required to meet design wind loads, a backup energy source (such as a backup emergency battery system) shall be installed on the Site to ensure that the tracker shall be able to move into the stow position if the power from the grid is interrupted during high wind conditions in excess of the vendor's design limit or the foundation design limit.

A-3.4 Civil Engineering

Contractor shall design all systems in accordance with applicable codes and standards. Contractor shall design necessary road improvements to meet state and local transportation codes, standards, conditional use permit stipulations and conditions, and requirements presented by construction equipment, delivery vehicles, and operation and maintenance traffic. Contractor shall perform required Site preparation, to include earthworks, SWPPP, and erosion control. Contractor shall attempt to minimize earthwork and vegetation disruption for the installation of the Plant to the extent it is compliant with the use permits; however, vegetation should be controlled to minimize fire danger and provide the ability to operate and maintain the Plant. Any land contours that may affect PV electrical generation should be included in the PV system performance estimate. If required, Contractor shall import engineered fill to slope the Site and prevent accumulation of standing water. Any direct burial cabling shall be protected with adequate bedding materials to ensure long-term cable integrity. Dust control shall be maintained in accordance with state and county requirements until Final Acceptance is achieved. Contractor shall provide other Site maintenance as needed during construction. Contractor shall coordinate interaction between Owner and any permitting authorities regarding the Work.

A-3.4.1 Human Access

Contractor shall make access to all equipment safe and reasonably ergonomic for maintenance staff. For example, if an inverter pad is elevated, the earthwork surrounding the concrete pad shall have a safe approach slope.

A-3.4.2 Erosion Control

Contractor shall submit a location-specific erosion control plan for local jurisdiction approval prior to construction.

All areas of temporary soil disturbance are to be graded, if necessary, and re-vegetated in a timely manner to limit erosion as required by the local jurisdiction.

A-3.4.3 Grading and Drainage

The grading and drainage plan shall be designed and installed in accordance with local code and permit requirements. All structures required for the drainage plan, if any, shall comply with state standard specifications for drainage facilities.

A-3.4.4 Dust Control

Contractor shall apply dust control materials to minimize raising dust from construction operations and traffic, including haul routes, using only dust control mixtures approved by the local jurisdictions.

A-3.4.5 Fire Prevention and Protection

As part of its Safety Plan, the Contractor shall include a fire prevention and response plan.

The Contractor shall perform all work in a fire-safe manner.

The Contractor shall comply with all state, federal, and local fire prevention regulations.

A-3.5 Roads and Construction Access

A-3.5.1 Construction Access

Contractor shall abide by all load limits established by the applicable state department of transportation (DOT).

Contractor shall be responsible for providing, operating, and maintaining equipment, services, and personnel with traffic control and protective devices, meeting the requirements of the *Manual of Uniform Traffic Code Devices* as required, to allow traffic flow on haul routes and onsite access roads in a safe manner. Contractor shall be responsible for any costs to comply.

Contractor is responsible for construction of temporary access around areas of excavation and other construction activity, if necessary and as required.

A-3.5.2 Onsite Roads

Contractor shall provide a minimum setback of 20 feet between the perimeter fence line and any equipment or as directed by local authorities if more distance is required. This setback space may be used as a perimeter road.

For interior service roads as necessary, Contractor shall allow a minimum road width of 16 feet between PV array blocks. Pathways between rows of modules and circuit blocks may be narrower, but designed with consideration of procedures required for accessing all modules and array equipment for maintenance and repairs. Interior roads (as needed) shall be 16 feet wide. Pathways between rows of modules and circuit blocks may be less. Road surfacing shall meet local fire and emergency vehicle access requirements.

Roads shall have a minimum 30-foot inside radius, unless otherwise instructed by state or local requirements. A smaller turning radius may be approved with written approval from the Owner.

A-3.5.3 Site Access Roads

The Site access road, if not currently in place, shall be designed and installed by the Contractor. If the Site access road does not exist, then it is to be improved by the Contractor to a 20-foot gravel road. This design shall be based on sufficient soils and subsurface investigation by a qualified professional to ensure that the constructed road will meet its intended purpose. The design life of the access road shall be 30 years (assuming annual maintenance). The Site access road shall be a gravel road sufficient to satisfy the loading requirements of the equipment vendors and to provide all-weather access for operation and maintenance of the Plant. Site access roadway design shall comply with local permit requirements.

Temporary construction roads and staging areas not connected to permanent roads (if any) shall be restored by Contractor in accordance with permit requirements.

A-3.6 Earthwork

A-3.6.1 General

Earthwork includes, but is not limited to, the following:

- Trench excavation (including rock excavation) and backfill for underground utilities
- Excavation and backfill (including rock excavation) for foundations
- Installation of granular fill and surfacing around concrete structures, drainage facilities, towers, and related Site structures, and within roadways
- Finish grading around all concrete pads (for example, an inverter pad) shall have a safe approach slope leading to the top of the pad or to a small step up not to exceed 8 inches in height

Contractor shall make its own estimate of the types and extent of the various materials to be encountered or required to accomplish the Work.

Contractor shall utilize sustainable practices where practical, such as recycling shipping containers, pallets, etc. All materials that are not practicably recyclable shall be disposed of in an approved landfill. Contractor shall clean up any spill or contamination that may occur on Site in accordance with approved standard procedures.

A-3.6.2 Excavation

Contractor shall be responsible for making all excavations in a safe manner and consistent with the requirements of the Occupational Safety and Health Administration.

Contractor shall provide adequate measures to retain excavation side slopes to ensure that structures, equipment, and persons working in or near the excavation are protected.

Contractor shall protect all abovegrade and belowgrade utilities.

A-3.6.3 Construction Signage

Contractor shall provide temporary signage for local traffic control in accordance with state DOT or local county requirements and in accordance with the Agreement.

A-3.6.4 Fencing

Contractor shall utilize temporary fencing whenever an existing fence is removed and as necessary to maintain security and prevent the movement of livestock. Contractor shall provide a minimum setback of 30 feet between the perimeter fence line and the solar panels and project substation. Fencing shall meet PacifiCorp design standards of **Appendix A-7.10 - PacifiCorp Engineering Handbook, Part 6B.5 Fence Application and Construction.**

A-3.6.5 Site Finish Grade

Contractor shall leave the Site in a clean condition upon completion of the work. Efforts shall be made to restore area to a clean condition as soon as practical. Contractor shall remove all trash, debris, and stockpiles. The Site access roads shall be returned to a condition that meets the original specification by repairing road damage such as ruts, gouges, and weather damage that may have occurred during the course of construction.

The Site finish grade within the equipment footprint and in areas required for operation and maintenance of the Plant shall be fully stabilized in a manner that meets or exceeds local county requirements.

Provisions of the SWPPP for final storm water drainage shall be implemented.

Contractor shall seed and mulch all areas of the Plant Site that have been disturbed beyond the permanent portion of the Site and access road, per the SWPPP.

A-3.7 Plant Design and State Requirements

Any technical requirements under any applicable state incentive program shall be met by the contractor. For example, any technical requirements under the State of Utah Energy Office incentive structure shall be met by the contractor.

A-3.7.1 Electrical Engineering

Contractor shall provide all electrical engineering design services, meeting applicable codes and standards and the requirements of the interconnecting utility.

The engineering and design shall include the appropriate sizing and cabling (above and below ground) that will connect all applicable equipment to the point of interconnection. The Plant electrical system shall be designed for electrical system losses on the DC wiring system to be no more than 2 percent and losses on the AC wiring system no more than 2 percent. In the event that the Contractor proposes a direct current (V_{DC}) system greater than 1,000 volts, then the Contractor is responsible for determining if the authority having jurisdiction will allow use of same and to design accordingly.

All protection equipment used throughout the system shall be sized and specified to reduce damage to all components to the utility interconnection point in the event of electrical failure.

The aboveground portion of the electrical systems shall be neatly routed to facilitate access, troubleshooting, maintenance, etc.

Trench depth for electrical wires shall be as follows:

- Bottom of trench ~ 3.5 feet typical for DC trench
- Bottom of trench ~ 4 feet below finish grade for AC trench (28kV)

- Bottom of trench ~ 5 feet below finish grade if both DC and AC (28kV) in same space

The electrical design shall include the design of equipment grounding and lightning and surge protection for the entire Plant Site. Contractor shall provide a comprehensive surge protection system and provide a lightning risk assessment. The results of the lightning risk assessment and consultation with PacifiCorp will be the basis for determining the extent of the lightning protection system (LPS) that is required.

An arc flash study shall be performed per **Appendix A-7.12 - PacifiCorp Generation Engineering New Generation Plant Construction Standard, Arc Flash Hazard Standard**.

Contractor shall design and specify all communications hardware and software required for system protection and remote monitoring and control. All monitoring and communication supplemental equipment and cabling shall be designed and specified by Contractor, subject to Owner review.

The power delivered to the grid must at all times meet the interconnect requirements for power factor. A one-line drawing is required illustrating the power factor control strategy.

A-3.8 Communication System

Contractor shall procure and install a SCADA system as required in the Interconnection Agreement.

Contractor shall install communications systems as required by the Interconnection Agreement.

Contractor shall install communications systems as required in Section A-3.9 Security.

Contractor shall supply all equipment necessary to connect to Transmission Provider's fiberoptic cable for each of the communications described in this section.

A-3.8.1 Communications System Testing and Warranty

Contractor shall test the installed communication system to demonstrate its ability to meet the requirements of its intended use. Testing shall be performed when the final system interconnections have been made.

A-3.9 Security

Contractor shall provide a security system for the Plant. The security system around the perimeter shall include a 7-foot-high chain link fence with 1-foot top guard (total 8-foot high) of three strands of nine-gage barbed wire. The perimeter fence shall include three locked gates: two with a width of 20 feet for vehicles and one pedestrian entrance with a width of 4 feet. Fencing shall meet guidelines in section A-3.6.4 Fencing. Contractor shall utilize temporary fencing whenever an existing fence is removed and as necessary to maintain security and prevent the movement of livestock.

Perimeter signage shall be provided by Owner and installed by Contractor in accordance with Owner standards. Signage shall be installed every 65 feet along the perimeter fence and on all gates. Signage shall be installed five feet above ground level.

Signage that will be provided by the Owner will include the following:

Warning! Hazardous Voltage Inside Keep Out

English SI# 7999852

Spanish SI# 7999854

No Trespassing

SI# 8252306

Mounting Hardware

SI# 7999092

Video Surveillance in Place

The Contractor shall be responsible for security during construction.

Contractor shall contract with AVTEC SYSTEMS INTEGRATOR, A DIVISION OF CACHE VALLEY ELECTRIC, (Security Sub-Contractor), to provide and install the necessary security equipment. Contact:

Avtec – System Integrator
Michael Petric
(801) 908-4191
michael.petric@cve.com

This equipment may include, but is not limited to:

a. LED Spot or LED flood lights.

b. Security cameras located such that they are capable of adequate identification of intruders covering the perimeter of the Site. Cameras shall be placed at a height that permits line-of-sight access to the property and minimizes shading onto the PV array.

c. Cameras with a control and detection system that assists in the detection and identification of intruders.

d. Network - Digital Video Recorders used to record video that could be used for evidence in the event of theft or vandalism.

e. Contractor shall negotiate with the Security Sub-Contractor to identify the scope of work that will be performed by the Security Sub-Contractor, to ensure that a complete and operational security system as described by the Security Sub-Contractor is provided. The

Security Sub-Contractor shall provide to the Contractor the security system design, which will indicate the location of cameras, DVRs, security lighting and any security communications equipment, based on the Contractor's overall System design. The work that may be provided by the Security Sub-Contractor may include the furnishing and installation of wiring, cabling, labor, tools, equipment, and ancillary materials required for a complete and operational security system. At minimum, it is expected the Security Sub-Contractor will provide the following equipment: cameras, network DVRs, and any specialized security communications equipment.

f. Contractor shall be responsible for the furnishing and installation of all necessary conduit, 120 volt alternating current (V_{ac}) power extensions for all Security related equipment. Contractor to allocate a minimum or (3) three each – 1" conduits from each Inverter Pad.

g. Contractor shall provide a free standing weather proof enclosure with adequate space required for Security Control Equipment as specified by the Security Sub-Contractor. Contractor may also install the solar facility SCADA equipment, in accordance with Section A-4.12, within the same enclosure.

h. Installation of telephone lines, and/or cellular modem(s), and/or local area network for the interconnectivity of all related Security System Equipment that feeds into NTO Security Operations Center.

i. Contractor shall provide fiber optic cable for Security System Communications. Fiber optic cable shall consist of a minimum of (4) four fiber strands between each inverter pad. Security fiber strands provided can be included in the fiber optic cabling that is provided as part of the SCADA Communications System.

j. The system shall be complete, tested, and fully operational. Prior to construction, Contractor shall provide the following:

    i. Descriptive statement and single-line block diagram to show how all related equipment will interface and operate as a complete system.

    ii. Product data: manufacturer's technical data sheets on each product to be used.

    iii. Drawings, including plans, elevations, equipment mounting heights, and dimensions required to show devices' locations and demonstrate accessibility compliance in accordance with referenced documents.

    iv. Detailed schematic wiring diagrams for all system devices; wiring information shall include cable type, conductor routings, quantities, and connection details at devices.

    v. Manufacturer's user's manuals for operations, administration, installation, and maintenance.

A-3.9.1 Security System Installation

All system components and appurtenances shall be installed in accordance with the manufacturer's specifications, referenced practices, guidelines, and applicable codes. All necessary interconnections, services, and adjustments shall be furnished as required for a complete and operable system as specified. Control signal, communications, and data

transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

All security system wiring shall be installed in dedicated conduit throughout. Cable shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other wiring. All low-voltage wiring outside the control console, cabinets, boxes, and similar enclosures shall be plenum rated where required by code.

All wiring conductors connected to terminal strips shall be individually numbered and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as identified and shown on the drawings.

A-4 Equipment

A-4.1 Equipment Supply

As described in detail throughout this document, Contractor shall purchase and furnish to the Site all material required to complete the Plant, including the following material:

- Miscellaneous steel
- Support steel posts
- Components (nuts, bolts, clamps, etc.)
- PV modules
- Fixed tilt racking or single axis tracker equipment (as applicable) and components
- DC cabling and combiner boxes
- DC junction boxes
- AC cabling
- Power centers, including inverters
- Electrical switchgear
- Transformers
- Meteorological station
- Snow Monitoring System
- Remotely accessible data acquisition system
- All materials related to drainage required by the civil engineering plan
- All electrical conduit and junction boxes
- Concrete equipment pads
- Fencing, gates, lighting, security cameras, and security camera recording equipment
- Communications structure (if required)
- Alarming Equipment

Each item of equipment to be supplied by Contractor shall be subject to inspection and testing during and upon completion of its fabrication and installation as per PacifiCorp Facility Connection (Interconnection) Requirements for Distribution Systems (34.5 kilovolts and below).

Contractor shall provide the manufacturer's flash test data for all modules to Owner upon procurement of modules.

Prior to the arrival of equipment and materials at the Site, the Contractor shall install a fenced, secured area and provide security for the storage of such equipment and materials. Contractor shall notify Owner of the location and layout of intended staging areas, parking areas, storage areas, office areas, workshops, and other temporary facilities. Temporary construction roads and staging areas not converted to permanent roads (if any) shall be restored in accordance with all permit requirements.

Contractor shall be responsible for receiving and storing all freight at the Site in a secure manner.

Installed equipment and materials shall be new, of good quality and suitable grade for the intended purpose, and not a lower grade or quality than specified in the design and engineering plans or in manufacturers' recommendations. Where applicable, utility-grade equipment shall be used. Commercial- or residential-grade equipment shall not be acceptable. No equipment shall utilize polychlorinated biphenyls (PCBs).

If Contractor proposes to use equipment that is non-utility grade, it is the responsibility of Contractor to identify the equipment and report it to PacifiCorp for approval. It is the responsibility of Contractor to identify any equipment using SF_6 gas. It is the responsibility of Contractor to identify any proposed batteries and provide quantities and associated data sheets. It is the responsibility of Contractor to provide data sheets and quantities on any proposed chemicals used on the Plant. Contractor shall provide a list of all major equipment to be purchased, constructed, and installed as part of the Plant. The list shall identify both the items and quantities.

A-4.2 Signage and Labeling

Permanent naming placards should be placed on all equipment, including inverters, combiner boxes, transformers etc. Naming on placards and/or tags shall match drawing naming convention. Security signage shall be in accordance with A-3.9 Security. All signage must meet current industry standards. Placards and signs shall have a life span of 20 years.

All cables shall be labelled to meet applicable codes and standards. All cables shall have a label affixed to the outer jacket with a Brady or equivalent cable marker at each termination of a type accepted by Owner before and installation. Labelling will match the point to point drawings. A method for ensuring labeling is complete must be included in the Contractor's QC Inspection Point Program.

A-4.3 Grounding and Bonding

Contractor shall provide detailed information (such as ground-grid drawings and calculations) for all proposed Plant grounding. Contractor is responsible for designing and providing the Plant system grounding and equipment grounding. The Plant grounding design shall be done in accordance with Institute of Electrical and Electronics Engineers (IEEE) standards for generating stations. Substation grounding shall be done in accordance with IEEE standards for substation grounding. All grounding designs shall be reviewed by Owner prior to Contractor commencing work.

All ground conductors shall be stranded copper and may be bare if exposed. Ground conductors in conduits shall be green-insulated. Ground lugs shall be mechanical and rated aluminum to copper. All belowgrade connections shall be exothermic welds. Step-up transformers and inverters and the Plant switchgear shall be bonded to the ground ring at opposing corners of the equipment. Mounting structures shall be grounded in a manner that is sized for maximum available short-circuit current and lightning current (if required).

Contractor shall submit to Owner grounding and lightning calculations for assurance of safe step and touch potentials on the Site, in accordance with Owner's standards. Contractor shall conduct a ground resistivity test, with opportunity for witness by Owner as provided in the Agreement, to verify that the grounding system meets minimum requirements for the overall grounding scheme. Interior fencing (including without limitation internal fences around interconnection equipment and inverters) shall be installed and grounded and substation grounding shall be done in accordance with PacifiCorp Engineering Handbook Parts 6B.5 and 6B.6. Fencing around the perimeter of the overall Plant Site shall not need to meet the aforementioned Handbook standards, but shall be grounded in accordance with local codes. Perimeter fences shall not be shared with the substation fence and shall be at least 30 feet from the fence around the interconnection equipment. A ground grid meeting the requirements of IEEE 80 shall be installed in the area of the interconnection equipment.

A-4.4 Surge and Lightning Protection

Contractor shall provide a lightning risk assessment performed to industry standards by a certified lightning protection professional, as outlined in section A-4.4.2 External Lightning Protection System (LPS). The results of this assessment, in consultation with Owner, shall be the basis for determining the requirements and extent of the facility LPS and a surge protection system that provides protection of the PV panels, DC power circuit, inverters, measurement control and communications systems, and other major electrical equipment.

A-4.4.1 Surge Protection

A staged, comprehensive surge protection system, inclusive of Type 1, 2, and 3 surge protective devices (SPDs), shall be incorporated as determined by the lightning risk assessment (A-3.7.1 Electrical Engineering) or as required by the photovoltaic and inverter manufacturers in all relevant pieces of electrical equipment. Protection shall be provided within the inverter on both the DC and AC sides as required by inverter manufacturer. Additionally, surge protection shall be provided in combiner boxes, trackers, and measurement control and communication systems as determined by the lightning risk assessment study. Type 3 surge protection installed within that equipment shall be mounted on DIN rails, and must have finger safe replaceable modules that can be exchanged without the use of tools. SPDs shall be applied on all power circuits (AC and DC) and all communications and control circuits in a coordinated, staged manner. The operating status of the power SPDs shall include visual indication, and shall be able to be remotely monitored by a set of integral contacts.

In addition to the performance requirements indicated above, all SPDs shall be compliant to the respective domestic or international standards, including, but not limited to, the following standards and guidelines:

Underwriters Laboratories, Inc. (UL) Standard 1449 3rd edition.

IEEE Guideline C62.41.1-2002

IEEE Guideline C62.41.2-2002

IEEE Standard C62.42-2005

IEEE Standard C62.45-2002

IEEE Standard 1100-2005

SPDs for PV DC Power Circuits

SPDs applied on PV DC power circuits shall meet all the requirements listed above in this general section and shall be specifically designed for and labeled to UL 1449 3rd edition and UL's Certification Requirement Decision for PV DC application. DC PV SPDs shall be rated for a short-circuit withstand capacity (I_{SCWPV}) of not less than 1,000 amperes (A). The SPDs must be specifically designed to be able to disconnect themselves from an energized DC circuit by means of an internal integral fused circuit and do so without damage caused by faulting arcs. SPDs must be selected for the voltage system that they are to be applied (such as 600; 1,000; 1,200; or 1,500 V_{DC}). SPDs shall be from an equipment manufacturer regarded as a Tier 1 Supplier. Surge Suppression, Inc. of Destin, Florida is the preferred manufacturer of any required SPDs.

SPDs Applied on AC Power Circuits

SPDs applied on AC systems must meet all the requirements listed above in this general section and must be specifically designed for and compliant to UL 1449 3rd edition. SPDs must be selected for the system voltage where they are to be applied. SPDs are to have a short-circuit current rating (SCCR) higher than the short circuit availability where they are installed, therefore not requiring external fusing. SCCR of 200,000 A is ideal. SPDs shall be from an equipment manufacturer regarded as a Tier 1 Supplier. Surge Suppression, Inc. of Destin, Florida is the preferred manufacturer of any required SPDs.

SPDs for Measurement, Control, Instrumentation, and Communications Circuits

All critical non-power circuits are to be protected with appropriate DIN rail-mounted pluggable surge protection for the system they are applied. Surge protection bases are to permit signal continuity even if the SPD module is removed from the base. SPDs shall be from an equipment manufacturer regarded as a Tier 1 Supplier. Surge Suppression, Inc. of Destin, Florida is the preferred manufacturer of any required SPDs.

A-4.4.2 External Lightning Protection System (LPS)

Based on the findings of the lightning risk assessment and/or the discretion of the Owner, an external LPS may be required to be installed. If so, Contractor shall provide a LPS to protect the overall plant from direct lightning strikes to any portion of it, including, but not limited to, solar panels, inverters, outside cabinets, and buildings housing electrical equipment. The LPS shall consist of air terminals of proper height and spacing (using the rolling sphere method), properly rated and properly designed and placed down-conductors to assure safety of personnel during discharges, and a properly designed and installed ground system.

The systems shall be designed in accordance with the latest globally recognized standards for such designs, which are either International Electrotechnical Commission (IEC) 62305-1 and IEC 62305-3, or NFPA 780.

Grounding systems shall be in compliance with IEEE Standard 142-1982, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

Designs are to be provided by a recognized expert LPS design firm, supplier, or professional engineering firm, and are to be submitted to the Owner.

All components of the LPS shall be in compliance with the selected system design standard chosen.

Careful consideration must be given to the design and placement of all air terminals so as to have no shadowing effect on PV panels.

A-4.5 Photovoltaic Modules

The PV modules shall:

a. Meet IEC 61215 (crystalline silicon PV modules) or IEC 61646 (thin film PV modules).

b. Meet IEC 61730: Photovoltaic Module Safety Qualification.

c. Meet IEC 61701: Salt Mist Corrosion Testing of Photovoltaic Modules; Severity 6.

d. Be listed to UL standard 1703 for the voltage specified.

e. Include all known and future duties, tariffs, export tariffs, customs, demurrage, and shipping costs.

f. Be from an equipment manufacturer regarded as a Tier 1 Supplier.

g. Module supplier should provide a bankability report from an independent engineer.

h. Manufacturer should provide an established track record of installed systems throughout the United States.

i. Demonstrate workmanship quality through a third party factory audit or testing score such as PV+ Test score of “Excellent” or better carried out by Solarpraxis AG/TÜV Rheinland, or Solarbuyer’s Independent Quality Assessment overall rating of “Good” or better with zero critical findings.

j. Demonstrate a 25-year rated lifetime via long-term outdoor testing and/or accelerated lifetime laboratory testing. Testing such as Thresher testing, PV Evolution Lab’s (PVEL’s) “Approved Vendor Program” or “Reliability Demonstration Test,” or Technischer Überwachungsverein (TÜV) long-term sequential testing of the specific model of the PV module selected is an acceptable demonstration of a 25-year module rating.

k. Demonstrate manufacturing quality by electroluminescence (EL) testing of every module for defects.

l. Acceptable PV module vendors are:

Canadian Solar
First Solar
Hanwha
JA Solar
Jinko Solar
Kyocera
LG
Panasonic
REC Solar
Renesola
Sanyo
Solar Frontier
SolarOne
SolarWorld
SunPower
Trina
Yingli

m. Demonstrate batch consistency by documenting that the batch of modules proposed for this project meets performance requirements. A minimum of five modules shall be tested to ensure performance and reliability under accelerated lifetime tests. Documentation shall include flash test results and EL images before and after the tests shown in Figure 1. Costs of the modules, shipping, testing, and summary report are the responsibility of the Contractor. The documentation of the batch, module sampling, EL imaging, flash testing, and summary report shall be provided to the Owner.

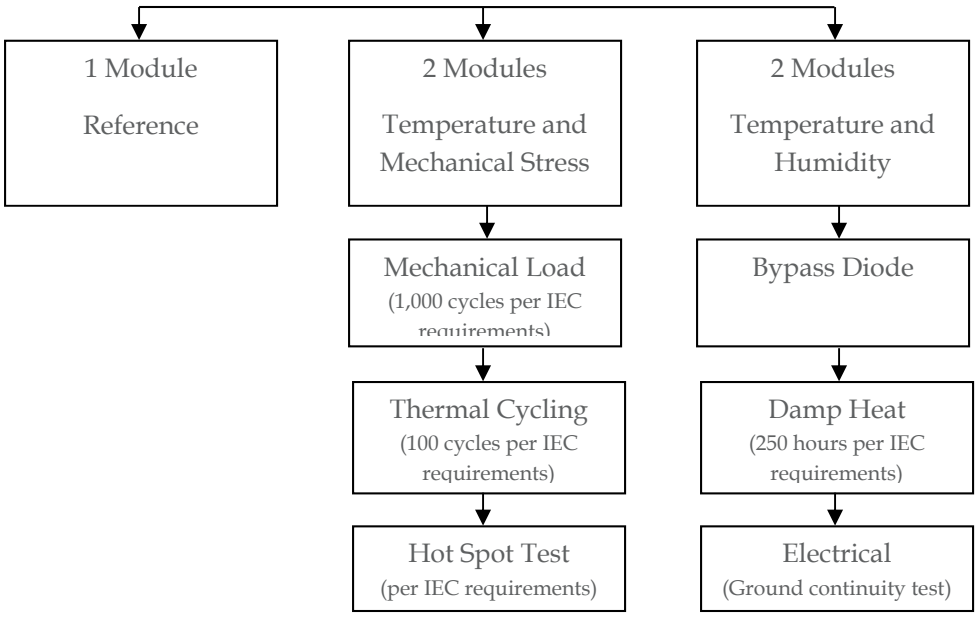

Figure 1: Module Manufacturing and Batch Quality Assurance

Note that the Owner, at its sole discretion, may randomly select up to 20 PV modules used in the Plant for delivery to a third party for quality verification testing. The costs of such verification testing will be the responsibility of Owner. Owner reserves the right to refuse the Bidder's proposed module if the independent tests indicate performance, workmanship, batch quality, or reliability issues.

A-4.6 Step-Up Transformers

Transformers shall meet transformer efficiency standards set forth in the most recent version of the U.S. Department of Energy "Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule." Transformers shall be rated for inverter source operation and the environment in which they will operate. The transformer shall be supplied with a no load tap changer with high-voltage taps capable of operating at 2.5 percent above and below nominal voltage at full rating. The transformer shall be supplied with a fused disconnect switch on the transformer high-voltage side to isolate the transformer in case of an internal fault. The switch/transformer configuration shall be designed for loop feed. Transformers shall be either dry-type, biodegradable fluid, or less-flammable oil insulating fluid. Enclosure finish shall be a top powder coat that is designed for a 25-year service life. Contractor shall provide and install step-up transformers as provided in the Agreement. Owner shall reserve the right to attend factory witness testing of step-up transformers.

Contractor that interconnects to the PacifiCorp system shall provide equipment and perform the work in compliance with the requirements of the **RFP Appendix A-2 - Interconnection Agreement, RFP Appendix A-7.04 - Two-Winding Distribution Transformer, Inverter Step-Up Liquid-Immersed (Pad Mounted, Compartmental Type) ZS-002**, and other applicable standards and specifications listed in **Appendix A-7 – Owner Standards and Specifications**.

A-4.7 Inverters

The inverter units shall be utilized for inverting the DC input from the Plant to AC output. These shall be calibrated and set so that the AC output, after inverter clipping and losses between the inverter to the meter, shall not exceed the Plant AC capacity at the meter. Contractor shall supply and install inverters, transformer pads, and wiring/cabling to this equipment in accordance with National Electrical Code (NEC) standards. Contractor will tie into the existing medium-voltage distribution system, connecting the system to the new generation facilities via medium-voltage transformers.

Inverters selected for this project shall:

a. Be UL listed to 1741 (Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources).

b. Comply with IEEE 1547-2003, including testing to IEEE 1547.1 and IEEE C62.45. Regulatory standards compliance shall also include IEEE C62.41.2 and CSA107.1-01.1. Inverters shall have voltage and frequency ride-through functionalities, as well as be capable of actively regulating voltage levels by providing adjustable active and reactive power. The inverters/plant controllers shall have the capability of reducing their active

power during certain pre-determined conditions, as specified in the Interconnection Agreement. The inverter shall have the capability to meet the following:

Ride-through region for voltage and voltage trip settings

Voltage at Point of Common Coupling (% Nominal Voltage)	Ride-Through Until (s)	Operating Mode	Maximum Trip Time (s)
>120			0.16
110- 120	12	Momentary Cessation	13
88 - 110	Continuous Operation	Continuous Operation	Continuous Operation
70 - 88	20	Mandatory Operation	21
50 - 70	10	Mandatory Operation	11
0 -50	1	Momentary Cessation	1.5

Default Interconnection System Response to Abnormal Frequencies

System Frequency Default Settings	Range of Adjustability (Hz)	Default Clearing Time (s)	Range of Adjustability (s)	Ride Through until (s)	Ride Through Operational Mode
f > 62	62 - 64	0.16	0 - 300	No Ride through	Not Applicable
60.5 - 62	60 - 62	300	0 - 300	299	Mandatory Operation
58.5 - 60.5	indefinite				
57.0 - 58.5	57 - 60	300	0 - 600	299	Mandatory Operation
< 57.0	53 - 57	0.16	0 - 5	No Ride through	Not Applicable

Notwithstanding the above, the inverter and associated system shall meet all requirements specified in the Interconnection Agreement. Contractor shall notify Owner at least two weeks prior to factory acceptance tests that will be performed to demonstrate these capabilities. Owner, or its representative, shall have the opportunity to witness factory acceptance tests.

c. Carry a minimum 5-year standard warranty with options for at least a 20-year extended warranty.

d. Be designed for a 30-year lifetime, assuming regular maintenance (including replacement of inverter components).

e. Have a maximum harmonic distortion less than 3 percent of total harmonic distortion at rated power output.

f. Have an efficiency greater than 97.5 percent without medium-voltage step-up transformer.

g. Be capable of rated output at 50ºC or higher.

h. Incorporate a no-load, two-pole, lockable disconnect switch or fusible disconnect for main DC power disconnect for maintenance personnel safety. DC load break switches should be installed at the combiner boxes and at the inverters (located as close to the array as possible). Be equipped with lightning protection.

Skid-mounted package units containing all equipment including DC switches, master fuse boxes, inverters, step-up transformers, and other power conditioning system equipment are preferred. Skid-mounted package units with integrated steps, side rails, and other safety features are preferred. The inverter manufacturer must approve all structures that contain inverters, especially as it relates to ventilation and temperature.

Inverters located outdoors shall be enclosed in lockable enclosures with a minimum rating of National Electrical Manufacturers Association (NEMA) 3R and with coatings in accordance with section A-3.3.5 Corrosion Protection. Any sensitive electronic equipment associated with, or part of, the inverter shall be installed in a NEMA 4 rated enclosure.

To the extent practicable, inverters should be mounted/oriented in such a way to avoid the effects of the sun (for example, facing the LCD display north to reduce sun exposure). If an LCD screen will be exposed to direct sunlight, a shade canopy shall be installed to provide shading for the screen.

Enclosure must have a door interlock system to prohibit the door(s) from being opened while energized.

Inverter output shall be protected by a circuit breaker with short- and long-time adjustable over-current protection. This circuit breaker shall be externally operated or the vendor shall furnish an external on/off (start/stop) switch.

Inverters shall employ a maximum power point tracking scheme to optimize inverter efficiency over the entire range of PV panel output for the given Site design conditions.

Inverters shall be equipped with all hardware for data collection and communication to the central SCADA server.

Inverter shall be equipped for direct external communication and control to Owner. If communications to Transmission Provider’s SCADA system is required by the

Interconnection Agreement then inverter communications and all available inverter controls shall be provided to the Transmission Provider over Transmission Provider's telecommunication network (see **RFP Appendix A-2**).

Inverter shall include a fused and disconnectable control power transformer (CPT).

Plant design for inverters rated to 1,000 V_{DC} shall comply with NEC Articles 690 and 490, and all other requirements applicable to installations rated over 600 volts (V).

Buildings, storage facilities, and enclosures shall be provided to the extent that protection is needed; the environment needs to be maintained for the long-term reliability, availability, and operation of the equipment; or that it is required by law or the Interconnection Agreement.

Inverter manufacturer shall:

a) Be certified to ISO 9001and ISO 14001 standards.

b) Be regarded as a Tier 1 Supplier.

c) Shall have supplied a minimum of 50 MW capacity in utility-scale projects located in North America

Acceptable inverter vendors are:

a) ABB
b) Advanced Energy
c) Bonfiglioli
d) Eaton
e) General Electric
f) Schneider Electric
g) SMA
h) Solectria

A-4.8 Fixed Tilt Racking Structure

The fixed tilt racking system (if applicable) shall include the racking structure and all module mounting hardware. The racking vendor may supply the supports if desired, or the supports may be provided by a third party. The rack's azimuth and tilt angle shall be specified on the engineering drawings.

The racking system shall be designed using the environmental loads and the Occupancy Category as discussed above in section A-3.3.2 Environmental Loads. The racking structures, support attachments, module mounting brackets, fastening hardware, and supports (if applicable) shall have a 30-year design lifetime. Equipment shall have corrosion protection coatings as discussed in section A-3.3.5 Corrosion Protection.

Fixed tilt racking vendors under consideration shall have installed a minimum of 50 megawatts (MW) capacity in utility-scale projects.

A-4.9 Single Axis Tracking Structure

The single axis tracking system (if applicable) shall include the racking structure, mounting hardware, drive motor(s), and controller system. Additionally, any equipment required for the safe operation and wind stow (if applicable) should be included in the bid. The vendor may supply the supports if desired, or the supports may be provided by a third party. The trackers shall be oriented on a north-south axis and shall automatically track the path of the sun each day. All control equipment enclosures shall be rated NEMA 4.

The tracking system shall be designed using the environmental loads and the Occupancy Category as discussed in section A-3.3.2 Environmental Loads of this specification. The torque tubes, support attachments, module mounting brackets, all fastening hardware, and supports (if applicable) shall have a 30-year design lifetime. Equipment shall have corrosion protection coatings as discussed in section A-3.3.5 Corrosion Protection. PV modules may be either 60-cell or 72-cell modules, and may be mounted in landscape orientation. PV modules may be mounted in portrait orientation only if backtracking is employed in the tracker controls.

As discussed in section A-3.3.6 Single Axis Tracking Structures, many trackers feature a "stow" option. If this feature is required for the racking, supports, and foundations to satisfy the design wind loads, a backup energy source shall be installed on the Site to ensure the tracker will be able to move into stow position during winds in excess of the suppliers design wind speed if the power from the grid is interrupted. Owner does not require the backup energy source if the stow feature is not needed. Contractor shall design the PV arrays' mounting systems, foundations, and piers as provided in the Agreement. The design shall be based upon standard industry practice, including the requirements of applicable codes, standards, and permits, as well as the information and specifications provided by the module, inverter, transformer, switchgear, racking, and all other vendors.

Single axis tracking vendors under consideration shall have installed a minimum of 50 MW of capacity in utility-scale projects.

A-4.10 Direct Current Fused Combiner Boxes

Combiner boxes shall be rated for maximum system voltage and maximum system continuous and short-circuit currents.

Enclosures shall be rated NEMA 4 and shall have integral key lock or provisions for padlocking.

DC inputs shall be fused with finger safe fuse holders for the hot conductors (positive or negative if bipolar array configuration is included and when required by inverter manufacturer).

Fuses shall have blown fuse indication.

Combiner box output shall have a means to be externally disconnected.

If the combiner box has a lightning protection device, the device should include a visual trip indicator.

A-4.11 Meteorological Stations

Contractor shall provide at least one meteorological station to provide adequate meteorological data to evaluate Plant performance. For systems greater than 3 MW (ac), two Meteorological Stations shall be installed. The meteorological station shall include at a minimum, the ability to measure:

- Reference cell temperature
- Reference cell irradiance at plane of array
- Ambient air temperature (two temperature stations are required for plants with a single Meteorological Station) having an accuracy of ±0.2 °C or better.
- Wind speed having an accuracy of ± 1.5 percent or better
- Wind direction having an accuracy of ± 5 degrees or better
- Global horizontal irradiation (Two pyranometers are required for plants with a single Meteorological Station.)
- Horizontal diffuse irradiation (two pyranometers are required for plants with a single Meteorological Station).
- Rain measurement
- Back of module temperature having an accuracy of ±0.5 °C or better, attached to modules in such a way as to reflect temperatures representative of the average of the array and adhered to middle of back of module using conductive epoxy and/or Kapton tape to avoid the creation of a hot spot

The irradiance meters shall have an accuracy of better than ± 2 percent.

The station shall have capability of recording and storing environmental conditions without AC power for a minimum of 5 days.

Installation, calibration, maintenance and operation of the meteorological station shall conform to standard industry practices. NIST calibration certificates will be provided for meteorological instruments listed above. The reference cells or modules shall be calibrated by the National Renewable Energy Laboratory (NREL) or an Owner-approved equivalent.

A-4.12 Supervisory Control and Data Acquisition

Contractor shall supply and install an Owner-approved monitoring hardware and software package from vendors such as Emerson, Schneider, GE, Siemens, DECK, Draker, or Meteo Control, including interconnection communications. The monitoring system must be selected to provide its 5-year Commercial Solar Monitoring Equipment and Service Package for the Plant. SCADA pricing should include hardware and software (including all software subscriptions) for a minimum of 5 years. The monitoring system shall provide energy generation data, historical data, solar insolation attributes, and meteorological data. The system shall be configured to sample data at a rate of once per second, with 1-to-10 minute average intervals, and shall be configured to update the server at least once every 15 minutes. The system shall be configured to sample and store the 1-to-10 minute averaged interval data for a period of 24 months.

The Contractor shall supply a meteorological station that will provide current weather data as noted in section A-4.11 Meteorological Stations.

The monitoring system shall be capable of issuing alarms and notices to instantly alert the system manager and operation and maintenance (O&M) contractor to potential system problems and outages. The metering and monitoring system shall comply with the accuracy requirements and general standards set forth in IEC 61724, with the exception of the irradiance meter, which shall have an accuracy of better than 2 percent of the reading.

The metering scheme shall be capable of reading the net electrical energy to the grid during daylight hours and the nighttime auxiliary loads when the Plant is in standby mode. The metering and monitoring system shall be compliant with Western Renewable Energy Generation Information System certification requirements for Renewable Energy Credit sales or trading per section A-4.13 Revenue Meter.

Data from the monitoring system can be accessed through the system's dashboard, which allows for public and administrator panel views. All electronics shall be enclosed in a NEMA 4 enclosure. This system may be housed in the same enclosure as the security equipment (see Section A-3.9). The data shall be collected at hardwired locations and transmitted wirelessly via a cellular modem to be provided and installed by Contractor. Contractor shall test the installed communications system to demonstrate its ability to meet the requirements of its intended use. Testing shall be done when the final system interconnections have been made.

Contractor shall furnish and install all materials and equipment necessary to complete the SCADA installation. The monitoring system shall be configured for automatic reporting of generation statistics required by Owner. The data shall be collected at the hardware locations and transmitted wirelessly via a wireless SCADA system to be provided and installed by Contractor. Points to be monitored by the SCADA system shall include, at a minimum:

- Meteorological station
  - Monitor and record all items in section A-4.11 Meteorological Stations
- Inverters
  - AC voltage
  - DC voltage
  - AC current
  - DC current
  - Kilowatts (kW)
  - Kilowatt hours (kWh)
- Metering
  - Monitor and store date from the Plant meter on an interval between 5 and 20 seconds
- Transformers
- Tracker control system integration, remote monitoring, and control
- Any buildings or shelters
- Plant switchgear

The following shall make up the SCADA calculated values list:

- Model versus actual performance in kW and kWh
- Day's energy in kWh
- Month's energy in kWh

- Year to date energy in kWh
- Total lifetime energy in kWh
- Plant performance ratio, current value
- Plant performance ratio, day's average
- Plant performance ratio, month's average
- Plant performance ratio, year to date average
- Plant performance ratio, since commissioning

All monitored plant electrical generation equipment (e.g., inverters, transformers, switchgear) shall be monitored to capture real time AC and DC electrical characteristics, including:

- Voltage
- Current
- Power
- Frequency
- Power factor

All monitored plant electrical generation equipment (e.g., inverters, transformers, switchgear) shall be monitored to capture all diagnostic information, including:

- Temperatures
- Alarms
- Status indicators
- Fault states

A-4.13 Revenue Meter

A bi-directional revenue grade meter shall be installed to measure the total Plant output at the switchgear for accurately metering energy (kWh) generated by the Plant. The revenue grade meter shall be American National Standards Institute C12.20 0.2% Class UL listed, ISO9001 certified, which is accepted by all authorities requiring revenue grade. The meter must have a display for easy reading of current power generation and lifetime generation and shall be compliant with Western Renewable Energy Generation Information System certification requirements for Renewable Energy Credit sales or trading.

This revenue meter will be supplied by the Transmission Provider. Contractor shall coordinate with the Transmission Provider for the installation of same.

A-4.14 Security Cameras and Related Equipment

The material furnished shall be in accordance with, but not limited to, the following codes and standards:

- NFPA 70 - National Electrical Code
- NFPA 101 - Life Safety Code
- UL 294 - Access Control Systems (if applicable)
- UL 1076 - Proprietary Burglar Alarm Units and Systems

- American with Disabilities Act - Public Law 101.336
- Utah Building Code

A-4.14.1 Security Equipment

General Requirements

All security system components shall be UL labeled.

Security System Components

Security system components may consist of LED spot or LED flood lights, cameras, alarms, network video recorders, communication lines, and all wiring required for all the components. The security system shall be sufficient to monitor and deter any theft or vandalism onsite. The security component supplier shall provide detailed specifications of each component.

The Security Sub-Contractor and Contractor shall coordinate with the SCADA design/instrumentation and control engineer to ensure sufficient bandwidth is available on the network to accommodate the proposed security system. Owner may elect to reduce the equipment needs based on the location of the Site and subsequent security requirements.

Surveillance cameras and pan/tilt/zoom (P/T/Z) drives shall meet the following minimum requirements. Surveillance cameras and P/T/Z drives shall be provided by the Security Sub-Contractor. Alternative solutions providing higher upgradeability and compatibility with future products are acceptable at no additional cost, subject to Owner's approval.

1. The P/T/Z unit shall meet the following design and performance specifications:
    a. The unit shall be microprocessor controlled with network / IP based programming via standard WEB based interface.
    b. Each pan/tilt drive unit shall operate as an independent unit with exclusive programming and setup data contained on each unit's nonvolatile memory.
    c. The unit shall be capable of 360-degree continuous pan rotation with a vertical unobstructed tilt of +36 to -85 degrees.
        a. Manual Control Speeds of: 0.1 degree to 40 degree per second (Pan), and 0.1 degree to 30 degree per second (Tilt)
        b. Preset Speeds of: 100 degree per second (Pan) and 30 degree per second (Tilt)
    d. The unit shall pan and tilt under manual control.
    e. The unit shall be capable of 16 learned tours And 256 configurable preset locations for Alarm Call-up configuration.
2. The camera shall meet the following specifications:
    a. The sensor type shall be 1/2-.8-inch Type Exmor CMOS Sensor.
    b. The camera shall provide a minimum of 1080p (1920x1080) resolution, at 30 Images per second (ips).

c. Camera shall provide a minimum of 2 simultaneous video streams: Dual H.264 or H.264 and Scalable MJPEG.

d. Camera shall allow for control and monitoring of video via IPv4 and IPv6 Networks.

3. The motorized lens shall meet the following design and performance specifications:

   a. The camera shall provide 16:9 Aspect Ratio and shall provide a 30X optical zoom and 12X Digital Zoom.

   b. The lens shall provide horizontal angle of view of 59.5 degrees (wide) to 2.1 degrees (telephoto).

   c. The lens shall feature an automatic focus with manual override.

   d. A step-down power transformer shall be provided for each camera. Transformers shall be rated 120/24 V_{AC} and shall have an adequate volt-ampere rating for the load at 40 degrees C ambient air temperature. Individual Fuse Distribution shall be provided.

4. The camera and lens housings shall be weatherproof and part of an Integrated Optics Cartridge (IOC). The IOC shall accommodate specified camera and lens combinations. IOC shall be dry nitrogen filled to 10 psig, to protect Camera Sensor / Lens optics from condensation and corrosion.

5. Camera assembly shall be provided with integrated IR Illumination. IR Illumination Transmitters shall be integrated to the Pan / Tilt Assembly Housing so as to provide IR Illumination for areas being viewed by the camera.

   a. IR Illumination shall be provided for distances up to and including 330’ft. from each camera location.

Video Wiring System

1. Description: 100-ohm, four-pair UTP, covered with a black PVC jacket.
   - Comply with ICEA S-90-661 for mechanical properties.
   - Comply with TIA/EIA-568-B.1 for performance specifications.
   - Comply with TIA/EIA-568-B.2, Category 6.
   - Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
     - Communications, Direct Burial Rated: Type F/UTP, complying with NFPA 262.
     - General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher. All terminations shall use TIA/EIA 568B wire termination color coding.
2. Power and/or Auxiliary Input/Output cable shall be multi-conductor twisted shielded cables selected for use with the specific equipment to be controlled for installation in concealed conduit system. Cables shall have outer jacket of PVC and shall be suitable for direct burial installation.

3. All cables and conductors that serve as control, sensor, low voltage power, or data conductors shall have surge protection circuits installed at each end that meet the IEEE C37.90.1 surge withstand capability test. Fuses shall not be used for surge protection.

Network Video Recorder and Multiplexor

1. The network video recorder (NVR) and multiplexer shall be provided as one integrated unit. The NVR shall be provided by the Security Sub-Contractor.
2. The NVR shall provide for live and playback viewing while the system continues to record new images. It shall be capable of time division, multiplexing multiple cameras and storing their digitized and compressed images on integral hard disk drives, and search and retrieval either locally at the unit or from a remote work station using a graphical user interface. It shall have Ethernet connectivity.
3. The NVR shall record video on an internal hard disk drive(s). It shall support multiple internal and external hard disk drives of minimum 500 gigabytes, or large enough to store up to 1 month of the camera recordings.
4. The NVR shall support archiving of images on an external archiving device. It shall support recording on portable / removable storage media.
5. The NVR viewing software shall provide the following displays as a minimum in live and playback mode: full-screen, sequencing, quad, 9-way, or 12-way. It shall allow the user to rearrange cameras in any multi-screen display, in both live and playback modes. The display options shall include but not limited to:
    a. Camera tilting
    b. Title display, per monitor
    c. Time and date, per monitor

A-4.14.2 Security Software

The Security Sub-Contractor shall provide a minimum of two software and database management licenses. Contractor shall provide two copies of the software on CDs for backup and a complete user manual. Software shall be Windows compatible. Contractor shall provide free software upgrades during the warranty period of the system as a minimum.

A-4.15 Wire, Cable, and Connectors

Contractor shall provide information about proposed wire, cable, and connectors, including all underground facilities. Cable shall be designed and installed for a service life of 30 years. Cable for DC feeders and PV panel interconnect shall be 2-kilovolt 90°C (wet or dry) power cable type USE-2 or RHH/RHW-2 with XLPE jacket and UL 1581, VW-1 rating or approved equal for intended use capable of meeting DC collection system design current requirements. Externally installed cables shall be sunlight and ultraviolet resistant, suitable for direct burial, and conform to NEC 300.5 Underground Installation, Table 300.5 Minimum Cover Requirements, rated to the maximum DC voltage of the Plant.

PV panel interconnect connectors shall be: (i) latching, polarized, and non-interchangeable with receptacles in other systems, and (ii) tap branch connectors with multi-contact termination connectors. Grounding member shall be first to make and last to break contact with mating connector and shall be rated for interrupting current without hazard to operator.

Cables shall be listed and identified as PV wire as stated in NEC Article 690. If a cable tray is utilized, there shall be no self-tapping screws, only a clamping mechanism to secure the top. All underground cable shall be mapped and identified along its entire run with hazard tape and tracing, 18 inches above the cable elevation and 18 inches below finish-grade elevation.

Galvanized, rigid metal conduit where underground cable is exposed above ground or stubbed up to junctions or poles shall be used. Rigid metal conduit shall be included in the corrosion mitigation plan and shall be designed for a 30-year life in the Site soils and conditions. All 90-degree bends shall be in long sweeps installed in accordance with standard utility practices. Underground cable shall be direct-buried a minimum of 3 feet below finish-grade elevation. **No underground cable splicing shall be acceptable under any circumstance.** All cable splices shall be brought above ground and housed in a suitable enclosure or, if below grade, placed in a suitable vault that is clearly marked.

Cables shall be labeled in accordance with Section A-4.2 Signage and Labeling.

A-4.16 Plant Switchgear

Switchgear shall be located outdoors in a NEMA 4 lockable enclosure. Switchgear shall include an auxiliary compartment containing all instrument transformers associated with the protective relays and the 120/240-V CPT shown in the one-line diagram(s). The protective relay system shall be specified, designed, and installed in accordance with interconnecting utility's requirements. Switchgear monitoring and communication hardware shall be included to meet the requirements of sections A-4.12 Supervisory Control and Data Acquisition and A-4.13 Revenue Meter, and the metering requirements of Owner. Relay current transformers shall be C400 accuracy class.

The CPT shall be fused and disconnectable. The CPT shall be sized and single-phase breakers shall be included to supply power to a 120-V convenience receptacle and an energy efficient light within the switchgear enclosure, switchgear heaters, and the 240/120-V_{AC} panelboard within the communications shelter (if applicable). The switchgear main breaker shall have vacuum fault interrupters and shall have provisions for bifurcation. Medium-voltage protective device selection and relaying should be based on the use of Schweitzer Electric Laboratories relays or approved other, as required and specified in the Interconnection Agreement.

In general, the interconnection design and components should meet the requirements of the interconnecting utility and the interconnection agreement (including the necessity of a grounding transformer if required).

A-4.17 Emergency Direct Current Battery System

The batteries and chargers location shall be specified in accordance with temperature and shading requirements, and the battery system shall meet the requirements set forth in the

Interconnection Agreement. The battery system shall be sized: to provide DC power to trip, close, and recharge the switchyard 8 hours after a loss of power; recharge within 12 hours; and supply sufficient power to the SCADA and communications systems for 12 hours minimum. The battery sizing calculation shall be provided by Contractor to Owner.

A-5 Warranties

A-5.1 General Contractor Warranty

Contractor shall provide a full-wrap 5-year warranty (parts and labor) for the Plant equipment. Contractor shall participate with Owner in annual Site visits to conduct a visual inspection of the Plant and discuss the Plant's performance and operation. Contractor promptly will notify Owner of any observed problems or concerns concerning the Project or Plant. Safety-related issues shall be reported as soon as possible.

Contractor shall follow all material requirements of the warranties of the principal equipment suppliers using the procedures detailed in the manuals delivered upon completion of the Plant. During the period of the Contractor warranty, Contractor shall have the benefit of the warranties from the major equipment suppliers listed below.

A-5.2 Solar Module Warranty

Provide the proposed module warranty duration, terms and conditions. At a minimum, solar module manufacturer shall provide a 25-year warranty on the solar modules with at least 80 percent of power output guaranteed at 25 years as more particularly described and provided in the module warranty to be provided by the Contractor. The solar module manufacturer shall confirm that the warranty applies on an "as installed basis," i.e., it will confirm the panels were installed according to its requirements and specifications for installation.

A-5.3 Racking and Tracking System Warranty

Provide the proposed tracker warranty duration, terms and conditions. The tracking manufacturer, if applicable, shall supply a 5-year warranty for the installed structure and a 5-year warranty on the motor, and the racking design shall be certified by both the tracking manufacturer and the solar module manufacturer such that all warranties apply on an "as installed" basis. An extended warranty for parts only (motorized drives) shall be provided for a period of 10 years by Contractor. The racking manufacturer, if applicable, shall supply a 10-year warranty for the installed structure, and the racking design shall be certified by both the racking manufacturer and the solar module manufacturer such that all warranties apply on an "as installed" basis.

The racking and tracking manufacturer shall supply a minimum five (5) years full parts and labor replacement warranty, as more particularly described and provided by the Contractor.

A-5.4 Inverter Warranty

Provide the proposed inverter warranty duration, terms and conditions. The inverter manufacturer shall provide a 5-year full parts and labor replacement warranty, as more particularly described and provided by the Contractor. A 6- to 10-year warranty also may be offered by the inverter manufacturer. The inverter manufacturer shall confirm its warranty on an "as installed basis."

A-5.5 Transformer Warranty

The transformer manufacturer shall provide a 5-year warranty for the transformers, as more particularly described and provided by the Contractor.

A-5.6 SCADA Monitoring System and Security Equipment Warranty

Provide the proposed SCADA Monitoring System warranty duration, terms and conditions. Provide the proposed security system warranty duration, terms and conditions. The SCADA and security equipment system manufacturers shall provide a 5-year full parts and labor replacement and software upgrade warranty, as more particularly described and provided by the Contractor.

A-5.7 Performance Warranty

In the event Contractor does not enter into a separate maintenance services agreement with Owner, then Owner shall conduct quarterly visual inspections of arrays for damaged modules or damaged tracking equipment (if applicable). Contractor shall be responsible to remedy issues.

Contractor will be provided with continuous access to Plant data as available through the SCADA performance monitoring system. Contractor shall respond (or cause Owner's O&M contractor, if different than the Contractor, to respond) within a commercially reasonable amount of time to any issues identified by monitoring of Plant data. The promptness of the response to any individual issue shall be considered commercially reasonable if, taking into account all relevant circumstances, a response within that time could reasonably be expected to avoid an impact on the annual output of the Plant. For example, all other things being equal, a commercially reasonable response time will be shorter during high insolation summer months and longer during low insolation winter months.

In the event Contractor is not selected to perform O&M services pursuant to a separate agreement, Contractor shall perform the following services for five (5) years following substantial completion:

- Monitor the data from the Plant on a regular periodic basis and promptly report to Owner any discrepancies or issues observed in the data.
- Meet Owner onsite once a year to inspect the Plant and discuss the Plant's performance and operation.

A-6 Applicable Codes and Standards

The Plant's design, engineering, construction, interconnection, startup, and testing shall follow the applicable codes, standards, and publications that are in effect at the time of Plant initiation, and which are consistent with current utility industry standards. The codes and standards utilized shall be the latest editions in effect at the notice to proceed date.

Materials manufactured within the scope of Underwriters Laboratories shall conform to UL standards and have an applied UL listing mark. If no UL compliance is available, material and equipment shall be labeled or listed by a nationally recognized testing laboratory.

Where codes do not govern specific features of the equipment or system, Prudent Utility Practice, equipment manufacturer specifications, and standard industry standards shall apply. Where local codes or ordinances will have an impact on the design, Owner and Contractor shall jointly address these with the local authorities having jurisdiction as provided in the Agreement.

A-7 Distribution or Transmission Interconnection

Contractor is responsible for the cost of designing, procuring equipment for, and installing all interconnection and metering facilities required to deliver the Plant's electrical output to the Point of Interconnection, in accordance with this Agreement and the Interconnection Agreement.

Contractor shall be fully responsible for working with and coordinating with the transmission provider to assure that the Plant is properly designed, constructed, and prepared to interconnect with the distribution system. Contractor shall provide the interconnection equipment and structures to the Point of Interconnection as shown on the detailed design drawings and specified in the Interconnection Agreement. Contractor shall coordinate its work on interconnection with the Owner and perform in accordance with any applicable requirements in the Interconnection Agreement. Contractor shall provide Owner and the transmission provider with at least 15 days advance written notice of the first test that involves either backfeed or delivering energy to PacifiCorp, and must be in compliance with the Interconnection Agreement.

A-8 Operations and Maintenance — Manuals and Training

A-8.1 Documentation

Contractor shall supply Owner with all manuals and/or handbooks (in printable electronic format) that provide, either in a single manual or handbook or collectively, complete operating and maintenance instructions (including inventories of spare parts and tools and parts lists with ordering instructions) for each major piece of equipment and system of the Plant. Each such manual and handbook shall comply with the requirements as set forth below and in RFP Appendix A-7.2 Attachment 1B Project Document Deliverables

A-8.1.1 Manuals

Contractor shall provide Owner with six (6) paper copies and one editable electronic copy of all manuals.

Hard copy manuals shall be on standard 8-1/2" x 11" paper. Drawings and schedules which are to be bound into the manual shall also be 8-1/2" x 11" or 11" x 17" folded. Each manual shall be assembled and bound in heavy-duty post binders designed for rough usage. Light duty and ring binders are not acceptable. Binder capacity shall not exceed four inches, nor shall material included exceed the designed binder capacity. If the material to be furnished exceeds this capacity rating, multiple volumes shall be furnished. Binders shall be sized to the material to be contained, and capacity should not be more than approximately one-half inch greater than the thickness of material within the binder. All documents, illustrations, specifications, equipment data sheets, drawings, operating and maintenance instructions shall be in the English language. Use of the English system of units on documents is preferred; if the metric system of units is used, the drawing, data sheet, specification or illustration shall clearly indicate that the metric system of units is used. Each manual shall include a Table of Contents, front cover, side label and laminated index tabs and shall be of a consistent format.

The electronic copy of the manuals shall be organized in folders consistent with tabs in the paper manuals. Electronic copies of installation, operation and maintenance manuals shall be

organized from the most general information in the top directory to the most specific information in the lowest level folder. The top level folders shall include a document containing a directory of the subfolders describing the contents of each and every subfolder. Electronic copies of Installation, Operation and Maintenance manuals shall be organized by project, system, subsystem, equipment and components. Manufacturers' or vendors' electronic manuals shall be delivered as individual files. Contractor shall not merge or combine manufacturer and vendor provided files containing manuals.

The manuals to be provided shall include:

1. Design Manuals

   Design manuals shall contain the following items:

   - Drawing List, Drawing and Specification Identification System, Units of Measurement and Formats
   - System List and Equipment Numbering System
   - List of applicable drawings
   - System design requirements
   - System and equipment descriptions
   - Equipment lists itemizing type, performance and technical requirements.
   - Overall performance data

2. Start Up, Operation and Shutdown Manual for the Plant, including comprehensive and complete procedures for checkout, startup and testing of the Project and will include as a minimum the following items:

   - Plant start-up and shutdown procedures
   - Startup schedule
   - Startup organization chart
   - Administrative procedures
   - Data sheets
   - Test procedures for all tests required for Mechanical and Electrical Completion and Final Acceptance.
   - Turnover sequences and procedures
   - Safety clearance procedure
   - Work responsibility matrix

3. Installation, Operation, and Maintenance Manuals for the Equipment, including information typically supplied for equipment and/or systems such as the following items:

    - System or equipment startup and shutdown procedures
    - Description / design criteria of each item of equipment
    - Nameplate information and shop order numbers for each item of equipment and components thereof
    - Operating procedures and instructions for commissioning, startup, normal operation, shut down, standby and emergency conditions and special safety precautions for individual items of equipment or systems
    - List of any start-up prerequisites
    - Normal range of system variables
    - Operating limits and hazards for all equipment and systems including alarm and trip set points for all devices
    - Testing and checking requirements
    - Effect of loss of normal power
    - Tolerance of electrical supply frequency variation
    - Final performance and design data sheets, specifications and performance curves for all equipment including test data and test curves
    - Preventive maintenance schedule and maintenance instructions for equipment including standard and special safety precautions
    - Lubrication schedule showing requirements and specifications for lubricants for equipment
    - Dismantling and assembly procedures for equipment with associated tests and checks prior to returning equipment to service.
    - Detailed assembly drawings to complement assembly procedures mentioned above including parts lists and numbers for replacement ordering.
    - Setting and running clearances and tolerances
    - Cleaning procedures
    - Specifications for any gases, chemicals, solvents or lubricants
    - Drawing showing space provided for equipment maintenance for equipment and any fixed facilities for maintenance such as trolley beams, etc.
    - Methods for trouble-shooting
    - List of maintenance tools furnished with equipment
    - Installation instructions, drawings and details

- Vendor drawings as appropriate
- Installation, storage and handling requirements.

The above requirements are a minimum; however, requirements which are clearly not applicable to specific items or components may be deleted, however, any additional information which is necessary for proper operation and care of the equipment shall be included.

A-8.2 Spare Parts

No later than 90 days after the Effective Date the Contractor shall provide to the Owner a recommended spare parts list, including quantities and prices if purchase with the contract, for the equipment and systems provided by the Contractor. The recommended spare parts list shall include all expendable items that may be required during the operation of the Project. Each of the spare parts shall be fully identified by reference to the spares list, part number, cost, and manufacturer drawing number. Contractor shall also identify spare parts that the Contractor recommends should be stocked locally to ensure prompt repair due to any failure that can be reasonably expected, taking into account the length of time required to obtain replacement parts.

The Contractor shall provide, receive, store locally, distribute and restock spare parts, materials, test equipment, instruments, tools, and consumables required for start-up and operation of the systems and equipment within its scope until **[Substantial Completion].**

If the Contractor, his suppliers, or sub suppliers cease manufacture of any of the spare parts, or if for any reason any spare part will become unavailable at any time during the life of the facility, the Contractor shall notify the Owner in writing at least 180 days prior to the unavailability of such spare parts. The Contractor shall provide the Owner the opportunity to purchase sufficient stock of spare parts to support the system for its expected life.

A-8.3 Tools and Equipment

Contractor shall provide all special tools, test instruments and computer programs, as applicable for maintenance and operation which are not normally or readily available. The Contractor shall submit a complete list of tools and equipment needed for erection/installation and maintenance and a list of special tools and equipment that will be provided, including prices. Special tools and equipment shall become the property of the Owner at the completion of the PV installation. The Owner reserves the right to purchase additional quantities of tools if desired.

A-9 Mechanical and Electrical Completion

Contractor shall achieve Mechanical and Electrical Completion and assure that the Plant has been synchronized with the PacifiCorp Interconnection Facility (in accordance with PacifiCorp's requirements) before conducting the Capability Verification, Guarantee Design Conditions, and Guaranteed Performance Tests.

Mechanical and Electrical Completion means:

a. Equipment for the Plant has been installed, including with the required connections and controls to produce electrical power.

b. All equipment related to the solar tracking system (if applicable) has been installed and checked for alignment, lubrication, and rotation.

c. All remaining electrical systems have been checked out and are ready for operation.

d. All electrical continuity and ground fault tests and all mechanical tests and calibrations have been completed.

e. All instrumentation is operational and has been calibrated in accordance with manufacturers' standards and guidelines and, where possible, loop checked.

A-10 Synchronization Procedures and Requirements

All testing shall be done in accordance with the Interconnection Agreement and all of the requirements to achieve electrical and mechanical completion of the plant.

A-11 Quality Assurance/Quality Control and Procedure for Plant Acceptance

A-11.1 Step 1 – Quality Assurance/Quality Control

Contractor shall submit to Owner a copy of its QA/QC plan for review not later than 45 days after contract execution for Owner review and comment. The Plant shall be managed in accordance with the program.

The QA/QC program shall include, but is not limited to, such procedures and systems as the following:

- Road construction
- Rebar and conduit placement
- Concrete placement and testing
- All wire insulation testing—Megger testing or very low frequency testing
- Mechanical system—trackers, mounting structures, tracker controls
- Factory testing of inverters and transformers by the manufacturer
- PV source open-circuit measurements—V_{OC} at combiner boxes
- Fuse tests
- Termination pull testing
- All visual inspections
- Grounding continuity testing
- Earth-ground resistivity testing

- PV module inspection and manufacturer documentation of factory test per the manufacturer's existing program
- Metering and instrumentation calibration testing
- Step-up transformer testing
- Inverter phase rotation and matching with utility
- Relay settings at the point of interconnection to Owner
- Verification of security camera system operations, including device points, sequences, and communications
- Other Contractor-prescribed procedures

All QA/QC testing procedures onsite shall be witnessed and documented by a qualified representative of Contractor. Owner shall observe and witness QA/QC as necessary and at its discretion. A qualified engineer of Contractor shall date and sign documentation indicating completion and acceptance of each onsite QA/QC test procedure.

A-11.2 Step 2 –Commissioning and Startup

Contractor shall provide the proposed commissioning and startup plan for the Plant.

Contractor shall coordinate with Owner to develop an acceptable commissioning plan that includes a checkout and startup procedure. This work will assure: that systems are activated in a manner that is safe for personnel as well as for the equipment, that Contractor work is complete and according to the contract documents, and that the systems perform as required by the contract documents and are ready to be turned over to Owner. As the construction and installation of the systems nears completion, Contractor shall prepare punch lists and conduct system walk-downs, sub-system and system checkouts, startups, testing, and turnovers.

The final approved Acceptance Test and Commissioning Procedures shall, at minimum, include the following:

- Safety plan during startup and commissioning
- Review of all QA/QC testing on the DC and AC sides of inverters
- Detailed procedure for Plant startup, including switching sequencing
- Confirm testing and energizing inverters in conformance with manufacturer's recommended procedures; note operating voltages; and confirm inverter is performing as expected
- Under full sun conditions, and after at least 15 minutes of operation, taking and recording Plant operating data—such as but not limited to megawatts direct current, megawatts alternating current (MW_{AC}), V_{DC}, V_{AC}, I_{DC}, I_{AC}, Solar Radiation, etc.
- Testing the system control and monitoring system to verify that it is performing correctly
- Testing the communication system for offsite monitoring
- Testing the Plant metering and protective relaying to verify they meet utility requirements

- Detailed procedure for interface and initialization with the grid
- Documentation of successful startup and commissioning procedure
- Written notification submitted by Contractor to Owner that the completion of Acceptance Testing and Commissioning has occurred

Upon successful completion of energizing and startup, the Plant will be considered operable. The Plant will then move to the Interim Operating Period where Contractor shall make the Plant ready for Capacity Testing.

A-11.3 Step 3 – Interim Operating Period

Following successful completion of the startup and commissioning of the Plant, the Contractor shall have a maximum of 45 days to resolve any operating issues. The Owner-designated operating and maintenance team shall receive training regarding the Plant during this period. After the successful execution of the Interim Operating Period, the Contractor shall perform a Capacity Test Procedure to verify the rated output for the Plant. Contractor is not required to use the maximum 45 days, rather it is an allowance of time.

A-11.3.1 Training

The Contractor shall provide training for the PV system as specified below. The Contractor shall determine the content and duration for each training session. The suggested class durations in this specification are meant to illustrate the level of training expected. Performance evaluation testing of all trainees (i.e. a written test) is required for all classes except the Orientation Training

A-11.3.2 Operator Training

The Contractor shall provide the necessary training in proper operation of the PV system and related equipment. It is anticipated that this session will last 3-5 days. This session will be limited to a maximum of 20 people. Emphasis shall be placed on hands-on operating experience interspersed with the critical background as necessary, including switching procedures and emergency response training.

A-11.3.3 Maintenance Training

The Contractor shall provide necessary training in maintenance of the PV system and related equipment, providing maintenance by the Owner option is chosen. The maintenance training shall be scheduled after successful completion of the availability guarantee period. It is anticipated that maintenance training will last 3-5 days. This session will be limited to a maximum of 20 people. The maintenance training shall include, but not be limited to:

- normal maintenance methods
- repairs and replacement
- diagnostic procedures
- equipment calibration
- re-energization

- special tests
- special tools
- safety and grounding procedures

A-11.4 Step 4 – Capacity Test Procedure

Upon notification that the Plant is ready for field testing, the Contractor, in the presence of Owner-designated engineers or a third-party independent engineer, shall complete the Capacity Test Procedure. The Plant will be tested under field environmental conditions (in the field irradiance, temperature, and measured capacity in MW) according to the procedures described in ASTM 2848 - 11e1 "Standard Test Method for Reporting Photovoltaic Non-Concentrator System Performance."

Contractor shall submit its proposed plan to comply with the testing procedures 60 days prior to the date that Contractor anticipates the commencement of the test. The objective of the Plant Capacity Test Procedure is to demonstrate to Owner that the Plant is likely to achieve the Energy Performance Guarantee (in MW_{AC}) under project test conditions. The submittal by Contractor regarding the Capacity Test Procedure shall, at a minimum, include a listing of test instrumentation, calibration procedures, test duration, type of data collected and collection frequency, test data collection procedures, and test reporting.

Contractor shall be authorized in writing by Owner to begin the Capacity Test Procedure, which will be to establish the full power rating of the Plant. If the rating falls below the guaranteed output, Contractor shall take measures to bring the Plant up to the required rating.

If Contractor chooses to take corrective measures to bring the power rating up to an acceptable level, then retesting may occur following notification to Owner in writing.

Contractor shall submit preliminary results of the Capacity Testing within 24 hours of the conclusion of the test. Upon Owner's acceptance of the preliminary test results, Contractor shall submit to Owner a detailed test report within 10 business days of the completion of the Capacity Test. The test report shall consist of the following:

- Any agreed upon deviations to the test procedures
- Instrument calibration sheets/certificates
- Test data (manual and from the data acquisition system)
- Corrected test data
- Field notes
- Calculations
- Post-test uncertainty analysis
- Conclusions

A-11.5 Step 5 – Substantial Completion

After the startup and commissioning is successfully demonstrated to Owner's satisfaction in accordance with **RFP Asset Purchase and Sale Agreement**, the Plant will be considered Substantially Complete. To demonstrate substantial completion, the Contractor shall:

a. Commission the completed system in accordance with the tests to verify that:

   i. The system is capable of being operated at all levels and operating modes in accordance with the operating guidelines, applicable laws, applicable standards, applicable permits, prudent utility practices, and requirements of the contract documents.

   ii. The Plant is functioning as expected within acceptable parameters and as designed at a nameplate capacity that is expected to generate the output as stated in **Appendix A-10 - Plant Performance Guarantee** in the first year of operation adjusted for actual weather conditions.

b. Facilitate completion or execution of any incentive- or rebate-related documents or other documents required for any warranty to become effective or to be assigned to Owner.

c. Coordinate with PacifiCorp confirming that the facility has been installed per the Interconnection Agreement.

d. Cause the Plant and all items of equipment and improvements at the Plant to be designed, manufactured, installed, calibrated, and tested where applicable in accordance with the published standards (as of the dates specified) listed in this Technical Specification; Contractor shall notify Owner of any standards of such organizations that are inconsistent with each other and advise Owner of the manner in which it intends to resolve such inconsistency in accordance with the published standard.

e. Acceptance testing of security system shall include verifying that each device point and sequence is operating correctly.

f. Provide Owner a startup manual in conformance with section A-8.1.1 as part of the plant startup procedures.

   g. Provide Owner with all training and documentation as required to satisfy the requirements for Substantial Completion as listed in **Appendix A-7.2 - Attachment 1B Project Document Deliverables**.

h. Within 45 days prior to Substantial Completion Contractor shall complete training of Owner in the operation and recommended maintenance of the Plant.

A-11.6 Step 6 – Final Completion

After Substantial Completion, Contractor shall complete all punch-list items; demobilize; clean and clear the Site; submit all as-built drawings; O&M manuals, and spare parts lists; complete all training; deliver all spare parts onsite; and transfer all permits to Owner. Prior to submitting its request for a Final Acceptance Certificate, Contractor shall perform the following tasks without limitation:

a. Identify punch-list items and provide timeline for completion. Following the Final Acceptance Date, Contractor shall complete the items on the punch-list in accordance with the standards described herein, and as quickly as reasonably practical. Contractor shall coordinate with Owner regarding continued Site access.

b. Conduct a final clean-up of the Site.

c. Remove all its equipment from the Site (other than equipment, supplies, and materials necessary or useful to the operation or maintenance of the Plant, and equipment, supplies, and materials directed by Owner to remain at the Site until completion of the Plant).

d. Tear down and remove all temporary structures on the Site built by Contractor or its Subcontractors and restore such areas to a condition consistent with that of a newly constructed solar PV power plant, except as required by any provision of this Agreement.

e. Remove all waste, rubbish, and hazardous material from and around the Site and disposed in accordance with all state, federal, and local regulations.

f. Provide Owner with copies of all O&M manuals and warranties for the Plant.

g. Provide final as-built documents upon completion.

h. Complete all performance testing in accordance with the Energy Test Procedures, and **RFP Appendix A-10**, with the exception of the Energy Performance Test.

i. Meet all requirements listed below**.**

A-11.6.1 Requirements for Final Completion.

Final Completion of the Work shall be deemed to have occurred only if all of the following have occurred:

(a) Contractor has achieved Substantial Completion in accordance with Article 14;

(b) Owner has received final "as-built" drawings in accordance with the terms of this Contract;

(c) the Punchlist Items have been completed to the reasonable satisfaction of Owner;

(d) Contractor has delivered the Final Release and Waiver of Liens and Claims in accordance with Section 7.6 and has delivered such other documents and certificates as Owner has reasonably requested to ensure compliance with all Applicable Laws;

(e) Contractor has paid Owner all amounts due hereunder and not in dispute; and

(f) Contractor has delivered to Owner a Notice of Final Completion stating that all the preceding conditions in this Section 15.4 have been satisfied.

A-11.6.2 Procedures for Final Completion.

When Contractor believes that it has achieved Final Completion, it shall deliver to Owner a Notice of Final Completion. Such Notice shall contain a report in a form reasonably acceptable to Owner, and with sufficient detail to enable Owner to determine that Contractor has achieved Final Completion. Owner shall, within twenty (20) Days following receipt of such Notice, either: (a) approve Contractor's Notice of Final Completion, indicating Owner's acceptance of the achievement of Final Completion; or (b) if reasonable cause exists for doing so, notify Contractor in writing that Final

Completion has not been achieved, stating in detail the reasons therefor. If Owner delivers the Notice under the preceding clause (b), Contractor promptly shall take such actions, including the performance of additional Work, to achieve Final Completion, and upon completion of such actions, shall issue to Owner a revised Notice of Final Completion pursuant to this Section 15.5. Such procedure shall be repeated as necessary until Final Completion has been achieved. If Owner fails to respond to Contractor's submitted Notice of Final Completion within the time set forth above, Owner shall be deemed to have approved Contractor's Notice of Final Completion. For all purposes of this Agreement, the Final Completion Date shall be the date on which Contractor delivers to Owner the Notice of Final Completion that Owner ultimately accepts or is deemed to have accepted (or pursuant to a later determination under the dispute resolution procedures, should have accepted). Any disputes regarding the existence or correction of any such alleged deficiencies shall be resolved pursuant to Article 35. Contract shall cause Final Completion to occur no later than sixty days following the Substantial Completion Date.

A-11.6.3 Energy Performance Test.

The Plant shall undergo an Energy Performance Test to be commenced after the Substantial Completion Date and to be completed after to the Final Completion Date. The Energy Performance Test shall be completed in accordance with the methodologies, assumptions, standards, protocols, correction curves and other requirements of **RFP Appendix A-10**.

A-11.6.4 Energy Performance Test Completion.

The Energy Performance Test shall be deemed to have been completed when such tests are completed in accordance with the Energy Performance Test Procedures and Contractor has either demonstrated achievement of the Energy Performance Guarantee or fully liquidated the Energy Performance Guarantee in accordance with Section 16.2.

A-11.6.5 Confirmation of Energy Performance Test Completion.

Promptly after completion of Energy Performance Test, Owner shall issue a Notice of Energy Performance Test Results.

Upon agreement by Owner, the Plant is considered to be at Final Completion.

RFP APPENDIX A.1 (WIND)
SCOPE OF WORK (PPA OR BTA)

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RFP APPENDIX A.1 (WIND)
SCOPE OF WORK (PPA OR BTA)

1.0 EXHIBIT INFORMATION

1.1 Purpose

1.1.1 Without limiting the information summarized herein, the purpose of this document is to summarize the *minimum* scope of work requirements for Contractor, which generally include:

(1) The engineering, procurement, and construction of the balance-of-plant infrastructure for the Project, including all civil works, structural works, and electrical works;

(2) The supply and delivery of Wind Turbines to the Project Site;

(3) The offloading and installation of all Wind Turbines for the Project, and all tasks necessary to achieve mechanical completion of the Wind Turbines;

(4) All tasks necessary to achieve commissioning completion of the Wind Turbines; and

(5) The furnishing and installation of the O&M Building and the meteorological towers.

1.2 Project Description

1.2.1 PacifiCorp is soliciting proposals for cost-effective renewable resources that are located in or can be delivered to PacifiCorp's west balancing authority area ("**PACW**"). Any wind energy project to be owned and operated by PacifiCorp shall meet the PacifiCorp requirements set forth herein.

1.3 References

1.3.1 This exhibit shall be used in conjunction with the Work Specifications which more fully describes the *minimum* performance specifications, quality standards, and other criteria for Contractor's Work.

1.4 Definitions

1.4.1 Unless defined in this exhibit, terms that begin with an upper case shall have the meaning defined RFP Appendix A.2 (Wind) (*Definitions*).

1.4.2 References to "**roads**" and "**roadways**" herein shall be understood to consist of all access roads, Wind Turbine string and spur roads, substation roads, transmission line service roads, meteorological tower roads, maintenance building roads, and temporary construction roads to be constructed for the Project.

1.5 Interpretation

1.5.1 References herein to requirements to perform and/or provide work, services, equipment, or other similar items shall be understood to be the responsibility of Contractor, unless explicitly noted as being a responsibility of Owner.

1.5.2 The headings of sections and subsections herein are for convenience only and shall be ignored in construing this exhibit.

2.0 GENERAL SERVICES

2.1 General Provisions

2.1.1 Contractor shall perform and/or provide all work, design services, procurement services, construction services, supervision, management, labor, equipment, materials, parts, apparatus, tools, consumables, temporary structures, temporary utilities, storage, quality control and other items necessary or appropriate to complete the Work described herein, unless explicitly stated otherwise, and all such Work shall be included in the Proposal.

2.1.2 Contractor shall perform all Work in conformance with the Requirements. In the event of any conflict or discrepancy between this Exhibit and any Requirement, the more stringent or higher quality Requirement shall take precedence over the less stringent or lesser quality Requirement.

2.1.3 Contractor shall inspect the Project Site prior to initiating the Work to obtain such additional or supplementary examinations, investigations, explorations, surveys, tests, studies, and/or data concerning conditions at or contiguous to the Project Site or otherwise, which may affect cost, progress, performance, or furnishing of the Work. All such inspections shall have been contemplated and included in the Proposal, and Contractor shall not be entitled to request or be granted any scope change claims based on the results of these investigations.

2.1.4 Contractor shall design all aspects of the Project based on verifiable criteria that are specific to the Project and the Project Site, including elevation, precipitation, frost depth, seismic loads, and subsurface conditions. All such design criteria shall be clearly displayed on the design drawings.

(1) Contractor shall submit with the Proposal a summary of Project Site conditions, including elevations (Wind Turbines, Project Substation, and Interconnection Line); climatic conditions (extreme ambient conditions, average ambient conditions, average annual precipitation, isokeraunic levels, lightning density, and mean relative humidity); wind loading (maximum recorded wind speed, basic wind speed, occupancy category and exposure category); seismic loading (occupancy category, site class, seismic importance factor, and spectral response acceleration); and snow loading (occupancy category, ground snow load, terrain category, exposure factor, snow importance factor, and ice loading). The source and relevant assumptions regarding all such data shall be provided in the form of RFP Appendix C-1 (*Bid Summary – Power Purchase Agreement*) or RFP Appendix C-2 (*Bid Summary – Build Transfer Agreement*), as applicable to the Agreement.

2.1.5 Contractor shall construct the Work, including Turbine Foundations, Access Roads, laydown yards, Collection System Circuits, the Project Substation, the Interconnection Line, the O&M Building, and all meteorological towers, at the Project Site.

2.1.6 Contractor shall minimize unnecessary disturbance of the existing Project Site conditions, and undeveloped areas of the Project Site shall be left in their current condition.

2.2 Construction Management

2.2.1 Contractor shall provide supervision, inspection, and quality control of the Work to ensure it is completed safely, competently, and efficiently. Contractor shall devote attention, skills, and expertise as is necessary to perform the Work in accordance with the Requirements.

2.2.2 Contractor shall provide traffic control at and within the Project Site, or as otherwise required to complete the Work, including, but not limited to, traffic control along any public or private roads.

2.2.3 Reserved.

2.2.4 Contractor shall furnish and maintain throughout construction of the Project a construction radio system for use by Owner and Owner's representative(s), including access to Contractor's primary safety channel. At least five (5) fully-functional radios shall be furnished for this purpose. This radio system shall be fully functional within 30 days of Contractor mobilization.

2.2.5 Contractor shall provide all necessary construction water, including, but not limited to, that which is required for temporary work, concrete preparation, dust control, rock drilling operations, and pressure washing of Wind Turbine components.

2.2.6 Contractor shall provide all necessary temporary/construction power, including, but not limited to, that required for the office trailers, temporary lighting, Project Substation, O&M Building, and meteorological towers. For the avoidance of doubt, Contractor shall be responsible for furnishing both the power supply and fuel source for such items.

2.2.7 Contractor shall provide all necessary fire management devices, per the fire management plan to be prepared by Contractor as a Contractor Deliverable, including water trailers, construction vehicle fire kits, or other similar devices, as applicable.

2.2.8 Contractor shall attend and actively participate in Owner-scheduled project meetings. These meetings may include, but are not limited to, (i) engineering update meetings to review progress against the Project Schedule, address issues related to the Work, and other similar items prior to construction of the Project; and (ii) Project management meetings during construction, including plan of the day, daily safety meetings, daily logistics planning, Project Schedule progress, weekly management updates, and monthly management updates.

2.2.9 Contractor shall support Owner with providing timely responses to reasonable requests for information from Owner or Owner's contractors, including Turbine Supplier.

2.2.10 Contractor shall ensure compliance with all land owner agreements for livestock management.

2.2.11 Contractor shall contact local authorities, pipeline companies, and utility companies to locate conflicting underground facilities *prior* to starting any excavation or trenching Work. Contractor shall be responsible for all damages resulting from contact with identified underground facilities in the vicinity of each excavation. In the event of any conflict with an underground facility, Contractor shall immediately notify Owner and shall document the nature of the conflict, relocation of the conflicting facility or structure, any damages which occurred, and final resolution. This documentation shall be provided to Owner within 48 hours of such conflict.

2.3 Project Schedule

2.3.1 Contractor shall prepare, implement, and manage a detailed schedule that reflects the project execution plan and anticipated sequence of site operations (the "**Project Schedule**"). The Project Schedule shall comply, at a minimum, with the Project Schedule Requirements as set forth in the Work Specifications.

(1) Contractor shall submit with the Proposal a detailed Project Schedule. Following execution of the Agreement, this baseline scheduled shall be updated and submitted to Owner for review on a weekly basis.

2.3.2 Contractor shall provide an individual (the "**Scheduler**") who will be dedicated to the Project and who shall develop and maintain the Project Schedule. The Scheduler shall be an experienced specialist that is skilled in critical path method scheduling; shall be capable of producing CPM reports within 24 hours of Owner's request; shall be present at the Project Site on a full-time basis during the construction of the Project; and shall attend and actively participate as needed in all Project meetings related to construction progress, alleged delays, or time impact.

2.3.3 Contractor shall cause the reports summarized in the Project Schedule Requirements, as set forth in the Work Specifications, to be submitted with each weekly Project Schedule update.

2.4 Project Documentation

2.4.1 Contractor shall prepare and submit all deliverables and submittals necessary for the successful completion of the Work, including, but not limited to, Job Books, As-Built Drawings, completion certificates, design documents, and all other manuals, drawings, plans, studies, calculations, safety-related documentation, reports, checklists, completion procedures, and other similar items (collectively, the "**Contractor Deliverables**"). All such materials shall be subject to review and/or approval by Owner, as applicable; shall be coordinated and discussed with all pertinent parties prior to and during the construction phase of the Project; and shall comply with, at a minimum, the Submittal Requirements set forth in the Work Specifications.

2.4.2 Contractor shall prepare, implement, manage, and observe the health and safety plan, the security plan, and the environmental plan (collectively, the "**HSSE Plans**"). These plans shall comply, at a minimum, with the Safety Plan Requirements and the Security Plan Requirements, respectively, each as set forth in the Work Specifications.

2.4.3 Contractor shall prepare, implement, and manage a detailed quality assurance plan that is specific to the Project and Project Site. This plan shall comply, at a minimum, with the Quality Plan Requirements set forth in the Work Specifications.

2.4.4 Contractor shall provide four (4) complete, full-size (size D), color sets *and* four (4) complete, 11-inch by 17-inch, color sets of As-Built Drawings in hard copy format, as well as one (1) complete, full-size (size D) set of As-Built Drawings in electronic format on external hard drive.

2.4.5 Contractor shall provide four (4) complete copies of Job Books in hard copy format and four (4) complete copies of Job Books in electronic format on external hard drive. Job Books shall comply, at a minimum, with the Job Book Requirements as set forth in the Work Specifications.

2.4.6 Contractor shall prepare, implement, and manage a detailed project execution plan that is specific to the Project and Project Site. The project execution plan shall be sufficient in scope and detail to convey the means and methods that will be employed by Contractor to perform all aspects of the Work. Key elements of the project execution plan shall include, but not be limited to, project management structure and key personnel; roles and responsibilities; staffing plans; communications protocol; engineering execution plans; and construction management plans, including, but not limited to, cost controls, schedule controls, mobilization, document management, materials management, details for receipt and transport of equipment, construction sequencing, movement of cranes during construction, and other similar items.

2.4.7 Contractor shall prepare, implement, and manage a detailed traffic management plan that is specific to the Project and Project Site. The traffic management plan shall clearly identify all haul routes from the nearest highway; proposed traffic flow within the Project Site, including public and non-public roads; plans for managing construction, delivery, public, and other traffic at the Project Site during construction; daily concrete truck delivery flow plans; and mitigation measures to reduce risk and impact to non-construction vehicles due to construction activities.

2.4.8 Contractor shall prepare, implement, and manage critical lift plans that are specific to the Project and Project Site. The critical lift plan shall clearly identify precautions for all critical lifts; coordination plans, including pre-lift meetings, with all participating personnel; and sample documentation/checklists for all critical lifts. Prior to performing any critical lift, Contractor shall perform a practice lift with a similar crane configuration and load configuration; practice lifts shall always be performed with the same crew and using the same lifting equipment as those used for the critical lift. Any lift exceeding ninety percent (90%) of a crane's load chart is prohibited. For purposes of this exhibit, a "critical lift" shall include, at a minimum, any lift that exceeds seventy-five percent (75%) of the rated capacity of the crane, per the respective crane's load chart; any lift that exceeds 50,000 pounds; any lift that requires the use of more than one crane; any lift requiring blind picks; any man-basket lifting operation; any load that is lifted/transported over or near energized electrical equipment, such as power lines, transformers, or switchgear; any lift in a confined space or restricted area (including an operating facility) where the load, or any part of the crane or equipment structure, could come within one (1) meter of any existing structure; or any lift where the equipment is set up near manholes, catch basins, sewers, sinkholes or other known surface or sub-surface interferences.

2.4.9 Contractor shall prepare a storm water pollution prevention plan (the "**SWPPP**") for the Project.

2.4.10 Contractor shall prepare and submit all required geotechnical documentation and submittals, as more particularly described in Section 4.0 herein.

2.4.11 Contractor shall prepare blasting plans and procedures for all blasting work to be performed at the Project Site. Such plans and procedures shall include, at a minimum, a description of safety buffer zones, parameters for blasting times during the day, and approved certification as required from the authority having jurisdiction. All such submittals shall be approved by Owner prior to use.

2.4.12 Contractor shall prepare and submit concrete and grout mix designs; concrete and grout placement procedures; and grout specification sheets as Contractor Deliverables. All such submittals shall be approved by Owner prior to use. Each mix design submitted by Contractor shall be accompanied by documentation of achieving Project-specific compressive strength requirements according to ACI procedures.

2.4.13 Contractor shall prepare energization plans and procedures for each Collection System Circuit, the Project Substation, and the Interconnection Line, at a minimum. Energization plans shall be submitted to Owner for approval *prior* to use. Energization plans shall include both electrical and communications infrastructure as well as backfeed plans, soaking plans, testing plans, and lock out tag out procedures, at a minimum.

2.4.14 Contractor shall provide a foundation inspection report for each Turbine Foundation excavation and every drilled pier constructed (if any) (each, a "**Foundation Inspection Report**"). A Foundation Inspection Report, including all accompanying documentation, shall be provided to Owner as a condition of each Turbine Foundation completion and shall include the minimum information set forth in the Work Specifications.

2.4.15 Contractor shall provide a bolt tensioning plan, including procedures for tightening / re-tightening, with recommendations covering the life of the Project.

2.4.16 Contractor shall prepare the design documents, including civil works, Turbine Foundations, Collection System Circuits, Communications System, Project Substation, Interconnection Line, O&M Building, and meteorological towers. All design documents shall meet the minimum requirements set forth in the Work Specifications.

2.4.17 Contractor shall prepare a set of studies and analyses for the Project (collectively, the "**Project Electrical Studies**") to demonstrate the adequacy of the proposed system design, including any studies and analyses that may be necessary to ensure compliance with the Requirements, including the Applicable Standards or utility requirements; the Project Electrical Studies shall be submitted to Owner for review *prior* to the procurement of the applicable Equipment. The following shall be included in the Project Electrical Studies, at a minimum:

(1) Load Flow Study: load flow study with power flow analysis for the Collection System Circuits. Final report shall include a table showing cable ampacity and percent loading per cable section corresponding to the Project one-line diagram. Cable ampacity shall not exceed 90 percent of the rated value, based on Project Site-specific thermal resistivity. All external heat sources shall be considered, including parallel circuits. Thermal design shall account for actual field soil samples and backfill requirements (native or engineered).

(2) Short Circuit Study: short circuit analysis of Collection System Circuits, Project Substation, and Interconnection Line, including secondary values on Wind Turbines. The short circuit analysis and study shall be utilized in Contractor's electrical designs to support relay coordination study and equipment specification.

(3) Annual Energy Loss Report: electrical losses evaluation, including estimate of annual energy losses for Project design based upon fully-loaded conditions and Project Site-specific wind distribution data, respectively. Such analysis shall be sufficient to demonstrate that the Electrical Loss Limit (see Section 6.1 herein) is not being exceeded, and shall be based upon Project-specific cabling and transformer specifications, Project Site-specific soil conditions, Project Site-specific wind data, and other similar considerations.

(4) Reactive Compensation Study: reactive power flow report, including power factor study at Point of Interconnection. The study shall identify reactive compensation required to meet the Requirements, including the requirements of interconnection for power factor and voltage regulation, and including any capacitor bank and/or reactor requirements. The study shall include varying combinations of active power (no load, partial load, full load) and voltage (min. 0.95 to 1.05 pu) at the Point of Interconnection.

(5) Harmonic Analysis Report: power quality analysis at the Point of Interconnection to determine the harmonic resonance and flicker conditions within the Project, and demonstration that the Project design meets the harmonics distortion requirements in the Requirements (including IEEE 519), including any necessary filtering or mitigation to be provided by Contractor.

(6) Concentric Induced Voltage Report: analysis to calculate the maximum induced voltage on the Collection System Circuit shield wires.

(7) Insulation Coordination Report: study to ensure the insulation coordination requirements of IEEE C62.22-2009 have been satisfied within the Project electrical design, including proper application of surge arresters to safeguard electric power equipment within the Collection System Circuits, Substation, and Interconnection Line against hazards of abnormally-high voltage surges of various origins.

(8) Transient Overvoltage Report: study to confirm any system modifications required to adequately limit transient overvoltage on the Collection System Circuits, including determination of the transient overvoltage levels on the Collection System Circuits after feeders have been isolated from the Substation due to a line-to-ground fault, and determination of the maximum energy required to be absorbed by each surge arrester on the Collection System Circuit feeders.

(9) Wind Turbine Ground Grid Report: analysis of Wind Turbine grounding design to verify the adequacy of the proposed design and the safety of personnel working in or around the Wind Turbine. The study shall confirm that the grounding system maintains touch and step voltages within tolerable limits, and shall be prepared in accordance with the procedures, data, and recommendations given in IEEE 80). The study shall determine the ground potential rise with respect to remote earth, and Turbine Foundations shall be modeled as they are actually constructed (i.e., if not solidly bonded (e.g., using wire ties), they should be modeled accordingly).

(10) Substation Grounding Report: grounding system study of ground grid conductors and interconnection (if any) with the ground grid. The study shall confirm that the grounding system maintains touch and step voltages within tolerable limits, and shall be prepared in accordance with the procedures, data, and recommendations given in IEEE 80. The study shall determine the ground potential rise with respect to remote earth.

(11) Effectively Grounded Report: study to confirm the Project is considered effectively grounded, as defined in IEEE C62.92.1-2000.

(12) Substation AC System Study: calculation of the capacity of the low-voltage AC systems in the Project Substation to determine size of station service.

(13) Substation DC System Study: calculation of the capacity of the batteries and chargers within the Project Substation with the DC service required for the equipment at the substation, as determined from a load profile developed for all DC loads. The study shall determine if the minimum voltages are maintained as specified and required by equipment vendors. The DC system shall be sized to accommodate future loads for ultimate switchyard configuration.

(14) Substation Bus Ampacity Study: calculation of bus ampacity in the Project Substation based upon continuous current rating as given on the one-line diagram and Project Site-specific conditions.

(15) Substation Bus Structural Analysis Study: analysis of bus structural design in the Project Substation including bus, insulators, bus structures, and foundations, and based upon the most stringent combination of wind, fault current, and ice load factors, as defined in the Applicable Standards and other applicable Requirements.

(16) Substation Bus Design Study: analysis of the performance of the buses, disconnect switches, and separately-mounted current transformers within the Project Substation to confirm that the ampacity, structural integrity, vibration, and required mechanical and electrical ratings are in accordance with the methods and recommendations of IEEE 605. Bus design, including gust factor, exposure height factor, importance factor, and corona considerations, shall be in accordance with the procedures and data given in IEEE 605.

(17) Substation Lighting Study: lighting illumination calculations for each Substation and Interconnection Substation, respectively, to determine the illumination levels within the new substations that will be achieved with added luminaries.

(18) Substation Lightning Study: direct stroke protection analysis for lightning at the Project Substation based upon Project Site-specific determinations for thunderstorm days, thunderstorm duration, isokeraunic levels, exposure, and other similar factors. The direct stroke protection system design shall include analysis using the rolling sphere method of the electrogeometric model given in IEEE 998. The direct stroke protection system design shall be in accordance with the procedures, data, and methods given in IEEE 998.

(19) Arc Flash Study: arc flash hazard analysis of the Equipment, including all energized equipment in the Wind Turbines, Collection System Circuits, Project Substation, Interconnection Line, and O&M Building. This analysis shall be performed in accordance with the latest version of NFPA-70E and IEEE 1584.

(20) Protection Coordination Study: relay and protection equipment coordination study, including detailed calculations, one-line and three-line diagrams, fuse curves, coordination curves, protected equipment data, and relay set points. This study shall include the Wind Turbine equipment (including switchgear), Collection System Circuits, Project Substation, and Interconnection Line. A narrative philosophy statement shall be submitted for comment before completing the coordination study, and the proposed settings for the Wind Turbine switchgear shall be delivered to Turbine Supplier for implementation *prior* to energization.

2.4.18 Contractor shall upload electronic copies of all Contractor Deliverables (including drafts and final) to Owner's web-based document management site.

2.4.19 Contractor shall prepare and maintain a documentation list for the Project. This list shall include, at a minimum, a listing of all Contractor Deliverables and the current status (including responsible party) and revision number of each. The naming and labeling conventions for all Contractor Deliverables shall be coordinated with and approved by Owner. The documentation list shall be updated by Contractor each time a new or revised drawing or document is issued, at a minimum.

2.4.20 Contractor shall prepare and maintain a complete log, including supporting documentation, of all requests for information (each, an "**RFI**") issued throughout performance of the Work. This log shall include, at a minimum, a listing of each RFI and the current status (including responsible party) and revision number of each. The naming and labeling conventions for all RFIs shall be coordinated with and approved by Owner. The documentation list shall be updated by Contractor each time a new or revised RFI is issued, at a minimum.

2.4.21 Contractor shall provide to Owner periodic written reports as to the actual progress of the Work in comparison to the Project Schedule. These reports shall include, but are not limited to, the plan of the day report, the weekly progress report, and the monthly progress report.

2.4.22 Contractor shall maintain color hard copies of all issued-for-construction drawings at the Project Site during performance of the Work, including at least one (1) complete set to be located in Owner's office trailers; such hard copies shall be updated by Contractor upon issuance of any revised issued-for-construction drawing. Contractor shall maintain separately a complete set of controlled redline drawings showing all Owner-approved changes made during construction, including reference to the applicable RFI number; such redlines shall be included in the Job Books.

2.4.23 Contractor (via Turbine Supplier) shall provide a Wind Turbine operations and maintenance manual, including in hard copy format and electronic format.

2.4.24 Contractor shall obtain (via Turbine Supplier) and utilize information for the design of the Wind Turbine Foundations, including, but not limited to, loading information, Markov matrices, and tower alignment information.

2.4.25 Contractor (via Turbine Supplier) shall provide an assessment of suitability of the Wind Turbines at the Project Site. This assessment shall include a representation from Turbine Supplier confirming the suitability of the Wind Turbine for the Project Site and its ability to withstand the Project Site conditions for a period of at least 20 years. Turbine Supplier's requirements for wake sector management (if any) shall be included in the suitability assessment.

2.4.26 Contractor (via Turbine Supplier) shall provide a current certification of compliance with IEC WT 01 / IEC 61400-1 / IEC 61400-22, either in the form of a Type Certificate or an A-Design statement of compliance, for the Wind Turbine model(s) being utilized for the Project. The Certificate shall be from Germanischer Lloyd, Det Norske Veritas, TÜV NORD Group, or an Owner-approved equal.

2.5 Signage

2.5.1 Contractor shall provide, install, and maintain throughout the performance of the Work all signage required by the applicable permits, the Applicable Standards, and other applicable Requirements.

2.5.2 Contractor shall provide and install a permanent sign on each Wind Turbine identifying the name of the Wind Turbine.

2.5.3 Contractor shall provide and install a permanent sign at each Wind Turbine string road listing the name(s) of all Wind Turbine(s) along that road.

2.5.4 Contractor shall furnish and install identification numbers and permanent, weatherproof labels on the base of all Wind Turbine towers, indicating Owner tower number and Collection System Circuit number, respectively.

2.5.5 Contractor shall furnish and install identification numbers and permanent, weatherproof labels on all Interconnection Line structures.

2.5.6 Contractor shall provide and install a permanent sign at the O&M Building location indicating Project name, Owner name, and entry requirements.

2.5.7 Contractor shall provide and install "no trespassing" signs at access road entry points and permanent speed limit signs at intervals of no greater than two (2) miles along all Project access roads, or less if required by the Contractor-furnished traffic management plan and/or Safety Plan.

2.5.8 Contractor shall, prior to the start of construction activities, measure the height of all overhead power lines or obstructions at the Project Site. Contractor shall provide, install, and maintain signage at each such crossing and incorporate any measures necessary to operate, move, and mobilize cranes and other equipment to ensure safe passage with adequate clearance.

2.5.9 Contractor shall provide, install, and maintain signage as needed for blind corners, steep hills, dips, trucks entering roadways, restricted areas, and other potential hazards. All such signage shall be installed prior to commencing construction activities.

2.5.10 Contractor shall provide, install, and maintain "buried cable" signs at all locations where an underground Collection System Circuit crosses a road or fence, respectively.

2.5.11 Contractor shall provide, install, and maintain signage as needed to provide reasonable information and direction to Project Site personnel and to facilitate orderly entrance and egress from the Project Site.

2.5.12 Contractor shall provide, install, and maintain danger signs, signals, lights, guard rails, reflectors on curves, and notices as may be necessary to adequately protect the Work and personnel of any company at the Project Site, including visitors, against injury or property damage.

2.5.13 Contractor shall provide, install, and maintain emergency response (E-911) address signs in accordance with local authorities.

2.5.14 Contractor shall provide, install, and maintain signage identifying personnel assembly locations for use during emergencies or Project Site evacuations.

2.5.15 Contractor shall provide, install, and maintain a contact sign at the entrance to all fenced areas.

2.5.16 Contractor shall provide a check-in stand at the entrance of all working areas for the location-specific safety documentation requiring sign-off of all people entering this work area. Documentation provided at such stand shall include a complete job hazard analysis.

2.5.17 Contractor shall uninstall, remove, and discard of all temporary signage at the completion of the Work, or as otherwise prescribed in the applicable permits.

2.6 Permits

2.6.1 Contractor shall obtain, pay for, and maintain all permits required for its performance of the Work.

2.6.2 Contractor shall maintain copies of all permits at the Project Site during construction of the Project.

2.6.3 Contractor shall comply with all requirements of Contractor-acquired permits, including closeout of such permits, and shall transfer to Owner such permits required for the operation and maintenance of the Project.

2.6.4 Contractor shall provide reasonable assistance, including engineering support, to Owner in applying for, obtaining, and maintaining the Owner-acquired permits.

2.7 Training

2.7.1 Contractor shall prepare and conduct comprehensive training of Owner and its operations and maintenance personnel in the safe operation and maintenance of the Project and its equipment. Such training shall cover, at a minimum, the Project Substation, the Collection System Circuits, the Communications System, the Interconnection Line, the O&M Building, the meteorological towers, and the Wind Turbines.

2.8 Temporary Facilities

2.8.1 Contractor shall furnish and install one (1) 24-foot by 60-foot double-wide office trailer for Owner's exclusive use. Each trailer shall be located at the laydown yard and shall be installed and ready-to-use no later than the Contractor mobilization date.

(1) Each trailer shall include at least four (4) offices, and Contractor shall furnish each such office in Owner's trailers with two (2) desks, two (2) two-drawer file cabinets, two (2) rolling arm chairs, two (2) visitor chairs, and one (1) 2-foot by 3-foot white board.

(2) Each trailer shall include at least one (1) conference area, and Contractor shall furnish each such conference area in Owner's trailers with six (6) 8-foot-long tables, 16 chairs, and one (1) 4-foot by 6-foot white board.

(3) Each trailer shall include at least one (1) unisex restroom, each complete with running water, one (1) flushable toilet, and one (1) flushable urinal.

(4) Each trailer shall include at least one (1) full-size drawing table, one (1) full-size drawing rack, and two (2) 4-foot by 6-foot bookshelves, respectively.

(5) Each trailer shall include one (1) full-size refrigerator with freezer and one (1) full-size microwave. All appliances shall be new and unused.

(6) Each trailer shall be furnished with central HVAC.

(7) Each trailer shall be furnished with at least one (1) first aid kit and one (1) fully-charged fire extinguisher, respectively. Contractor shall maintain and recharge such fire extinguishers throughout the duration of the construction activities, as required.

(8) Contractor shall provide and install phone service, broadband internet service, electric service, and running water for each Owner trailer, including connection of all communications (phone and internet) to the jobsite. Phone service shall include at least one (1) four-line phone system up to the wall jacks in each trailer. Internet service shall include high-speed internet infrastructure wiring up to the wall jacks in each trailer and high-speed wireless internet service (wifi) throughout the trailer compound, respectively. All utility services shall include use and service charges to Contractor's account, including for Owner's trailers.

(9) Contractor shall furnish bottled water and ice in each Owner trailer and for Owner's exclusive use throughout the duration of the construction activities.

(10) Contractor shall provide daily cleaning services within each Owner trailer throughout the duration of the Work. This shall include cleaning restrooms and trash collection, pickup, and removal, respectively.

2.8.2 Reserved.

2.8.3 Contractor shall provide separate office trailers for his own use (including for Turbine Supplier). Contractor shall be solely responsible for furnishing his trailer(s), including any utility services.

2.8.4 Contractor shall furnish, install, and maintain portable chemical toilets for use by site construction personnel, including Owner, Turbine Supplier, and subcontractors. This shall include cleaning (at least weekly), emptying, and disposal of such toilets through substantial completion of the Project or Contractor demobilization, whichever occurs last. Following such date, Contractor shall remove all such toilets from the Project Site.

2.8.5 Contractor shall design, permit, furnish, construct, and maintain, as required, any temporary fuel containment facilities required to support ongoing construction activities. This shall include removal of all such facilities following substantial completion of the Project or Contractor demobilization, whichever occurs last.

2.8.6 Contractor shall design, permit, furnish, construct, and maintain (including disposal), as required, any hazardous materials/waste facilities required to support ongoing construction activities. This shall include removal of all such facilities following substantial completion of the Project or Contractor demobilization, whichever occurs last. Contractor shall provide Owner with a copy of all hazardous material manifests.

2.8.7 As required to perform the Work, Contractor shall procure, permit, install, construct, and maintain batch plant(s) at the Project Site, including all necessary labor and materials related to the operation of the batch plant, and removal of the batch plant at the conclusion of the Work. The batch plant shall be removed from the Project Site by Contractor within 30 days of the final Turbine Foundation completion date. Power to operate the batch plant shall be the sole responsibility of Contractor.

2.8.8 As required to perform the Work, Contractor shall procure, permit, install, construct, and maintain fixed and/or mobile rock crusher(s) at the Project Site, including all necessary labor and materials related to the operation of the rock crusher(s), and removal of the rock crusher(s) at the conclusion of the Work. The location of any fixed rock crusher(s) shall be at the temporary facility areas, and the location of any mobile rock crusher(s) shall remain within the designated disturbance areas. Power to operate the rock crusher(s) shall be the sole responsibility of Contractor.

2.8.9 Contractor shall design, furnish, construct, install, and maintain one (1) temporary laydown yard.

(1) Contractor shall incorporate into the design and construction of the laydown yard any space required by Turbine Supplier for storage or other purposes.

(2) Contractor shall furnish and maintain a system of temporary lighting for use in the Project Laydown Yard and other construction areas where required. All temporary lighting shall be removed at the completion of construction.

(3) Fencing and gates are not required for the laydown yard.

2.9 Debris

2.9.1 Contractor shall assume ownership of all construction-related debris and unsuitable materials, and each shall be removed from the Project Site and be properly disposed of by Contractor.

2.9.2 Contractor shall maintain a continuous and regular clean-up program to avoid accumulation of debris, waste, wreckage, and/or rubbish within the Project Site resulting from the Work, and shall maintain the Project Site in a neat and orderly condition throughout the performance of the Work.

2.9.3 Contractor shall provide all trash collection, pickup, and removal related to the Work, including within Owner's office trailers and other temporary facilities, and including disposal of cable reels. Dumpsters and trash receptacles shall be provided in sufficient quantities and with sufficient volume to support timely trash removal from the Project Site and preclude windblown trash generated during construction activities. Dumpsters and trash receptacles shall be emptied at a reasonable frequency to prevent overflowing or accumulation of trash around the dumpster or receptacle.

2.9.4 Contractor shall cause its subcontractors, employees, and other representatives to refrain from littering at or within the Project Site, or within other areas (including along public roadways) used in conjunction with the Work.

2.9.5 Contractor shall use lined washout pits, washout dumpsters, or other suitable means to contain the excess concrete and runoff from the cleaning of concrete trucks. All washout waste shall be properly disposed of off-Project Site by Contractor in accordance with the Requirements.

2.10 Project Site Closeout and Restitution

2.10.1 Contractor shall remove all tools, equipment, surplus materials (including unused or useless materials), waste materials, temporary work (including temporary erosion control features), temporary buildings, temporary facilities (including batch plants, rock crushers, and office trailers), and rubbish from the Project Site prior to final completion, and shall cause any facilities used by Contractor during the performance of the Work to be restored to the same or better condition that such facilities and the Project Site were in on the date the Contractor commenced work at the Project Site, ordinary wear and tear excepted.

2.10.2 Contractor shall perform restitution, restoration, and/or reclamation of Work areas to include, but not limited to, the following. Notwithstanding anything that follows, all Work areas at the Project Site shall be restored, at a minimum, in accordance with the requirements set forth in the applicable permits, the SWPPP, and the other Requirements, as appropriate.

(1) Clean all drains and ditches at completion of the construction Work, and leave the Project Site in a neat and presentable condition wherever construction operations have disturbed the conditions existing at the time of starting the Work.

(2) Preserve and/or restore to their pre-construction condition all land and water resources adjacent to construction areas.

(3) Notwithstanding the following paragraph (a), Wind Turbine Pads, laydown areas, roadway shoulders, and roadway turning radii shall be decompacted and reclaimed, including proper grading, aggregate touchup, and seeding with an approved mixture.

(a) Crane pads shall be preserved in a suitable manner to support the use of cranes in ongoing Wind Turbine maintenance activities following construction (e.g., cranes required for gearbox removal and / or installation).

(4) Re-dress all road surfaces within the Project Site.

(5) Seed all cut / fill slopes utilizing an approved seed mixture.

(6) Fill all depressions and water pockets caused by construction operations, and remove all obstructions within waterways.

(7) Spread surplus fill on-Project Site in areas and depths approved by Owner.

(8) Spread recovered aggregate from laydown yard within approved disturbance limits at Owner-approved locations.

(9) Collect large rocks or boulders unearthed during excavation as part of the Work but not utilized in the construction of the Project and store at an Owner-approved location at the Project Site.

3.0 LOGISTICS SERVICES

3.1 Transportation and Delivery

3.1.1 Contractor shall furnish and deliver all Equipment to the Project Site.

3.1.2 Contractor shall perform all off-Project Site clearing necessary for the transportation of Equipment to the Project Site, including, but not limited to, tree trimming / removal and clearing of overhead obstructions.

3.1.3 Contractor shall upgrade and maintain public roads, bridges, and culverts as required for the transportation of Equipment to the Project Site, and including obtaining any necessary permits.

3.1.4 Contractor shall furnish and operate assist vehicles (i.e., prime movers) as necessary for delivery and movement of Equipment at and within the Project Site and as needed to traverse steep grades.

3.1.5 Contractor shall inspect all delivery trucks upon arrival to the Project Site to ensure they are free of debris, mud, and vegetation, and to ensure they are in good mechanical condition. Contractor shall also regularly inspect trucks and other equipment for oil leaks. Any vehicles that fail to pass this inspection shall be turned away, unless expressly permitted by Owner.

3.1.6 Contractor shall complete a test run for Wind Turbine deliveries at the Project Site by use of non-loaded trucks to demonstrate that road dimensions will be appropriate for successfully delivering components from the Project Site entrance (to be defined by Owner) to the Wind Turbine Pads in the most critical points in terms of access. Such trial run(s) shall be completed prior to commencing deliveries of Wind Turbine equipment to the Project Site, and shall be coordinated between the Turbine Supplier, Owner, and Owner's contractors.

3.2 Offloading

3.2.1 Contractor shall receive, visually inspect, and inventory all equipment and material deliveries to the Project Site. Contractor shall submit reports to Owner within 24 hours of delivery regarding receipt, inspection, and inventorying of all such deliveries, including any damage identified.

3.2.2 Contractor shall furnish all rigging, tooling, hoisting equipment, lifting devices, and other similar items necessary to offload the equipment.

3.2.3 Contractor shall offload all equipment at the Project Site. Contractor shall offload and stage all Wind Turbine deliveries at the Wind Turbine Pad location nearest each Wind Turbine.

3.2.4 Contractor shall furnish and maintain protective tarps to eliminate unwanted materials from entering Wind Turbine equipment after removal of shrink wrapping.

3.2.5 Contractor shall furnish and install adequate measures to prevent Wind Turbine equipment from being blown over or otherwise damaged while stored at the Project Site. This shall include tie down of blades and other similar measures.

3.3 Coordination

3.3.1 Contractor shall actively coordinate the sequence of Work with Owner and Owner's contractors to support the Project Schedule.

3.3.2 Contractor shall coordinate with all transportation contractors to mitigate congestion within the Project Site. Contractor shall provide directions to the Project laydown yard to all heavy load transportation vehicles upon arrival to the Project Site and, if required by the transportation plan, Contractor shall provide an on-Project Site vehicle escort for all such deliveries to the respective delivery location(s).

3.3.3 Contractor shall coordinate with local utilities, railroad, and pipeline companies to facilitate crossings and interconnections necessary to perform the Work.

3.3.4 Reserved.

4.0 GEOTECHNICAL SERVICES

4.1 General Provisions

4.1.1 Contractor shall conduct all geotechnical, geophysical, and other similar subsurface investigations and testing necessary for the complete engineering, procurement, and construction of the Project. For the avoidance of doubt, all such investigations shall be completed before commencing the applicable Work.

4.2 Field Investigations

4.2.1 Contractor shall drill geotechnical borings and conduct material sampling at the location of each Wind Turbine; the location of the Project Substation; along the Interconnection Line; the location of the O&M Building; and the location of each free-standing meteorological tower, respectively.

4.2.2 Contractor shall perform soil resistivity measurements at the location of each Wind Turbine; the location of the Project Substation; along the underground Collection System Circuits; and along the Interconnection Line.

4.2.3 Contractor shall perform any additional geophysical or other site investigations, including, but not limited to, deepened borings, additional borings, test pits, seismic refractions, cone penetrometer soundings, *in situ* testing, and other similar or related methods, as necessary to supplement the required geotechnical investigations summarized herein or to otherwise provide the data and recommendations required in the geotechnical engineering report.

4.2.4 If using rock anchor foundations, Contractor shall perform a rock analysis to identify the presence of fissures, rock joints, or other discontinuities that will control the overall strength of the rock mass, including, but not limited to, rock mass rating, rock classifications, depth of overburden, rock quality designation, joint spacing and orientation, stratifications, rock material strength, and water pressure in joints.

4.3 Lab Testing

4.3.1 Contractor shall perform all laboratory testing of soil and rock samples as necessary to classify the materials and to obtain physical characteristics of the subsurface materials, such as strength, compressibility, and compaction.

4.4 Submittals

4.4.1 Contractor shall submit the following for review and approval by Owner *prior* to initiating subsurface investigations:

(1) Name and qualification statement for proposed geotechnical engineer.

(2) Proposed scope of subsurface investigation, including number, location, and depths of borings; anticipated plan for laboratory testing; and detailed descriptions of additional site investigation techniques, including electrical resistivity or other necessary testing.

4.4.2 Contractor shall submit a complete geotechnical engineering report containing the required information summarized in the Work Specifications.

5.0 CIVIL AND STRUCTURAL SERVICES

5.1 General Provisions

5.1.1 Contractor shall repair all drain tiles damaged during performance of the Work, including during road installation, Collection System Circuit installation, Turbine Foundation installation, crane walks, or otherwise. Repairs shall be consistent with or better than the original tile installation.

5.1.2 Contractor shall furnish, install, and maintain throughout the duration of the Work all fence crossings and gates at the Project Site.

5.2 Project Site Preparation

5.2.1 Contractor shall provide all Project Site preparation as necessary to complete the Work, including, but not limited to, all clearing, grubbing, stripping, grading, compaction, demolition, blasting, excavation, soil stabilization, drainage, roadways, and parking areas.

5.2.2 Contractor shall provide and maintain throughout the duration of construction activities all necessary construction surveying and marking necessary to construct the Project and complete the Work, to include, but not limited to, the following. Contractor shall be solely responsible for locating any survey monuments at or near the Project Site, and shall replace such monuments if they are disturbed during performance of the Work.

(1) Grading limits.

(2) Limits of disturbance.

(3) Access roads and crane paths.

(4) Project Substation pads.

(5) Collection System Circuit routing.

(6) Interconnection Line routing, including centerline and structure locations.

(7) O&M Building, including pads and parking area.

(8) Wind Turbine locations.

(9) Laydown and storage areas.

(10) Culturally-, archeologically-, and/or environmentally-sensitive areas.

(11) Utilities, pipelines, and other buried facilities.

5.2.3 Contractor shall maintain all construction areas throughout the duration of the Work. Maintenance of such areas shall include washboard removal, pothole removal, snow removal, and other similar items, in a condition suitable for daily construction traffic. Maintenance by Contractor of graveled roads at the Project Site is included in these maintenance requirements.

5.2.4 Contractor shall furnish, install, and maintain temporary orange snow fencing around all archeologically-, culturally-, and environmentally-sensitive areas at the Project Site, including those identified in the applicable permits. All temporary fencing shall be removed at the completion of construction.

5.3 Rock Excavation and Removal

5.3.1 Contractor shall excavate and remove all rock as necessary to complete the Work, including any necessary blasting. Contractor shall notify Owner prior to the use of explosives at the Project Site; no blasting shall be performed without explicit written confirmation by Owner.

5.4 Roads

5.4.1 Contractor shall design, furnish, construct, and install all roads, including Wind Turbine access roads, temporary turnarounds, intersection/radius improvements, crane paths, and transitions to/from existing roads.

5.4.2 Contractor shall design, furnish, construct, and install all public road improvements in accordance with the road use agreements, including upgrading and maintaining any public roads, bridges, and culverts as specified therein.

5.4.3 Contractor shall, prior to mobilization to the Project Site, videotape and document the condition of existing public roads for the purpose of quantifying the extent of any Contractor-caused wear and tear.

5.4.4 Contractor shall repair all wear, tear, and other damage to roads during and throughout construction of the Project, including, but not limited to, that which is caused by traffic or weather. Maintenance of Project roads by Contractor shall include, but not be limited to, washboard removal, pothole removal, and snow removal.

5.4.5 Contractor shall furnish, install, and maintain roadway gates according to the landowner agreements and other applicable Requirements.

5.4.6 Contractor shall inspect and test each roadway in accordance with the Work Specifications.

5.5 Turbine Foundations and Wind Turbine Pads

5.5.1 Contractor shall design, furnish, construct, and install one (1) Wind Turbine Pad per Wind Turbine location. Contractor shall maintain the Wind Turbine Pads throughout the duration of the Work.

5.5.2 Contractor shall design, furnish, construct, and install one (1) Turbine Foundation per Wind Turbine location, including grounding.

5.5.3 Contractor shall design, furnish, construct, and install a gravel ring (i.e., “beauty ring”) at each Wind Turbine location.

5.5.4 Contractor shall inspect and test each Wind Turbine Foundation and Wind Turbine Pad in accordance with the Work Specifications.

5.6 Drainage and Erosion Control

5.6.1 Contractor shall furnish, construct, install, and maintain all temporary and permanent drainage or erosion and sediment control, as necessary to control the erosion of embankments, temporary and final exposed slopes, and temporary stockpiles, and including the use of Best Management Practices (as defined in the Work Specifications).

5.6.2 Contractor shall furnish, construct, and install any necessary controls to protect water quality.

5.6.3 Contractor shall continuously monitor construction operations to avoid creating conditions that could lead to excessive erosion of soil with surface runoff from Work areas.

5.7 Dust Control

5.7.1 Contractor shall provide construction dust control at the Project Site throughout the duration of the Work, including furnishing of all labor, equipment, and materials, including water and/or palliatives, necessary for dust control and as necessary to reduce the risk of dust becoming a nuisance.

6.0 ELECTRICAL SERVICES

6.1 General Provisions

6.1.1 Contractor shall relocate, drop, or cross power lines as needed and as appropriate to complete the Work, with prior approval of the appropriate authority(ies). Contractor shall be responsible for obtaining and maintaining any necessary permits and / or easements for such work.

6.1.2 Contractor shall furnish and install ANSI-approved arc flash labels warning of the dangers of arc flash. Such labels shall be supplied and affixed to any equipment that may require service or maintenance while energized, as specified in the Contractor-provided arc flash study.

6.1.3 Contractor shall design and construct the Project such that the total annual energy losses under both fully-loaded conditions and Site-specific wind distribution data (to be provided by Owner), respectively, measured between the generator leads of each Wind Turbine and the Point of Interconnection shall not exceed 2.5 percent (2.5%) (the "**Electrical Loss Limit**"). For the avoidance of doubt, this shall include all medium-voltage transformers, Wind Turbine cabling, Collection System Circuit cabling, main step-up transformer, and the Interconnection Line up to the Point of Interconnection.

6.1.4 Contractor shall receive explicit approval from Owner or Owner's representative(s) of the design of all transmission lines (including the Interconnection Line) and substations (including the Project Substation) prior to construction. Owner shall have unlimited access to such designs throughout the design process, and construction of all such facilities shall be completed by one of Owner's approved subcontractors, as more particularly detailed in Appendix C (Wind) (*Approved Subcontractors*).

6.2 Collection System Circuits

6.2.1 Contractor shall design, furnish, construct, and install the Collection System Circuits.

(1) Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe Collection System Circuit configuration.

(2) Contractor shall complete all electrical connections of the Wind Turbines to the Collection System Circuits, as more particularly described in Section 7.5.3 herein.

(3) Contractor shall complete all fiber optic terminations, including, but not limited to, those at the Wind Turbines, O&M Building, Project Substation, and permanent meteorological towers.

6.2.2 Contractor shall perform directional boring at all Collection System Circuit crossings with a stream, county road, pipeline, or other buried facility.

6.2.3 Contractor shall test, commission, start-up, and place into successful operation each Collection System Circuit, including the electrical infrastructure, communications infrastructure, and pad-mount transformers (if any). At a minimum, testing shall include all requirements set forth in the Work Specifications.

6.3 Project Substation

6.3.1 Contractor shall design, furnish, construct, and install one (1) Project Substation.

(1) Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe Project Substation configuration.

(2) Contractor shall furnish all capacitor banks, reactors, and/or other reactive compensation equipment necessary for the Project.

(3) Contractor shall furnish and install fencing around the perimeter of the Substation, including one (1) man-gate and one (1) vehicle gate, respectively.

(4) For purposes of the Proposal, a full CCTV system is not required at the Project Substation, although Contractor shall install conduits and gang boxes (including covers for gang boxes) and leave appropriate space for future installation of a CCTV system at the Project Substation.

(5) Contractor shall furnish main step-up transformers in the quantity shown in the Work Specifications.

6.3.2 Contractor shall test, commission, start-up, and place into successful operation the Project Substation, including the electrical infrastructure and communications infrastructure. At a minimum, testing shall include all requirements set forth in the Work Specifications.

6.4 Interconnection Line

6.4.1 Contractor shall design, furnish, construct, and install the Interconnection Line.

(1) Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe Interconnection Line configuration.

(2) Contractor shall furnish all Work up to the point of delineation with the interconnecting utility at the interconnection switchyard / substation.

6.4.2 Contractor shall test, commission, start-up, and place into successful operation the Interconnection Line, including the electrical infrastructure and communications infrastructure. At a minimum, testing shall include all requirements set forth in the Work Specifications.

6.5 Communications System

6.5.1 Contractor shall design, furnish, construct, and install the Communications System, including the Turbine SCADA System.

(1) Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe Communications System configuration.

(2) Contractor shall furnish and install all network and communication devices, including programming and configuration, necessary for the Communications System.

(3) Contractor shall provide an open-process control ("**OPC**") interface for communication with Owner's OSI PI historian.

(4) Contractor shall furnish and install all fiber optic cabling between the Wind Turbines, Project Substation, and O&M Building.

6.5.2 Contractor shall test, commission, start-up, and place into successful operation the Communications System, including the electrical infrastructure and communications infrastructure, and including the Turbine SCADA System. At a minimum, testing shall include all requirements set forth in the Work Specifications.

6.6 Interconnection Substation / Switchyard

6.6.1 Contractor shall design, furnish, construct, and install the interconnection switchyard / substation, or cause such work to be performed by the interconnecting utility under the terms of the Project's interconnection agreement. All such work shall be completed in accordance with the Work Specifications or the interconnecting utility's requirements, whichever is more stringent.

7.0 WIND TURBINES

7.1 General Provisions

7.1.1 Contractor shall meet with Owner and Turbine Supplier prior to installation of the first Wind Turbine to participate in a one-day, in-person page turn of the Wind Turbine installation manual.

7.1.2 Contractor shall clean and wash all external Wind Turbine surfaces prior to erection to remove dirt generated by delivery and on-site storage.

7.2 Equipment Supply

7.2.1 Contractor shall furnish complete, fully-functional Wind Turbines, in a quantity sufficient to comprise the Project capacity. Wind Turbines shall be delivered to the Wind Turbine Pad location nearest each Wind Turbine.

(1) A climb assist system (one per Wind Turbine) shall be included in the Proposal as *optional* equipment; if a climb assist is standard equipment in the proposed Wind Turbine model, the Proposal shall indicate as much.

(2) A service lift system (one per Wind Turbine) shall be included in the Proposal as *optional* equipment; if a service lift is standard equipment in the proposed Wind Turbine model, the Proposal shall indicate as much.

(3) The Turbine Equipment shall be factory tested in accordance with the minimum requirements set forth in the Work Specifications and Owner shall have the right to witness such testing as set forth therein.

7.2.2 Contractor shall furnish the following Turbine Equipment, all to be delivered to the Project Site laydown yard:

(1) Turbine SCADA System.

(2) Anchor cages (one (1) per Wind Turbine), each including anchor bolts, PVC, embedment ring, nuts, washers, leveling nuts, and anchor bolt protective caps.

(3) Wind Turbine Foundation bolt templates for tower erection and, more particularly, for anchor bolt alignment, in a sufficient quantity to support the Wind Turbine Foundation installation schedule.

(4) Obstruction light brackets.

(5) Obstruction lights, including wiring.

(6) Wind Turbine earthing system

(7) Medium-voltage transformers.

7.2.3 Contractor shall furnish all containers, stands, frames, feet, racks, and any other items required to transport the Turbine Equipment (collectively, the "**Delivery Devices**") and all specialized lifting and rigging equipment necessary for Wind Turbine offloading or installation (collectively, the "**Special Tools**").

7.2.4 Contractor shall furnish and deliver to the Project Site all consumables, consumable parts, and installation spare parts necessary or appropriate to perform the Work.

(1) Contractor shall furnish touch-up paint as necessary to repair any damage to Turbine Equipment that occurs during the transportation, offloading, erection, and/or commissioning of the Wind Turbines.

(2) Contractor shall furnish the first fill of all grease, oil, and other lubricants and consumables in the Turbine Equipment. All such lubricants and consumables shall be approved by Owner prior to use.

(3) Contractor shall furnish protective tarps to eliminate unwanted materials from entering Turbine Equipment after removal of shrink wrapping.

7.2.5 Contractor shall furnish all dehumidifiers, turning gears, and other similar equipment and tools that are necessary to properly store and maintain the Turbine Equipment prior to Wind Turbine erection in accordance with the storage instructions.

7.2.6 Contractor shall provide an arc flash hazard analysis of the Turbine Equipment and ANSI-approved warning labels warning of the dangers of arc flash to be affixed to any Turbine Equipment that may require service or maintenance while energized.

7.2.7 Contractor shall furnish the Spare Parts Inventory, as more particularly described in the Agreement.

7.3 Freewheeling

7.3.1 Contractor shall provide standstill maintenance (i.e., freewheeling) of Wind Turbines during construction, if necessary.

7.4 Technical Advisors

7.4.1 Contractor shall provide (via Turbine Supplier) technical advisors at the Project Site to provide advice, consultation (including answering questions), and clarification regarding the Turbine Supplier manuals, specifications, and other Wind Turbine-related technical documents. Such technical advisors shall be available during the loading, offloading, assembly, erection, installation, storage, and achievement of mechanical completion of the Turbine Equipment.

7.5 Equipment Installation

7.5.1 Contractor shall apply touch-up paint as necessary to repair any damage to Wind Turbine equipment, including damage that occurred prior to or during Wind Turbine erection.

7.5.2 Contractor shall assemble, install, construct, and erect all Wind Turbines, including all components, equipment, down-tower assembly, stairs, climb assists (if elected by Owner), service lifts (if elected by Owner), and other similar items, and including furnishing of the main crane(s) with suitable capacity for Wind Turbine erection.

(1) Contractor shall furnish all labor, equipment (including rigging, tooling, hoisting equipment, and lifting devices), and materials that are necessary to assemble and install the Wind Turbines.

(2) Contractor shall design, furnish, construct, and install concrete pads for the stair support columns and stair landing for each Wind Turbine.

(3) Contractor shall grout, install, shim, and level all tower base sections, including providing all necessary grease, shim packs, leveling feet, and other necessary items or consumables.

(4) Contractor shall furnish and install one (1) fire extinguisher (sized according to the Applicable Standards and other Requirements) and one (1) fire extinguisher bracket in each Wind Turbine, as required by local fire codes or other Requirements.

7.5.3 Contractor shall install the electrical wiring and cabling in each Wind Turbine, including all necessary pulling, dressing, lugging, taping, splicing, and terminations, to interface to the Turbine Foundation.

(1) Contractor shall furnish all labor, equipment, and materials that are necessary for the electrical connection of the Wind Turbines to the Collection System Circuits, including all down-tower cabling.

(2) Contractor shall install the grounding system in each Wind Turbine, including grounding of Wind Turbine stairs.

(3) Contractor shall furnish and install all temporary Wind Turbine obstruction lights, including wiring and mounting brackets.

(4) Contractor shall furnish and install all permanent Wind Turbine obstruction lights, including wiring and mounting brackets.

(5) Contractor shall test the Wind Turbine tower electrical wiring and cabling. At a minimum, testing shall include all requirements set forth in the Work Specifications.

7.5.4 Contractor shall successfully achieve mechanical completion of each Wind Turbine, including documentation of progress on Turbine Supplier-supplied forms for each Wind Turbine, in accordance with the applicable instructions set forth in the installation manual and mechanical completion checklists.

7.5.5 Contractor shall provide a final broom cleaning of each Wind Turbine prior to handoff following mechanical completion.

7.5.6 Contractor shall collect and repackage all returnable items on loan from Turbine Supplier, including, but not limited to, shipping frames, delivery devices, brackets, lifting and rigging equipment, specialized tooling, and other returnable items. Contractor shall repackage all such items inside emptied parts containers according to instructions provided by Turbine Supplier, and shall provide inventory tracking and packing lists for such repackaged items. Contractor shall load all such repackaged items on transport trucks as made available by Turbine Supplier at the Project laydown yard according to the schedule set forth in the Agreement. Contractor shall be responsible for moving all such items from the Wind Turbine Pads to the laydown yard for transport as necessary.

7.5.7 Contractor shall provide qualified personnel to perform lock-out / tag-out, switching, and other similar activities during the commissioning of the Wind Turbines by Turbine Supplier.

7.6 Inspection and Commissioning

7.6.1 Contractor shall complete all fiber optic communications system terminations in each Wind Turbine and at the Turbine SCADA System server, respectively.

7.6.2 Following mechanical completion of each Wind Turbine, Contractor shall perform an inspection of each Wind Turbine. During inspection, if deficiencies or discrepancies in the requirements of the installation manual or any other Requirement are discovered, Contractor shall inform Owner of the discrepancy and such discrepancy shall be resolved prior to Wind Turbine commissioning.

7.6.3 Contractor shall start-up, test, commission, and successfully achieve commissioning completion of all Wind Turbines and other Turbine Equipment, including the Turbine SCADA System and service lifts (if elected by Owner), and including achievement of SCADA completion and all reliability tests being successfully run, including all testing set forth in the Work Specifications.

7.7 Coordination

7.7.1 Contractor shall actively coordinate the sequence of Work with Owner and Turbine Supplier to support the Project Schedule.

7.7.2 Contractor shall coordinate with Turbine Supplier on the handoff following mechanical completion. At a minimum, such coordination shall ensure that Turbine Supplier is aware that the respective Wind Turbine has successfully completed mechanical completion so that Turbine Supplier may commence inspection and commissioning activities. Additionally, Contractor shall share reasonable information with Turbine Supplier and turn over Wind Turbine access to Turbine Supplier as part of this coordination.

7.7.3 Contractor shall attend and actively participate in all Wind Turbine mechanical completion walk-downs with Turbine Supplier.

7.7.4 Contractor shall provide qualified support personnel to perform all lock-out-tag-out, switching, startup and testing activities in connection with Turbine Supplier’s commissioning, start-up and testing of the Wind Turbines.

7.7.5 Contractor shall coordinate with Turbine Supplier on any termination of power or fiber optic cabling in Wind Turbines following mechanical completion.

7.7.6 Contractor shall coordinate with the meteorological tower consultant on the installation of the meteorological towers and the termination of cabling during installation.

8.0 METEOROLOGICAL TOWERS

8.1 Power Curve Testing

8.1.1 Contractor shall include a Wind Turbine power curve test as a separate and optional line item in the Proposal. Such test shall be designed and performed in accordance with the Work Specifications, and shall include a number of tested Turbines consistent with the number of permanent meteorological towers to be installed (see Section 8.2.1 below).

(1) The Proposal shall include the guaranteed power curve level in the event the optional test is elected by Owner, as well as all test parameters expected to be incorporated (e.g., description of uncertainties, shear and turbulence filters, etc.).

(2) The optional price for the initial power curve test, if elected, shall be paid by Owner. However, should subsequent tests be performed at Contractor's option or because the initial test is unsuccessful, all such costs shall be the responsibility of Contractor.

8.2 Existing Meteorological Towers

8.2.1 Contractor shall decommission any existing, temporary meteorological towers at the Project Site. All equipment from these existing towers shall be removed from the Project Site.

8.3 Permanent Meteorological Towers

8.3.1 Contractor shall design, furnish, construct, and install permanent meteorological towers according to the following schedule and based on the number of Wind Turbines installed.

No. of Wind Turbines Installed	No. of Permanent Met Towers
Less than 50	2
51 to 100	4
101 to 150	6
151 to 200	8
201 to 250	10
251 to 300	12

(1) Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe permanent meteorological tower configuration.

(2) Contractor shall furnish and install fencing and gates around each permanent meteorological tower.

8.3.2 Contractor shall test, commission, start-up, and place into successful operation the permanent meteorological towers. At a minimum, testing shall include all requirements set forth in the Work Specifications.

8.4 Temporary Meteorological Towers

8.4.1 If Owner elects the optional power curve test, Contractor shall design, furnish, construct, and install temporary meteorological towers in the same quantity as the permanent meteorological towers.

(1) Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe temporary meteorological tower configuration.

8.4.2 If Owner elects the optional power curve test, Contractor shall test, commission, start-up, and place into successful operation the temporary meteorological towers. At a minimum, testing shall include all requirements set forth in the Work Specifications.

8.4.3 If Owner elects the optional power curve test, Contractor shall decommission all temporary meteorological towers at the conclusion of Owner's site calibration test; such work shall include removal and disposal of any meteorological tower foundations. All equipment from these towers shall be stored at an Owner-designated location at the Project Site. Removal of such temporary meteorological towers must occur prior to the commencement of Turbine Foundation construction and Wind Turbine erection activities for the applicable Wind Turbine.

9.0 O&M BUILDING

9.1 General Provisions

9.1.1 Contractor shall design, furnish, construct, and install one (1) O&M Building.

(1) Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe O&M Building configuration.

(2) Contractor shall furnish and install a backup generator for the O&M Building.

(3) Contractor shall furnish and construct an oil storage building.

(4) Contractor shall furnish and construct a garbage enclosure.

(5) Contractor shall furnish and install fencing around the perimeter of the O&M Building, including one (1) man-gate and one (1) vehicle gate, respectively.

(6) Contractor shall provide professional cleaning service for the O&M Building at the conclusion of the Work, including, but not limited to, cleaning light fixtures, mirrors, sinks, toilets, cabinets, and lockers; washing floors; washing windows; and waxing VCT.

10.0 SERVICE AND MAINTENANCE

10.1 General

10.1.1 Contractor shall provide all planned and unplanned maintenance for the facility (including Turbines and all balance-of-plant infrastructure), management services, administrative services, and other similar activities throughout the term of the Agreement and until such time that Owner assumes control of the facility, as further described in RFP Appendix K (*Wind General Services Contract-Operations and Maintenance Services*).

RFP APPENDIX A.2 (WIND)
DEFINITIONS (PPA OR BTA)

The following words shall have the respective meanings set forth below when used in Appendix A (Wind).

"**Access Roads**" means all of the complete, fully-functional roads to be constructed by Contractor under the Agreement.

"**Agreement**" means the written agreement between Owner and Contractor covering the furnishing of Work and other services in connection therewith. Other documents and deliverables are attached to the Agreement and made a part thereof as provided therein.

"**Applicable Standards**" has the meaning set forth in the Work Specifications.

"**As-Built Drawings**" means a complete set of drawings prepared by Contractor or a Subcontractor which accurately and completely represent the Work as constructed and installed.

"**BOP**" means balance-of-plant.

"**Collection System Circuit**" means the permanent electrical and communications infrastructure required to transmit energy and performance and operating data between each Wind Turbine and the Project Substation, or to the Turbine SCADA System control panel as appropriate.

"**Communications System**" means the supervisory, control, and data acquisition system for the Project Substation equipment (including all breakers, switches, transformers, relays, and meters) and permanent meteorological towers; all fiber optic cabling and supporting devices within the Collection System Circuits; and the Turbine SCADA System.

"**Contractor**" means the person, firm, or corporation with whom Owner has entered into the Agreement.

"**Contractor Deliverables**" means all drawings, plans, studies, reports, calculations, specifications, pictures, videos, test results, manuals, completion certificates, completion procedures, checklists, documents, and other similar items necessary for the successful completion of the Work.

"**Equipment**" means all of the parts, components, equipment, materials, apparatus, structures, tools, supplies, consumables, goods, and other items required or appropriate for a complete, fully-functional Project or that otherwise form or are intended to form part of the Work or the Project, including all equipment, materials, apparatus, structures, tools, supplies and other goods provided and used by Contractor and the Subcontractors for performance of the Work, but that are not incorporated into the Project, and excluding all Owner-Supplied Equipment.

"**Foundation**" means each Wind Turbine foundation.

"**Job Book**" means a manual to be prepared by Contractor and approved by Owner, which will include all Contractor engineering, design, purchasing, and other information relating to the Work.

"**Interconnection Line**" means the [TBD]-kV high-voltage transmission line connecting the Project Substation with the Point of Interconnection. "TBD" is a Project-specific voltage to be specified in the Proposal, but generally expected to be 115 kV or greater.

"**O&M Building**" means the operations and maintenance building for the Project.

"**Owner**" means PacifiCorp.

"**Point of Interconnection**" means the point where the Interconnection Line connects to the interconnection facilities constructed and owned by the interconnecting utility to which electrical power produced by the Project will be delivered.

"**Project**" means the generating facility described in the Proposal.

"**Project Schedule**" means the schedule of key dates, milestones, and other activities for timely completion of the Work, reflecting the project execution plan and anticipated sequence of site operations.

"**Project Site**" or "**Site**" means the location, or proposed location, of the Project.

"**Project Substation**" means the 34.5/[TBD]-kV substation to be located at the Project Site, with all necessary equipment to connect the Project to the interconnecting utility's grid. "TBD" is a Project-specific voltage to be specified in the Proposal, but generally expected to be 115 kV or greater.

"**Proposal**" means the formal offer of Contractor together with all information submitted that pertains to this RFP.

"**Prudent Wind Industry Practices**" means (a) those practices, methods, equipment, specifications and standards of safety, performance, dependability, efficiency and economy as are acceptable for construction and professional engineering firms performing design, engineering, procurement and construction services in North America on facilities of the type and size similar to the Project, which in the exercise of reasonable judgment and in the light of the facts known at the time the decision was made, are considered good, safe and prudent practice in connection with the design, construction and use of electrical and other equipment, facilities and improvements, with commensurate standards of safety, performance, dependability, efficiency and economy, are in accordance with generally accepted national standards of professional care, skill, diligence and competence applicable to design, engineering, construction and project management practices, and are consistent with Applicable Laws; and (b) those practices, methods, standards and acts that at a particular time in the exercise of reasonable judgment would have been acceptable to those engaged in, or approved by a significant portion of, the wind power industry for similar facilities in similar geographic areas as a reasonable effort to accomplish the desired result in a manner consistent with Applicable Laws, Applicable Standards, safety, environmental protection, economy and expedition.

"**Quality Plan**" means quality assurance and quality control plan to be prepared by Contractor in compliance with the requirements in the Work Specifications.

"**Requirements**" means the Work Specifications, Prudent Wind Industry Practices, applicable laws, applicable permits, Applicable Standards, the Project Schedule, the Project's interconnection Agreement, the Project design documents, and the other requirements of the Agreement.

"**RFP**" means request for proposals.

"**Safety Plan**" means safety plan to be prepared by Contractor in compliance with the requirements in the Work Specifications.

"**SCADA**" means supervisory control and data acquisition.

"**Security Plan**" means security plan to be prepared by Contractor in compliance with the requirements in the Work Specifications.

"**Turbine Supplier**" means a Project-specific Wind Turbine supplier to be specified in the Proposal.

"**Wind Turbine**" means each of the complete, fully-functional wind turbine generators to be part of the Project.

"**Wind Turbine Pad**" means both the crane pads and hardstands, where (i) "**crane pads**" refer to a hardstand area in connection with the erection or service of a Wind Turbine and (ii) "**hardstands**" refer to any area where Wind Turbine components, Wind Turbine equipment, transport equipment, or storage equipment are stored, placed, or parked, and including parking areas, laydown areas, and other such working areas.

"**Work**" means all actions, capital, contracts, labor, equipment, and materials necessary to construct the proposed Project and furnish wind energy and environmental attributes (including operating the Project) to Owner at the specified delivery point.

"**Work Specifications**" means the minimum performance specifications, quality standards, and other criteria required for the performance of the Work by Contractor, each as described in more detail in RFP Appendix A.3 (Wind) (*Work Specifications*).

RFP APPENDIX A.3 (WIND)
WORK SPECIFICATIONS (PPA OR BTA)

TABLE OF CONTENTS

RFP APPENDIX A.3 (WIND)
WORK SPECIFICATIONS (PPA OR BTA)

1.0 EXHIBIT INFORMATION

1.1 Purpose

1.1.1 Without limiting the information summarized herein, the purpose of this document is to summarize the *minimum* performance specifications, quality standards, and other criteria required for the engineering, procurement, and construction of the Project.

1.2 Project Description

1.2.1 PacifiCorp is soliciting proposals for cost-effective renewable resources that are located in or can be delivered to PacifiCorp's west balancing authority area ("**PACW**"). Any wind energy project to be owned and operated by PacifiCorp shall meet the PacifiCorp requirements set forth herein.

1.3 References

1.3.1 This exhibit shall be used in conjunction with RFP Appendix A.1 (Wind) (*Scope of Work*) which more fully describes the *minimum* scope of work requirements for Contractor.

1.3.2 In addition to anything summarized herein, all Work related to the Project shall conform to the following Owner standards

(1) RFP Appendix A-7.01: (*Attachment 1A – Project Document Formatting and Requirements*).

(2) RFP Appendix A-7.02: (*Attachment 1B – Project Document Deliverables*).

(3) All Project submittals *except* Project Substation and Interconnection Line: RFP Appendix A-7.03: (*Computer Aided Design (PacifiCorp Energy) General AutoCAD / Drafting Standards, Specification DCAP876*).

(4) RFP Appendix A-7.04.1: Standard ZS102 (*Two-Winding Distribution Transformer, Inverter Step-Up Liquid-Immersed (Pad Mounted, Compartmental Type)*).

(5) RFP Appendix A-7.04.2: Standard ZS101 (*Two-Winding Distribution Transformer, Inverter Step-Up Liquid-Immersed (Pad Mounted, Compartmental Type)*).

(6) RFP Appendix A-7.05: Standard ZS061 (*Material Specification – Electrical Equipment – Insulating Oil*).

(7) RFP Appendix A-7.06: Standard ZS065 (*Material Specification – Wind, Ice, and Seismic Withstand*).

(8) RFP Appendix A-7.07: Standard ZS066 (*Material Specification – Contaminated-Environment Protection*).

(9) RFP Appendix A-7.08: Standard SP-TRF-INST (*Transformer Receiving, Installation and Testing Procedure*).

(10) RFP Appendix A-7.09: Standard 006F (*Meter and Relay Equipment Memorandum*).

(11) RFP Appendix A-7.10: Substation and High Voltage Equipment, Part B – Substation Configurations, Section 6B.5 (*Fence Application and Construction*).

(12) RFP Appendix A-7.11: Substation and High Voltage Equipment, Part B – Substation Configurations, Section 6B.6 (*Substation Grounding*).

(13) RFP Appendix A-7.12: Standard GEN-ENG-RELAY-0001 (*Protective Relaying Standard*).

(14) RFP Appendix A-7.13: Standard GEN-ENG-RELAY-0002 (*Arc Flash Hazard Standard*).

(15) RFP Appendix A-7.14: Standard GEN-ENG-RELAY-0003 (*Relay Current Transformer (CT) and Potential Transformer (PT) Insulation Integrity Test*).

(16) RFP Appendix A-7.15: Standard GEN-ENG-RELAY-1003 (*Thermal Plant Protective Relay Maintenance and Testing – PRC-005*).

(17) RFP Appendix A-7.16: Relay Testing and Commissioning Checklist.

(18) RFP Appendix A-7.17: Standard GPCP-EQPMNT-INST (*Relay Installation Procedure*).

(19) RFP Appendix A-7.18: Standard GPCP-CT-INST (*Current Transformer Installation Procedure (Relay)*).

(20) RFP Appendix A-7.19: Standard GPCF-CT-INST (*Current Transformer Installation Form (Relay)*).

(21) RFP Appendix A-7.20: Standard SG-001 (*Substation High-Voltage Warning Signs*).

(22) RFP Appendix A-7.21: Specification for Substation Equipment Installation Testing Commissioning.

(23) RFP Appendix A-7.22: SV 0012 (*Bird and Animal Protection, General Installation Instructions*).

(24) RFP Appendix A-7.23: SV 251 (*Bird and Animal Protection for Miscellaneous Equipment*).

(25) RFP Appendix A-7.24: TD 051 (*Sign, Danger*).

(26) Project Substation and Interconnection Line only: Engineering Procedure No. 211 (*Substation Engineering AutoCAD Review for External Consultants*). [Note to PacifiCorp: this document was in the last RFP but is not in the current appendix list. Please confirm if it should be included.]

(27) Project Substation and Interconnection Line only: Engineering Procedure No. 211A (*External Engineering MSA Review Process*). [Note to PacifiCorp: this document was in the last RFP but is not in the current appendix list. Please confirm if it should be included.]

(28) Project Schedule only: RFP Appendix B (*Critical Path Schedule Requirements*).

1.4 Definitions

1.4.1 Unless defined in this Exhibit, terms that begin with an upper case shall have the meaning defined RFP Appendix A.2 (Wind) (*Definitions*).

1.4.2 References to "**roads**" and "**roadways**" herein shall be understood to consist of all access roads, Wind Turbine string and spur roads, substation roads, transmission line service roads, meteorological tower roads, maintenance building roads, and temporary construction roads to be constructed for the Project.

1.4.3 As used herein, "**raceway**" shall be understood to include conduit (rigid and flexible), underground duct, wireway, cabinets and boxes, and all materials and devices required to install, support, secure, and provide a complete system for support and protection of electrical conductors.

1.5 Interpretation

1.5.1 References herein to requirements to perform and/or provide work, services, equipment, or other similar items shall be understood to be the responsibility of Contractor, unless explicitly noted as being a responsibility of Owner.

1.5.2 The headings of sections and subsections herein are for convenience only and shall be ignored in construing this exhibit.

2.0 STANDARDS OF PRACTICE

2.1 General Provisions

2.1.1 Contractor shall be responsible for the interpretation of the data provided herein and validation of the proposed design.

2.1.2 Any proposed materials, structures, and/or assemblies shall be maintainable in the simplest and most cost-effective manner possible.

2.1.3 All materials shall be new, unused, of the highest quality, free of defects and irregularities, and consistent for use in wind generation facilities.

2.1.4 Equipment shall be installed, assembled, and tested in strict compliance with the manufacturer's drawings, code markings, and instructions.

2.2 Supervision and Engineer of Record

2.2.1 All engineering shall be performed under the supervision of and stamped by the engineer(s) of record, who shall be a registered professional engineer with a current license in the Project jurisdiction. Such professional engineer(s) shall be registered in the applicable discipline for the drawings being signed and sealed.

2.2.2 All Work concerning the geotechnical services shall be supervised and directed by a qualified, competent, practicing geotechnical engineer. A geotechnical engineer or engineering geologist shall observe, log borings, obtain soil samples, and record blow counts of the samples, drill rates, rock quality, depth to ground water, and other pertinent data under the direction of a licensed geotechnical engineer.

2.2.3 All Project submittals shall be subject to review and/or approval by Owner, as applicable, and shall meet the minimum requirements for submittals set forth in Section 3.2 (*Submittal Requirements*) herein.

2.3 Applicable Standards

2.3.1 The Applicable Standards shall include (i) the minimum standards and industry codes and any other criteria required for the performance of the Work by Contractor, (ii) each of the standards and industry codes listed below, and (iii) each of the relevant standards and codes issued by the organizations listed below (collectively, the "**Applicable Standards**").

(1) Aluminum Association ("AA")

(2) American Association of State Highway and Transportation Officials ("AASHTO")

(3) American Concrete Institute ("ACI")

(4) American Institute of Steel Construction ("AISC")

(5) Association of Iron and Steel Engineers ("AISE")

(6) American National Standards Institute ("ANSI")

(7) American Society of Civil Engineers (“ASCE”)

(8) American Society of Heating, Refrigeration, and Air Conditioning Engineers (“ASHRAE”)

(9) American Society of Mechanical Engineers (“ASME”)

(10) American Society of Nondestructive Testing (“ASNT”)

(11) American Society of Testing and Materials (“ASTM”)

(12) American Water Works Association (“AWWA”)

(13) American Welding Society (“AWS”)

(14) Code of Federal Regulations (“CFR”)

(15) Concrete Reinforcing Steel Institute (“CRSI”)

(16) Crane Manufacturer Association of America (“CMAA”)

(17) United States Environmental Protection Agency (“EPA”)

(18) Federal Aviation Agency, Department of Transportation (“FAA”)

(19) Federal Energy Regulatory Commission (“FERC”).

(20) Federal Highway Administration (“FHWA”)

(21) IAPMO Uniform Plumbing Code

(22) Illuminating Engineering Society (“IES”)

(23) Institute of Electrical and Electronic Engineers (“IEEE”)

(24) Instrumentation Society of America (“ISA”)

(25) Insulated Cable Engineering Association (“ICEA”)

(26) International Building Code (“IBC”)

(27) International Electrotechnical Commission (“IEC”)

(28) Applicable state requirements, including State Department of Transportation

(29) National Electric Code (“NEC”)

(30) National Electrical Contractors Association (“NECA”)

(31) National Electric Safety Code (“NESC”)

(32) National Electrical Manufacturers Association (“NEMA”)

(33) National Electrical Testing Association ("NETA")

(34) National Fire Protection Association ("NFPA")

(35) National Safety Council ("NSC")

(36) Occupational Safety and Health Administration ("OSHA")

(37) Post-Tensioning Institute ("PTI")

(38) Scientific Apparatus Makers Association ("SAMA")

(39) Sheet Metal and Air Conditioning Contractors National Association ("SMACNA")

(40) Society for Protective Coatings ("SPC")

(41) Telecommunications Industry Association/Electronic Industries Association ("TIA/EIA")

(42) Underwriter's Laboratories ("UL")

(43) DNV-OS-C502, Offshore Concrete Structures.

2.3.2 Unless otherwise specified, all engineering, procurement, and construction associated with the Project shall comply with the latest revision of all applicable codes and standards including, but not limited to, those listed herein. Any departure from the referenced codes and standards must be fully explained in writing and submitted for Owner's review and approval prior to implementation.

2.3.3 All specific standards applicable to pieces of equipment, structures, and/or buildings may not be listed herein. Specifications may describe the specific standards that may apply.

2.3.4 Any general standard or organization listed above shall be understood to include all relevant codes, standards, and/or guidelines under that particular standard or organization. For example, ACI shall include ACI 301, ACI 305, ACI 306, ACI 318, etc.

2.3.5 Unless otherwise specified herein, in the case of conflict between any Applicable Standards, the more stringent requirement shall apply.

2.4 Approved Suppliers

2.4.1 This Section 2.4 contains a list of approved materials, equipment suppliers, and subcontractors. In the event that Contractor is considering the selection of a material, equipment supplier, or subcontractor that is not listed herein, Contractor shall request approval from Owner prior to executing any contract for the procurement of such material or with such equipment supplier or subcontractor. Equipment catalog cut sheets shall be submitted for Owner review and approval prior to procurement.

2.4.2 Collection system:

(1) Approved cable suppliers:

(a) Prysmian.

(2) Approved junction box suppliers:

(a) Hubbell (Trinetics).

(3) Approved pad-mount transformer suppliers:

(a) Cooper-Eaton.

(b) General Electric.

(c) Howard.

(4) Approved 34.5-kV disconnect switch suppliers:

(a) Cleveland / Price.

(b) Morpac.

(c) Royal.

(d) Southern States.

(e) USCO.

(5) Approved 34.5-kV circuit breaker suppliers:

(a) ABB (with spring/hydraulic mechanism).

(b) Siemens.

(6) Approved grounding rod suppliers:

(a) Blackburn.

(b) Weaver.

(7) Approved cable splice suppliers:

(a) 3M.

(b) Kanusa.

(8) Approved fault indicator suppliers:

(a) Cooper.

(b) Power Delivery Products.

(c) Schweitzer.

(9) Approved compression connection suppliers:

(a) Burndy.

(b) CMC.

(c) Polaris Connectors.

2.4.3 Project Substation:

(1) Approved substation engineering contractors:

(a) Refer to Appendix C (*Approved Subcontractors*)

(2) Approved substation construction contractors:

(a) Refer to Appendix C (*Approved Subcontractors*)

(3) Approved main step-up power transformer suppliers:

(a) ABB.

(b) Delta Star.

(c) Efacec USA.

(d) GE Prolec Transformers.

(e) HICO.

(f) Hitachi Power Systems Ltd.

(g) Hyundai Heavy Industries (HHI).

(h) JSHP Transformer Corporation.

(i) Mitsubishi Electric Power Products, Inc.

(j) Pennsylvania Transformer (PTTI).

(k) Siemens Energy.

(l) Smit Transformers.

(m) Tebian Electric Apparatus Stock Company Ltd (TBEA).

(n) SPX Transformer Solutions (Waukesha).

(4) Approved station service transformer suppliers:

(a) ABB.

(b) General Electric.

(c) Cooper Power.

(5) Approved high-voltage voltage transformer suppliers:

(a) ABB (U.S. or Sweden).

(b) Alstom.

(c) Trench N.A.

(6) Approved 34.5-kV voltage transformer suppliers:

(a) ABB.

(b) Alstom.

(c) General Electric.

(d) Ritz.

(7) Approved high-voltage current transformer suppliers:

(a) ABB (U.S. or Sweden).

(b) Alstom.

(c) Trench N.A.

(8) Approved 34.5-kV current transformer suppliers:

(a) ABB.

(b) Alstom.

(c) General Electric.

(d) Ritz.

(9) Approved high-voltage circuit breaker suppliers:

(a) ABB (with spring/hydraulic mechanism).

(b) Siemens.

(10) Approved 34.5-kV circuit breaker suppliers:

(a) Schneider Electric.

(b) Siemens.

(11) Approved high-voltage surge arrestor suppliers:

(a) ABB.

(b) Cooper Power.

(c) General Electric.

(d) Hubbell.

(12) Approved 34.5-kV surge arrestor suppliers:

(a) ABB.

(b) Cooper Power.

(c) General Electric.

(d) Hubbell.

(13) Approved high-voltage disconnect switch suppliers:

(a) Cleveland / Price.

(b) Pascor Atlantic.

(c) Southern States.

(14) Approved 34.5-kV disconnect switch suppliers:

(a) Cleveland / Price.

(b) Royal.

(c) Southern States.

(d) Hubbell.

(e) USCO.

(15) Approved battery charger suppliers:

(a) Alcad / Hindle.

(b) Enersys (formerly Exide / Yuasa).

(c) LaMarche.

(16) Approved battery suppliers:

(a) Enersys (formerly Exide / Yuasa); preferred.

(b) C&D.

(17) Approved capacitor bank suppliers:

(a) ABB.

(b) Cooper Power.

(c) General Electric.

(18) Approved control building suppliers:

(a) Trachte.

(19) Approved panel suppliers:

(a) Gexpro.

(b) Codale.

(20) Approved relay suppliers:

(a) Schweitzer Engineering Laboratories (SEL).

(21) Approved grounding rod suppliers:

(a) Not used.

(22) Approved compression connection suppliers:

(a) Burndy.

(b) Hubbell.

(c) Travis Pattern.

(d) Alcoa.

2.4.4 Interconnection Line:

(1) Approved Interconnection Line engineering contractors:

(a) Refer to Appendix C (*Approved Subcontractors*)

(2) Approved Interconnection Line construction contractors:

(a) Refer to Appendix C (*Approved Subcontractors*)

(3) Approved OPGW suppliers:

(a) Corning.

(b) Fukijikura.

(4) Approved grounding rod suppliers:

(a) Blackburn.

(b) Weaver.

2.4.5 Meteorological towers:

(1) Approved meteorological tower suppliers:

(a) Nello Corporation.

(b) Renewable NRG Systems.

(2) Approved anemometer suppliers:

(a) Vaisala.

(b) Thies (First Class Advanced).

(c) RISØ / WindSensor (Class 1).

(d) RM Young (vertical anemometers).

(3) Approved wind direction sensor suppliers:

(a) Vaisala.

(b) Thies.

(4) Approved data logger suppliers:

(a) Campbell Scientific.

2.4.6 Wind Turbines:

(1) Approved Turbine Suppliers:

(a) General Electric.

(b) Siemens.

(c) Vestas.

3.0 GENERAL SPECIFICATIONS

3.1 General Provisions

3.1.1 All Work, including construction, materials storage, grading, landscaping, cut/fill, erosion control, and other similar or related activities, shall not extend beyond the designated disturbance areas. Unnecessary disturbance of the existing Project Site conditions shall be minimized, and under no circumstance may Contractor perform any Work or cause any disturbance beyond these corridors without explicit written confirmation from Owner.

3.1.2 Existing access to the Project Site, including along public roads, shall remain open throughout construction.

3.1.3 All existing infrastructure, including communications towers, pipelines, telephone lines, and electrical lines, shall be maintained in their current condition throughout the construction of the Project.

3.2 Submittal Requirements

3.2.1 This Section 3.2 sets forth the *minimum* requirements for all Contractor-provided submittals, including Contractor Deliverables.

3.2.2 General requirements:

(1) Contractor shall name and label all submittals using an Owner-approved naming convention. Such naming convention shall be used consistently for all submittals, and the only filename modification for revised submittals shall be a change in revision number. Unidentifiable submittals will be returned for proper identification.

(2) Submittals shall be accompanied by copies of native, electronic design files (e.g., AutoCAD .dwg file, PLS-CADD .bak file, etc.), including for interim design transmittals (e.g., 30%, 90%, etc. as applicable) and As-Built Drawings.

(3) All design submittals shall be provided in a common and consistent coordinate system. Such coordinate system shall be subject to Owner approval.

3.2.3 Quality requirements:

(1) Scanned submittals are not acceptable. All submittal text shall be electronically recognizable and searchable.

(2) Submittals to Owner shall be of suitable quality for legibility and reproduction purposes. Every line, character, and letter shall be clearly legible. Drawings shall be useable for further reproduction to yield legible hard copies.

(3) Documents submitted to Owner that do not conform to specified requirements shall be subject to rejection by Owner, and upon request, Contractor shall resubmit conforming documents. If conforming submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. Contractor's (or its subcontractor's) failure to initially satisfy the legibility quality requirements will not relieve Contractor (or its subcontractors) from meeting the required schedule for submittals.

3.2.4 Quantity requirements:

(1) Contractor shall electronically transmit one (1) copy of all submittals to Owner, including modifications to submittals, except as otherwise specified in RFP Appendix A.1 (Wind) (*Scope of Work*) or elsewhere in the Agreement.

(2) Contractor shall transmit submittals as hard copy format (if required) in the quantities set forth in RFP Appendix A.1 (Wind) (*Scope of Work*) or elsewhere in the Agreement.

3.2.5 Languages and dimensions:

(1) All words shall be in the English language.

(2) All dimensional units shall be in English units. When both metric and English units of measurement are presented, English dimensional units shall prevail.

(3) All drawings and dimensions shall be to scale; not-to-scale ("**NTS**") dimensions will not be permitted on scalable drawings. A scale bar shall be included to permit use following photo-reduction.

3.2.6 Submittal completeness:

(1) Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Owner to review the information effectively.

(2) Where standard drawings are furnished which cover a number of variations of the general class of equipment, each drawing shall be annotated to indicate exactly which parts of the drawing apply to the equipment being furnished. Use hatch marks to indicate variations which do not apply to the submittal. The use of "highlighting markers" will not be an acceptable means of annotating submittals. Such annotation shall also include proper identification of the submittal permanently attached to the drawing.

3.2.7 Transmittal of submittals:

(1) Submittals and Project documents shall be transmitted in (i) nonproprietary, native electronic format, incorporating any necessary reference files; and/or (ii) Adobe (*.pdf) files created directly from native electronic format.

(2) All electronic submittals shall be uploaded to Owner's web-based document management site. Selected submittals may also be required to be provided on CD, DVD, or flash drive, as specifically prescribed in RFP Appendix A.1 (Wind) (*Scope of Work*).

(3) All electronic submittals shall be clearly named and versioned (e.g., revision number, date appended to file name).

(4) Each submittal shall be accompanied by a completed transmittal letter. Submittals that are not accompanied by a completed transmittal letter will not be accepted and will be returned to Contractor. All Contractor transmittal letters submitted to Owner shall contain the following information, at a minimum:

(a) Transmittal number.

(b) Date of transmittal.

(c) Contractor's name.

(d) Project name.

(e) Owner's project number.

(f) Filename and revision number.

(g) Description of the information contained in the specific transmittal.

(h) Purpose of transmitting to Owner (i.e., issued for information, issued for review, etc.), including applicable Agreement references.

(5) Contractor shall check and approve submittals of subcontractors and manufacturers prior to transmitting them to Owner. Contractor's submission shall constitute a representation to Owner that Contractor approves such submittal(s) and has determined and verified all information contained therein, and Contractor assumes full responsibility for doing so; and Contractor has coordinated each submittal with requirements of the Work and the Agreement.

(6) Contractor shall, at the time of each submission, call to the attention of Owner in the letter of transmittal any and all deviations from the Requirements.

3.2.8 Owner's review:

(1) Owner's review and approval of submittals will not relieve Contractor of responsibility for any deviation from the Requirements unless Contractor has in writing called Owner's attention to such deviation at the time of submission, and Owner has given written concurrence in and approval of the specific deviation. Approval by Owner shall not relieve Contractor from responsibility for errors or omissions in submittals.

(2) Contractor shall make all modifications noted or indicated by Owner and return the required number of revised submittals until approved. Direct specific attention in writing, or on revised submittals, to changes other than the modifications called for by Owner on previous submittals. After submittals have been approved, submit copies thereof for final distribution. Previously-approved submittals transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or fabrication, correct the submittal and resubmit for review.

(3) Contractor shall not construct any portion of the Work until issued-for-construction drawings have been approved by Owner. Wind Turbine Foundations shall not be constructed until the Wind Turbine Foundation drawings and calculations have been approved by Owner, including its independent engineer.

(4) Contractor shall submit equipment catalog cut sheets for Owner review and approval prior to procurement.

3.2.9 Design submittals:

(1) The civil works design documents shall include a plan view of all access roads, crane paths, Wind Turbine Pads, Wind Turbine locations, staging / laydown areas, and limits of disturbance; profile views for all vertical curves; Wind Turbine delivery flow plan; grading and drainage plans; erosion control details; fencing and gate details; public road improvement details; compaction details; backfill / fill properties; road materials properties; road cross-sections; drawing index; bill of materials; construction sequencing; and inspection, testing, and quality control requirements, at a minimum.

(2) The Turbine Foundation design documents shall include reinforcing steel details; rebar shop drawings; conduit details; grouting details; civil requirements (e.g., backfill, compaction, drainage, etc.); structural calculations; tensioning sequencing and parameters; drawing index; bill of materials; construction sequencing; and inspection, testing, and quality control requirements, at a minimum.

(3) The Collection System Circuit design documents shall include a plan view of the overall system; one-line electrical diagram; cable installation details, including cable specifications, trench details, splice details, and cable marker details; cable crossing details, including road crossings, utility crossings, pipeline crossings, and directional boring; grounding details, including trench grounds and Wind Turbine grounding; termination details, including junction boxes and Wind Turbine switchgear; junction box details; meteorological tower power details; conduit and cable schedules; the Project Electrical Studies, as defined in RFP Appendix A.1 (Wind) (*Scope of Work*); drawing index; bill of materials; construction sequencing; and inspection, testing, and quality control requirements, at a minimum.

(4) The Communications System design documents shall include a plan view of the fiber optic cable layout; fiber optic loop diagram, including communication loop and connection details for all Wind Turbines, permanent meteorological towers, and the O&M Building; communications block diagram, including all Communications System equipment, Owner-Supplied Equipment (including Wind Turbines and the Turbine SCADA System), and utility equipment; logic descriptions; points lists; rack layout diagrams; HMI screen development; fiber termination diagrams; drawing index; bill of materials; construction sequencing; and inspection, testing, and quality control requirements, at a minimum.

(5) The Project Substation design documents shall include a general arrangement plan; physical layout diagrams; civil works drawings, including subgrade preparation, grading, drainage, and erosion control; protection and control system designs and philosophies; one-line diagrams; three-line diagrams; wiring diagrams, including A/C and D/C schematics; cable specifications and arrangements; conduit and cable schedules; panel scheduled; loop drawings; elevation drawings; connector and fitting details; foundation plans and details, including all structural calculations; ground grid plans; metering diagrams; conduit and trough plans; fencing details; control building drawings the Project Electrical Studies, as defined in RFP Appendix A.1 (Wind) (*Scope of Work*); drawing index; bill of materials; construction sequencing; and inspection, testing, and quality control requirements, at a minimum.

(6) The Interconnection Line design documents shall include plan and profile drawings; structure details and drawings, including elevations, spacing, and hardware; civil works drawings, including subgrade preparation, grading, drainage, and erosion control; foundation design and embedment drawings; anchoring and guying details; structural calculations; PLS-CADD design files; grounding details; drawing index; bill of materials; construction sequencing; and inspection, testing, and quality control requirements, at a minimum. Interconnection Line electrical phasing shall be placed on the plan and profile drawings. Phasing should match the phasing at the Project Substation terminations with minimal rolls and phase swapping.

(7) The O&M Building design documents shall include electrical works, including grounding and lighting plans, one-line diagrams, electrical load list, power distribution board, communications, and construction specifications; civil works, including site plan, subgrade preparation, grading/drainage, paving plan/design, and laydown area; structural works, including structural steel drawings, foundation and equipment pads (locations and details), rebar, design calculations, and construction specifications; mechanical works, including equipment arrangements/locations, equipment list, HVAC layout, fire protection and monitoring, piping and plumbing, vendor drawings (as applicable), and construction specifications; architectural works, including building layout/plans/elevations, finishes, schedules for windows and doors, and hardware; drawing index; bill of materials; construction sequencing; and inspection, testing, and quality control requirements, at a minimum.

(8) The meteorological tower design documents shall include foundation plans and details, including all structural calculations, pier details, and footing details; tower details, including boom elevations, boom directions, equipment mounting, guying details, and hardware details; instrument details, including all equipment listed under Section 8.0 of RFP Appendix A.1 (Wind) (*Scope of Work*); wiring schematics; H-frame diagrams; grounding details; power supply details; drawing index; bill of materials; construction sequencing; and inspection, testing, and quality control requirements, at a minimum.

(9) Issued-for-construction drawings shall not be changed or substantially-deviated from without Owner approval.

(10) As-Built Drawings: As-Built Drawings shall be issued as the next sequential revision from previous releases. The revision block shall state "As Built". All clouds, revision diamonds, and other interim control markings shall be removed, and all information listed as "later" or "hold" shall be completed. The As-Built Drawings shall include a final bill of materials. As-Built Drawings shall be created in the latest version of AutoCAD, or in the version of AutoCAD utilized by Owner, as applicable.

(11) All design submittals shall bear the Project name and the status of the submittal (e.g., Preliminary, Issued for Bid, Issued for Construction, As Built).

(12) Each drawing and submittal shall be sequentially numbered with a unique identifier.

(13) All materials shall be fully identified by Contractor, and each engineering package shall include a bill of materials, including all equipment and materials to be procured. Every item in the bill of materials shall have a unique identifier (typically numerical). Each bill of materials shall list product name, manufacturer, unique product / part number, and quantity.

3.3 Project Schedule Requirements

3.3.1 This Section 3.3 provides an outline for the *minimum* contents and requirements of the Project Schedule to be prepared by Contractor.

3.3.2 For purposes of only this Section 3.3, the following words shall have the respective meanings set forth below.

(1) "**Activity**" means a discrete part of a contract that can be identified for planning, scheduling, monitoring, and controlling the construction Work. Activities included in a construction schedule consume time and resources, but shall not include planned work stoppages. Activities shall not normally reflect the Work of more than one trade.

(2) "**Baseline**" schedule means the initial Project Schedule, as approved by Owner.

(3) "**Critical path**" means the longest sequence of activities in a project plan which must be completed on time for that project to complete by the stated due date.

(4) "**Critical path method**" or "**CPM**" means a method of planning and scheduling a construction contract where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Agreement.

(5) "**Float**" means the measure of leeway in starting and completing an activity. Float time (including total float) is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly-owned, expiring Project resource available to both parties as needed to meet schedule milestones and Agreement completion date.

(6) "**Predecessor activity**" means an activity that precedes another activity in the network.

(7) "**Resource loading**" means the allocation of manpower, equipment, or material necessary for the completion of an activity as scheduled.

(8) "**Successor activity**" means an activity that follows another activity in the network.

(9) "**Total float**" is the measure of leeway in starting or completing an activity without adversely affecting an intermediate deadline or the planned Agreement completion date.

3.3.3 General requirements:

(1) Contractor's accepted Baseline schedule will be set forth in Appendix B (*Critical Path Schedule Requirements*).

(2) Contractor shall utilize Primavera Professional Project Management Software from Oracle for preparation of the Project Schedule. At a minimum, this shall be version Primavera P6.7 or newer.

(3) Activities in the Project Schedule shall be defined so that no single construction activity is longer than 20 calendar days and no single other activity is longer than 30 calendar days, respectively, unless specifically allowed by Owner.

(4) Each activity shall be assigned a number. Numbering shall be such that predecessor activity numbers are smaller numerically than successor activity numbers in the Baseline Project Schedule. Contractor shall use even-numbered activities for base Agreement Work, and odd-numbered activities for change order work. No activity number shall change after approval of the Baseline Project Schedule.

(5) The Project Schedule shall include a clear and logical work breakdown structure, wherein all items are assigned a sensible activity number based upon the type of work being performed. Such work breakdown structure shall be subject to approval by Owner.

(6) Procurement process activities shall be included for all long-lead and major items (as defined by Owner) as separate activities in the Project Schedule. Procurement cycle activities shall include, but not be limited to, submittals, approvals, purchasing, fabrication, and delivery.

(7) The Project Schedule shall indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

(a) Preparation and processing of submittals.

(b) Mobilization and demobilization.

(c) Acquisition of key permits.

(d) Completion of interconnection studies and interconnection agreement, respectively.

(e) Purchase of major equipment.

(f) Delivery.

(g) Fabrication.

(h) Utility interruptions.

(i) Installation.

(j) Work by Owner that may affect or be affected by Contractor's activities.

(k) Startup and initial operations.

(l) Tests and inspections.

(m) Training.

(8) The Project Schedule shall include Milestones indicated in the Agreement, including, but not limited to, guaranteed Milestone completion dates. All major milestones shall be presented at the top of the Project Schedule.

(9) The Project Schedule shall show the Work in Gantt chart format, on a sheet size of 11-inch by 17-inch, the scale and spacing shall allow room for notation and revisions, and the font shall be sized such that it is easily legible when printed.

(10) Each revised or updated Project Schedule shall show actual progress compared to the originally-accepted Baseline schedule and any proposed changes in the schedule of remaining Work.

(11) The Project Schedule shall clearly identify all critical path activities. Scheduled start and completion dates shall be consistent with Agreement milestone dates.

(12) Contractor shall not use artificial activity durations, preferential logic, or other devices for sequestering Float. Owner retains the right to reject any schedule submittal in which Contractor has sequestered Float. Any activity with lag greater than two (2) days shall be identified in the activity description.

(13) Constraint dates shall be kept to a minimum, and all constraints shall be identified with descriptive text in the activity description.

(14) All activities shall have a predecessor activity and successor activity except for the first and last activities in the Project Schedule.

(15) Each Project Schedule shall meet the minimum requirements for submittals set forth in Section 3.2 (*Submittal Requirements*) herein.

(16) The Project Schedule shall include allowances for delays that may be encountered for reasonably-expected weather conditions, non-working holidays, and other similar items.

3.3.4 Concurrent with each Project Schedule submittal, Contractor shall submit the following reports:

(1) General: electronic copies of the complete Project Schedule file in P6 executable (*.xer) format (including the Project-specific *.plf layout filters) and Adobe (*.pdf) format, respectively.

(2) Critical path report: list of all activities on critical path, sorted in ascending order by activity number.

(3) Activity report: list of all activities sorted by activity number and then start date, or actual start date if known. Within each activity, Contractor shall indicate estimated completion percentage in no greater than 10 percent (10%) increments.

(4) Logic report: list of preceding and succeeding activities for all activities, sorted in ascending order by activity number.

(5) Total float report: list of all activities sorted in ascending order by activity number and showing total float by activity.

(6) Three-week look ahead: list of all planned Work activities during the current week and the subsequent two-week interval, sorted in ascending order by activity number.

(7) Tabulated reports and/or schedule layouts showing the following:

(a) Identification of activities that have been added, deleted, or changed.

(b) Changes in activity durations in workdays.

(c) Changes in total float.

(d) Detailed schedule layout showing start and finish date variances.

(e) Critical path and near critical path (1 to 15 days float) layout with variances.

(f) Major milestone report with variances.

(g) Activity constraints, including type.

(8) Format for each activity in all reports described above shall contain, at a minimum, activity number, activity description, resource loading, original duration, remaining duration, early finish date, late start date, late finish date (or actual start date and/or actual finish date, as applicable), and total float in calendar days.

3.4 Job Book Requirements

3.4.1 This Section 3.4 sets forth an outline for the *minimum* contents of the Job Books to be prepared by Contractor.

3.4.2 Job Book outline:

(1) General:

(a) Index:

1. Job Book index

2. Drawing index, including all categories listed under Section 3.4.2(2)(b) below

(b) Schedule:

1. Final Project Schedule

2. Actual delivery schedule of Owner-Supplied Equipment

(c) Contractor plans:

1. Safety Plan

2. Security Plan

3. Environmental Plan

4. Project execution plan

(d) Health and safety statistics:

1. Project construction Work hours and statistical information

2. Incident reports, including accidents, thefts, injuries, and near misses

(e) Changes:

1. Project Change Orders

2. Contractor correspondence concerning Change Orders

(f) Permits:

1. Owner permits

2. Contractor permits

3. Certification of compliance to permit requirements

(g) Training:

1. Project construction training records

2. Copies of training manuals

(h) Reporting:

1. Plan of the day reports

2. Weekly progress reports

3. Monthly progress reports

(i) Contracting:

1. List of Subcontractors used on the Project

2. Summary of all work performed by Subcontractors

3. Copies of all subcontracts for construction services (non-priced)

4. Copies of purchase orders for major equipment

(2) Drawings and manuals:

(a) Design documentation:

1. Project Site plan

2. As-built Wind Turbine coordinates

3. Design basis and Project Site data

4. Engineering calculations and design studies

5. Final geotechnical engineering report

(b) Issued for construction drawings:

1. Civil works

2. Collection System Circuits

3. Turbine Foundations

4. Project Substation (including civil, structural, and electrical)

5. Interconnection Line

6. SCADA System

7. O&M Building

8. Meteorological towers

9. As-Built Drawings, including all items listed under Section 3.4.2(b) above

10. Project bill of materials

11. Correspondence between Owner and Contractor, including RFIs

(c) Manuals and data sheets for all major equipment within or a part of the following:

1. Collection System Circuits

2. Project Substation

3. Interconnection Line

4. SCADA System

5. O&M Building

(d) Other equipment documentation:

1. Instruction manuals where appropriate for building systems

2. Equipment factory acceptance test reports

3. Spare parts list

4. Warranty agreements (including contact information) for all Equipment

(e) Material safety data sheets

(3) Quality assurance documentation:

(a) Construction photographs:

1. Photographs of construction activities

2. Photographs of Project Site restoration

(b) Civil / structural works:

1. Access Road inspection documentation

2. Drainage structure inspection documentation

3. Soil testing results

4. Compaction testing results

5. Moisture and density analysis

6. Concrete mix design(s) and placement procedures

7. Grout mix design(s) and placement procedures, including specification sheets

8. Concrete and grout testing results / reports

9. Concrete batch tickets

10. Non-conformance and corrective action reports

(c) Turbine Foundations:

1. Wind Turbine pad inspection and testing results

2. Turbine Foundation subgrade inspection and testing results

3. Foundation Inspection Report, as defined in RFP Appendix A.1 (Wind) (*Scope of Work*)

4. Reinforcing steel placement inspection

5. Concrete mix design(s) and placement procedures

6. Grout mix design(s) and placement procedures, including specification sheets

7. Concrete and grout testing results

8. Concrete batch tickets

9. Concrete pour logs

10. Grout placement inspection

11. Pre-backfill Turbine Foundation inspection

12. Turbine Foundation backfill testing

13. Reinforcing steel, embedment ring, and anchor bolt mill certificates

14. Non-conformance and corrective action reports

(d) Collection System Circuits:

1. Trenching and cable installation inspection

2. Splice inspections, including coordinates of splice locations

3. Termination inspections

4. Junction box inspection, including coordinates of cabinet locations

5. Directional boring inspection

6. Pad-mount / medium-voltage transformer installation inspection

7. Energization and testing procedures

8. Electrical testing and commissioning results, including commissioning checklists

9. Non-conformance and corrective action reports

(e) Project Substation:

1. Construction inspection documentation

2. Energization and testing procedures

3. Electrical testing and commissioning results, including commissioning checklists

4. Non-conformance and corrective action reports

(f) Interconnection Line:

1. Construction inspection documentation

2. Energization and testing procedures

3. Electrical testing and commissioning results, including commissioning checklists

4. Non-conformance and corrective action reports

(g) Agreement certificates (e.g., Certificate of Access Road Completion).

(h) Other certifications:

1. Reinforcing steel mill certificates

2. Flange bolt certifications

3. Tooling calibration records and testing certificates

4. Rigging inspection reports

5. Welding certifications

6. Equipment receipt, inspection, and inventory reports

(4) Wind Turbine binders (One per Wind Turbine):

(a) Wind Turbine Equipment receipt and visual inspection forms

(b) Certificate of Wind Turbine Mechanical Completion

(c) Wind Turbine punch lists

(d) Turbine Supplier assembly and erection checklists

(e) Anchor bolt tensioning logs, including 10% inspection

(f) Torque logs, including tower, nacelle, rotor, and rotor blades

(g) Wind Turbine wiring testing results

(h) Wind Turbine grounding testing results

(i) Service lift installation checklist (if applicable)

3.5 Quality Plan Requirements

3.5.1 This Section 3.5 sets forth an outline for the *minimum* contents and requirements of the Quality Plan to be prepared by Contractor.

3.5.2 Quality Plan outline:

(1) Overview:

(a) Purpose and scope of quality assurance program

(b) Description of quality system procedures

(2) Personnel:

(a) Roles and responsibilities:

1. Project director(s)
2. Project manager
3. Quality manager
4. Construction manager / site manager
5. Project engineer(s)
6. Superintendents and foremen
7. Testers / inspectors (including third parties)

(b) Organization chart (including all personnel listed in Section 3.5.2(2)(a) above)

(c) Reporting responsibilities:

1. Lines of authority
2. Communication procedures
3. Authority to stop work

(3) Administration:

(a) Document control:

1. Document control plan / procedure
2. Transmittal process, including naming convention
3. Document revision process / change management
4. Redlines and as-built documents

(b) Routine documentation procedures:

1. Daily, weekly, and monthly reporting
2. Incident reporting
3. Non-conformance reports
4. Technical clarifications / requests for information
5. Notice of design change process
6. Field design change process

(c) Personnel training:

1. Requirements (competency / certification)
2. Records

(d) Quality meetings

(4) Inspections, testing, and non-conformance:

(a) Audits:

1. Schedule of audits
2. Audit personnel
3. Non-conformance reports

(b) Inspections (including frequency, duration, procedures, and documentation for each):

1. Tools and equipment
2. Materials
3. Field work (e.g., civil works, electrical works, structural works)
4. Field tests and laboratory qualifications
5. Checklists and installation procedures

(c) Non-conformance reporting

(d) Issues / conflict resolution process

(5) Sample forms:

(a) Non-conformance report

(b) Request for information

(c) Transmittal

(d) Inspections

3.5.3 Other Quality Plan requirements:

(1) The Quality Plan shall be specific to the Project and the Project Site.

(2) The Quality Plan shall be sufficient in scope and detail to convey the means and methods that will be employed by Contractor to perform all aspects of the Work.

(3) The Quality Plan shall clearly communicate the anticipated actions of Contractor in the event of defects or non-conformance of the Work, including corrective action.

3.6 Safety Plan Requirements

3.6.1 This Section 3.6 sets forth an outline for the *minimum* contents and requirements of the Safety Plan to be prepared by Contractor.

3.6.2 Safety Plan outline:

(1) General:

(a) Purpose and scope of safety program

(b) Project Site description

(c) Project Site map

(d) Roles and responsibilities / key personnel / contact information

(2) Project Site rules:

(a) Project Site / employee orientation

(b) Project Site- and task-specific training

(c) Stretching program

(d) Firearms / weapons

(e) Motor vehicle operation qualifications and requirements

(f) Heavy equipment operation qualifications and requirements

(g) Substance abuse program

(h) Removal of employees

(i) Subcontractor management

(j) Badging requirements

(k) Tours / third-party visits

(l) Disruption avoidance plan

(m) Incident notification procedures

(3) Emergency procedures:

(a) Safety stand-down procedures

(b) Explosion procedures

(c) Severe weather procedures

(d) Bomb threat procedures

(e) Utility emergency procedures

(f) Civil disturbance procedures

(g) Tower rescue procedures

(h) Snake / insect bite and dangerous animals

(i) Spill control and prevention plan

(j) Evacuation procedures

(k) Emergency route map

(l) Emergency contacts and first responder list

(4) Health and safety programs:

(a) Job safety and environmental analysis ("**JSEA**") program / pre-task planning

(b) Toolbox talks

(c) Personal protective equipment ("**PPE**") requirements

(d) Fire prevention and suppress procedures

(e) Fall protection program

(f) Walking / working surfaces

(g) Scaffold standards

(h) Tower climbing program

(i) Crane and erection safety program

(j) Crane walking procedures

(k) Excavation and trenching program

(l) Hazard communication / hazardous materials program

(m) Electrical safety

(n) Lockout / tagout ("**LOTO**") program

(o) Motor vehicle and traffic safety program

(p) Respiratory protection program

(q) Concrete safety program

(r) Confined space entry program

(s) Inspection / audit program

(t) Incident / injury reporting and investigation program

(u) Hand and power tool safety program

(v) First aid / CPR / medical response program

(w) Bloodborne pathogens

(x) Permitted work requirements

(y) Blasting requirements

(z) Competency requirements

(aa) Hunting safety

(bb) Environmental program

(5) Required checklists and forms:

(a) Accident / injury / incident report forms

(b) Site orientation training verification form – employee

(c) Site orientation training verification form – visitor

(d) Stretch and bend sign-in form

(e) Safety audit checklist

(f) Site inspection forms

(g) Critical lift planning forms and checklists

(h) Excavation inspection form

(i) Competency evaluation forms

(j) JSEA form

(k) Toolbox talk form

(l) Rigging inspection forms

(m) Hazardous materials inventory form

(n) Heavy equipment inspection forms (daily, monthly)

(o) Heavy equipment operator certification form

(p) Respirator compliance checklist

(q) Respirator fit test certification form

(r) Form of LOTO permit and extraction form

(s) Form of hot work permit

(t) Form of dig permit

(u) Form of blasting permit

(v) Form of confined space entry permit

3.6.3 Other Safety Plan requirements:

(1) The Safety Plan shall be specific to the Project and the Project Site.

(2) The Safety Plan shall be sufficient in scope and detail to convey the means and methods that will be employed by Contractor to perform all aspects of the Work.

(3) All rigging shall be rated; inspected daily and monthly; and load tested in accordance with the Applicable Standards or other more rigorous requirements set forth in the Safety Plan. The manufacturer-rated capacities shall be legible and permanently affixed. Inspection reports shall be maintained at the Project Site and available for review by Owner. Copies of testing certificates and calibration records for all tooling shall be maintained at the Project Site and available for review by Owner.

(4) Contractor shall conduct daily job hazard analysis meetings for each task to be performed in order to identify and mitigate potential hazards prior to beginning Work. Each such meeting shall be specific to the task and shall be conducted at the respective work area. A job hazard analysis form shall be completed daily for each such meeting.

(5) Contractor shall conduct site safety orientation for all personnel working on the Project Site, including, but not limited to, Owner, Turbine Supplier, subcontractors, office personnel, and visitors, prior to their being released to work on the Project Site.

(6) Contractor shall liaise and coordinate with local emergency services, including coordination with local "life flight" to identify landing sites available for helicopter emergency evacuation of personnel.

(7) Contractor shall perform all necessary emergency response drills, to be performed at least quarterly, including coordination with local emergency response officials and hospitals and incorporating the dispatch of ambulance and life flight to the Project Site.

(8) Contractor shall immediately report all near misses, accidents, thefts, injuries (including first aid), and safety incidents to Owner's site manager and health and safety representative(s). A written incident report shall be submitted to Owner within 48 hours of each incident.

(9) Contractor shall provide all necessary safeguards to ensure safety and security of, at a minimum, the Project Site, equipment, and personnel at the Project Site.

(10) Contractor shall provide drug and alcohol testing for all injuries requiring more than first aid; if drug or alcohol use is reasonably suspected; in the event of equipment damage that causes a loss of more than 10 hours of operable work; or in the event of equipment damage that exceeds $5,000 in estimated damage to the equipment or related work. Drug and alcohol testing shall be performed as soon after the event as reasonably possible.

3.7 Security Plan Requirements

3.7.1 This Section 3.7 sets forth an outline for the *minimum* contents and requirements of the Security Plan to be prepared by Contractor.

3.7.2 Security Plan outline:

(1) General:

(a) Purpose and scope of security program

(b) Project Site description

(c) Project Site map

(d) Roles and responsibilities / key personnel / contact information

(2) Project Site security procedures:

(a) Controlled entry procedures

(b) Badging requirements

(c) Site / employee orientation

(d) Suspicious activity and unauthorized visitor procedures

(e) Security threats / emergency procedures

(f) Firearms / weapons

(g) Site security procedures

(h) Equipment security procedures

(i) Security guards and patrols

(j) Incident notification procedures

3.7.3 Other Security Plan requirements:

(1) The Security Plan shall be specific to the Project and the Project Site.

(2) The Security Plan shall be sufficient in scope and detail to convey the means and methods that will be employed by Contractor to perform all aspects of the Work.

3.8 Foundation Inspection Reports

3.8.1 A Foundation Inspection Report, as defined in RFP Appendix A.1 (Wind) (*Scope of Work*), shall be provided for each Turbine Foundation excavation and every drilled pier constructed (if any). Each report shall include the following minimum information:

(1) Information on the foundation excavation, including, but not limited to, date, ambient air temperature, line name, structure number, location, structure type, foundation type, size and condition (e.g., dry excavation, casing, slurry) of excavation, soil conditions, depth to rock, depth to water, and method of disposal of excavated/displaced material.

(2) Concrete and concrete placement information, including, but not limited to, concrete supplier, concrete mix number, batch tickets (including batch time), number of cubic meters placed (including time of placement for each truck), concrete temperature, results of concrete testing, name of person performing concrete testing, number of test cylinders cast, placement and compaction method (e.g., free fall, tremie, slurry displacement, pumped), curing measures, and protection against freezing or heat.

(3) A delivery ticket shall be prepared for each load of concrete delivered, including, but not limited to, the number of cubic meters delivered, the quantities of each material in the batch, the ambient temperature at the time of delivery, the time at which the cement was added, the amount of water able to be added at the pour site, and the numerical sequence of the delivery. The delivery ticket shall be handed to the authorized representative of Contractor by the truck operator at the time of delivery, and a copy of each delivery ticket shall be included in the Foundation Inspection Report.

3.9 Rigging and Tooling

3.9.1 All rigging shall be rated; inspected daily and monthly; and load tested in accordance with the Applicable Standards or other more rigorous requirements set forth in the HSSE Plan (as defined in RFP Appendix A.1 (Wind) (*Scope of Work*). The manufacturer-rated capacities shall be legible and permanently affixed. Inspection reports shall be maintained at the Project Site and available for review by Owner.

3.9.2 Copies of testing certificates and calibration records for all tooling shall be maintained at the Project Site and available for review by Owner.

3.10 Fencing, Walls, and Gates

3.10.1 All permanent fencing and gate materials, including for the Project Substation, O&M Building, and meteorological towers, shall be galvanized in accordance with ASTM A392.

3.10.2 Unless stated otherwise, fencing shall be 8-foot-high (7-foot fence plus 1-foot barbed wire), anti-climb, chain link, perimeter fencing. Fencing fabric shall be woven into a 2-inch diamond mesh.

3.10.3 Barbed wire shall be shall be a minimum of 2-strand, #12-1/2 steel wire gauge with 4 half-round barbs of #14 steel wire gauge at 5-inch spacing. After weaving, the wire shall be galvanized per ASTM A121. Barbed wire fencing posts shall be galvanized, standard-weight steel pipe. At least three (3) lines of barbed wire shall be provided when used.

3.10.4 Unless stated otherwise, or as necessary to complete the Work, gate widths shall be consistent with road widths, wherein all gate posts shall be set outside of the road width area.

3.10.5 Sufficient space and graded area shall be provided near each gate to allow truck turning.

3.10.6 All corner posts and gate posts shall be set (embedded) in concrete.

3.10.7 All gates shall be designed to adequately contain livestock without being pushed open, bending, or otherwise failing. Further, all gates shall be designed to adequately prevent opening due to wind conditions expected at the Project Site.

3.10.8 A gate shall be installed at every location where a roadway penetrates an existing fence line at the Project Site. Each such gate shall be a double-hung, prefabricated, finished metal gate. Each such gate shall be a minimum 40-feet-wide manual swing gate with a pipe frame and manufacturer's standard coating finish; complete with hinges and latching hardware; complete with a metal hinge post and removable center post; lockable; and each gate post shall be set in concrete.

3.10.9 Cattle guards shall cover the full road width, and be installed level and provided with a stable base capable of sustaining heavy loads without shifting or settling.

3.11 Signage

3.11.1 Temporary signage shall be legible and of sufficient durability to last the duration of construction activities.

3.11.2 Temporary signage shall be approved by Owner prior to installation.

3.11.3 All signage and equipment marking (including numbering and labeling) are subject to approval by Owner.

3.12 Dust Control

3.12.1 Water used for dust control shall be treated to ensure no negative impacts to human health and ecology, including downstream environments.

4.0 GEOTECHNICAL WORK SPECIFICATIONS

4.1 General Provisions

4.1.1 All geotechnical, geophysical, and other similar subsurface investigations and testing described herein or within RFP Appendix A.1 (Wind) (*Scope of Work*) shall be completed before commencing the applicable Work.

4.1.2 The geotechnical engineering report shall be utilized for the design and construction of all Project structures, including Turbine Foundations. All foundations shall be designed with consultation of a licensed geotechnical engineer.

4.1.3 The maximum loads (including load factors) applied to the foundations and used for design shall be determined from the structure design of the supported structure considering load cases and Applicable Standards associated with the particular structure type.

4.1.4 Foundation designs shall neglect or degrade soil strength properties at the top of the foundation as a result of frost or disturbance during drilling per recommendations of the geotechnical engineer.

4.1.5 The Project Site premises shall at all times remain free from accumulations of waste materials or rubbish resulting from the subsurface investigations.

4.1.6 All field investigations and all laboratory testing shall comply with the Applicable Standards, including the most current, applicable ASTM standards.

4.2 Field Investigations

4.2.1 Geotechnical borings and material sampling shall be provided at the following minimum frequencies:

(1) Wind Turbines: each Wind Turbine location.

(2) Project Substation: minimum of five (5) locations at the Project Substation.

(3) Interconnection Line: each angled and dead-end structure, respectively, as well as any additional borings and samplings necessary to ensure that adjacent borings are no more than one (1) mile apart.

(4) O&M Building: minimum of one (1) location at the O&M Building.

(5) Meteorological towers: each free-standing meteorological tower location.

4.2.2 Geotechnical borings and material sampling shall be provided at the following minimum depths:

(1) All borings: minimum depth of 35 feet below base of foundation, or greater if specified below.

(2) Wind Turbines: minimum depth of at least one (1) foundation diameter for spread footer foundations, or minimum depth of at least 10 feet beyond the anticipated depth of the foundation at such location (including anchors, if applicable) for rock anchor foundations.

(3) Project Substation: to a minimum depth necessary to provide sufficient information for the data and recommendations required in the geotechnical engineering report.

(4) Interconnection Line: to a minimum depth necessary to provide sufficient information for the data and recommendations required in the geotechnical engineering report.

(5) O&M Building: to a minimum depth necessary to provide sufficient information for the data and recommendations required in the geotechnical engineering report.

(6) Meteorological towers: to a minimum depth necessary to provide sufficient information for the data and recommendations required in the geotechnical engineering report.

4.2.3 Sufficient rock core samples shall be obtained from each boring to adequately characterize and test the material, including coring from the point at which competent rock is encountered and until the appropriate boring depth is achieved (at a minimum). All core samples shall be delineated and digitally photographed in color. Unaltered rock core samples shall be placed in a core box and taken to a laboratory for analysis.

4.2.4 Additional geotechnical and geophysical investigations shall be performed as necessary to adequately describe and characterize the Project Site materials and provide the data and recommendations required in the geotechnical engineering report. These shall include, but not be limited to, standard penetration tests, and Shelby tube samples, additional borings, test pits, seismic refractions, cone penetrometer soundings, *in situ* testing, and other similar or related methods.

4.2.5 If using rock anchor foundations, a rock analysis shall be performed to identify the presence of fissures, rock joints, or other discontinuities that will control the overall strength of the rock mass, including, but not limited to, rock mass rating, rock classifications, depth of overburden, rock quality designation, joint spacing and orientation, stratifications, rock material strength, and water pressure in joints.

4.2.6 Soil resistivity testing shall be completed using the Wenner Four-Electrode method.

4.2.7 Existing utilities in the vicinity of borings or other subsurface test locations shall be identified and protected.

4.2.8 Borings shall be backfilled with cement-bentonite grout and in a manner and with materials required under the applicable laws of the location of the Project Site. Excess cuttings shall be disposed of by Contractor in accordance with the applicable Requirements and subject to Owner approval.

4.2.9 Borings shall be drilled using methods that minimize the potential for disturbance, sloughing or mixing of materials within samples. When water is encountered in a hole in cohesionless materials, rotary wash drilling methods with bentonite or polymer slurry shall be used, maintaining a positive head in the borehole at all times.

4.2.10 Unless explicitly stated otherwise, all rock core sampling shall be complete, full-boring-length samples. Such coring shall span from the point at which competent rock is encountered and until the appropriate boring depth is achieved (at a minimum).

4.2.11 All core samples shall be delineated and digitally photographed in color. Unaltered rock core samples shall be placed in a core box and taken to a laboratory for analysis.

4.2.12 Contractor shall obtain 24-hour water level readings in boreholes or install piezometers for long-term water level readings as required to determine prevailing groundwater levels.

4.2.13 A geologic review should consist of a review of the geologic data along the Project alignment. This review should identify and document areas of landslides, potential landslides, potential geologic hazards, past (historical) earth movements, and transitions between geologic units. Special consideration should be given to identify active and potential landslide zones.

4.3 Lab Testing

4.3.1 All testing described herein shall be performed by an independent, experienced third party.

4.3.2 Laboratory testing shall be sufficient to provide the data and recommendations required in the geotechnical engineering report, at a minimum. Laboratory testing shall include chemical testing to evaluate corrosion potential and to determine the required cement type for concrete.

4.3.3 At a minimum, laboratory testing shall include the following:

(1) Moisture content (ASTM D2216).

(2) Grain size analysis (per ASTM D422).

(3) Atterberg limits (per ASTM D4318).

(4) Maximum soil density (per ASTM D4253).

(5) Specific gravity (per ASTM D854).

(6) Compaction characteristics of the soil (per ASTM D698 or ASTM D1557 A).

(7) Unit weight determination (per ASTM D653).

(8) Core recovery percentage and rock quality designation when rock is encountered.

(9) Perform multi-channel analysis of surface wave tests.

(10) Soil resistivity testing (per ASTM-G57-95a). Results to be submitted in Ω-cm.

(11) Direct shear angle.

(12) Cohesion constant.

(13) Unconfined compressive strength (per ASTM D2166).

(14) Unconsolidated undrained (UU) triaxial compression (per ASTM D2850).

(15) Consolidation test parameters (per ASTM D2435).

(16) Soil corrosiveness (chloride, sulfate, and pH).

(17) California bearing ratio.

(18) Dry and wet densities.

4.4 Submittals

4.4.1 The geotechnical engineering report shall contain the following, at a minimum:

(1) Boring location drawings and coordinates.

(2) Field photographs.

(3) Description of the drilling and sampling program.

(4) Final boring logs.

(5) Description of the geology.

(6) Subsurface and groundwater conditions encountered.

(7) Summary of results of field and laboratory tests performed.

(8) Foundation recommendations (as further described in Section 4.4.2 below).

(9) Specific design criteria for the Project (as further described in Section 4.4.2 below).

4.4.2 Contractor's design criteria shall address the following items, as a minimum:

(1) Impacts of new construction on existing facilities.

(2) Factors of safety used in determining allowable foundation loads.

(3) Recommended foundation types for all structures.

(4) Discussion of the dynamic soil properties at the Project Site, including dynamic shear modulus, Poisson's ratio, Young’s Modulus, and shear wave velocity.

(5) Recommendations for designing for seismic issues, including liquefaction potential. Identify the building code site coefficient/site classification for seismic design.

(6) Recommendations for site dewatering and construction practices, including design water level.

(7) For shallow foundations:

(a) Allowable soil bearing values and minimum bearing depths.

(b) Anticipated total and differential settlements.

(c) Uplift resistance.

(d) Lateral resistance.

(e) Subgrade modulus.

(f) Dynamic spring constants for foundations supporting vibrating machines, if applicable.

(8) For deep foundations:

(a) Type of deep foundation (e.g., drilled shaft, rock anchor).

(b) Diameter (or dimensions) and depth of foundation members.

(c) Minimum spacing and group reduction factors.

(d) Allowable compressive, uplift, and lateral capacities, including allowable skin friction and end bearing capacities.

(e) Anticipated settlements and lateral deflections.

(f) Static and dynamic spring constants.

(9) For retaining structures:

(a) Active, passive and at-rest earth pressures for both drained and undrained conditions and requirements for type of backfill.

(b) Required rotation or translation to mobilize active and passive pressures.

(c) Recommendations of methods to insure drained conditions.

(10) Recommendations for slopes:

(a) Temporary excavation slopes and OSHA soil types.

(b) Permanent slopes.

(11) Temporary and permanent excavation support requirements.

(12) Corrosion potential and chemical attack to construction materials.

(13) Recommended cement type in concrete and corrosion protection for buried steel, based on chemical test results. Recommended cement type shall be based on soluble sulfate content in the soil and ACI recommendations.

(14) An evaluation of the expansive, dispersive, and collapsing nature of the on-Site soil materials and discussion of design features to resist these tendencies.

(15) Recommendations for earthwork requirements including acceptable fill materials, moisture contents, compactive effort, lift thickness, proofrolling, equipment, and compaction testing.

(16) Recommended aggregate gradations for general fill, load bearing fill, granular road base, and granular surfacing.

5.0 CIVIL WORKS SPECIFICATIONS

5.1 General Provisions

5.1.1 All civil works design shall conform to Turbine Supplier's requirements for roads, crane pads, and hardstands (the "**Turbine Supplier Project Site Requirements**").

5.2 Design Working Life

5.2.1 The design working life of the civil works shall be a minimum of 30 years.

5.2.2 The design of the civil works shall be consistent with the following storm events:

(1) Roadways (including all drainage facilities, such as swales and culverts) shall be designed to withstand a 100-year, 24-hour storm event.

(2) Wind Turbine Pads shall be designed to withstand a 100-year, 24-hour storm event.

5.3 Project Site Preparation

5.3.1 Project design shall take into account existing Project Site conditions with respect to, at a minimum, soil characteristics, permit conditions, site clearing, grading, and drainage.

5.3.2 Clearing and grubbing requirements:

(1) Clearing shall be understood to include felling and disposal of trees, brush, and other vegetation.

(2) Stripping shall be understood to consist of excavation and removal of all topsoil and organic matter.

(3) Topsoil shall be stockpiled for later use during landscape reclamation activities. Topsoil shall be stockpiled only in areas designated where it will not interfere with construction operations or existing facilities. Stockpiled topsoil shall be reasonably free of subsoil, stumps, roots, debris, and stones larger than two (2) inches in diameter. Topsoil shall not be used as structural fill. Appropriate erosion control measures shall be utilized on stockpiled topsoil.

(4) Debris, rubbish, shrubs, organic matter, and vegetation from developed areas shall be grubbed and removed from the Project Site in accordance with applicable permit instructions and other pertinent Requirements.

(5) Root mats and stumps shall be completely removed from the Project Site construction areas, holes refilled with select material and compacted adequately for the ultimate expected loading for the material used, and graded to drain.

5.3.3 Removal of or damage to trees without written approval of Owner is prohibited outside the designated disturbance areas. Trees shall be adequately protected, including protecting tops, trunks, and roots of existing trees at the Project Site which are to remain, as follows:

(1) Box, fence around, or otherwise protect trees before any construction Work is started.

(2) Do not permit heavy equipment or stockpiles within branch spread.

(3) Trim or prune to obtain working space in lieu of complete removal when possible. Conduct operation as follows:

(a) With experienced personnel.

(b) Conform to good horticultural practice.

(c) Preserve natural shape and character.

(d) Protect cuts with Owner-approved tree paint.

(4) Grade around trees as follows:

(a) Trenching: where trenching is required around trees which are to remain, avoid cutting the tree roots by careful hand tunneling under or around the roots. Avoid injury to or prolonged exposure of roots.

(b) Raising grades: where existing grade at a tree is below the new finished grade and fill not exceeding 15 inches is required, place 1 to 2 inches of clean, washed gravel directly around the tree trunk. Extend gravel out from trunk on all sides at least 20 inches and finish 2 inches above finished grade at tree. Install gravel before earth fill is placed. Do not leave new earth fill in contact with any tree trunks.

(c) Lowering grades: re-grade by hand to elevation required around existing trees in areas where new finished grade is to be lower. As required, cut the roots cleanly 3 inches below finished grade, and cover scars with tree paint.

(5) Remove when damage occurs and survival is doubtful, following approval by Owner.

(6) Replace with similar item when damaged through carelessness and so requested by Owner.

5.3.4 All underground utilities, pipelines, and other buried facilities shall be located and marked before construction activities, and such items shall be appropriately considered in the Project design.

5.4 Blasting

5.4.1 Blasted material shall be crushed and screened for use as fill on access roads and in other areas of the Project Site assuming the aggregate meets the appropriate geotechnical specifications for this application. Contractor shall be responsible for verifying that the quantity and quality of such rock is suitable for use as aggregate at the Project Site.

5.4.2 Owner shall be notified prior to the use of explosives at the Project Site, and such blasting shall be completed, at a minimum, in accordance with the applicable permits and Contractor-furnished blasting plan.

5.4.3 When the use of explosives is necessary for the Work, Contractor shall use the utmost care not to endanger life or property and shall comply with all applicable laws and other Requirements and conduct the necessary advance notifications.

5.4.4 Under no circumstance shall caps or other exploders or fuses be stored, transported, or kept together with powder.

5.4.5 All explosives shall be handled in a secure manner, and all such storage places (if permitted) shall be marked clearly "DANGER - EXPLOSIVES" or as otherwise required by law.

5.4.6 All permits and licenses required for blasting shall be obtained, paid for, and maintained by Contractor.

5.4.7 Blasting shall be performed only by persons who are qualified, competent, and thoroughly experienced in the use of explosives for rock excavation.

5.4.8 Charge holes shall be located properly and drilled to correct depths for charges used.

5.4.9 Charges shall be limited in size to the minimum required for reasonable removal of material by excavating equipment.

5.4.10 Excessive overbreak or damage to adjacent structures, exposed cut slopes, equipment, utilities, or buried pipeline and conduit shall be avoided as follows:

(1) With properly designed pattern.

(2) By use of Owner-approved explosion mats.

5.4.11 Blasting near utilities, pipelines, or facilities (buried or above-ground) shall be subject to approval of owning agency and Owner.

5.4.12 Before delivery of any explosives to the Project Site, Contractor shall have obtained a blasting endorsement on their public liability and property damage insurance policy.

5.4.13 Contractor shall control debris resulting from blasting, including minimizing, to the extent practicable, the size of said debris. Contractor shall use the utmost care not to endanger life or property, and to comply with all applicable laws and conduct the necessary advanced notifications.

5.4.14 Blast mats shall be utilized as required in sensitive areas, including, but not limited to, archeologically-sensitive areas, environmentally-sensitive areas, existing Project Site facilities, and other Project infrastructure.

5.5 Excavation, Filling, and Backfilling

5.5.1 Materials suitable for use as fill at the Project Site shall include only materials that are free of debris, roots, organic matter, frozen matter, coal, ashes or cinders, and as recommended by the geotechnical engineering report.

5.5.2 Surplus fill shall be spread on-Site and in areas and depths approved by Owner. Surplus materials shall not be exported off-Site without the approval of Owner.

5.5.3 All excavations shall be maintained in a safe, clean, and sound condition up to the time of concrete placement. The stability of all excavations shall be maintained by providing adequate sheeting, shoring, and bracing to support any lateral earth pressure. Stability considerations shall include the surrounding land surfaces that may impact the Project or nearby improvements. Sheeting, shoring, and bracing shall be removed as backfilling proceeds.

5.5.4 Permanent slope and rock stability measures shall be part of the Project design, and shall incorporate the recommendations and requirements set forth in the geotechnical engineering report. Safe stabilization for all slopes, regardless of the type of rock or soil conditions, shall be guaranteed including protection of all personnel and structures against any damage from cave-ins, heaving, or other earth movements.

5.5.5 All structure foundations shall be surveyed and staked prior to excavation. The methods of staking and final alignment of the concrete caisson, anchor bolts, reinforcing steel, stub angles, and embedment sections shall be designed such that the finished condition of the Work meets the requirements for alignment, position, elevation, and rotation.

5.5.6 All excavations shall have at least two (2) means of ingress and egress.

5.5.7 The main access to all Wind Turbine excavations shall have safe and functional access and walking surface.

5.5.8 Structural fill lifts shall not exceed a thickness of 8 inches. Other fill lifts shall not exceed a thickness of 12 inches.

5.5.9 Embankments (fill and cut) shall have a slope of 3H:1V or flatter.

5.6 Laydown Yard

5.6.1 The laydown yard shall be sufficient in size to allow for simultaneous (i) storage of equipment, including any Owner-Supplied Equipment, that will not be stored at the Wind Turbine Pads; (ii) storage of office trailers and other temporary facilities; (iii) parking for approximately 20 Owner vehicles; and (iv) regular construction traffic.

5.6.2 The laydown yard shall be covered throughout with crushed rock surfacing. All crushed rock surfacing at the laydown yard shall conform, at a minimum, to the specifications prescribed in Section 5.9.9 (*Crane pads shall* be designed and constructed to allow for use of cranes in ongoing Wind Turbine maintenance activities following construction (e.g., cranes required for gearbox, generator, and transformer removal and / or reinstallation).

5.6.3 Crushed Rock Surfacing) herein.

5.6.4 The laydown area shall remain suitable for use in all weather conditions.

5.6.5 The laydown yard shall not exceed two percent (2%) grade, or less if required for the safe storage of equipment or to meet manufacturer's requirements for storage of equipment.

5.6.6 The laydown yard shall comply with the Turbine Supplier Project Site Requirements.

5.6.7 Fencing shall be installed around the perimeter of the laydown yard, and vehicle gates shall be installed at all entrances to the laydown yard. All fencing and gates shall comply with the minimum specifications in Section 3.10 (*Fencing, Walls, and Gates*) herein.

5.7 Roads

5.7.1 All roads shall be constructed within the permitted corridors.

5.7.2 Roads shall be designed, constructed, and maintained adequately to support all anticipated construction loads, equipment delivery (including Owner-Supplied Equipment), crane crawling, construction traffic usage, and weather conditions to be expected.

5.7.3 Roads shall comply with the Turbine Supplier Project Site Requirements.

5.7.4 Road entries, intersections, and turns that will be used by heavy equipment shall be designed to accommodate the longest vehicle anticipated to utilize the road so that it will be able to maneuver through the entire Project Site without leaving the graveled road area. Consideration of cantilevered loads (e.g., Wind Turbine blade ends) shall be taken into account to ensure obstructions adjacent to the roadway are cleared and will not endanger the equipment delivery.

5.7.5 Roads shall be designed with turnarounds to assist in truck and trailer flow throughout the Project Site. Backup motions for tractor trailers shall be kept to a minimum and are subject to Owner approval.

5.7.6 Dead-end roads shall be designed with adequate turnaround space for a tractor/trailer to turn around without leaving the graveled road area. If backup motions for tractor trailers are necessary, the backup path shall be as straight and short as possible. All turnarounds shall be constructed using the same gravel design as the roads.

5.7.7 Roads shall be designed to have a graveled roadway surface with sub-grade cleared and compacted to at least ninety-five percent (95%) of the maximum density within the moisture content of two percent (2%) below optimum to two percent (2%) above optimum, as determined by ASTM Standard D698, unless a higher level of compaction is required by the geotechnical engineering report.

5.7.8 Roads shall be rocked with crushed rock material over a stabilized subgrade. All such crushed rock surfacing shall conform, at a minimum, to the specifications prescribed in Section 5.9.9 (*Crane pads shall* be designed and constructed to allow for use of cranes in ongoing Wind Turbine maintenance activities following construction (e.g., cranes required for gearbox, generator, and transformer removal and / or reinstallation).

5.7.9 Crushed Rock Surfacing) herein.

5.7.10 Roads shall be constructed within permitted boundaries and shall be subject to grading permit review and approval, if required, from the agency(ies) having jurisdiction.

5.7.11 Roads shall be cleared of overhead obstructions (e.g., power lines).

5.7.12 Roads shall be able to accommodate two-way traffic during normal conditions but may be converted to one-way traffic when wide vehicles are entering the Project Site and delivering equipment and/or materials.

5.7.13 Roads shall be a *minimum* of 20 feet wide (unless permits or land leases in place at the time the contract was signed specify a 16-foot final road width). Where crane walks are to be utilized, roads shall have a minimum 10-foot temporary compacted earthen shoulder on each side.

5.7.14 Roads shall have a minimum turning radius on curves of no less than is required for Wind Turbine and other equipment deliveries. Roads shall be widened through turns and curves, as necessary.

5.7.15 Roads shall be designed and constructed with a maximum grade of ten percent (10%) grade, or less if required by the Turbine Supplier Project Site Requirements. Approaches to Wind Turbine Pads from access roads shall be designed and constructed sufficiently level so as to allow transport vehicles, including Wind Turbine transport vehicles, to park on a flat surface during offloading.

5.7.16 Roads shall have no more than two percent (2%) crown, unless such roads will be utilized as crane paths, in which case the maximum crown shall be one percent (1%). All roadways, including shoulders, shall be graded so as to self-drain, and must not allow water to puddle.

5.7.17 Maximum allowable rutting is two (2) inches.

5.7.18 Roads shall meet all required design elements at substantial completion.

5.7.19 Maximum vertical crest and dip on roads is six (6) inches vertical to 50 feet horizontal, or less if required by the Turbine Supplier Project Site Requirements.

5.7.20 The longitudinal radii (convex or concave) of roads shall not be less than 750 feet.

5.7.21 All non-Wind Turbine roadways shall be able to accommodate light traffic consisting of general purpose pickup trucks, SUVs, and bucket trucks, or as required during construction to perform the Work. During construction, equipment delivery trucks shall also be able to safely travel these roadways.

5.8 Turbine Foundations

5.8.1 Turbine Foundations shall be constructed at each Wind Turbine location.

5.8.2 Turbine Foundations shall be conventional spread footing / gravity-type foundations. No alternate Turbine Foundation type, including P&H or rock anchor, shall be utilized without Owner approval.

5.8.3 Turbine Foundations shall be reinforced concrete designed in accordance with Turbine Supplier Project Site Requirements; ASCE/AWEA RP2011 "*Recommended Practice for Compliance of Large Land-based Wind Turbine Support Structures*"; ACI 318; and other relevant Applicable Standards and Requirements.

5.8.4 Turbine Foundations shall, at a minimum, be designed using the final geotechnical engineering report, including allowable soil bearing pressure values determined by geotechnical investigation from soil borings at each specific Wind Turbine site and equipment loads provided by the Turbine Supplier. No portion of Turbine Foundations shall be constructed on fill material or within ten (10) feet of a fill slope without Owner approval.

5.8.5 Turbine Foundations shall include a grounding grid. The design and construction of the grounding system in such foundations shall meet or include the following requirements, at a minimum:

(1) Turbine Supplier Project Site Requirements.

(2) Incorporate the recommendations and minimum requirements set forth in the geotechnical engineering report.

(3) Proper grounding of equipment and structures.

(4) Installation of adequate ground for personnel safety, including touch and step potentials (to be demonstrated by Contractor via calculations in the grounding study).

(5) Proper grounding for lightning and surge protection.

(6) Incorporate local resistivity measurements.

(7) A ground resistance <= 2 Ω.

5.8.6 All local requirements and the NESC shall be adhered to in the grounding design and construction.

5.8.7 Turbine Foundations shall be designed to have adequate stiffness to maximize the system natural frequency within practical limits.

5.8.8 Turbine Foundation anchor bolts shall have a minimum projection of two (2) anchor bolt diameters beyond the tightened anchor nuts. Anchor bolts not meeting this requirement may be rejected by Owner.

5.8.9 Turbine Foundation materials, including rebar, anchor bolts, forms, concrete, and grout, shall comply with the applicable structural requirements in Section 6.0 (*Structural Works Specifications*) herein.

5.9 Wind Turbine Pads

5.9.1 A Wind Turbine Pad shall be constructed at every Turbine Foundation location.

5.9.2 Wind Turbine Pads shall be sufficient in size to allow for simultaneous offloading, storage, and assembly of all Wind Turbine components, including, but not limited to, rotor, nacelle, and tower sections.

5.9.3 Wind Turbine Pads shall comply with the Turbine Supplier Project Site Requirements.

5.9.4 Wind Turbine Pads shall be cleared of brush, boulders, and other debris around each Turbine Foundation, up to the pad limits, and shall be continually maintained to ensure a safe working environment.

5.9.5 Wind Turbine Pads shall not exceed two percent (2%) grade, or less if required for the safe execution of Work, including Wind Turbine assembly, storage, or erection.

5.9.6 Wind Turbine Pads shall have a graveled surface with sub-grade cleared and compacted to at least ninety-five percent (95%) of the maximum density within the moisture content of two percent (2%) below optimum to two percent (2%) above optimum, as determined by ASTM Standard D698, unless a higher level of compaction is required by the geotechnical engineering report.

5.9.7 Following Wind Turbine installation, a gravel ring (i.e., “beauty ring”) shall be installed around the perimeter of each Wind Turbine location, at a minimum distance of twenty (20) feet beyond the Wind Turbine tower wall in all directions. All crushed rock surfacing around the perimeter of each Wind Turbine location shall conform, at a minimum, to the specifications prescribed in Section 5.9.9 (*Crane pads shall* be designed and constructed to allow for use of cranes in ongoing Wind Turbine maintenance activities following construction (e.g., cranes required for gearbox, generator, and transformer removal and / or reinstallation).

5.9.8 Crushed Rock Surfacing) herein.

5.9.9 Crane pads shall be designed and constructed to allow for use of cranes in ongoing Wind Turbine maintenance activities following construction (e.g., cranes required for gearbox, generator, and transformer removal and / or reinstallation).

5.10 Crushed Rock Surfacing

5.10.1 The maximum aggregate size for surface fill (i.e., crushed rock surfacing) shall not exceed three (3) inches, including, but not limited to, that used for roadways, Wind Turbine Pads, Project Substation, laydown yard, and the O&M Building.

5.10.2 Unless explicitly stated otherwise, all crushed rock surfacing shall be of thickness required by Project Site loading requirements, including those set forth in (i) the Turbine Supplier Project Site Requirements and (ii) the geotechnical engineering report.

5.10.3 Unless explicitly stated otherwise, all aggregate shall conform to local department of transportation requirements.

5.10.4 An aggregate job mix formula shall be established prior to the start of fill operation based on recommendations from the final geotechnical engineering report. This mix shall not be changed without prior approval of Owner. Testing data, including sieve analysis, shall be submitted for all aggregate sources.

5.11 Drainage and Erosion Control

5.11.1 The working areas of the Project Site shall be well drained during and after construction, respectively. All drainage shall be away from buildings and foundations.

5.11.2 Roadway cross sections shall be shaped to move water away from the road, such as crowning or cross-slopes, and roads shall be designed and constructed to prevent water ponding. Storm water shall not channel flow across constructed roads.

5.11.3 Controls shall be provided to protect the water quality and shall be in accordance with all Requirements, including applicable laws, applicable permits, and the Contractor-provided SWPPP.

5.11.4 Culvert pipe ends, swales, and ditches shall be designed to control concentrated flow velocities and minimize erosion and siltation.

5.11.5 Wetlands impacts shall be avoided to the maximum extent practicable and are subject to regulatory approval or other applicable Requirements.

5.11.6 All storm water flows shall be returned to their original drainage patterns and the Project shall not increase flow rates from their historic levels.

5.11.7 Sheet flows shall be collected in roadside drainage swales and conveyed to culverts or channels to safely pass storm water flows.

5.11.8 Culverts or low-water crossings shall be placed under roads where required to pass existing storm water concentrated flows.

5.11.9 Erosion and sediment control, both during and after construction, shall be provided as required by the Requirements to retain sediment onsite and to control the erosion of embankments, temporary and final exposed slopes, and temporary stockpile(s).

5.11.10 Silt fences, check dams, drainage ditches or swales, straw mulch, and pre-manufactured geotextiles, geotubes, geogrids, cellular geoweb, and other similar items (collectively, the "**Best Management Practices**") shall be utilized as appropriate.

5.11.11 Synthetic, toxic, or otherwise harmful erosion-control materials shall be made inaccessible to livestock on or adjacent to the Project Site during the construction period.

5.11.12 Construction operations shall be continuously monitored by Contractor to avoid creating conditions that could lead to excessive erosion of soil with surface runoff from Work areas.

5.11.13 Local agencies may enforce requirements that limit certain construction activities during a portion of the year (e.g., due to storm events). These requirements shall be incorporated into the proposed SWPPP, erosion control plan, and Project Schedule.

5.12 Site Restoration

5.12.1 Seeding shall occur during a time / season when the probability of successful seed germination is maximized. Hydro-seeding is acceptable for slopes.

5.13 Testing and Quality Control

5.13.1 All testing described herein shall be performed by an independent, experienced third party. Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities.

5.13.2 All roadways, compacted areas, Wind Turbine Pads, and Turbine Foundations shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

5.13.3 Roadway testing shall include the following, at a minimum:

(1) Maximum dry density and optimum moisture content: per ASTM D698 or ASTM D1557

(2) In-place density by nuclear methods (shallow): per ASTM D2922

(3) Aggregate sampling: per ASTM D75

(4) Sieve analysis of fine and coarse aggregates: per ASTM C136

(5) California Bearing Ratio of laboratory-compacted soils: per ASTM D1883

(6) Sand equivalent value: per ASTM D2419

(7) Liquid limit, plastic limit, and plasticity index: per ASTM D4318

(8) Roadway subgrade and surfacing compaction shall be verified at a minimum of every 1,000 feet. Roadway subgrades shall be proof-rolled over the entire length.

(9) Aggregate base shall be analyzed with a sieve at a minimum of every 2,500 cubic yards.

5.13.4 Turbine Foundation testing shall include the following, at a minimum:

(1) Third-party certification of integrity of Turbine Foundation sub-base.

(2) Concrete and grout strength.

(3) Compaction of backfill around Wind Turbines / Turbine Foundations.

(4) Compaction of Wind Turbine Pads.

(5) Turbine Foundations and Wind Turbine Pads shall be tested in accordance with the recommendations set forth in the geotechnical engineering report. Such areas shall be fully proof-rolled.

5.13.5 Copies of testing reports shall be submitted to Owner within 10 days of completing such test. Testing reports shall include a summary of testing procedures and acceptance criteria. Notwithstanding the preceding requirements, a copy of test results for each Turbine Foundation shall be provided to Owner *prior* to erection of the applicable Wind Turbine.

6.0 STRUCTURAL WORKS SPECIFICATIONS

6.1 General Provisions

6.1.1 All buildings, support structures, foundations (including Turbine Foundations), and equipment pads shall be constructed on competent material. All loose materials shall be removed from excavation bottoms. Unsatisfactory foundation subgrade material shall be removed and replaced with compacted structural fill material or with suitable concrete.

6.1.2 All buildings, foundations, meteorological towers, equipment supports, and other structures shall be designed in accordance with the latest edition of the Applicable Standards.

6.1.3 As further described in Section 3.0 (*Geotechnical Specifications*), the geotechnical engineering report shall be utilized for the design and construction of all Project structures, including Turbine Foundations. All foundations shall be designed with consultation of a licensed geotechnical engineer.

6.1.4 The maximum loads (including load factors) applied to the foundations and used for design shall be determined from the structure design of the supported structure considering load cases and Applicable Standards associated with the particular structure type.

6.1.5 Foundation designs shall neglect or degrade soil strength properties at the top of the foundation as a result of frost or disturbance during drilling per recommendations of the geotechnical engineer.

6.1.6 All exposed foundation edges shall have a 0.75-inch chamfer.

6.1.7 All foundations and slabs-on-grade shall have a minimum projection of 6 inches above ground level, except that concrete pier-type foundations shall have a minimum projection of 12 inches of concrete above ground level.

6.1.8 Structure foundations shall be surveyed and staked prior to excavation.

6.2 Design Working Life

6.2.1 The design working life of the structural works (excluding Turbine Foundations) shall be a minimum of 30 years, and the design working life of the Turbine Foundations shall be a minimum of 40 years.

6.3 Concrete

6.3.1 Concrete materials shall be in accordance with the requirements set forth in Table 1 (*Summary of Requirements for Concrete Materials*) herein, at a minimum.

6.3.2 A nominal slump at the point of delivery shall be as shown in Table 2 (*Slump Requirements*) herein, as tested in accordance with ASTM C143.

Table 1: Summary of Requirements for Concrete Materials

Material	Material Requirements
Cement	ASTM C150, Type I, II, or V (as required)
Water	Clean, potable, and free from injurious amount of oil, acid, alkali, organic matter or other deleterious substances.
Coarse aggregate	Crushed stone, washed gravel, or other acceptable inert granular material conforming to ASTM C33
Fine aggregate	Clean natural sand, ASTM C33
Fly ash	ASTM C618; determined by Contractor and approved by Owner
Air-entraining agent	ASTM C260
Chemical admixture	ASTM C494; determined by Contractor and approved by Owner
Plasticizer	ASTM C494 / ASTM C1017; determined by Contractor and approved by Owner
Form oil	Light colored paraffin oil or other acceptable non-staining material
Curing agent	ASTM C309; determined by Contractor and approved by Owner
Floor sealer	ASTM C1315; determined by Contractor and approved by Owner
Concrete repair	Determined by Contractor and approved by Owner
Compound	Determined by Contractor and approved by Owner
Joint sealant	ASTM C1193; determined by Contractor and approved by Owner
Non-shrink grout	Determined by Contractor and approved by Owner
Pre-formed joint filler	Determined by Contractor and approved by Owner
Concrete	Minimum concrete compressive strength to be determined by Contractor and subject to Owner review and approval.
Grout	Minimum grout compressive strength to be determined by Contractor and subject to Owner review and approval.

Table 2: Slump Requirements

Description	Minimum (inches)	Maximum (inches)
Turbine Foundations	2.0	5.0
Reinforced walls and footings	2.0	5.0
Slabs on-grade	2.0	4.0
Drilled piers (dry, uncased, or permanent casing drill method)	4.0	6.0
Drilled piers (temporary casing drill method, wet and dry)	6.0	8.0
Drilled piers (slurry displacement drill method)	7.0	9.0

6.3.3 Cast-in-place concrete shall be in accordance with the latest applicable requirements of the ACI, ASTM, and CRSI, at a minimum.

6.3.4 Ready-mixed concrete manufacturing and delivery shall conform to ASTM C94.

6.3.5 Concrete for foundations shall have a specified compressive strength of not less than 5,000 psi.

6.3.6 Concrete mix designs and concrete placement procedures shall be approved by Owner prior to use.

6.3.7 Aggregates shall be tested per ASTM C33 for potentially reactive materials. If such test results indicate that aggregates are reactive, an alkali-silica reaction ("**ASR**") mitigation plan shall be provided.

6.3.8 Concrete shall be placed only in the presence of a duly-authorized representative of Contractor.

6.3.9 Concrete placement shall not be permitted when weather conditions or other pertinent factors prevent proper placement and consolidation.

6.3.10 Concrete shall be placed at a sufficient rate to ensure that lifts below have not taken initial set before fresh concrete is deposited. In any event, concrete shall be placed within 45 minutes after mixing. This period may be extended to 90 minutes provided that the combined air temperature, relative humidity, and wind velocity are such that the plasticity of the fresh concrete is satisfactory for placement and consolidation, and that the specified mixing water is not exceeded. Concrete which has partially set shall not be retempered but shall be discarded.

6.3.11 Concrete requirements shall be adjusted for hot weather:

(1) Hot weather concreting shall be in accordance with ACI 305R.

(2) When hot weather conditions exist that would materially impair the quality or strength of concrete, the concrete shall be placed in compliance with ACI 305R and as herein specified.

(3) Ingredients shall be cooled before mixing to maintain concrete temperature at time of placement below 90°F.

(4) Mixing water may be chilled, or chopped ice may be used to control the concrete temperature, provided the water equivalent of the ice is calculated to the total amount of mixing water.

(5) Reinforcing steel shall be covered with water-soaked-burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

(6) Retarding admixtures shall not be used unless otherwise accepted in mix designs.

6.3.12 Concrete requirements shall be adjusted for cold weather:

(1) Cold weather concreting shall be in accordance with ACI 306R.

(2) After the first frost and until the mean daily temperature in the vicinity of the Work falls below 40°F for more than 24 hours, the concrete shall be protected against freezing for not less than 48 hours after it is placed.

(3) Whenever the mean daily temperature in the vicinity of the Work falls below 40°F for more than 24 hours, the concrete shall be maintained at a temperature not lower than 50°F for at least 72 hours after it is placed and shall be protected against freezing for five (5) days immediately following the 72 hours of protection at 50°F. This continuance of protection against freezing shall be such that the drop in temperature of any portion of the concrete will be gradual and will not be lower than 40°F in 24 hours.

(4) When artificial heat is employed, special care shall be taken to prevent the concrete from drying.

(5) The use of calcium chloride will not be permitted.

(6) A non-corrosive, non-chloride set accelerating admixture may be used when approved by Owner.

(7) Concrete damaged by freezing shall be removed and replaced at Contractor's expense.

(8) Concrete shall not be permitted to freeze for at least seven (7) consecutive days following placement.

6.3.13 The maximum aggregate size for concrete shall not exceed 1.5 inches.

(1) Smaller maximum aggregate size, such as 0.75 inches, may be necessary for pumped or tremie concrete.

(2) Rounded aggregates may be necessary to produce desired workability.

6.3.14 All exterior exposed concrete shall have an air content of 4.5 percent (4.5%) to 7.5 percent (7.5%).

6.3.15 Concrete shall be conveyed from mixer to forms as rapidly as practicable without segregation or loss of ingredients. Concrete shall be placed in forms nearly as practicable in final position to avoid re-handling.

6.3.16 Chutes, if used, shall slope sufficiently to ensure flow of properly proportioned concrete and must be kept free of hardened or partially set concrete.

6.3.17 Concrete shall be carried in at such a rate that the concrete is at all times plastic and flows readily into the spaces between the bars. No concrete that has partially hardened or been contaminated by poor material shall be used nor shall re-tempered concrete be used.

6.3.18 Immediately after depositing, concrete shall be compacted by agitating thoroughly in an approved manner to force out air pockets. The mixture shall be worked into corners around reinforcement and inserts to prevent formation of voids. Tapping or other external vibration of forms will not be permitted. Care shall be used in use of vibrators to prevent segregation of sand pockets or bleeding. Vibrators shall be moved continuously in and out of concrete, keeping stationary only a few seconds in any position. Vibrators shall not be used to transport concrete within forms.

6.3.19 For concrete poured within forms and not involving drilled pier construction, concrete shall not drop freely over five (5) feet in unexposed work or over three (3) feet in exposed work. Where greater drops are required, tremies, concrete pump, or other approved methods shall be used.

6.3.20 Concrete may be dropped into drilled piers installed using the dry method under the conditions that concrete shall not hit any reinforcing bars or sidewalls and that concrete with all aggregates shall be able to flow freely into the spaces between the reinforcing bars. Vibration of concrete falling more than 20 feet is not required. The concrete shall be placed in the pier in one continuous operation unless agreed otherwise by Owner.

6.3.21 For concrete involving massive structures, including Turbine Foundations, concrete mix or construction procedure shall be modified such that excessive heat produced by hydration shall be prevented.

6.3.22 Cast-in-place concrete, at Contractor's option, may be placed by pumping in accordance with ACI 304; however, it shall use a specifically-designed mix for pumping concrete, as fine aggregate gradation and water and cement content are more critical and different from the regular concrete mix. The mortar used for lubricating the pumping equipment shall be discarded.

6.3.23 Concrete shall not be conveyed through aluminum or aluminum alloy pipes.

6.3.24 Maximum water/cement ratio: 0.45.

6.3.25 Joints:

(1) A good bond and watertight joint are required at construction joints.

(2) Joints shall be obtained by adequately preparing and protecting the surface of the first pour or lower part of the construction joint.

(3) Joint surface shall be level and reasonably rough, clean, moist and some aggregate particles should be exposed. Any laitance or soft layers shall be removed from the top surface of the hardened concrete.

(4) Turbine Foundations shall not have joints, unless approved by Owner and only for the base and pedestal interface in a spread footer foundation.

6.3.26 All fins and other surface projections shall be removed from all formed surfaces.

6.3.27 All surfaces are to be at the specified elevation and left true and level.

6.3.28 Surfaces that will be exposed shall be cleaned and rubbed to produce a smooth, uniform surface that is free of marks, voids, surface glaze, and discoloration. Slab foundations shall receive a light broom finish. Care shall be taken to see that all excess water is removed before making any finish.

6.3.29 The unformed surfaces of concrete shall be screened and given an initial float finish followed by additional floating and troweling as required. Precaution shall be taken by Contractor to protect the finished surface from stains and abrasions.

6.3.30 The removable ends of all form ties shall be removed and the recesses resulting from such removal shall be filled with dry patching mortar.

6.3.31 "Cure & Seal 1315 UV" curing compound, manufactured by Symons Corporation, or an approved equal, shall be applied to all outside foundations to a depth of 12 inches below final ground grade.

6.3.32 Concrete shall be protected from loss of moisture for at least seven (7) consecutive days by membrane curing compound and the curing medium shall be maintained so as to prevent detrimental loss of water from the concrete for the duration of the entire curing period.

6.3.33 Unhardened concrete shall be protected from heavy rains, flowing water, excessive heat, or mechanical damage. Finished surfaces shall be protected from stains, abrasions, or physical damage.

6.3.34 Defects:

(1) Defects in formed concrete surfaces shall be repaired within 24 hours, and defective concrete shall be replaced within 48 hours, after the adjacent forms have been removed.

(2) All concrete which is porous, honeycombed, or otherwise defective shall be repaired.

(3) Defective concrete shall be repaired by chipping out the unsatisfactory material to a minimum depth of 0.5 inches and placing new concrete, which shall be formed with keys, dovetails, or anchors to attach it securely in place with Owner approval.

(4) Concrete surfaces, including structural concrete, that contain defects which adversely affect durability, strength, and/or appearance shall be repaired by a method approved by Owner or replaced.

6.3.35 Concrete testing:

(1) Prepare concrete test cylinders conforming to ASTM C31 prior to the first pour of each day, and at a rate of not less than one set of cylinders for each 50 cubic yards or fraction thereof and not less than one set for each foundation or structure.

(2) Field slump tests in accordance with ASTM C143 shall be performed prior to the pour from each truck. Adjustment or fixing of concrete *in situ* shall not be allowed.

(3) Air content, concrete temperature, and air temperature tests shall be performed prior to the pour from each truck. All testing shall be done in accordance with the requirements of ASTM C231 (air) and ASTM C1064 (temperature).

(4) Electronic copies of concrete test reports shall be provided to Owner within 72 hours of testing but not less than 24 hours in advance of commencing Wind Turbine erection activities at the relevant Wind Turbine location. In the event of failure of any concrete test, Owner shall be immediately notified and a repair/remediation plan shall be provided.

6.4 Grout

6.4.1 Nonmetallic, shrinkage-resistant grout shall be ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

6.4.2 Grout mix designs, grout specification sheets, grouting plans, and grouting procedures shall be approved by Owner prior to use.

6.4.3 Sufficient grout cubes shall be taken to allow for, at a minimum, 1-day, 2-day, 3-day, 7-day, and 28-day testing, plus two (2) additional cubes per sample for accelerated or delayed testing.

6.4.4 Grout test reports shall be provided to Owner within 72 hours of testing, and for Turbine Foundations, at least at least 24 hours in advance of commencing or continuing (as is the case with grouting of tower base sections) Wind Turbine erection activities at the relevant Wind Turbine location. In the event of failure of any grout test, Owner shall be immediately notified and a repair/remediation plan shall be provided.

6.4.5 Grouted surfaces that contain defects which adversely affect durability, strength, and/or appearance shall be repaired by a method approved by Owner or they shall be replaced.

6.5 Forms

6.5.1 Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings.

6.5.2 Forms shall be substantial and sufficiently tight to prevent leakage, and shall be properly supported and braced to maintain position and shape. Forms for all exposed surfaces shall produce smooth, dense, and true finishes free of fins, imperfections, or other defects.

6.5.3 Forms shall be cleaned and oiled before concrete is placed. Oil is to be applied before reinforcement is placed.

6.5.4 Formwork for walls, columns, sides of beams, gravity structures, slabs-on-ground, and other vertical-type formwork not supporting the weight of concrete shall remain in place for at least 24 hours after concrete placement is completed.

6.5.5 Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected.

6.5.6 Forms may be of wood, plywood, concrete-form-grade hardboard, metal or other acceptable material, which will produce smooth, true surfaces.

6.5.7 Metal forms shall have smooth surfaces free from any pattern, irregularities, dents, or sags.

6.5.8 Commercial formulation form-coating compounds shall be used that will not bond with, stain, nor adversely affect concrete surfaces, nor impair subsequent treatments of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compound.

6.5.9 Form ties shall be factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. For concrete that will be exposed, provide ties so portion remaining within concrete after removal is at least 1.5 inches inside concrete. Form ties shall not leave holes larger than one (1.0) inch in diameter in concrete surfaces.

6.5.10 Remove forms in a manner to avoid damage to the structure, with particular care for corners and edges.

6.6 Drilled Piers

6.6.1 All drilled piers shall be designed consistent with the primary load application, either as laterally loaded piers or as compression/uplift piers.

6.6.2 Circular shafts shall be dug by means of a power driven rotary bucket or auger type drilling rig.

6.6.3 Diameter and location of piers shall be as per the design.

6.6.4 A steel lining shall be used for soil conditions that make it necessary to protect personnel, prevent cave-ins, or hold out ground water. Linings shall be withdrawn concurrent with placement of concrete in such a manner as to prevent formation of rock pockets or ground water mixing with concrete. Concrete shall have sufficient head above bottom of lining being withdrawn to hold out water and maintain shaft diameter.

6.6.5 Concrete reinforcement shall be placed in dry pier excavation, unless otherwise approved by Owner, clear of all loose earth, gravel, and rock.

6.6.6 Concrete shall be placed in continuous operation to top of pier elevation, using an elephant trunk, concrete pump, or other approved method. Time delays between shaft drilling and concrete placement shall be minimized particularly in unstable and/or granular type soils prone to sloughing or caving.

6.6.7 When it is necessary to place concrete under water, a tremie pipe or concrete pump shall be used. The lower end of the tremie pipe shall be kept submerged in the concrete throughout concrete placement.

6.6.8 All methods used to design and construct drilled piers shall be in accordance with ACI 336.1.

6.6.9 Permanent casings shall not be used without prior approval by Owner.

6.6.10 The volume of concrete required for each drilled shaft shall be plotted on a graph of concrete volume versus depth.

6.6.11 In locations where drilled pier foundations are impractical or cannot be constructed due to cost, soil, environmental, access or permitting considerations, alternate foundation types will be allowed with the approval of Owner. Alternate foundation types may include spread or block footings, direct embedded, vibratory caissons, socketed, rock anchors, grouted, grouped piles with pile cap (e.g., concrete filled pipe piles, auger cast-in-place piles, H-piles), micro-pile, and other similar items. The selection of the foundation type and construction methods should consider site disturbances, access and long-term drainage and erosion control.

6.7 Reinforcing Bar

6.7.1 All reinforcing steel, including welded wire mesh, shall be accurately located and held in position by the use of proper reinforcing steel supports, spacers, and accessories in accordance with ACI SP-66 "*Detailing Manual*" and CRSI's "*Manual of Standard Practice*".

6.7.2 At time of placing concrete, all reinforcing shall be free of loose rust, scale, oil, paint, mud or other coatings which may destroy or reduce the concrete bond.

6.7.3 All reinforcing bars shall conform to ASTM A615 and have a minimum yield strength of 60 ksi.

6.7.4 Where not otherwise specified or shown by the written dimension, the minimum coverage of the concrete over the steel shall be as follows:

(1) Concrete cast against and permanently exposed to earth: 3 inches.

(2) Formed concrete exposed to earth or weather: 2 inches.

(3) Concrete in beams and columns not exposed to ground or weather: 1.5 inches.

(4) Concrete slabs and walls not exposed to weather: 1.5 inches.

6.8 Anchor Bolts

6.8.1 The threads on the upper end of each anchor bolt shall protrude sufficiently to satisfy the Requirements and adequately complete tensioning activities.

6.8.2 Prior to setting anchor bolts, the threads on the upper end of each anchor bolt shall be given a light coat of oil or grease to prevent adherence of concrete.

6.8.3 When installed, anchor bolts shall be cleaned and the portions to be embedded in concrete shall be cleaned and free of oil or other deleterious substances which would adversely affect the bond between the bolt and concrete, unless otherwise specified by the Turbine Supplier.

6.8.4 During the concrete finish and clean-up, concrete adhering to the portions of the anchor bolt extending above finished concrete grade shall be removed giving particular attention to concrete at the finish grade line which would prevent base plates from seating fully on the finished concrete elevation.

6.8.5 Anchor bolts shall be properly located, accurately positioned, and maintained securely in place before placing of concrete.

6.8.6 Unless otherwise required by the Turbine Supplier, anchor bolts, nuts, and washers shall comply with the following:

(1) Anchor bolts: ASTM A615 or A722, Grade 150.

(2) Nuts: ASTM A563, heavy hex carbon steel.

(3) Washers: ASTM F436, hardened carbon steel.

(4) Finish: Not used.

6.8.7 Anchor bolt ring-plates shall be fabricated by Contractor as needed following the templates provided by the Turbine Supplier. Embedment rings shall be new material.

(1) Embedment ring shall be minimum 1.5-inches thick, ASTM A36 Grade 36 or ASTM A572 Grade 50, and new material (not reused).

(2) Template rings shall be minimum 1.5-inches thick, ASTM A36 Grade 36 or ASTM A572 Grade 50.

6.9 Tolerances

6.9.1 Anchor bolts, concrete piers, and flat slabs shall be set carefully and maintained at the lines and elevations within the following tolerances, unless otherwise specified by the Turbine Supplier:

(1) Location of concrete piers with respect to foundation center: ±1/4 inch.

(2) Distances between bolt centers in the same foundation: ±1/8 inch.

(3) Elevation at top of anchor bolts and flat slabs: -0 to +1/4 inch.

(4) Angular deviation from vertical (i.e., out of plumb): 1/16 inch in 1 foot.

(5) Distance between anchor bolt centers between adjacent foundations for a structure: ±1/4 inch.

(6) Horizontal angular alignment (i.e., rotation) of anchor bolt group: ±1°.

(7) Flat slab deviation from level: 1/16 inch in 4 feet.

6.10 Project Substation Foundations

6.10.1 All Project Substation buildings, support structures, foundations, and equipment pads shall be designed in accordance with the Applicable Standards and other applicable Requirements, and the type of foundations required and allowable bearing values for soil and rock shall be as recommended by the geotechnical engineer based on the subsurface conditions found in the geotechnical engineering report. All loose materials shall be removed from excavation bottoms. Unsatisfactory foundation subgrade material shall be removed and replaced with compacted structural fill material or with 2000-psi concrete. Total foundation settlements will be limited to one (1) inch or as required by applicable building or industry codes, and equipment supplier's recommendations.

6.10.2 Equipment foundations shall be of reinforced concrete including all formwork, rebar, waterstop, and other similar items.

6.10.3 Main step-up transformer foundation and containment shall be provided with secondary oil containment equal to at least 110% of the volume of oil present in the transformer in addition to the volume of rain water for a 100-year storm event over the area of the containment; a calculation shall be provided by Contractor to demonstrate compliance with this requirement. Oil containment shall be a concrete containment with a sump placed within the containment area.

6.10.4 Equipment support structures shall be low profile (non-lattice) framing consisting of galvanized structural steel tubing and rolled shapes as the basic structural element. Steel support structures shall be designed, fabricated, and erected in accordance with the provisions of the AISC.

6.10.5 Reinforced concrete support structure foundations and equipment pads shall be designed and constructed in accordance with the provisions of ACI 318, ASTM A615, and allowable soil bearing pressures resulting from site soil sampling, laboratory testing, and geotechnical analysis and recommendations set forth in the geotechnical engineering report.

6.10.6 Reinforced concrete, cast-in-place drilled piers utilizing stub angles (lattice tower structures) or anchor bolts (tubular steel pole structures) to attach the structure to the foundation are the preferred foundation types.

6.10.7 Requirements and restrictions for access, site disturbances, conduits for power and communications, and other similar items shall be incorporated into the foundation design as appropriate.

6.10.8 For stub angle type foundations, a minimum of four (4) inches of clear space is required from the outermost reinforcing steel to the side of the excavation.

6.10.9 For anchor bolt type foundations, a minimum of six (6) inches of clear space is required from the outermost reinforcing steel to the side of the excavation.

6.10.10 The anchor bolt embedment length shall be not less than the development length for the strength of concrete specified.

6.10.11 Compression/uplift type foundations shall be straight piers and shall not be belled on the bottom. The parameters shown in Table 3 (*Stub Angle Type Foundation Parameters*) shall be used to design stub angle (compression/uplift loaded pier) type foundations:

Table 3: Stub Angle Type Foundation Parameters

Description	Load Factor*	Criteria
Settlement, individual pier	1.1	0.50 inch
Differential settlement measured against other piers in the same structure	1.1	0.25 inch
Predicted ultimate capacity, compression (bearing)	Safety factor of 2.0 over maximum factored loads	
Predicted ultimate capacity, uplift	Safety factor of 2.0 over maximum factored loads	
* Note: Load Factors for the NESC Combined Ice and Wind District Loading (e.g., NESC Heavy) shall be applied in lieu of the Load Factors in this table.		

6.11 Overhead Power Line Structure Foundation Design

6.11.1 Information presented in this Section 6.11 shall apply to both Interconnection Line structure foundations and Collection System Circuit overhead structure foundations, as applicable, and unless explicitly stated otherwise.

6.11.2 Structure foundations shall be surveyed and staked prior to excavation.

6.11.3 Reinforced concrete support structure foundations and equipment pads shall be designed, and constructed in accordance with the provisions of ACI 318, ASTM A615, and allowable soil bearing pressures resulting from site soil sampling, laboratory testing, and geotechnical analysis and recommendations.

6.11.4 Reinforced concrete, cast-in-place drilled piers utilizing stub angles (lattice tower structures) or anchor bolts (tubular steel pole structures) to attach the structure to the foundation are the preferred foundation types.

6.11.5 Compression/uplift type foundations shall be straight piers and shall not be belled on the bottom. The parameters shown in Table 3 shall be used to design stub angle (compression/uplift loaded pier) type foundations.

6.11.6 For stub angle type foundations, a minimum of four (4) inches of clear space is required from the outermost reinforcing steel to the side of the excavation.

6.11.7 For anchor bolt type foundations, a minimum of six (6) inches of clear space is required from the outermost reinforcing steel to the side of the excavation.

6.11.8 The anchor bolt embedment length shall be not less than the development length for the strength of concrete specified.

6.12 Overhead Power Line Structure Design

6.12.1 Information presented in this Section 6.12 shall apply to both Interconnection Line structures and Collection System Circuit overhead structures, as applicable, and unless explicitly stated otherwise.

6.12.2 Overhead power line structures shall be wood, monopole type, steel lattice tower type, or a combination thereof.

6.12.3 Structural design of all overhead power line structures, including, but not limited to, the tower, conductor cable, OPGW, shield wire, and insulator hardware, shall be in accordance with all applicable loading conditions and sagging/tension limits set forth in the Applicable Standards.

6.12.4 Vertical clearances of conductors above ground, all obstacles, and overhead power line components shall be maintained as defined in the Applicable Standards with clearances maintained assuming the maximum final sag (after creep).

6.12.5 All clearances shall be maintained assuming the worst case (smallest clearance) wire condition, either initial tension/sag conditions or final tension/sag (after creep) conditions.

6.12.6 Sag and tension limits shall conform to the requirements set forth in the Applicable Standards, including, but not limited to, NESC C2 2012.

6.12.7 Deflection line angle ranges per structure configuration shall meet design requirements.

6.12.8 Structure configurations shall be designed for a maximum shield angle of 30° measured from the shield wire outward to the phase position.

6.12.9 Guys and guy anchors (if required) shall be sited within existing easements.

6.12.10 Structures shall be guyed as required using Class A, zinc-coated, high-strength, stranded steel (ASTM A475), guy material.

6.12.11 All angle and dead-end structures shall be of a self-supporting design.

6.12.12 All structures shall be designed to withstand, without failure or permanent deformation, the applicable loadings set forth in the Applicable Standards, including, but not limited to, NESC C2 2012.

6.12.13 Stability shall be provided for the structure as a whole and for each structural element.

6.12.14 The non-linear behavior of the structure, under load, shall be incorporated into the design of the structure.

6.12.15 The structure design calculations, fabrication details, and fabrication drawings shall be supplied to Owner for review prior to fabrication.

6.12.16 Terminal dead end structures shall consider all load cases defined for the Project.

6.12.17 Loading combinations for both “all wires intact” and “all wires removed from one side” conditions must be considered for all dead-end structures.

6.12.18 Structures shall be designed for the combination (any combination) of intact and/or dead-ended wires that create the highest stress in the structure.

6.12.19 Suspension attachments for conductor and shield wire shall not be in uplift at a temperature of 0°F.

6.12.20 The design shall incorporate manufacturer (wire and damper manufacturers) recommendations for vibration protection of conductors and OPGW/shield wires.

6.12.21 Tensions shall be limited to protect conductor against damage due to vibration.

6.12.22 Tension limits may consider the use of vibration protection devices but shall not exceed the limits specified.

6.12.23 All wire systems (OPGW and conductor) shall be designed to prevent wire damage due to Aeolian vibration.

6.12.24 Any outer guy wire that is near a road or could present a safety hazard shall have a yellow safety shied to enhance visibility.

6.13 Overhead Power Line Assemblies and Component Design

6.13.1 Information presented in this Section 6.13 shall apply to both Interconnection Line structures and Collection System Circuit overhead structures, as applicable, and unless explicitly stated otherwise.

6.13.2 All assemblies, hardware, and components of assemblies shall be designed to meet the strength requirements set forth in the Applicable Standards, including, but not limited to, NESC C2 2012, and shall be verified that all standard or non-standard material, assemblies, hardware, and components of assemblies meet the strength requirements for the application and intended use.

6.13.3 All non-standard material shall be approved by Owner prior to implementing its use in design.

6.13.4 Any piece of hardware in an insulator assembly must, at a minimum, match the ultimate strength of the insulator.

6.13.5 All hardware shall be selected such that the hardware supports the defined loads without exceeding the factored strengths as specified by the hardware manufacturer.

6.13.6 The parts of each assembly, including insulators, shall be verified that they can be assembled properly.

6.13.7 Assemblies shall be articulating so that undue binding or overstressing will not occur during wire movements.

6.14 Structural Steel Fabrication and Connections

6.14.1 Structural steel shall be fabricated and assembled in shop to greatest extent possible.

6.14.2 Specific structural steel materials shall comply with the following, at a minimum:

(1) W-shapes: ASTM A992/A992M (50 ksi yield strength).

(2) Channels, angles-shapes: ASTM A36/A36M.

(3) Plate and bar: ASTM A36/A36M.

(4) Cold-formed hollow structural sections: ASTM A500, Grade B structural tubing.

(5) Steel pipe: ASTM A53/A53M, Type E or S, Grade B.

(6) Weight class: standard.

(7) Finish: galvanized.

(8) Welding electrodes: comply with AWS requirements.

6.14.3 Galvanizing repair paint shall be SSPC-Paint 20 ASTM A780.

6.14.4 Design and fabrication shall be according to AISC's "*Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design*".

6.14.5 High-strength structural steel shall be identified according to ASTM A6/A6M and maintain markings until structural steel has been erected.

6.14.6 Materials shall be marked and match-marked for field assembly.

6.14.7 Structural-steel assemblies shall be completed, including welding of units, before starting galvanizing operations.

6.14.8 High-strength bolts shall be shop installed according to the RCSC's "*Specification for Structural Joints Using ASTM A325 or A490 Bolts*" for type of bolt and type of joint specified.

6.14.9 Weld connections shall comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding Work.

6.14.10 Backing bars or runoff tabs shall be removed, back gouged, and ground steel smooth.

6.14.11 Built-up sections shall be assembled and welded by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "*Code of Standard Practice for Steel Buildings and Bridges*" for mill material.

6.14.12 Weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel shall be verified that they will limit distortions to allowable tolerances.

(1) Butt welds shall be ground flush.

(2) Exposed fillet welds shall be ground or filled to smooth profile.

(3) Exposed welds shall be dressed.

6.14.13 Zinc coating shall be applied by the hot-dip process to structural steel according to ASTM A123/A123M.

6.14.14 Vent holes shall be filled and ground smooth after galvanizing.

6.15 Testing and Quality Control

6.15.1 All testing described herein shall be performed by an independent, experienced third party. Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities.

6.15.2 All structural works shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

6.15.3 Structural works testing shall include the following, at a minimum (for the avoidance of doubt, additional Turbine Foundation testing requirements are specified in Section 5.13 herein):

(1) Concrete and grout properties (strength, slump, air content, temperature).

(2) Compaction.

6.15.4 Copies of testing reports shall be submitted to Owner within 10 days of completing such test. Testing reports shall include a summary of testing procedures and acceptance criteria.

7.0 COLLECTION SYSTEM SPECIFICATIONS

7.1 General Provisions

7.1.1 The Collection System Circuits shall be installed only within parcels that are leased by the Project.

7.1.2 The Collection System Circuits shall be designed and constructed to a high level of reliability and shall meet or exceed the requirements set forth by the interconnection utility.

7.1.3 The Collection System Circuits shall be designed and constructed in accordance with the Project Electrical Studies, as defined in RFP Appendix A.1 (Wind) (*Scope of Work*).

7.1.4 The Collection System Circuits shall be designed and constructed to meet the Electrical Loss Limit set forth in RFP Appendix A.1 (Wind) (*Scope of Work*).

7.1.5 No more than 15 Wind Turbines or 27 megawatts of combined capacity shall be installed on any single Collection System Circuit.

7.1.6 Access to the Collection System Circuits shall be from existing roads or new access roads within the permitted area. Exact Collection System Circuit routing shall be determined, however, the preferred routing shall be to parallel the access roads and crane paths as much as possible, so long as such routing does not increase the required number of crane breakdowns. When not practical or efficient to parallel the access roads, the Collection System Circuit shall be routed in a straight line, shortest distance as much as possible.

7.1.7 All manufacturer installation instructions for the installation of all Collection System Circuit components shall be obtained and followed.

7.2 Design Working Life

7.2.1 The design working life of the Collection System Circuits shall be a minimum of 30 years.

7.3 Civil Works Requirements

7.3.1 All civil works for the Collection System Circuits shall comply with the applicable specifications in Section 5.0 *(Civil Works Specifications*).

7.3.2 Excavation by blasting for the Collection System Circuits is prohibited.

7.3.3 Trench widths shall be kept to a minimum to allow sufficient space for equipment installation.

7.3.4 The trench bottom shall be firm for the entire length and width.

7.3.5 Trenches shall be kept free from water.

7.3.6 Conduit and cable shall not be placed on frozen ground.

7.3.7 All splice pits (if used) and backfill shall be compacted to a minimum of 85 percent (85%) of standard proctor density, unless otherwise noted on the design drawings.

7.4 Power Cabling

7.4.1 All Collection System Circuit power cabling shall be 34.5-kV, three (3)-phase, 60 Hertz.

7.4.2 Jacketed, single-conductor, appropriately-sized concentric neutral, insulated medium-voltage underground distribution power cable insulated with either TRXLP or EPR shall be used. All underground Collection System Circuit power cabling shall be supplied with a minimum of 100 percent (100%) insulation that meets or exceeds all requirements of applicable AEIC, IEEE, ICEA, NEMA, and UL standards.

7.4.3 Notwithstanding the following sentence, all underground Collection System Circuit cabling shall be direct buried at a depth of at least 42 inches below grade. All crossings, including road and utility crossings, shall be installed in conduit and buried at a depth of at least 48 inches below grade.

7.4.4 All Collection System Circuit cables shall be UL listed.

7.4.5 Collection system Circuit cable shall be of a discharge-free design and suitable for direct burial, installation in duct and exposure to sunlight on an alternating current, three-phase, 34.5-kV nominal, 60-Hertz power system.

7.4.6 Allowable conductor sizes are 1/0 AWG through 1250 kcmil.

7.4.7 All central conductors shall be Class B stranded. No more than one (1) conductor per cable shall be allowed. Conductor material shall be aluminum or copper.

7.4.8 A sufficient amount of cable slack shall be provided to allow installation of elbows and termination of the cables to the appropriate junction box and/or Wind Turbine switchgear terminal and permit ready disconnection of the elbows and mounting on the parking stands. For the avoidance of doubt, such slack shall allow for the installation / service disconnection of connectors, dead breaks, and other similar devices.

7.4.9 Excess slack shall be provided to allow re-termination in the event of failure. The excess slack at each Wind Turbine location shall be in the form of a maintenance loop. Sufficient cable length shall be provided such that the cables may be re-terminated at least two (2) times after installation.

7.4.10 All Collection System Circuit power cabling shall be provided with terminators and labels. Labels shall be permanently attached at both ends. Labels shall be sequentially numbered.

7.4.11 No splices shall be permitted to underground cabling unless explicitly approved in writing by Owner. If such underground splices are permitted by Owner, underground splices shall be identified using GPS-located marker balls, and splices shall only be performed by a skilled, qualified craft worker; the coordinates of each splice shall be recorded and noted within the As-Built Drawings.

7.4.12 Bedding material shall be installed around all buried Collection System Circuits to provide physical and/or thermal protection for buried cable. All trench bedding and/or backfill materials shall be screened and visually inspected for materials in excess of two (2) inches. All bedding and/or backfill material shall be composed of materials that are native to the Project Site. Such materials shall be free of debris, roots, organic matter, frozen matter, coal, ashes or cinders.

7.4.13 Cable marking tape shall be furnished and installed in all trenches. Such tape shall be metallic and detectable. Marking table shall be placed 12 to 18 inches above cable.

7.4.14 Excessive bending of cabling shall be avoided, and the manufacturer recommended bending radius shall not be exceeded.

7.4.15 All crossings, including road and utility crossings, shall be marked on each side using a cable marker.

7.4.16 GPS-located marker balls shall be placed within all cable trench at the following:

(1) Minimum of every 300 feet of trench length;

(2) All crossings (road, pipeline);

(3) All turns in the Collection System Circuit; and

(4) Every splice location (see Section 7.4.11 above)

7.4.17 BIL voltage rating: 200 kV.

7.4.18 Maximum short-circuit conductor temperature: 250°C.

7.5 Fiber Optic Cabling

7.5.1 Fiber optic cable shall be installed in the same trench as the Collection System Circuit power cabling.

7.5.2 Refer to Section 8.0 (*Communications System Specifications*) for additional requirements.

7.6 Pad-Mount Transformers

7.6.1 If not supplied internal to the Wind Turbine, each Wind Turbine location shall include a medium-voltage, pad-mount transformer. Such transformer shall be sufficiently sized to allow the full Wind Turbine capacity to be delivered.

7.6.2 Pad-mount transformers shall be in accordance with the requirements set forth in Table 4 (*Summary of General Requirements for Pad-Mount Transformers*) herein, at a minimum.

Table 4: Summary of General Requirements for Pad-Mount Transformers

Description	Value
Quantity	1 per Wind Turbine
Type	Oil filled, hermetically sealed, outdoor installation
Voltage ratio	34,500 / 690* Volts (*: varies by Wind Turbine)
Phases	3
Windings	2 (MV, LV)
Steady state temperature rise	65°C above ambient
Frequency	60 Hz
Impulse levels	150 kV (General), 200 kV (Windings)
Vector group	Grounded wye/delta
Cooling	ONAN
Tapping range	±5%, 2.5% steps, manual control
Paint finish	Munsell Green
Guaranteed losses	Not used
Temperature gauge	Required
Pressure level indicator	Required
Pressure relief device	Required
Oil sampling valve	Required (to be located on the end of the drain valve inside the LV compartment)
Filling orifice	Required
Tank ground tag	Required
Oil level indicator	Required
Grounding	Solid (MV source, LV winding) Un-grounded delta (MV winding)

7.6.3 Pad-mount transformers shall be fitted with in-line, medium-voltage rated, current-limiting fuse protection per phase utilizing suitably-rated, oil-immersed, current-limiting fuses. The selection of these fuses shall be such as to ensure:

(1) Compliance with the requirements of IEC 60787, or ANSI/IEEE equivalent.

(2) Short circuit protection of the MV transformer winding.

(3) That degradation of the fuses does not occur as a result of the flow of repeated transformer magnetizing in-rush currents.

(4) Ease of replacement following an in-service operation.

7.6.4 Enclosure:

(1) The pad-mount transformer shall include a fully-enclosed, transformer mounted, MV and LV termination, steel cabinet, suitable for outdoor installation, as per ANSI C57.12.28. The cabinet must be so designed as to fully enclose all cable tails, cable terminations, grounding tags and transformer fittings within a tamper and rodent resistant, secure enclosure.

(2) The cabinet shall extend to floor level, fully shrouding all cable tails, having the facility for being directly bolted to the supporting concrete plinth. The cabinet depth shall be 24 inches.

(3) The MV and LV compartments shall be partitioned such that access to each compartment is via a separate door. External access shall be available through the LV compartment door only, with access to the MV compartment door lock being available within the LV compartment. The doors shall be fitted with an all steel, robust, tamper proof, three point (i.e., top, mid, and bottom) integral locking system. Each door shall have the facility of being securely locked shut via the application of a dedicated pad lock.

(4) The transformer name plate and all transformer indication fittings (e.g., oil level indicator, oil temperature indicator) shall be located within the LV compartment, while all transformer operational fittings (e.g., tap changer switch, isolation switch etc.) shall be located within the MV compartment.

(5) The cabinet doors shall be fitted with anti-close stays designed such that both doors can be held open at right angles. The anti-close stay design shall be sufficiently strong enough to withstand the prevailing wind conditions.

7.6.5 Foundations / vaults:

(1) Pad-mount transformers shall be installed with a fiberglass box pad.

(2) Box pads shall be installed level and plumb, and set on concrete with a rock base. Excavations shall be filled with a minimum 2,000 psi slurry mix.

7.7 Junction Boxes

7.7.1 Junction boxes shall be stainless steel or fiberglass.

7.7.2 Junctions boxes shall be installed level and plumb, and set on concrete with a rock base, with excavations filled with a minimum 2,000 psi slurry.

7.7.3 Junction boxes shall be clearly marked with an appropriate high-voltage sign identifying the junction box number and Collection System Circuit number.

7.7.4 Junction boxes shall meet the requirements of ANSI C57.12.28, including water resistance.

7.7.5 The coordinates of each junction box shall be recorded and noted within the As-Built Drawings.

7.7.6 Junction boxes shall be lockable with a padlock.

7.7.7 No medium-voltage cable run shall exceed 10,000 feet without a sectionalizing junction box.

7.8 Overhead Installation

7.8.1 All Collection System Circuits shall be installed underground.

7.9 Surge Arrestors

7.9.1 Surge arrestors shall be provided at the end of each string of Wind Turbines. Surge arrestors shall be 35-kV class, 600A, 30kV/24.4MCOV equipment meeting the requirements of ANSI C62.11 for Station Class installation in a 60-Hertz outdoor installation.

7.9.2 Surge arrestors shall be provided in pre-molded rubber elbows.

7.9.3 Surge arrestors shall provide overvoltage system protection in an insulated, fully shielded, submersible, dead-front device.

7.10 Grounding

7.10.1 Grounding connections at junction boxes and pad-mount transformers (if any) shall be bolted to facilitate separation of grounds for continuity testing and ground mat testing.

7.10.2 Ground rods shall be incorporated into the grounding system. Ground rods shall be copper-clad, 5/8-inch diameter, 10-foot-long rods at a minimum.

7.10.3 Turbine Foundations shall include a grounding grid. The design and construction of the grounding system in such foundations shall meet or include the following requirements, at a minimum:

(1) Requirements set forth by Turbine Supplier.

(2) Incorporate the recommendations and minimum requirements set forth in the geotechnical engineering report.

(3) Proper grounding of equipment and structures.

(4) Installation of adequate ground for personnel safety, including touch and step potentials (to be demonstrated by Contractor via calculations in the grounding study).

(5) Proper grounding for lightning and surge protection.

(6) Incorporate local resistivity measurements.

(7) A ground resistance <= 2 Ω.

7.10.4 All local requirements and the NESC shall be adhered to in the grounding design and construction.

7.10.5 Meteorological towers shall be independently grounded; meteorological tower grounding shall not be interconnected to the Wind Turbine grounding system.

7.11 Bollards

7.11.1 Bollards shall be installed around every junction box and pad-mount transformer (if any), respectively. Bollards shall be installed no closer than four (4) feet from the junction box or pad-mount transformer (if any).

7.11.2 Bollards shall be a minimum three (3)-inch diameter steel pipe, concrete filled for equipment protection, painted safety yellow, and extend five (5) feet above grade.

7.11.3 Bollards shall include two (2) embedded galvanized steel eye bolts in each bollard at an elevation of forty-two (42) inches above grade that is sufficient to allow for the connection of lengths of chain.

7.12 Conduit

7.12.1 Conduit size shall be in accordance with ANSI / NFPA 70, at a minimum.

7.12.2 The location of all conduit shall be surveyed and recorded within the As-Built Drawings.

7.12.3 Non-metallic conduit shall be protected from sunlight.

7.12.4 The interior surface of all conduits shall be smooth to prevent damage to the cables. When cable is pulled into a duct, a suitable pulling lubricant shall be used.

7.12.5 HDPE conduit shall be SDR13.5 or heavier if needed to avoid damage when pulling into the bored hole. HDPE shall be one continuous length or connected together with fused joints.

7.12.6 Use suitable temporary plugs or caps to protect installed conduit against entrance of dirt, moisture, and debris.

7.12.7 All above-ground power and communications cabling shall be installed in conduit. All below grade crossings, including road and utility crossings, shall be installed in conduit. Conduit shall be installed from each Wind Turbine to each pad-mount transformer (if any).

7.12.8 All conduit materials required shall be furnished new and undamaged in accordance with the following requirements, at a minimum:

(1) Duct: polyvinyl chloride, Schedule 40 PVC in accordance with NEMA TC-2.

(2) Couplings: plastic, for use with duct previously specified and “Duct-to-steel” adapters as required, including joint cement.

(3) Spacers: plastic high impact, interlocking, base and intermediate type

(4) Factory bends and sweeps: Schedule 40 PVC, 3-foot minimum radius (or greater if required to not violate the minimum bending radius of the cable being installed in it).

(5) End bells: plastic.

(6) Plugs: plastic, high impact, tapered to fit end bell provided.

(7) Duct binder: hemp or sisal twine coupling.

7.13 Connectors and Fittings

7.13.1 Connectors and fittings shall be of the proper size and design to assure permanent, secure, and low-resistance connections.

7.13.2 Connectors and fittings shall be all welded or swaged type for aluminum tubing connections and compression or puddle-welded type for aluminum cable connections.

7.13.3 Tubular aluminum welded or swaged splicing sleeves shall be used for necessary splices in aluminum tubing.

7.13.4 For connections between aluminum tubing and cable, use a welded or swaged tubing-to-terminal pad connector and a compression-type cable-to-terminal pad connector on the end of the cable.

7.13.5 Flexible terminal types shall be furnished where tubing connections are made to bushing studs of transformers, breakers, and other equipment. Expansion-type connectors shall be used with internal ball-type alignment guides.

7.13.6 For electrical pad connections, stainless steel hex-bolts, hex-nuts, flat washers, and Belleville washers shall be provided. Belleville washers shall have a minimum compression rating of 4,000 pounds. Bolt lengths shall be sized to provide minimal projection beyond hex nut to prevent excessive noise due to corona, but entire hex nut must be engaged.

7.13.7 For copper to aluminum connections, stainless steel bolts shall be used for copper to aluminum bar or rod connections, and faced or sleeved aluminum connectors shall be used for cable connections.

7.13.8 All connections between stranded aluminum or ACSR-type conductors and equipment stud terminals shall be made with a stud-to-pad type stud connector and a compression-type cable-to-pad type conductor termination.

7.13.9 All dead-end fittings, terminals, splices, and other similar items for ACSR and other types of stranded aluminum conductor shall be tubular compression type fittings. In no case shall any type of stranded aluminum conductors be used with bolted or clamp-type fittings, except for through-type connections to surge arresters on transformers. At least five percent (5%) extra dead-end body filler plugs for each type used shall be provided.

7.13.10 Stranded and tubular copper bus work, where used, shall have connectors and fittings with a minimum of four (4) bolts or two (2) "U"-bolts on each side of each joint.

7.13.11 Fittings shall develop the full strength of the conductor and shall be capable of carrying the full current capacity of the conductor.

7.13.12 Fittings for shield wire dead ends, splices, and taps shall conform to the following:

(1) Shield wire dead-end fittings shall be compression type with bolted jumper connection. Shield wire insulators shall be located as indicated.

(2) Compression sleeves for shield wire tension splices shall be used which will develop at least ninety percent (90%) of shield wire strength.

7.13.13 "Alcoa Filler Compound" shall be furnished for application in conductor dead-end bodies and Alcoa No. 3 Electrical Joint Compound (Alnox), or approved equal for aluminum connections. At least five percent (5%) overage shall be furnished for all filler compounds furnished.

7.13.14 Bus support clamps for rigid bus shall be fixed or slip type as required to firmly support the bus but allow for temperature expansion and contraction.

7.13.15 Bolted ground connectors and flexible type grounding jumpers shall be provided for operating handles of disconnect switches.

7.13.16 All transformer and oil circuit breaker stud connectors shall be tinned bronze material.

7.13.17 All grounding connectors in contact with galvanized structures shall be tinned bronze material.

7.13.18 All compression tees are to be open type compression run and 4-hole NEMA pad tap.

7.13.19 Bundled jumpers from power circuit breakers to disconnect switches shall be furnished.

7.13.20 For disconnect switch connections, NEMA-type terminal pad connectors shall be provide with at least four (4) bolts.

7.13.21 All materials furnished shall have mechanical and electrical ratings, types, sizes, and other similar items coordinated with adjacent hardware and fittings.

7.13.22 All hardware furnished shall be static-free type.

7.13.23 Ground jumpers shall be provided direct from switch-operator ground pad to ground connector on operating handle or mechanism of switch. No other ground connection is to be made to pad. Ground mat(s) shall be furnished at each switch-operator.

7.13.24 Bus grounding stud, welded or swaged, shall be furnished as indicated.

7.13.25 Wire guides and bundle conductor spacers shall be provided as required and indicated to maintain adequate clearance and support on cable jumpers, connections, and overhead lines.

7.14 Miscellaneous Material

7.14.1 Cable accessories, terminators, dead front, load break and/or dead break elbows shall be designed and manufactured for the cable to be utilized and rated 600-amp for outdoor 34.5-kV use.

7.14.2 Dead front, load break, and/or dead break elbows shall be supplied with test ports.

7.14.3 Cable fault indicators shall be installed. The remote head shall be mounted in the cabinet wall to allow viewing from outside the cabinet. Fault indicators shall be installed at no more than every third Wind Turbine location.

7.14.4 Miscellaneous wire material such as armor rod, line guard, spacers, dampers, tension splices, compression sleeves, and jumper terminals shall be provided.

7.15 Testing and Quality Control

7.15.1 All testing described herein shall be performed by an independent, experienced third party. Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities.

7.15.2 All Collection System Circuits shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

7.15.3 Collection System Circuit testing shall include the following, at a minimum:

(1) All testing specified in the Applicable Standards, including NETA.

(2) All testing reasonably recommended or required by the applicable equipment suppliers.

(3) All exposed cable sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

(4) Resistance testing on grounding grid at each Wind Turbine location and junction box.

(5) Megger test of all 34.5-kV Wind Turbine cables.

(6) Very low frequency ("**VLF**") test of all 34.5-kV power cabling.

(7) Final continuity tests after completion of all system connections. Acceptable continuity tests shall include a Megger test or VLF test at 100 percent of rated voltage.

(8) Partial discharge testing on each splice. All partial discharge testing shall be performed at a minimum of 200 percent of the rated voltage of the cable and at 60 Hertz. All partial discharge testing shall be performed following installation of the cabling, but prior to installation.

(9) Compaction testing shall be verified at a minimum of every 1,000 feet and at every splice pit location.

(10) Communications system testing according to Section 8.0 (*Communications System Specifications*).

(11) Pad-mount transformer minimum testing:

(a) Transformer turns ratio ("**TTR**") on all tap positions.

(b) Insulation resistance test (i.e., Megger), including winding-to-winding and winding-to-ground measurements.

(c) Winding resistance test.

(d) Insulation power factor test.

(e) Oil testing prior to energization and at least 30 days following energization, respectively.

(f) No-load and load loss test.

(g) Temperature rise test, to be performed on one (1) randomly-selected unit.

(h) Dissolved gas analysis, to be performed on every purchased unit, plus one (1) additional DGA test before the temperature rise test listed above.

7.15.4 Copies of testing reports shall be submitted to Owner within 10 days of completing such test. Testing reports shall include a summary of testing procedures and acceptance criteria.

8.0 COMMUNICATIONS SYSTEM SPECIFICATIONS

8.1 General Provisions

8.1.1 The Communications System shall be designed with data continuity and reliability as priority.

8.1.2 All monitoring and control devices and systems shall be suitably zone protected against lightning electromagnetic impulses in accordance with IEEE C37.90.1.

8.1.3 The Communications System shall be compliant with all Applicable Standards, including NERC Functional Model Registered Entity function, NERC Reliability Standards, Regional Entity Standards, approved regional variances, and/or FERC Orders. Further, the Communications System shall comply and be designed to work in accordance with applicable system operator approved protocols, operating guides, standards, business practice manuals, and/or approved rules. In so far as either a state utility commission or provincial authority has instituted additional regulations, the communications system should be design to accommodate where no conflict exists with NERC or FERC. Design should include parameters for operating under conditions specified by rules stated hereto as well as capability to function on an evidentiary basis.

8.1.4 All Communications System design and construction shall conform to the Turbine Supplier's requirements.

8.2 Design Working Life

8.2.1 The design working life of the Communications System equipment shall be a minimum of 30 years.

8.3 Civil Works Requirements

8.3.1 All civil works for the Communications System shall comply with the applicable specifications in Section 5.0 *(Civil Works Specifications*).

8.3.2 Excavation by blasting for the Communications System is prohibited.

8.3.3 Trench widths shall be kept to a minimum to allow sufficient space for equipment installation.

8.3.4 The trench bottom shall be firm for the entire length and width.

8.3.5 Trenches shall be kept free from water.

8.3.6 Conduit and cable shall not be placed on frozen ground.

8.3.7 All splice pits (if used) and backfill shall be compacted to a minimum of 85 percent (85%) of standard proctor density, unless otherwise noted on the design drawings.

8.4 System Functionality

8.4.1 The Communications System shall be capable of centrally and remotely monitoring, controlling, and recording the performance of the Project Substation equipment, permanent meteorological towers, Wind Turbines, and other critical sensors.

8.4.2 The Communications System design shall include configuration files and a comprehensive data points list and protocol specification for communications between all Project components requiring communications, data transfer, and control monitoring using the fiber network integrated into the Communications System. Such configuration files shall have the ability to be configured by Owner, and Contractor shall furnish development application software for each configurable device.

8.4.3 The Communications System shall include the necessary equipment (hardware and software) for the exchange of signals with Project Substation equipment to support grid monitoring.

8.4.4 The Communications System shall include the necessary equipment (hardware and software) for the exchange of signals with the permanent meteorological towers to support data monitoring.

8.4.5 The Communications System shall include the necessary equipment (hardware and software) for the exchange of signals and integration of any required reactive compensation devices (e.g., capacitor banks, reactors).

8.4.6 Remote monitoring, control, and reporting of the Communications System equipment shall be available through a web-based configuration accessible from a standard internet browser. The system shall be connected to the internet at all times and shall remain behind an Owner-managed firewall.

(1) Owner shall have unlimited access to Project data through the web-based system.

(2) Owner shall have no limitation on number of users through web-based system.

(3) Varying levels of access to the web-based system shall be permitted through secure login and user permissions.

8.4.7 Upon loss of utility power interconnection or failure of utility power, restart of the instrumentation and control system to a fully-functioning condition should require no local manual operations. Synchronization shall be performed automatically.

8.5 Fiber Network

8.5.1 Fiber optic cable shall be installed in the same trench as the Collection System Circuit power cabling.

8.5.2 When fiber cables are installed in a trench, the fiber cable shall be placed in conduit or continuous innerduct; the fiber cable shall be rated for underground use; and there shall be a suitable locating cable installed in the innerduct/conduit. Innerduct shall have a minimum diameter of 1.25 inches.

8.5.3 Fiber optic shall be separated from any power cables when co-located in a trench.

8.5.4 All fiber cables shall consist of a minimum of 12-strand multi/single mode fiber. All fiber runs greater than one (1) mile in length shall be single-mode fiber, or as otherwise required to maintain a minimum of at least one (1) gigabyte bandwidth throughout the backbone of the system.

8.5.5 If metallic armored fiber optic cable is used, protection from induced voltage shall be installed.

8.5.6 All fiber cables shall be designed with a minimum of fifty percent (50%) spare fiber, or at least an additional six (6) feet of fiber cable supplied at each end, whichever is greater.

8.5.7 All communications cables, including fiber cables, shall be appropriately labeled with a permanently-attached label at both ends. Labels shall be sequentially numbered.

8.5.8 The fiber system shall be designed for a minimum of five (5) dB system margin.

8.5.9 The fiber system design shall be a fiber ring topology or a "daisy-chained" system.

8.5.10 Conduits for fiber entry into the Wind Turbine areas shall include a pull string for pulling the cable.

8.5.11 Fiber cables may be routed through Project Substation control cable trenches with other control wiring provided that a high-visibility color innerduct is used for identification and protection of the fiber cables.

8.5.12 All splices shall be fusion splices. Other types of splices are subject to Owner approval.

8.5.13 Maximum attenuation:

(1) 0.36 dB/km at 1310 nm.

(2) 0.22 dB/km at 1550 nm.

8.5.14 Terminations shall be completed with either an approved fiber optic pigtail kit or with approved mechanical connectors and an approved fanout kit.

8.5.15 Data collection loops shall be designed so that a loss of a power circuit does not cause a loss of data collection from the Turbines during the power outage.

8.6 Monitoring and Control Requirements

8.6.1 Design and installation of the Communications System shall be provided with all hardware, telemetry, communication and other requirements as required by the interconnection utility.

8.6.2 The Communications System shall be provided with the following supervisory screens, at a minimum.

(1) Project Substation one-line diagram, including all breakers, switches and transformers and the real-time status of each (current, power, voltage, power factor, and reactive power, as applicable).

(2) Project Substation alarms and notifications:

(a) Status of all relays.

(b) Status of all alarms and notifications.

(3) Main power transformer status, including the following for each main power transformer:

(a) Operation and fault status, including alarms.

(b) Relay statuses.

(c) Temperatures (winding, oil).

(d) Tap changer position.

(4) Breaker status, including the following for each medium- and high-voltage breaker:

(a) Operation and fault status, including alarms.

(b) Relay statuses.

(c) Breaker readings (current, power, voltage), including per Collection System Circuit.

(5) Control building status, including the following:

(a) Operation and fault status, including alarms.

(b) Enclosure alarms (fire/smoke alarm status, enclosure temperature, intrusion, etc.)

(c) Battery charger voltage and status.

(d) Intrusion detection.

(e) HVAC status.

(6) Wind Turbine status, including the following:

(a) Wind Turbine status (e.g., online, offline for maintenance, curtailed) for each unit.

(b) Wind Turbine generation level for each unit.

(c) Total Project power.

(d) Atmospheric conditions.

(7) Other supervisory screen requirements:

(a) All major components (e.g., breakers, transformers, meteorological towers) shall be listed separately.

(b) Alarms and faults shall be color-coded where applicable (e.g., green, yellow, red).

8.6.3 The Communications System shall include control functionality for the following, at a minimum:

(1) Active power.

(2) Reactive power.

(3) Frequency.

(4) Voltage.

(5) Power factor.

(6) Noise-related operations.

8.6.4 Fault notification shall be provided through real-time text messaging or e-mail alerts, as determined by Owner. Fault notification messages and recipients shall be specified by Owner.

8.7 Reporting and Storage Requirements

8.7.1 All reporting shall be in Generation Availability Data System ("**GADS**"), wind format.

8.7.2 SCADA system reporting shall include, at a minimum, the following for the Project Substation, permanent meteorological towers, and Wind Turbines:

(1) Performance parameters, availability, operation counters, faults, and alarms.

(2) Browsing and filtering of historical data.

(3) Creation of pre-defined and custom reports.

8.7.3 All stored data and generated reports shall be exportable as ASCII and Microsoft Excel formats.

8.7.4 The system shall not permit unwarranted tampering with or changing of raw data or functionality.

8.8 Data Storage Requirements

8.8.1 All data monitored by the Communications System shall be recorded and stored. Local controllers shall have sufficient buffer for at least 30 days of data storage in the event of power loss.

8.8.2 Historical data shall be stored in an SQL database or Owner-approved equivalent for the life of the Project. Data shall be stored in the database as no higher than 1-minute averages, with accompanying statistical values including, but not limited to, minima, maxima, and standard deviation. All data shall be retrievable.

8.9 Testing and Quality Control

8.9.1 All testing described herein shall be performed by an independent, experienced third party. Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities.

8.9.2 All communications system equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

8.9.3 Communications system testing shall include the following, at a minimum:

(1) All testing specified in the Applicable Standards, including NETA.

(2) All testing reasonably recommended or required by the applicable equipment suppliers.

(3) All exposed cable sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

(4) Verify all alarms, indications and analog quantities are communicated and received properly by the RTU and displayed correctly on the HMI.

(5) Verify all communication channels (intra- and inter-Project Substation), including Project Substation LAN, operate as expected.

(6) Verify fiber optic system performance (power losses, splice or connector losses, etc.) using optical domain reflectometer ("**OTDR**"). All such testing shall be done with an OTDR in both directions of the strands. For single-mode fiber, test both directions at 1310 nm and 1550 nm.

(7) All fiber optic cable shall be visually inspected and OTDR-tested prior to installation.

(8) Provide system functionality and compatibility at the control room / O&M Building.

(9) Test each cable and strand on every fiber run from termination to termination.

(10) Provide entire Project Site testing to ensure proper operation of all data points into the component gateways and testing of all data points provided to third parties with that party.

8.9.4 Copies of testing reports shall be submitted to Owner within 10 days of completing such test. Testing reports shall include a summary of testing procedures and acceptance criteria.

9.0 PROJECT SUBSTATION SPECIFICATIONS

9.1 General Provisions

9.1.1 The Project Substation shall be designed and constructed to a high level of reliability and shall meet or exceed the requirements set forth by the interconnection utility.

9.1.2 The Project Substation shall be designed and constructed in accordance with the Project Electrical Studies, as defined in RFP Appendix A.1 (Wind) (*Scope of Work*).

9.1.3 The Project Substation shall be designed and constructed to meet the Electrical Loss Limit set forth in RFP Appendix A.1 (Wind) (*Scope of Work*).

9.1.4 Project Substation basic impulse level shall be at least 200 kV for the 34.5-kV system and subject to Owner approval on the high-voltage system (to be determined based on the Project voltage level). Design of the high-voltage and 34.5-kV systems shall be for a short circuit rating calculated based on the results of a Contractor-furnished short circuit study.

9.1.5 Minimum conductor clearance criteria shall be per the NESC. Clearances shall be increased at locations where additional clearances are required for access to equipment.

9.1.6 Notwithstanding the immediately following sentence, no splices shall be made within the Project Substation, including both power and instrument and control conductors. Shields may be spliced where necessary to permit connection to the Project Substation ground system.

9.1.7 Conductors shall be terminated at each end, labeled, tied, and bundled, respectively.

9.1.8 Project Substation equipment paint shall be ultraviolet resistant. The coating shall consist of rust-inhibiting epoxy primer, standard intermediate coating, and two (2) finish coats of paint. The total coating shall be a minimum of five (5) mils dry. The paint color shall be an ANSI 70 sky grey color, unless otherwise approved by Owner.

9.1.9 All manufacturer installation instructions for the installation of all Project Substation components shall be obtained and followed.

9.1.10 Backup power at the Project Substation shall be provided from two (2) sources. The Interconnection Line and local distribution system may each be utilized as a source, although the battery system may not be utilized as one of these sources. A standby generator, conforming with the requirements set forth in RFP Appendix A-7.25 (*ZS-020 Substation Equipment AC Standby Generator System*), shall be installed if two sources of backup power are not available.

9.2 Design Working Life

9.2.1 The design working life of the Project Substation equipment shall be a minimum of 30 years.

9.3 Civil Works Requirements

9.3.1 All civil works for the Project Substation shall comply with the applicable specifications in Section 5.0 *(Civil Works Specifications*).

9.3.2 Excavation by blasting for the Project Substation is prohibited.

9.3.3 Trench widths shall be kept to a minimum to allow sufficient space for equipment installation.

9.3.4 The trench bottom shall be firm for the entire length and width.

9.3.5 Trenches shall be kept free from water.

9.3.6 Conduit and cable shall not be placed on frozen ground.

9.3.7 Project Substation equipment shall have wind and seismic withstand capability in accordance with the Applicable Standards, including IEEE 693 and AISC's "*Manual of Steel Construction*".

9.4 Conductors

9.4.1 All cable furnished shall conform, at a minimum, to the requirements included in Table 5 (*Summary of Cable Requirements*):

Table 5: Summary of Cable Requirements

Cable Type	Description
Low-voltage power	600 volts, single-conductor, Class B stranded copper; EPR or XLP insulated; CSP or CPE jacketed.
Low-voltage power	600 volts, three-conductor; concentric lay, stranded copper with a ground wire in the interstices; FRXLPE or FREPR insulation; CSP, or CPE jacketed overall.
Control	Control cable, 600 volt, multiple-conductor, as required, stranded copper, 10 AWG, 12 AWG, 14 AWG; multiple-conductor, XLP insulation; CSP, or CPE jacketed overall.
Instrumentation	Instrumentation cable, 600 V, flame retardant single-and multiple-twisted pairs and triads, shielded instrument cable with individually shielded pairs, overall shield, and overall jacket; FRXLPE or FREPR insulation; CSP, or CPE jacketed overall. (Single pair or triad 16 AWG, multi-pair or triad 18 AWG).
Lighting and receptacles	Lighting circuit runs totally enclosed in conduit, NEC Type RHH-RHW-USE with XLPE insulation for use in outdoor or unheated areas.
Shielded control	Control cable, shielded, 600 volt, multiple conductor, as required, stranded copper, 10 AWG, 12 AWG, 14 AWG; multiple conductor, XLP insulation; CSP, FRPVC or CPE jacketed overall

9.4.2 Power conductor size and ampacity shall be coordinated with circuit protection devices.

(1) Conductor size shall be determined for 125% of connected load at the design basis maximum outdoor ambient temperature.

(2) Below-grade power cable conductor size shall be determined in accordance with the methods in IEEE 835.

9.4.3 Installation of conductors shall be understood to include placement, splicing, and terminating conductors; coiling and taping of spare conductors; identification, testing, and verification of each circuit, cable, and conductor.

(1) Manufacturer's pulling or side wall tension shall never be exceeded.

(2) Recorded cable tension reports shall be provided to Owner.

9.4.4 Insulated cable, conductors, and conductor accessories shall be furnished and installed in accordance with the requirements of these Specifications and the recommendations given in IEEE 525. Insulated cable, conductors, and conductor accessories shall be furnished in quantities sufficient for a complete installation as indicated in these Specifications.

9.4.5 All Project Substation control and instrument cables shall be shielded.

(1) Connectors, sizes 12 - 2 AWG, shall be vinyl or nylon pre-insulated ring-tongue type

(2) Connectors, sizes 1 AWG – 750 kcmil, shall be uninsulated two-hole rectangular tongue.

9.4.6 The cable furnished shall be flame retardant construction in accordance with the applicable ICEA standards and suitable for wet or dry locations.

9.4.7 All cable shall have surface printing showing manufacture's name, insulation type, jacket type, conductor size, conductor type, voltage rating, and numbered footage markers.

9.4.8 Control and instrument cables, 600-volt class cables, and medium-voltage cables shall be terminated with ring-tongue connectors.

9.5 Voltage Transformers

9.5.1 All voltage transformers shall be connected through an indoor, panel mounted, voltage injection test facility. Each voltage transformer neutral shall be brought through into the control building for termination and single point grounding within the associated protection relay panel.

9.5.2 All voltage transformers shall be a 2 winding, 0.3 class unit, suitable for outdoor installation. Turn ratios shall be determined by Contractor.

9.5.3 Capacitive Coupled Voltage Transformers ("**CCVT**") shall have the facility for grounding through an external grounding switch.

9.6 Current Transformers

9.6.1 All current transformers shall be connected through an indoor, panel mounted, current injection test facility. Each current transformer neutral shall be brought through into the control building for termination and single point grounding within the associated protection relay panel.

9.6.2 The facility for short circuiting the secondary tails of all current transformers, with removable links, must be provided. All current transformers are to be connected through an indoor, panel mounted current injection test facility.

9.7 Main Step-Up Transformers

9.7.1 The main step-up transformer(s) shall be sufficiently sized to allow the full Project capacity to be delivered to the point of interconnection.

9.7.2 The main step-up transformer(s) shall be in accordance with the requirements set forth in Table 6 (*Summary of General Requirements for Main Step-Up Transformers*) herein, at a minimum.

Table 6: Summary of General Requirements for Main Step-Up Transformers

Description	Value
Quantity	See Section 9.7.4
Type	Oil filled, hermetically sealed, outdoor installation
Voltage ratio	TBD* / 34,500 / 13,200 Volts (*: varies by Project)
Phases	3
Windings	3 (HV, MV, Tertiary)
Steady state temperature rise	65°C above ambient
Frequency	60 Hz
Impulse levels	TBD kV (HV), 200 kV (MV), 110 kV (Tertiary)
Vector group	Grounded wye
Cooling	ONAN / ONAF / ONAF
Tapping range	±5%, 2.5% steps, manual control (DETC)
Paint finish	ANSI 70 sky grey color
Guaranteed losses	Not used
Temperature gauge	Required
Pressure level indicator	Required
Pressure relief device	Required
Oil sampling valve	Required
Filling orifice	Required
Tank ground tag	Required
Oil level indicator	Required
Grounding	Solid (primary and secondary windings) Buried delta (tertiary winding)

9.7.3 An electronic impact recorder with GPS capability shall be installed by the manufacturer; if rail shipment is specified, an additional impact recorder shall be mounted on the railcar. The impact recorder shall be furnished with a sealed protective cover. Immediately prior to scheduled pickup of the transformer, the supplier shall start the recorder and verify it is operating properly.

9.7.4 Each main step-up transformer shall have a 150-MVA rating (ONAN, 65°C). The Project shall incorporate parallel main step-up transformers in 150 MVA increments, where each such transformer is identical and interchangeable (mechanically and electrically). Load from each Collection System Circuit shall be split evenly across each transformer. Example: a 250-MW project shall incorporate two (2) 150-MVA main step-up transformers with approximately 125 MW on each unit.

9.8 Station Service Transformer

9.8.1 The station service transformer shall be sized according to the Contractor-provided AC system study.

9.8.2 The station service transformer shall be in accordance with the requirements set forth in Table 7 (Summary of General Requirements for Station Service Transformers) herein, at a minimum.

Table 7: Summary of General Requirements for Station Service Transformers

Description	Value
Quantity	1
Type	Oil filled, pole-mounted, outdoor installation
Voltage ratio	34,500 / 120 / 240 Volts
Phases	1 or 3 (depending on Project electrical design)
Windings	2 (MV, LV)
Steady state temperature rise	65°C above ambient
Frequency	60 Hz
Impulse levels	200 kV
Vector group	Grounded wye/delta
Cooling	ONAN
Tapping range	±5%, 2.5% steps, manual control
Paint finish	ANSI 70 sky grey color
Guaranteed losses	Not used
Temperature gauge	Required
Pressure level indicator	Required
Pressure relief device	Required
Oil sampling valve	Required
Filling orifice	Required
Tank ground tag	Required
Oil level indicator	Required
Grounding	Solid (MV source, LV winding) Un-grounded delta (MV winding)

9.9 Circuit Breakers

9.9.1 High-side bus circuit breakers shall be outdoor, air insulated, three-pole, single-throw, 60 Hertz, dead-tank design with dual trip coils, alarms, interlocks and contacts necessary to meet the Project design. Such circuit breakers shall utilize SF6 gas as the interrupting medium. Such breakers shall consist of three sections: high-voltage compartment, mounting provisions, and low-voltage compartment.

9.9.2 34.5-kV circuit breakers shall be installed for protection of the Collection System Circuits, capacitor banks, and reactors, respectively. Such circuit breakers shall be outdoor, distribution, 60 Hertz, vacuum or SF6 circuit breakers consisting of three sections: high-voltage compartment, mounting provisions, and low-voltage compartment.

9.9.3 Circuit breakers shall contain bushing current transformers for metering and/or protective relaying applications. Current transformers utilized for metering shall be provided with accuracy levels as required by the applicable metering standards of entities which will be installing metering within the station.

9.9.4 Mounting provisions shall be formed-steel supports that mount the breaker to a foundation and provide height adjustment.

9.9.5 The low-voltage compartment of the circuit breakers shall contain the control components and operating mechanism including anti-condensation heaters.

9.9.6 The stored energy mechanism shall drive a common shaft which operates all three phases and the auxiliary switches for breaker position contacts.

9.9.7 The control enclosure shall contain the relays, meters, and switches for the breakers.

9.9.8 The circuit breakers shall have provisions for mounting the protective relays in the control cabinet and remotely.

9.10 Disconnect Switches

9.10.1 High-side, motor-operated, line disconnect switches shall be provided for isolation of the main step-up transformer and Collection System Circuits from the high-side bus system.

9.10.2 High-side breaker disconnect switches shall be outdoor, non-load break, 3-phase gang, manually operated.

9.10.3 All switches shall include contacts and interlocks wired for protection and control with provisions for padlocking for personnel safety and maintenance. All switches shall have hard-wired interlocks and shall be designed and implemented to prevent operation in an undesired state.

9.10.4 High-side, motor-operated, line disconnect switches shall be installed for isolation of the Interconnection Line.

9.10.5 34.5-kV disconnect switches shall be outdoor, non-load break, 3-phase gang, manually operated. These switches shall provide isolation of 34.5-kV breakers, reactors, capacitor banks, and/or grounding transformers, as applicable.

9.11 Grounding Transformers

9.11.1 Grounding transformers shall be sized to effectively ground the portion of the Collection System Circuit that is disconnected from the main Project Substation 34.5-kV bus when the Project Substation feeder or collector breaker is open.

9.11.2 The duration of time that the grounding transformer shall provide effective grounding shall be determined assuming that the Collection System Circuit was at full rated generation at the time when a fault condition occurs on the Collection System Circuit, the time required for the collector breaker to trip due to the fault condition, and the additional time that the isolated Wind Turbines on the Collection System Circuit continue to contribute energy to the fault after the collector breaker opens.

9.11.3 Effective grounding shall be as defined in IEEE Standard 142 and meet the following two conditions, at a minimum:

(1) The positive sequence reactance is greater than the zero sequence resistance (X1 > R0)

(2) The zero sequence reactance is less than or equal to three (3) times the positive sequence reactance (X0 <= 3X1).

9.12 Space Heaters

9.12.1 Breakers and other outdoor equipment shall be furnished with space heaters (if not already provided by manufacturer of the equipment) that are thermostatically controlled and shall be rated single phase 240V for operation on 120V and shall include personnel protection screens.

9.13 Surge Arrestors

9.13.1 High-side voltage surge arrestors shall meet the requirements of ANSI C62.11 for Station Class installation in a 60-Hertz outdoor installation. Surge arrestors shall be provided on the high-voltage bushings of the main step-up transformer.

9.13.2 34.5-kV surge arrestors shall meet the requirements of ANSI C62.11 for Station Class installation in a 60-Hertz outdoor installation. Surge arrestors shall be provided at the 34.5-kV breakers.

9.13.3 Equipment surge arrestors shall be station class, metal-oxide type surge arrestors for outdoor use and polymer housing. Surge arrestors shall be shatterproof.

9.14 Rigid Bus

9.14.1 Design of the bus systems shall be in accordance with IEEE 605, at a minimum.

9.14.2 Loading and seismic performance shall be in accordance with the Project design and Project Site location. Such information is subject to verification by Contractor.

9.14.3 Rigid bus, at a minimum, shall be seamless, Schedule 40 tube made of 6063-T6 aluminum alloy fabricated per ASTM B241.

9.14.4 A damping conductor shall be furnished in all horizontal bus.

9.14.5 Bus shall have one-quarter inch (1/4”) drain holes in all bus/fittings that could possibly trap water.

9.14.6 Station post insulators shall be of sufficient strength to support the rigid bus and shall be ANSI 70 gray color.

9.15 Connectors and Fittings

9.15.1 Connectors and fittings shall be of the proper size and design to assure permanent, secure, and low-resistance connections.

9.15.2 Connectors and fittings shall be all welded for aluminum tubing connections and compression or puddle-welded type for aluminum cable connections.

9.15.3 Tubular aluminum welded splicing sleeves shall be used for necessary splices in aluminum tubing.

9.15.4 For connections between aluminum tubing and cable, use a welded tubing-to-terminal pad connector and a compression-type cable-to-terminal pad connector on the end of the cable.

9.15.5 Rigid bus connections to transformers, breakers, CCVTs, or freestanding current transformers are prohibited.

9.15.6 For electrical pad connections, stainless steel hex-bolts, hex-nuts, flat washers, and Belleville washers shall be provided. Belleville washers shall have a minimum compression rating of 4,000 pounds. Bolt lengths shall be sized to provide minimal projection beyond hex nut to prevent excessive noise due to corona, but entire hex nut must be engaged.

9.15.7 For copper to aluminum connections, stainless steel bolts shall be used for copper to aluminum bar or rod connections, and faced or sleeved aluminum connectors shall be used for cable connections.

9.15.8 All connections between stranded aluminum or ACSR-type conductors and equipment stud terminals shall be made with a stud-to-pad type stud connector and a compression-type cable-to-pad type conductor termination.

9.15.9 All dead-end fittings, terminals, splices, and other similar items for ACSR and other types of stranded aluminum conductor shall be tubular compression type fittings. In no case shall any type of stranded aluminum conductors be used with bolted or clamp-type fittings, except for through-type connections to surge arresters on transformers. At least five percent (5%) extra dead-end body filler plugs for each type used shall be provided.

9.15.10 Stranded and tubular copper bus work, where used, shall have connectors and fittings with a minimum of four (4) bolts or two (2) "U"-bolts on each side of each joint.

9.15.11 Fittings shall develop the full strength of the conductor and shall be capable of carrying the full current capacity of the conductor.

9.15.12 Fittings for shield wire dead ends, splices, and taps shall conform to the following:

(1) Shield wire dead-end fittings shall be compression type with bolted jumper connection. Shield wire insulators shall be located as indicated.

(2) Compression sleeves for shield wire tension splices shall be used which will develop at least ninety percent (90%) of shield wire strength.

9.15.13 "Alcoa Filler Compound" shall be furnished for application in conductor dead-end bodies and Alcoa No. 3 Electrical Joint Compound (Alnox), or approved equal for aluminum connections. At least five percent (5%) overage shall be furnished for all filler compounds furnished.

9.15.14 Bus support clamps for rigid bus shall be fixed or slip type as required to firmly support the bus but allow for temperature expansion and contraction.

9.15.15 Bolted ground connectors and flexible type grounding jumpers shall be provided for operating handles of disconnect switches.

9.15.16 All transformer and oil circuit breaker stud connectors shall be tinned bronze material.

9.15.17 All grounding connectors in contact with galvanized structures shall be tinned bronze material.

9.15.18 All compression tees are to be open type compression run and 4-hole NEMA pad tap.

9.15.19 Bundled jumpers from power circuit breakers to disconnect switches shall be furnished.

9.15.20 For disconnect switch connections, NEMA-type terminal pad connectors shall be provide with at least four (4) bolts.

9.15.21 All materials furnished shall have mechanical and electrical ratings, types, sizes, and other similar items coordinated with adjacent hardware and fittings.

9.15.22 All hardware furnished shall be static-free type.

9.15.23 Ground jumpers shall be provided direct from switch-operator ground pad to ground connector on operating handle or mechanism of switch. No other ground connection is to be made to pad. Ground mat(s) shall be furnished at each switch-operator.

9.15.24 Bus grounding stud, welded or swaged, shall be furnished as indicated.

9.15.25 Wire guides and bundle conductor spacers shall be provided as required and indicated to maintain adequate clearance and support on cable jumpers, connections, and overhead lines.

9.16 Grounding System

9.16.1 The grounding system/grid shall be installed throughout the Project Substation, including beyond the substation fence line.

9.16.2 The ground grid shall be designed in accordance with IEEE 80 and using SES-CDEGS software or Owner-approved equal.

9.16.3 The Project Substation grounding system shall be an interconnected network of bare #4/0 AWG copper conductor and copper-clad ground rods (ground wells may be used instead of ground rods if dictated by the soil analysis). The system shall be designed such that Project Substation personnel are protected from the hazards that can occur as the Project Substation grounding system provides the earth return electrode during power system phase to ground faults.

9.16.4 Ground resistivity testing shall be performed *prior* to final design to determine ground analysis parameters. The ground resistivity shall be measured with the methods given in IEEE 81.

9.16.5 The Project Substation grounding grid shall be designed in accordance with the methods and recommendations of IEEE 80. The grounding system shall have adequate capacity to dissipate heat from ground current under the most severe conditions in areas of high ground fault current concentrations, with grid spacing such that safe voltage gradients are maintained. Ground conductors shall be sized for fault duration of 0.5 seconds.

9.16.6 Ground conductor size shall be sized accordingly to specific ground conditions and equipment requirements.

9.16.7 Bare conductors to be installed below grade shall be spaced in a regular pattern that is consistent with the grounding analyses. Each junction of the grid shall be bonded together by an exothermal welding process. Above ground shall be NEMA two-hole connectors.

9.16.8 Grounding connections shall be made to fences and equipment. Equipment grounds shall conform to the following general guidelines:

(1) Grounds shall conform to the NESC.

(2) All equipment grounding connections shall be connected to the ground grid.

9.16.9 All Project Substation bus and equipment support structures shall be connected to the station ground grid. Metal support structures in direct metallic contact with other metal structures do not require a separate grounding connection to the station ground grid. Fences shall be grounded in accordance with the requirements of the NESC.

9.16.10 The ground grid shall extend at least three (3) feet outside the perimeter fence of the Project Substation and shall be bonded to the fence as required to meet acceptable levels of both touch and step potential and ground potential rise.

9.16.11 A minimum of six (6) inches of *washed* crushed aggregate shall cover the entire Project Substation footprint, including those areas reserved for future build-out, *plus* a minimum of three (3) feet outside the perimeter fence, in order to help reduce touch and step potentials. A greater level of washed crushed aggregate shall be installed if necessary to meet the Requirements and satisfy the recommendations set forth in the geotechnical engineering report. The minimum resistivity shall be 3,000 ohm-meters. Crushed rock shall conform to ASTM C33, gradation 1.5 to No. 8 particles.

9.16.12 All grounding materials required shall be furnished new and undamaged in accordance with the following requirements, at a minimum:

(1) Rods:

(a) 5/8-inch x 10-foot (minimum) copper-clad standard type or as grounding calculations required.

(b) The copper cladding shall be electrolytically bonded to the steel rod or bonded by a molten welding process.

(c) Cold rolled copper cladding is not acceptable.

(d) Soil conditions may require ground rods to be drilled.

(2) Cable:

(a) Bare: soft-drawn copper, Class B stranding, ASTM BB.

(b) Insulated: soft-drawn copper; Class B stranding with green-colored PVC insulation; UL 83; Type TW, THW or THHN.

(3) Wire mesh: copper clad; 6 AWG; 6-inch x 6-inch mesh spacing; copper weld or Owner-approved equal.

(4) Bus and bars: soft copper; cross section not less than 1/8-inch thick by 1-inch wide; ASTM 8187.

(5) Exothermal welds: molds, cartridges, materials, and accessories as recommended by the manufacturer of the molds for the items to be welded. Cadweld heavy duty or Owner-approved equal. Molds and powder shall be furnished by the same manufacturer.

(6) Flush ground plates: Cadweld B-162 Series, B-164 Series, or Owner-approved equal ground plates with NEMA hole spacing.

9.16.13 All clamps, connectors, bolts, washers, nuts, and other hardware used with the grounding system shall be made of copper. Compression fittings above grade are prohibited.

9.17 Lightning Protection

9.17.1 Lightning protection shall be designed in accordance with IEEE 998.

9.17.2 Overhead shield wires installed on the take-off towers and lightning masts shall be provided for protection from direct lightning strikes.

9.17.3 The shield system shall be adequately tied into the Project Substation ground grid.

9.17.4 Steel masts for direct stroke protection shall be round tapered seamless extruded or spun aluminum tubes.

(1) The overall height of the masts above grade shall be determined from the direct stroke protection study, as more particularly described in Exhibit [TBD] (*Scope of Work*).

(2) Masts shall have a single uniform taper from top to bottom.

(3) Each mast shall be capped with a suitable finial.

(4) Each mast shall be equipped with an internal vibration dampening device.

(5) The design of masts shall have a safety factor of two (2) based on the allowable yield stress for the mast material in accordance with the latest ASCE specifications governing design of structures.

(6) The horizontal deflection at the top of each free-standing mast shall be limited to L/20 of its height above foundation.

(7) Each mast shall be installed on a concrete foundation with galvanized steel anchor bolts. Foundations, bolts, and welding shall be in accordance with the Requirements, including Section 6.0 (*Structural Works Specifications*).

(8) Each mast shall be provided with two grounding pads located 12 inches above the foundation.

9.18 Lighting

9.18.1 A lighting system shall be furnished for the Project Substation. The lighting system shall provide personnel with illumination for Project Substation operation and maintenance under normal conditions, and means of egress under emergency conditions. Dark sky lighting is recommended.

9.18.2 The power supply for the lighting system shall be from 120/208 or 277/480 volt, 3-phase, 4-wire lighting panel. Single-phase lighting is also acceptable.

9.18.3 The lighting system shall be designed in accordance with IES standards to provide acceptable illumination levels.

9.18.4 Lighting sources and fixture selections shall be based on the applicability of the luminaries for the area under consideration.

9.18.5 Lighting levels shall meet, at a minimum, the requirements of the NESC, including Table 111-1 therein.

9.18.6 Outdoor lighting shall be LED type.

9.19 Equipment Labeling

9.19.1 All major equipment and devices shall be properly labeled with nameplates made of laminated three-ply plastic, equal to Lamicoid to meet Applicable Standards (including those for safety) and other Requirements.

9.19.2 Nameplates shall be a minimum of 1/8-inch thick, with yellow outer layers on a black core.

9.19.3 Nameplate edges shall be chamfered.

9.19.4 Nameplates shall be fastened to the equipment by using a minimum of one (1) blank rounded screw on each end.

9.20 Substation Video Surveillance

9.20.1 For purposes of the Proposal, a CCTV system will not be installed at the Project Substation, although Contractor shall install conduits and gang boxes (including covers for gang boxes) and leave appropriate space for future installation.

9.21 Electrical Equipment Enclosures

9.21.1 Control cabinets, pull boxes, and junction boxes shall be in accordance with NEMA standards and type number and shall be suitable for the Project location conditions. Minimum design shall be:

(1) Indoor: NEMA 1

(2) Outdoor: NEMA 3, stainless or aluminum.

9.21.2 All enclosures shall be provided with pad-locking provisions.

9.22 Battery System

9.22.1 All battery systems shall conform, at a minimum, to the Applicable Standards of IEEE, ANSI, and NEMA, as well as other applicable Requirements.

9.22.2 Batteries shall be provided with racks, connection devices, tools, instruction books, protection shield covers, rail protection system, and other standard items. They shall also include redundant fans for the required ventilation. Such fans shall be installed directly above the location where batteries are to be installed.

9.22.3 Battery charger requirements:

(1) Two (2) fully-rated, self-cooled battery chargers shall be installed. The battery chargers should be connected in parallel to charge the batteries simultaneously.

(2) Project Substation battery chargers shall be $125V_{DC}$ output, sized as required for eight (8)-hour recharge while serving continuous load.

(3) Chargers shall include an AC circuit breaker in the charger input circuit to provide a disconnect point and overcurrent protection. Chargers also shall include DC ammeters, DC voltmeters, AC power failure alarm relays, high/low DC voltage alarm relays, ground detection alarm relays, and battery temperature compensation systems which reduce the charge rate if necessary.

(4) Chargers shall maintain output voltage within plus or minus one-half percent (0.5%) from no load to full load, with an input power supply deviation in voltage level of plus or minus ten percent (10%) and an input power supply deviation in frequency of plus or minus five percent (5%).

(5) Chargers shall automatically vary the charging rate in accordance with the requirements of the Project Substation battery.

(6) Each battery charger-eliminator furnished shall be self-regulating, natural cooled, solid-state silicon controlled full wave rectifier type designed for single and parallel operation with the batteries specified under the Specifications. Charger shall be able to provide the DC load requirements in the event that battery is disconnected.

(7) The chargers will be served from the Project Substation AC system.

(8) Solid-state electronic circuits shall have AC and DC transient voltage protection and shall be designed to recharge a totally discharged battery without overloading and without causing an interrupting operation of AC or DC circuit breakers.

(9) Charger shall be a full capacity charger, and shall have the capacity to recharge the battery in eight (8) hours following complete discharge. Charger shall also have an equalizing charge mode. Battery charger will be self-regulating after charging levels are manually selected. Battery charger shall be manufactured in NEMA 1 enclosures suitable for placement in an indoor, environmentally controlled atmosphere. Charger shall require only front access, and will allow either top or bottom conduit/cable entry.

9.22.4 The Project Substation shall include a DC system, including, but not limited to, batteries, two (2) battery chargers, and panelboards.

(1) Battery size shall be determined using the battery load profile.

(2) Nominal voltage shall be $125V_{DC}$ with 60 cells.

(3) Batteries shall be capable of being recharged to rated capacity from a discharge down to zero (0) volts per cell, following an equalization charge.

(4) Batteries shall be capable of being recharged within eight (8) hours following a complete discharge.

(5) Design shall be based on an eight (8)-hour discharge time to 1.75 volts per cell and the voltage is to be maintained for the minimum 30-year life of the battery.

9.22.5 Each battery cell shall be wet cell, lead-acid pasted plate-type with lead-calcium alloy plate grids or sealed type with 30-year expected life. Cell containers shall be sealed, clear, shock absorbing, heat resistant plastic, with electrolyte high and low-level markers and spray-proof vents. Batteries shall be manufactured for full float service with a high discharge rate, low deterioration rate, and low maintenance. Batteries shall be supplied complete with all accessories (e.g., battery rack, inter-cell connectors). Racks shall be a two (2)-step configuration.

9.22.6 The DC panel and bolted breakers shall have a main bus current rating as required to supply the connected load. The continuous current ratings and interrupting ratings of the feeder breakers shall be based on the available fault current and the characteristics of the connected loads or the battery chargers.

9.22.7 The capacity of each battery shall be determined in accordance with IEEE 485 and the specifications herein. With the battery initially fully charged at the floating voltage specified, and with the battery chargers disconnected, the battery shall be capable of supplying the duty cycle specified. The ambient temperature during the duty cycle shall be 25°C.

9.22.8 The duty cycle for battery sizing shall include:

(1) One (1) minute at the level of current required to operate all Project Substation circuit breakers plus the continuous load.

(2) 478 minutes of continuous load (actual but not less than 15A).

(3) One (1) minute at the level of current required to operate all Project Substation circuit breakers plus the continuous load.

9.23 Raceway

9.23.1 Raceway shall conform, at a minimum, to the recommendations included in IEEE 525.

9.23.2 Raceway that contains multiple cable circuits shall have all cables with identical insulation ratings.

9.23.3 Individual raceway systems shall be established for the following services:

(1) 600-volt control cable.

(2) Special electrical noise-sensitive circuits.

(3) Fiber optic cable.

9.23.4 Hot-dipped, rigid galvanized conduit (after fabrication) shall be used for above-ground power and control cables.

9.23.5 Flexible conduits shall be used only at locations where vibration is required. The maximum contiguous length of flexible conduit shall be three (3) feet.

9.23.6 All raceway and conduit locations shall be coordinated with other equipment and structures. All raceway and conduit shall be installed perpendicular or parallel to the major equipment and bus structures.

9.23.7 All raceway and conduit shall be installed in a neat, rectangular form. Special attention shall be given to securing a neat appearance.

9.23.8 All raceway materials required shall be furnished new and undamaged in accordance with the following requirements, at a minimum:

(1) Duct: polyvinyl chloride, Schedule 40 PVC in accordance with NEMA TC-2.

(2) Couplings: plastic, for use with duct previously specified and “duct-to-steel” adapters as required, including joint cement.

(3) Spacers: plastic high impact, interlocking, base and intermediate type

(4) Factory bends and sweeps: Schedule 40 PVC, three (3)-foot minimum radius.

(5) End bells: plastic.

(6) Plugs: plastic, high impact, tapered to fit end bell provided.

(7) Duct binder: hemp or sisal twine coupling.

(8) Riser termination: rigid hot-dip galvanized mild-steel coupling.

(9) Riser bends: rigid steel conduit elbows, factory or field made, three (3)-foot minimum radius, 90 degree, entirely concrete encased below grade; hot-dip galvanized rigid mild steel in accordance with ANSI C80.1 and UL 6; the conduit interior and exterior surfaces having a continuous zinc coating with an overcoat of transparent enamel or transparent lacquer.

9.24 Protective Relaying

9.24.1 Protective relaying shall provide secure and selective isolation of equipment when necessary during faults, abnormal or hazardous operating conditions.

9.24.2 All relays shall be microprocessor-based and wired to a central communication processor with IRIG-B time stamping. The communication processor shall integrate all relaying.

9.24.3 Relay panels shall be located in the Project Substation control building and shall include all hard-wired and soft-wired protection and control interlocks. Relay panels shall be installed in a new control room.

9.24.4 Protective relaying design and equipment selection shall be provided in accordance with the Requirements, including, but not limited to, the Applicable Standards and prudent electrical industry practices.

9.24.5 All protection device settings shall be provided for Owner's review no later than 60 days prior to the system energization date.

9.24.6 Programming of devices shall be provided in electronic format straight from the device.

9.24.7 Owner will review and approve the final design prior to procurement of equipment.

9.24.8 The local utility shall require review and confirm line protection and signal exchange requirements. Owner shall facilitate such reviews.

9.24.9 Protection shall be provided for all breakers, bus, transformers, 34.5-kV lines, high-side lines, capacitors, and inductors.

9.24.10 The relaying schemes shall monitor and respond to overcurrents, phase faults, ground faults, and other system abnormalities. Protection schemes to be utilized shall include, but not be limited to, line impedence/differential, bus differential, transformer differential, breaker failure, backup relaying, switch into fault, and sync check.

9.24.11 Annunciation and alarms shall be communicated to the Operator through an RTU that will signal loss of protection integrity including but not limited to: coil monitoring, loss of tripping power, gas pressure, relay failure, and other similar items.

9.24.12 High-side lines shall include primary and backup relaying.

9.24.13 The primary and backup systems shall use two (2) different manufacturers and protection philosophies to minimize common failure modes.

9.24.14 Main step-up transformer protection shall include primary and backup relaying and monitor for oil and winding temperature.

9.24.15 Observe IEEE 1050 for protective instrument grounding.

9.24.16 Meters shall be installed on the high-side of the main step-up transformer (revenue grade), on each medium-voltage (34.5-kV) Collection System Circuit feeder, and within each Wind Turbine, although to the extent that the SCADA System can register production by Wind Turbine, a separate meter within each Wind Turbine is not required.

9.24.17 All relays shall have digital read-out on the front.

9.25 Control Building

9.25.1 The control building shall be a new, prefabricated building. All electrical equipment shall be installed in the building prior to shipment.

9.25.2 The control building shall be located within the fenced area of the Project Substation.

9.25.3 The control building shall be grounded and include HVAC.

9.25.4 The control building shall contain a data concentrator and communications processor to collect Project Substation data signals for facility use.

9.25.5 The control building shall include adequate space and clearance for all Turbine Supplier-furnished Turbine SCADA System equipment.

9.25.6 Local user controls shall be included that are capable of overriding the controller if required for any reason. Local controls, including monitoring screens and keyboards, shall be placed in the control building.

9.26 Fencing and Gates

9.26.1 The Project Substation perimeter shall be fenced. The fence shall be tied into the Project Substation grounding grid.

9.26.2 At least one (1) vehicle gate shall be installed at the Project Substation. The vehicle gate shall be a double-hung, 20-foot-wide (minimum), manual, rolling gate. At least 10 remote-entry devices shall be supplied and programmed by Contractor for Owner's use.

9.26.3 At least one (1) walk gate shall be installed at the Project Substation. The walk gate shall be a lockable, single-hung, 4-foot-wide, swing-gate for personnel access.

9.26.4 All fencing and gates shall comply with the minimum specifications in Section 3.10 (*Fencing, Walls, and Gates*) herein.

9.27 Testing and Quality Control

9.27.1 All testing described herein shall be performed by an independent, experienced third party. Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities.

9.27.2 All Project Substation equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

9.27.3 Project Substation testing shall include the following, at a minimum:

(1) All testing specified in the Applicable Standards, including NETA.

(2) All testing reasonably recommended or required by the applicable equipment suppliers.

(3) All exposed cable sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

(4) Insulation testing of all installed cables.

(5) Point-to-point wiring checks of all installed wiring.

(6) After completion of wiring installation work, all circuits shall be tested for continuity, grounds, shorts.

(7) Breaker function testing.

(8) PT/CT turns ratio and polarity testing.

(9) Breaker contact resistance testing.

(10) Ground resistance and continuity testing.

(11) Surge arrestor testing.

(12) Instrument transformer testing.

(13) Ground grid testing.

(14) Relay functional testing.

(15) Disconnect switch testing.

(16) Reactor / capacitor bank testing (if applicable).

(17) Control building testing.

(18) Minimum main step-up transformer testing, all on the purchased unit(s):

(a) All tests identified as “Routine” in IEEE C57.12.00 Table 18 and performed in accordance with IEEE C57.12.90.00.

(b) Temperature rise at the maximum 65°C rating.

(c) Temperature indicator accuracy test.

(d) Induced potential test with the transformer connected at high voltage, with the transformer’s own bushings in place, accompanied by partial discharge monitoring (to conform to ANSI C57.12.90).

(e) Impulse tests on all winding terminals, with the transformer’s own bushings in place.

(f) Switching surge tests on the high-voltage winding, with the transformer’s own bushings in place.

(g) Test all control wiring for continuity, grounds, and correct connections; and test operation of all relays, indicators, switches, lights, and interlocks.

(h) Resistance measurements of all windings on the rated voltage connection and all load tap connections. Test results shall be reported in ohms at 85°C

(i) Doble insulation power factor tests conforming to Method II in Table 4 of Article 10.10 of ANSI C57.12.90. The power factor shall be equal to or less than 0.5% at 20°C.

(j) Perform the supplier's standard tests on each surge arrester.

(k) Zero sequence.

(l) SFRA, at factory and at Project Site.

9.27.4 All Project Substation foundations shall be tested in accordance with Section 6.15 (*Testing and Quality Control*) herein.

9.27.5 Copies of testing reports shall be submitted to Owner within 10 days of completing such test. Testing reports shall include a summary of testing procedures and acceptance criteria.

10.0 INTERCONNECTION LINE SPECIFICATIONS

10.1 General Provisions

10.1.1 The Interconnection Line shall be designed and constructed to a high level of reliability and shall meet or exceed the requirements set forth by the interconnection utility.

10.1.2 The Interconnection Line shall be designed and constructed in accordance with the Project Electrical Studies, as defined in RFP Appendix A.1 (Wind) (*Scope of Work*).

10.1.3 The Interconnection Line shall be designed and constructed to meet the Electrical Loss Limit set forth in RFP Appendix A.1 (Wind) (*Scope of Work*).

10.1.4 Minimum clearance for energized parts of overhead portions of the Interconnection Line shall at a minimum meet or exceed requirements specified in the applicable permits, including, but not limited to, those set forth in the current edition of the National Electric Safety Code. Electrical clearances shall be maintained in the design and construction of all jumper assemblies.

10.1.5 PLS-CADD software shall be utilized to spot and perform detailed analysis and design of the Interconnection Line. Copies of all PLS-CADD electronic design files shall be provided to Owner in final form at the conclusion of the Project. Copies of preliminary PLS-CADD electronic design files shall be provided to Owner with each preliminary design. The ellipse amplitude safety factor in PLS-CADD shall not be less than 1.0.

10.1.6 The Interconnection Line, when in operation, shall be corona free and shall not cause radio or television interference, nor excessive noise in excess of requirements set forth in the Applicable Standards, applicable permits, or other applicable Requirements.

10.1.7 If it is determined by the meteorological report that an area is prone to icing, galloping should be considered.

10.1.8 Weather cases and loading criteria shall be developed by Contractor based on requirements set forth in the Applicable Standards, including, but not limited to, NESC C2 2012, as well as the Project-specific meteorological study.

10.1.9 All manufacturer installation instructions for the installation of all Interconnection Line components shall be obtained and followed.

10.2 Design Working Life

10.2.1 The design working life of the Interconnection Line equipment shall be a minimum of 30 years.

10.3 Civil Works Requirements

10.3.1 All civil works for the Interconnection Line shall comply with the applicable specifications in Section 5.0 *(Civil Works Specifications*).

10.4 Structural Works Requirements

10.4.1 All Interconnection Line structures, foundations, assemblies, and components shall be designed and constructed in accordance with the applicable structural works specifications in Section 6.0 (*Structural Works Specifications*).

10.5 Structure Spotting

10.5.1 Structure spotting and profile generation shall be completed with PLS-CADD. All structure spotting shall be based on profile data provided by the surveyor and aerial mapper, right-of-way, landowner input, routing constraints, permitting conditions, and field investigation.

10.5.2 All structure spotting shall be based upon the profile data provided by the design and shall consider data from routing constraints and field investigation.

10.5.3 Site specific structure locations and site specific constraints are as determined by the design data.

10.6 Conductors, Shield Wire, and OPGW

10.6.1 All conductor cables, shield wire, and OPGW shall be installed by controlled tension methods.

10.6.2 Pre-stressing of any type of wire shall not be permitted without the prior written approval of Owner.

10.6.3 If conductors are bundled, all conductors in any one bundle shall be sagged simultaneously and all shall be clipped in on the same day.

10.6.4 Each sag span and control span shall be measured with surveyor's transits to verify exact span lengths, prior to sagging.

10.6.5 All conductor cables, shield wire and OPGW sag spans and control spans shall be measured before sagging.

10.6.6 Conductor cables, shield wire, and OPGW shall be installed in accordance with IEEE's "*IEEE Guide to the Installation of Overhead Transmission Line Conductors*", Standard No. 524, and sagged to within a tolerance of three (3)-inch sag increase and no sag decrease. Transits shall be used for sagging and shall be maintained in good operating condition and checked for accuracy and adjusted, if necessary, a minimum of once per week during sagging operation.

10.6.7 Conductor cables, shield wire, and OPGW shall not be dead-ended and clipped sooner than two (2) hours and should be fully tensioned within 24 hours of initial stringing. In no case shall more than 72 hours elapse between the stringing of conductor/ground wires and their final tensioning.

10.6.8 No single conductor cable within a bundle shall be more than one (1) inch from its sag position relative to the other conductor cables.

10.6.9 No more than one (1) splice or repair on any one (1) conductor in any one (1) span shall be made. Splices shall be a minimum of 25 feet from any structure.

10.6.10 Wire tension limits shall be in accordance with the Applicable Standards, including, but not limited to, NESC C2 2012.

10.6.11 The exact location where each reel of conductor was installed shall be recorded.

10.6.12 Final sag measurements, including but not limited to each sag span's record date, span number, span length, ruling span, wire temperature, ambient temperature, initial sag for the span, time in blocks, time of day and sag measurements, shall be recorded.

10.6.13 OPGW (including a primary and secondary (redundant) OPGW) shall be installed the entire length of the overhead route and coordinated with the SCADA System/communication/protection specification.

10.6.14 OPGW shall include a minimum fiber count of 48, single mode.

10.6.15 OPGW design tension limits shall be specified in the Project-specific sections.

10.6.16 Stringing tensions for the OPGW shall not exceed twenty percent (20%) of the ultimate cable strength.

10.6.17 Splice locations shall be selected and provided with weatherproof splice boxes suitable for the selected OPGW.

10.6.18 At each splice location, a 50-foot coil of spare wire shall be maintained.

10.6.19 Spare wire may be coiled on the pole, placed in an underground vault, or coiled in an aerial slack storage device.

10.6.20 The OPGW shall be solidly bonded to the steel pole with a braided soft drawn copper jumper and steel structures shall incorporate a welded grounding nut for that purpose.

10.6.21 Shield wire shall be minimum 3/8-inch, 7-strand EHS steel wire.

10.6.22 Shield wires and OPGW shall be bonded to the pole grounding system using a suitable ground wire.

10.7 Insulators and Hardware

10.7.1 All surfaces of metal parts shall be relatively smooth with no projecting points or irregularities, which may cause corona.

10.7.2 Nuts shall be hexagonal and of corona-free design.

10.7.3 All ferrous material except stainless steel shall be hot dip galvanized to conform to ASTM A153.

10.7.4 Cotter keys shall be austenitic stainless steel and each piece shall be marked for identification with the manufacturer’s part or catalog number.

10.7.5 Non-ceramic, porcelain, or toughened glass insulators shall be used for both suspension and dead-end applications and types (non-ceramic, porcelain, or toughened glass) or manufacturer of insulators shall not be mixed.

10.7.6 Insulator length, strength, and required number shall be determined based on loading requirements, switching surge and lightning requirements, and by contamination levels.

10.7.7 The standard porcelain insulator unit to be used is a 5.75-inch by 10-inch bell with a ball and socket coupling.

10.7.8 Insulators shall be wet-process porcelain.

10.7.9 Materials shall be packaged in weather-resistant cartons or crates suitable for outdoor storage.

10.7.10 The insulators shall be protected with suitable material to prevent damage to the sheds, bell, connections, and/or end fittings during shipping.

10.7.11 Line guards and armor rods shall be installed in conjunction with suspension clamp assemblies.

10.7.12 The center of the armor rods shall be within one (1) inch of the suspension clamp.

10.7.13 The termination of the armor rods shall be within one-half (0.5) inch of each other.

10.7.14 In the assembly of insulators and insulator hardware, every cotter key shall be inspected to ascertain that it is in place and properly seated and spread.

10.8 Grounding

10.8.1 All overhead poles shall be grounded locally at each pole.

10.8.2 The ground should consist of a copper ground wire connected to a 0.5-inch, coated, carbon steel ground rod.

10.8.3 Grounding systems shall be designed in accordance with all Applicable Standards and best engineering practices.

10.8.4 Maximum resistance shall be no greater than 10 ohms. If ground resistance is greater than 10 ohms, special grounding designs shall be prepared.

10.8.5 A ground resistance test shall be done at every structure.

10.9 Lightning Protection

10.9.1 The Interconnection Line shall be protected against lightning by the use of shield wire(s).

10.9.2 The shield wires shall be located so as to intercept lightning strikes and prevent direct strikes to the conductors.

10.9.3 Position of shield wires, ground resistance, and electrical parameters of the line insulation shall be coordinated to produce a calculated performance equal or superior to the standard value.

10.9.4 The isokeraunic level of the area of the line shall be determined by Contractor and shall be used in the design of the shielding/grounding system.

10.9.5 The method of grounding and the required ground resistance to minimize the outage rate shall be calculated.

10.10 Marking and Lighting

10.10.1 All Interconnection Line structures shall be marked in accordance with RFP Appendix A.1 (Wind) (*Scope of Work*).

10.10.2 The Interconnection Line lighting system shall comply with the requirements as defined in US DOT-FAA Advisory Circular No. AC 70/7460-1K: *Obstruction Marking and Lighting*.

10.11 Testing and Quality Control

10.11.1 All testing described herein shall be performed by an independent, experienced third party. Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities.

10.11.2 All Interconnection Line equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

10.11.3 Interconnection Line testing shall include the following, at a minimum:

(1) All testing specified in the Applicable Standards, including NETA.

(2) All testing reasonably recommended or required by the applicable equipment suppliers.

(1) All exposed conductor and OPGW sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

(2) Resistance testing on grounding grid at each structure location.

11.0 WIND TURBINE OFFLOADING AND ERECTION SPECIFICATIONS

11.1 General Provisions

11.1.1 Wind Turbine erection shall follow a "reference" approach, wherein complete erection of the first Wind Turbine shall occur prior to erecting any subsequent Wind Turbines. Such initial Wind Turbine erection shall be reviewed and approved by Owner and the Turbine Supplier before continuing Wind Turbine erection activities, and such approval shall not be unreasonably withheld or delayed. The "reference" Wind Turbine, once accepted, shall serve as a model finished product for all subsequent Wind Turbine erections.

11.1.2 Wind days shall be actively minimized by scheduling Wind Turbine erection activities at times of day when wind speeds are projected to be lowest.

11.1.3 Wind Turbines shall be erected such that the tower door orientation is downwind of the of the prevailing wind direction.

11.1.4 Each crane, including the main erection crane(s) and any base/mid crane(s), shall be equipped with redundant anemometers at Wind Turbine hub height for measurement of wind speeds. Wind speeds shall be recorded from these instruments prior to the start of all lifting activities, and measurements shall be recorded on a Contractor-furnished data logger. Handheld anemometers shall also be furnished to determine safe wind speeds for all other operations. All such wind data shall be shared with Owner upon request.

11.1.5 Wind Turbine cleaning:

(1) All exterior Wind Turbine surfaces shall be cleaned via pressure washing; light brushing with mild, biodegradable detergent shall be performed as necessary. Following cleaning, all surfaces shall appear clean at a minimum distance of 50 feet.

(2) All washing, including runoff, shall be in accordance with the applicable permits and other Requirements.

11.2 Procedures

11.2.1 Transportation, offloading, storage, and erection of Wind Turbines shall be performed in accordance with the applicable instructions provided by the Turbine Supplier, the specifications provided herein, and the requirements set forth in RFP Appendix A.1 (Wind) (*Scope of Work*), including critical lift plans.

11.2.2 Mechanical completion of each Wind Turbine, including documentation of progress on Turbine Supplier-furnished forms, shall be successfully achieved in accordance with the instructions set forth in the installation manual and mechanical completion checklists provided by the Turbine Supplier.

11.2.3 All rigging utilized for the transportation, offloading, or erection of Wind Turbines shall be rated; inspected daily and monthly; and load tested in accordance with Applicable Standards or other more rigorous requirements set forth in the HSSE Plan, as defined in RFP Appendix A.1 (Wind) (*Scope of Work*). Inspection reports shall be maintained at the Project Site and available for review by Owner.

11.2.4 Copies of testing certificates and calibration records for all tooling shall be maintained at the Project Site and available for review by Owner.

11.3 Testing and Quality Control

11.3.1 All testing described herein shall be performed by an independent, experienced third party. Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities.

11.3.2 All Wind Turbine electrical wiring shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

11.3.3 Wind Turbine testing shall include the following, at a minimum:

(1) All testing specified in the Applicable Standards, including NETA.

(2) All testing reasonably recommended or required by the applicable equipment suppliers.

(3) Structural works testing for grout properties, in accordance with Section 6.0 (*Structural Works Specifications*) herein.

(4) All exposed cable sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

(5) Megger test of all 34.5-kV Wind Turbine cables.

(6) Final continuity tests after completion of all system connections. Acceptable continuity tests shall include a Megger test or VLF test at 100 percent of rated voltage.

12.0 METEOROLOGICAL TOWER SPECIFICATIONS

12.1 General Provisions

12.1.1 References to "meteorological towers" herein shall be understood to include both permanent and temporary meteorological towers, unless explicitly stated otherwise.

12.1.2 Meteorological towers shall be sized and constructed appropriately to allow instrumentation to be placed at Wind Turbine hub height. A side-by-side (i.e., goalpost) anemometer orientation, as shown in IEC 61400-12-1, shall be utilized; such side-by-side anemometers will be mounted at Wind Turbine hub height on each permanent meteorological tower. Similarly, any height provided by a foundation for the temporary meteorological tower shall be taken into consideration relative to the final constructed hub height of the Wind Turbine.

12.1.3 Meteorological towers shall be designed and fabricated to the latest EIA/TIA-222-FS Structural Standards for Steel Antenna Towers and Antenna Supporting Structures and according to other Applicable Standards.

12.1.4 Meteorological towers shall be painted / marked in accordance with the Applicable Standards and applicable permits.

12.1.5 All meteorological tower designs, including foundation design, shall be approved by Owner prior to procurement of such equipment or materials.

12.1.6 All meteorological towers shall incorporate a safety climb cable.

12.1.7 Sufficient grounding and lightning protection per IEC 61400-12 shall be installed on all meteorological towers, including lightning finials. Meteorological towers shall be independently grounded; meteorological tower grounding shall not be interconnected to the Wind Turbine grounding system.

12.1.8 All anemometers shall be type "first class", heated sensors. All anemometers shall be calibrated in accordance with MEASNET's Anemometer Calibration Procedure and performed by a MEASNET-certified organization.

12.2 Design Working Life

12.2.1 The design working life of the meteorological tower equipment shall be a minimum of 30 years.

12.3 Civil Works Requirements

12.3.1 All civil works for the meteorological towers shall comply with the applicable specifications in Section 5.0 *(Civil Works Specifications*).

12.4 Structural Works Requirements

12.4.1 All meteorological tower foundations shall be designed and constructed in accordance with the applicable structural works specifications in Section 6.0 (*Structural Works Specifications*).

12.5 Power Curve Testing Requirements

12.5.1 If a power performance test (i.e., power curve test) is performed, installation of the meteorological towers shall be scheduled sufficiently early in the construction of the Project to allow for adequate wind data collection before installation of the respective Wind Turbine at that location, including earthwork or Foundation construction. At least three (3) months of data collection shall be assumed to be required from the time that each meteorological tower is installed until the time it is removed.

12.5.2 If a power performance test (i.e., power curve test) is performed, meteorological towers shall be constructed in sets of two, or one permanent meteorological tower and one temporary meteorological tower, in order to maximize data collection time for Owner's site calibration (see Section 12.5.1 herein).

12.5.3 If a power performance test (i.e., power curve test) is performed, upon completion of data collection for the power performance test site calibration (see Section 12.5.1 herein) and at the request of Owner, temporary meteorological towers shall be decommissioned and removed, including any temporary foundations and fencing. All equipment and instrumentation from the decommissioned towers shall be returned to Owner at a location requested by Owner. For the avoidance of doubt, and unless explicitly approved by Owner, Wind Turbines may only be installed (including earthwork and construction of Foundations) *after* the temporary meteorological tower at the respective Wind Turbine location has been removed.

12.6 Permanent Meteorological Towers

12.6.1 Permanent meteorological towers shall be self-supported (non-guyed), galvanized lattice structures, each designed and certified for maximum wind and ice loading for the particular Project Site conditions.

12.6.2 Permanent meteorological towers shall be installed at a location at the Project Site to be specified by Owner.

12.6.3 All permanent meteorological tower locations shall be fenced.

(1) Fencing shall be placed to allow a minimum of ten (10) feet of free space around the tower base.

(2) At least one (1) walk gate shall be installed at each permanent meteorological tower. The walk gate shall be a lockable, single-hung, 4-foot-wide, swing-gate for personnel access.

(3) All fencing and gates shall comply with the minimum specifications in Section 3.10 (*Fencing, Walls, and Gates*) herein.

12.6.4 Each permanent meteorological tower shall include the following instruments:

(1) Two (2) cup anemometers at Wind Turbine hub height in a goal-post configuration.

(2) One (1) cup anemometer at mid-blade height.

(3) One (1) cup anemometer at lower-blade height.

(4) One (1) vertical anemometer near Wind Turbine hub height (below goal post).

(5) Two (2) wind direction sensors near Wind Turbine hub height (below goal post).

(6) One (1) temperature / relative humidity sensor with radiation shields near Wind Turbine hub height (below goal post).

(7) One (1) barometric pressure sensor near Wind Turbine hub height (below goal post).

(8) One (1) temperature / relative humidity sensor with radiation shields at 10 meters above ground level.

(9) One (1) precipitation sensor.

12.6.5 Each permanent meteorological tower shall include the following auxiliary equipment:

(1) One (1) NEMA4X fiberglass enclosure for data logger and auxiliary equipment.

(2) One (1) data logger. Each shall be Campbell Scientific, model CR1000.

(3) One (1) satellite or cellular data modem.

(4) One (1) radio. Each shall be Campbell Scientific, model 401A.

(5) Signal surge protection terminals. Each shall be Phoenix Contact, type Termitrab 24V.

12.6.6 Each permanent meteorological tower shall include the following other equipment:

(1) Two (2) obstruction lights, including top- and mid-level, and including mounting brackets. The top-level light shall be mounted below the goal post.

(2) Grounding and lightning protection, including lightning finial.

(3) Instrumentation booms.

(4) Cabling.

(5) H-frame equipment rack.

(6) Fiber patch panel.

(7) Safety climb cable.

(8) Temporary power supply for data logger and aviation lights (if a power performance test (i.e., power curve test) is performed.

12.7 Temporary Meteorological Towers

12.7.1 Temporary meteorological towers shall be either self-supported (non-guyed) or guy-wire-supported, galvanized lattice structures, each designed and certified for maximum wind and ice loading for the particular Project Site conditions.

12.7.2 Temporary meteorological towers shall be installed at a location at the Project Site to be specified by Owner. Care shall be taken by Contractor to ensure that the constructed elevation of the temporary meteorological towers and the hub height anemometers is identical to the final hub height elevation of the respective Wind Turbine at that location.

12.7.3 Temporary meteorological towers shall not be fenced.

12.7.4 All guy wires shall include avian protection, including bird diverters.

12.7.5 Each temporary meteorological tower shall include the following minimum instruments:

(1) Two (2) cup anemometers at Wind Turbine hub height in a goal-post configuration.

(2) One (1) cup anemometer at mid-blade height.

(3) One (1) cup anemometer at lower-blade height.

12.7.6 Each temporary meteorological tower shall include the following auxiliary equipment:

(1) One (1) NEMA 4X fiberglass enclosure for data logger and auxiliary equipment.

(2) One (1) data logger. Each shall be Campbell Scientific, model CR1000.

(3) One (1) radio. Each shall be Campbell Scientific, model 401A.

(4) Signal surge protection terminals. Each shall be Phoenix Contact, type Termitrab 24V.

12.7.7 Each temporary meteorological tower shall include the following other equipment:

(1) One (1) obstruction light, including mounting bracket. The light shall be mounted below the goal post

(2) Grounding and lightning protection, including lightning finial.

(3) Instrumentation booms.

(4) Cabling.

(5) H-frame equipment rack.

(6) Safety climb cable.

(7) Temporary power supply for data logger and aviation lights.

12.8 Meteorological Tower Obstruction Lighting

12.8.1 All meteorological towers shall be provided with aviation obstruction lights, including top- and mid-level as required, and including all mounting assemblies, GPS controller, and photocell as required by the Federal Aviation Administration and all other Applicable Standards, including US DOT-FAA Advisory Circular No. AC 70/7460-1K: *Obstruction Marking and Lighting*.

12.8.2 Meteorological tower aviation obstruction lights shall be programmed to blink in unison, including with those aviation obstruction lights that are installed on the Wind Turbines.

12.8.3 Aviation obstruction lighting equipment shall be designed for continuous operation.

12.8.4 Aviation obstruction lights shall be FAA Type L-864 (single, red, flashing configuration).

12.8.5 Obstruction lighting shall incorporate an uninterruptible power supply capable of supplying back-up power for at least one (1) hour.

12.9 Communications

12.9.1 All permanent meteorological towers shall be connected to, and communicate with, the Communications System and allow data recording and storage through the data archival features of the Communications System.

12.9.2 Communication from each permanent meteorological tower to the Communications System shall be via dedicated fiber optic circuit. Such communication path shall follow the same route as the Collection System Circuits in order to minimize disturbed area.

12.10 Power

12.10.1 Permanent power supply for each permanent meteorological tower shall be taken from the nearest Wind Turbine or Collection System Circuit. Such permanent power supply path shall follow the same route as the Collection System Circuits in order to minimize disturbed area.

12.11 Testing and Quality Control

12.11.1 All testing described herein shall be performed by an independent, experienced third party.

12.11.2 All meteorological tower equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

12.11.3 Meteorological tower testing shall include the following, at a minimum:

(1) All testing specified in the Applicable Standards.

(2) All testing reasonably recommended or required by the applicable equipment suppliers.

(3) All meteorological tower foundations shall be tested in accordance with Section 6.15 (*Testing and Quality Control*) herein.

(4) All exposed cable sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

(5) Resistance testing on grounding grid at each tower location.

(6) Final continuity tests after completion of all system connections. Acceptable continuity tests shall include a Megger test or VLF test at 100 percent of rated voltage.

(7) Verify all alarms, indications and analog quantities are communicated and received properly by the RTU and displayed correctly on the HMI.

(8) Verify all communication channels operate as expected.

12.11.4 Copies of testing reports shall be submitted to Owner within 10 days of completing such test. Testing reports shall include a summary of testing procedures and acceptance criteria.

13.0 O&M BUILDING REQUIREMENTS

13.1 General Provisions

13.1.1 The O&M Building shall be constructed at a location at the Project Site to be approved by Owner.

13.1.2 The O&M Building shall be designed and constructed such that it is ADA compliant, including parking, doorways, restrooms, and other building features.

13.1.3 The O&M Building shall comply with all Turbine Supplier requirements for the building, if any, including office quantity, furnishings, warehouse requirements, and other similar items.

13.1.4 All manufacturer installation instructions for the installation of all O&M Building equipment and components shall be obtained and followed.

13.2 Design Working Life

13.2.1 The design working life of the O&M Building shall be a minimum of 20 years.

13.3 General Building Requirements

13.3.1 General:

(1) The operations and maintenance building shall have the outer dimensions and indicative layout shown in Figure 1 herein, at a minimum. It is expressly noted that a washer and dryer (as shown in Figure 1) are not required.

(2) Material and color (interior/exterior) samples shall be compiled for Owner's review.

13.3.2 Metal building:

(1) The main frames shall be clear span.

(2) The sidewall columns shall be tapered with inset girts.

(3) The bay spacings shall be 20 feet on center.

(4) Primer color shall be standard red.

(5) Arkema's KYNAR 500 26-gauge architectural wall panels, or Owner-approved equal, shall be applied to all exterior walls. Architectural panels shall have semi-concealed fasteners. The Premium 70 finish coating system shall have a superior high-build primer application that is then coated with premium fluorocarbon coating that contains seventy percent (70%) KYNAR 500 resin.

(6) Closure strips, sealing tape, and joint sealants shall be furnished and utilized as needed to complete the metal building erection per industry standard.

(7) To ensure weather tightness and rodent control, a finished base angle at the bottom of each wall sheet shall be included.

(8) Provision for thermal expansion movement of the standing seam panels shall be accomplished by the use of clips with a movable tab.

13.3.3 Roof:

(1) The roof pitch shall be 1½:12.

(2) The roof covering shall be American's 24-gauge Aluminum Coated Steel 360º Seamless Roof System or Owner-approved equal. The panels shall be 20-feet wide with 3-inch-high crown. The high crown shall include factory-applied, all-weather mastic. The panel overlaps shall be seamed mechanically to ensure weather tightness of the roof system.

(3) Deluxe eaves which match the rake of the building shall be included.

(4) Dektite boot flashings at 4-inch to 12-inch pipe penetrations shall be provided.

(5) Gutters and downspouts shall be furnished and installed. Splash blocks shall be included at all downspouts. Downspouts shall not drain onto sidewalks or aprons, and rain water shall not cross sidewalks.

13.3.4 Doors:

(1) Doors for the O&M Building shall be furnished according to the schedule set forth in Table 8 (*O&M Building Door Schedule*) herein, at a minimum.

Table 8: O&M Building Door Schedule

Room	Type	Qty	Size [ft]	Door Type	Frame Type	Lock Function	Panic Hardware	Closer	Fire Rated	Lite Size	Kick Plates
Offices	Interior	TBD	3 x 7	Wood	Metal	Keyed	No	No	No	8"x24"	No
Conference Rm	Interior	TBD	3 x 7	Wood	Metal	None	No	No	No	8"x24"	No
Break Rm	Interior	TBD	3 x 7	Wood	Metal	Push/Pull	No	Yes	No	8"x24"	Yes
Restrooms	Interior	TBD	3 x 7	Wood	Metal	Push/Pull	No	Yes	No	None	Yes
Control Rm	Interior	TBD	3 x 7	Metal	Metal	Keyed	No	Yes	60 min.	8"x24"	Yes
Maint. Shop	Interior	TBD	3 x 7	Metal	Metal	Keyed	No	Yes	60 min.	8"x24"	Yes
Maint. Shop	Exterior	TBD	3 x 7	Metal	Metal	Key Card	Yes	Yes	No	8"x24"	Yes
Contractor Parts Storage	Double	TBD	6 x 7	Metal	Metal	Keyed	No	Yes	60 min.	8"x24"	Yes
Front Entry	Exterior	TBD	3 x 7	Metal	Metal	Key Card	Yes	Yes	No	8"x24"	Yes
Overhead	Roll-Up	TBD	16 x 16	Metal	Metal	Yes	No	No	No	None	No

(2) Exterior doors:

(a) Overhead doors shall be 16-foot by 16-foot doors, spaced a minimum of 12 feet apart, with vinyl seal on both sides of track, hood baffle, reversing "Feather Edge", and take-up reel. Each door shall be motor operated, and openers shall come with one (1) three-stage (open/stop/close) push button. Bollards shall be installed on each side of the overhead door(s) and shall meet the specifications included in Section 13.3.1 herein.

(b) Exterior doors shall be 3-foot by 7-foot commercial-grade, insulated-steel service doors with ball-bearing hinges, hydraulic closer, latch guard, weather-stripping, self-sealing sweep, ADA-compliant aluminum threshold, and keyed lockset.

(c) All door jambs shall be completely flashed to give door opening a finished appearance.

(d) All exterior doors shall be equipped with key card readers, as further described in Section 13.3.19 herein.

(e) All exterior doors shall be equipped with a SCADA-integrated intrusion alarm. Such alarms shall be programmed to provide immediate silent notifications in the event of after-hours and/or non-card-reader access.

(f) Panic hardware shall be provided on any door, including those listed as "No" in the applicable column of Table 8, where local fire codes require they be installed.

(g) All exterior steel doors shall be painted.

(3) Interior doors:

(a) Interior doors shall be 3-foot by 7-foot by 1.75-inch-thick flush solid-core birch doors. All interior doors shall be installed in primed hollow metal frames with three (3) 4.5-inch by 4.5-inch commercial hinges. The frames shall be painted and the doors shall be stained and varnished.

(b) All doors with push/pull hardware shall include kick-plates installed on push sides.

(c) All wood doors shall be commercial grade.

(d) All interior doors shall have medium-duty commercial lever locksets.

(e) All interior doors and woodwork shall be stained and varnished. All interior hollow metal doors and door frames shall be painted.

(f) Doors shall be fire rated as set forth in Section 13.5.2 (*Fire Protection System*).

(4) Contractor parts storage door:

(a) Contractor parts storage door shall be an inswing, double 6-foot by 7-foot commercial-grade, steel service door with ball-bearing hinges, hydraulic closer, latch guard, with a keyed lockset.

(5) Door hardware:

(a) Door bumpers shall be provided on every door.

(b) Door keying shall be provided on every door. Restroom doors shall include dead bolt.

(c) Windows shall be installed in all doors, except restrooms.

13.3.5 Windows:

(1) 4-foot by 5-foot aluminum horizontal slider windows, equal to Plyco Model M3025, shall be provided in the following quantities:

(a) Offices: 1 per interior office, 2 per corner office.

(b) Meeting room: 2.

(c) Break room: 1.

(d) Maintenance shop: 2.

(e) Contractor parts storage: 1.

(2) Window frames shall be thermally broken with standard color.

(3) Operable units shall include screens.

(4) Exterior windows shall be glazed with tinted insulated glass and argon gas filled.

13.3.6 Room schedule:

(1) The building shall include all rooms set forth in the schedule in Table 9 (*O&M Building Room Schedule*) herein, at a minimum, including the requirements set forth therein.

Table 9: O&M Building Room Schedule

Room	Floor	Base	Walls	Nominal Ceiling Height	Ceiling Type
Common areas Offices Break room Conference rooms Utility closet	Vinyl composition tile	4-inch vinyl	Painted drywall	8’0”	2x4 acoustical tiles
Control Room	Anti-static vinyl composition tile	4-inch vinyl	Painted drywall	8’0”	2x4 acoustical tiles
Restrooms	Glazed ceramic/ porcelain tile, with floor drain	4-inch glazed ceramic/ porcelain tile	Ceramic tile/ painted drywall	8’0”	2x4 vinyl covered sheetrock
Maintenance Shop	Sealed concrete, with floor drain	Not applicable	29 ga. white liner (steel)	17’0”	Exposed structure
Contractor parts storage	Sealed concrete	Not applicable	Painted drywall	8’0”	2x4 acoustical tiles

13.3.7 Flooring:

(1) All tile shall be waxed.

(2) All tile and grout shall be sealed.

(3) Vinyl composition floor tile shall be 12-inch by 12-inch by 1/8-inch tile adhesive applied to concrete floors. Base shall be 4-inch high, vinyl base adhesive applied to walls with covered profile.

(4) Ceramic/porcelain tile shall be set by the thin-set method. Anti-fracture membrane at control joints in floors for restroom areas shall be provided.

(5) Ceramic/porcelain wall tile in restrooms shall be 5-foot high on all sides, with painted drywall above.

13.3.8 Casework, countertops, and windowsills:

(1) Cabinets shall be installed in the break room. Wall cabinets and hardware shall be wood veneer MDF-type, Owner approved. Cabinets shall be both counter height and overhead.

(2) Countertops shall be installed in the breakroom. Countertops shall be Corian, or Owner-approved equal.

13.3.9 Walls:

(1) All drywall shall be 5/8-inch, taped, sanded, and textured.

(2) All restroom walls shall have 5/8-inch moisture-resistant drywall with at least two (2) coats of semi-gloss latex applied.

(3) Three (3)-foot wainscot shall be applied along all exterior walls.

(4) A 29-gauge steel liner panel to approximately 8-feet high shall be used along the exposed shop wall. A 2-inch by 2-inch galvanized base angle to attach liner panel at the concrete floor shall be provided.

(5) Walls shall be fire rated as set forth in Section 13.5.2 (*Fire Protection System*).

(6) Vapor retarder: not required for walls.

(7) Retractable wall requirements: not used.

13.3.10 Ceilings:

(1) All ceiling tile shall be Armstrong Cortega or Owner-approved equal.

(2) The ceiling over the electrical storage, storage, and shared workshop shall be covered with 2-inch by 8-foot beams at 16 feet on center with one (1) layer of 7/16-inch OSB over the top. This shall be designed as a dust cover and not a mezzanine.

13.3.11 Signage:

(1) A 6-inch plastic vinyl building address and numbers on the front of the building shall be furnished and installed.

(2) Men’s and women’s restroom signs shall be furnished and installed.

(3) Handicap (ADA compliant) and visitor parking sign(s) on steel posts in front of the handicap stalls shall be furnished and installed.

(4) Interior signage, as required by the Applicable Standards and other requirements, shall be furnished and installed.

13.3.12 Restroom accessories:

(1) Toilet partitions shall be installed between each toilet. Partitions shall be wall- and ceiling-mounted with baked enamel finish complete with door, latch, rubber stop, and coat hook at each stall.

(2) Standard mirrors in toilet rooms shall be approximately 36 inches by 40 inches in size. Such mirrors shall be furnished and installed in each restroom.

(3) Paper towel dispensers and toilet paper holders shall be furnished and installed.

(4) Handicap grab-bar hardware shall be furnished and installed.

(5) Liquid soap dispensers shall be furnished and installed.

(6) At least eight (8) lockers shall be furnished and installed in the men's restroom. At least four (4) lockers shall be furnished and installed in the women's restroom. Each locker shall measure at least 8 feet by 12 inches by 12 inches and each in standard manufacturer's colors. A minimum of one (1) movable hardwood bench shall be furnished and installed near each set of lockers.

13.3.13 Appliances:

(1) The following appliances shall be installed in the kitchen / break room:

(a) Microwave.

(b) Refrigerator with ice maker.

(c) Stove / oven.

(d) Dishwasher.

(2) All appliances shall be new, unused, white, and Maytag (or Owner-approved equal).

13.3.14 Bollards:

(1) Bollards shall be a minimum 3-inch-diameter steel pipe, concrete filled for equipment protection, painted safety yellow, and extend five (5) feet above grade.

13.3.15 Aprons and sidewalks:

(1) HVAC pads shall have minimum dimensions of 4 feet by 4 feet by 4 inches.

(2) A concrete slab shall be installed along the length of the O&M Building near the exterior shop door and roll-up doors. Such slab shall be designed to accommodate AASHTO HS44-20 loading.

(3) All aprons and sidewalks shall be reinforced concrete with a broom finish. Minimum thickness shall be 4 inches.

(4) Sidewalk and curb at handicap stall shall be sloped per ADA requirements for handicap access.

(5) Sidewalks and aprons shall have 4-inch ABS sleeve under the structure every 15 feet, at a minimum.

13.3.16 Parking and driveways:

(1) The parking area shall be sufficient to simultaneously accommodate parking for at least 10 vehicles and allow deliveries to the O&M Building front entry and warehouse.

(2) All car parking areas shall be shaped and graded for drainage.

(3) Wheel stops and lighting shall be provided for the parking area.

(4) A concrete slab shall be poured in the parking lot to accommodate ADA parking requirements. Parking lot striping and handicap symbol shall be painted on the concrete paving.

13.3.17 Freight loading and unloading area:

(1) A 300-foot by 300-foot asphalt area shall be installed to accommodate loading and unloading of freight from delivery trucks.

(2) The loading and unloading area should allow access to the overhead doors of the maintenance shop.

13.3.18 Fencing and gates:

(1) The O&M Building perimeter shall be fenced.

(2) At least one (1) vehicle gate shall be installed at the O&M Building. The vehicle gate shall be a double-hung, 20-foot-wide (minimum), motorized, rolling gate. At least 10 remote-entry devices shall be supplied and programmed by Contractor for Owner's use.

(3) At least one (1) walk gate shall be installed at the O&M Building. The walk gate shall be a lockable, single-hung, 4-foot-wide, swing-gate for personnel access.

(4) All fencing and gates shall comply with the minimum specifications in Section 3.10 (*Fencing, Walls, and Gates*) herein.

13.3.19 Electronic security system:

(1) For all access control components, the subcontractor must be "Software House" certified.

(2) Vehicle access control system: not used.

(3) Personnel access control system:

(a) This system shall be installed for all man doors and vehicular gates. The system shall consist of stand-alone distributed smart panels that make the access decision and must have a stand-alone storage database capability that is downloaded routinely to the central computer database. The master computer or any other computer unit that has the proper password must be able to query it. The unit must have different levels of password control to access the data or program the unit.

(b) The card system must use a proximity or RFID card.

(c) This system must have anti-passback capabilities to prevent multiple use of the card in a short time frame. This can be accomplished through read-in and read-out card readers with a timeout feature that prevents multiple uses at the same reader with in a user-defined time frame.

(d) This system must be able to work in a local area network and/or wide area network environment and allow access from other computers on the network.

(e) The software must be capable of providing an audit trail of all who have accessed the database and all changes made by an individual.

(4) Security CCTV system:

(a) For purposes of the Proposal, a CCTV system will not be installed, although Contractor shall install conduits and gang boxes (including covers for gang boxes) and leave appropriate space for future installation.

13.3.20 Garbage enclosure:

(1) The O&M Building shall include a separate, detached garbage enclosure. The enclosure shall be installed at an Owner-approved location.

(2) The enclosure shall be constructed of treated wood.

(3) The enclosure shall be 10-feet high on all sides and shall include at least 12 inches of clear space between the dumpster and enclosure in all directions.

(4) The front of the enclosure shall include a solid screening gate on a metal frame with hinges and a center latch. Such gate shall swing out to an angle greater than 90 degrees and create an opening wide enough to allow a truck to easily access the dumpster. Pins shall not be required to hold gates open while the dumpster is being accessed.

13.3.21 Oil storage building:

(1) The O&M Building shall include a separate, detached building for oil storage. The building shall be installed at an Owner-approved location.

(2) The oil storage building shall have dimensions of at least 10-feet by 50-feet, with a minimum interior area sufficient for the storage and convenient access of up to ten (10) 55-gallon drums of oil.

(3) The oil storage building shall have a wood frame.

(4) The oil storage building shall include solid walls on three (3) sides, with one (1) roll-up door on the final side.

(a) The door shall be sliding type or roll-up type.

(b) The door shall be furnished with a keyed lockset.

(c) The door shall be wide enough to permit the safe and comfortable entry by a standard, loaded fork lift.

(5) The oil storage building shall have a ramped entry on the door side, sufficient to allow forklift access and with a minimum 5-foot concrete slab extension.

(6) A concrete floor shall be installed throughout the interior of the oil storage building.

(a) The floor shall include concrete curbs on all sides, each at least 6-inches high.

(b) A non-skid composite grate shall be furnished and installed above the concrete floor.

(c) The concrete floor shall be safely sloped towards a Contractor-installed sump pit in the rear corner of the building, which shall include a Contractor-furnished and Contractor-installed sump pump. The pump shall be used to manually remove effluent as needed; automatic discharge is not expected.

(d) The concrete floor (including the floating grate) shall be designed with sufficient structural capacity to simultaneously support the load of a standard, loaded fork lift and other stored materials. At least 15,000 pounds of floor load capacity shall be provided.

(7) The oil storage building shall have a metal roof which shall be slanted away from the door side and which shall be designed with similar loading criteria as was used for the O&M Building. The roof pitch for the oil storage building shall match the roof pitch utilized on the O&M Building.

(8) The oil storage building shall have power, heating, and lighting installed and operable.

(9) The oil storage building shall include ventilation for chemical storage.

(10) The interior of the building shall have at least 10 feet of clearance from floor to ceiling, or more if necessary to permit safe forklift access and use.

(11) One (1) eye wash station shall be furnished and installed in the oil storage building. Eye wash bottles may be substituted where they satisfy local regulations.

(12) Portable CO_2 and dry chemical fire extinguishers shall be furnished and installed in the oil storage building, in a quantity and type sufficient to ensure compliance with the Applicable Standards and other requirements. At a minimum, one (1) 10-pound ABC-type fire extinguisher (including mounting device / cabinet) shall be installed in the building.

(13) Bollards shall be installed on each side of the outside of the overhead door(s) in the oil storage building. Bollards shall meet the specifications included in Section 13.3.1 herein.

(14) Minimum signage, exterior of oil storage building:

(a) No smoking.

(b) No open flames.

(c) Maximum floor capacity (including loaded forklift).

(d) Personal protective equipment requirements.

(e) Authorized personnel only.

(15) Minimum signage, interior of oil storage building:

(a) Eye wash station.

(b) Fire extinguisher location.

13.3.22 Storm shelter:

(1) Not used.

13.4 Civil / Structural Requirements

13.4.1 All civil works for the O&M Building shall comply with the applicable specifications in Section 5.0 *(Civil Works Specifications*).

13.4.2 All O&M Building foundations shall be designed and constructed in accordance with the applicable structural works specifications in Section 6.0 (*Structural Works Specifications*).

13.4.3 Excavated material shall be backfilled and compacted on the outside of the foundation walls adjacent to green areas and graded around building to provide proper drainage. The outside foundation walls adjacent to hard surfaces and future additions shall be filled with compacted granular fill.

13.4.4 Fill shall be compacted to at least 95 percent (95%) of the maximum density within the moisture content of two percent (2%) below optimum to two percent (2%) above optimum, as determined by ASTM Standard D698, unless a higher level of compaction is required by the geotechnical studies. Contractor shall furnish compaction-testing results to Owner.

13.4.5 The O&M Building perimeter (including parking and all fenced area) shall be rocked throughout with crushed rock material over a compacted subgrade. Such crushed rock material shall include at least six (6) inches of aggregate, and shall conform to the requirements in Section 5.10 (*Crushed Rock Surfacing*) herein.

13.4.6 The O&M Building shall have a reinforced-concrete foundation covering the building footprint.

(1) Minimum concrete strength shall be 3,000 psi for footings and walls, respectively, and 3,500 psi for floors in place in 28 days.

(2) Rebar shall conform to ASTM A615. Placement shall be in accordance with ACI 318.

(3) Welded wire fabric shall conform to ASTM A185. Plain wire shall conform to ASTM A82. Placement shall be in accordance with Chapters 7 and 12 of ACI 318 and the CRSI's "*Manual of Standard Practice*".

(4) The O&M Building floor shall be at least six (6) inches thick.

(5) All foundations shall extend a minimum of six (6) inches above the adjacent finished grade.

(6) Concrete for equipment pads and containment areas shall be sealed with petroleum resistant sealant. All exposed concrete slabs, interior or exterior, shall have a combination sealer/curing compound, ASTM C309 or equivalent applied.

(7) Footing, wall, and floor heights shall be set with a laser transit to improve accuracy of determining heights for construction.

(8) Design of structural and miscellaneous steel shall be in accordance with the AISC's "*Manual of Steel Construction*". Design of structural and miscellaneous steel shall also be in accordance with NEMA Standard SG6, NEMA Standard TT1, and the International Code Council's "*International Building Code*", respectively.

(9) High strength bolts, nuts, and washers shall be galvanized in accordance with ASTM F2329. Bolts, nuts, and washers under 0.5 inches in diameter shall conform to ASTM A307, Grade B, ASTM A563 and ASTM F844 respectively, and shall be galvanized in accordance with ASTM F2329.

(10) Anchor bolts, anchor bolt assemblies, and concrete embedments shall be galvanized.

(11) Anchor bolts shall conform to ASTM A449, ASTM F1554, Grade 36 or A307. Anchor bolt sleeves shall conform to ASTM A501.

(12) All structural welding shall conform to the requirements of AWS Standard D1.1.

(13) Galvanizing as specified herein, shall conform to the requirements of ASTM A123, ASTM A153 or ASTM A2329 as applicable.

(14) Stainless steel shall conform to ASTM A167.

(15) Design of structural and miscellaneous aluminum shall be in accordance with the latest version of the Aluminum Association's "Aluminum Design Manual" and "Aluminum Standards and Data".

(16) Materials for structural and miscellaneous aluminum including structural shapes and plates shall conform to ASTM B209 and ASTM B308 and shall be aluminum alloy 6061-T6.

(17) Bolts and nuts shall conform to ASTM F468 and ASTM F467, respectively, and shall be aluminum alloy 6061-T6. Washers shall be aluminum-clad steel Alclad 2024-T4 or approved equal.

(18) Vapor retarder: 10 mil polyethylene placed under office floor and anywhere floor finish or coating shall be used to help reduce any moisture migration through the slab. All joints shall be taped and all penetrations shall be repaired and taped.

13.5 Mechanical Requirements

13.5.1 The following plumbing-related items shall be provided, at a minimum, in the quantities shown:

(1) Men's restroom:

(a) Wall-mounted toilet (2).

(b) Urinal (1).

(c) Floating sink (1).

(d) Shower (2).

(2) Women's restroom:

(a) Wall-mounted toilet (1).

(b) Floating sink (1).

(c) Shower (1).

(3) Kitchen:

(a) Sink with faucet (1).

(b) Ice maker connection (1).

(4) Maintenance shop area:

(a) Floor sink (1).

(b) Wash sink (1).

(c) Eye wash station (1).

(d) Propane or natural gas hot water heater (1), of sufficient size to satisfy the facility's needs.

(5) Utility closet:

(a) Floor sink (1).

13.5.2 Fire protection system:

(1) The fire protection system shall receive the approval of Owner's insurance carrier.

(2) Portable CO_2 and dry chemical fire extinguishers shall be furnished and installed in the building, in a quantity and type sufficient to ensure compliance with the Applicable Standards and other requirements. At a minimum, one (1) 10-pound ABC-type fire extinguisher (including mounting device / cabinet) shall be installed at every exit door, break room, and utility room, respectively.

(3) All local alarm, detection, and suppression panels shall report status to the main fire alarm panel located in the control room.

(4) All areas of the building shall be provided with smoke and heat detectors as the form of fire detection.

(5) The following walls and door shall be fire rated for the minimum times shown, or as required by the authority having jurisdiction, whichever is greater:

(a) Interior wall between warehouse and office areas: 60 minutes.

(b) Interior doors between warehouse and office area: 60 minutes.

(c) Interior SCADA / communications room walls: 60 minutes

(d) Interior door to SCADA / communications room: 60 minutes

13.5.3 Potable water system:

(1) The potable water system shall be designed to provide potable water, both hot and cold, at the proper pressure, temperature, and flow rate to all plumbing fixtures and equipment.

(2) The potable water system shall include chlorination, charcoal filters, or other treatment as required.

(3) All internal water piping shall be copper.

(4) Potable water piping shall be insulated as required.

(5) Potable water piping shall be sterilized in accordance with AWWA standards for disinfecting purposes prior to filling.

(6) At least two (2) insulated exterior hose bibs shall be installed.

13.5.4 Sanitary wastewater:

(1) Sanitary wastewater shall be collected from the various points of origin in the facility and diverted to a septic tank, and discharge from the septic tank shall be routed to a leach field.

(2) A pumped sanitary wastewater system shall only be used if a gravity system is impractical.

(3) Floor drains shall be installed in the break room, shop area, and each restroom.

13.5.5 Heating, ventilating, and air conditioning system:

(1) Heating elements shall be propane or natural gas-fired. Cooling elements shall be electric.

(2) The heating, ventilating, and air conditioning systems shall satisfy the workspace environmental requirements for personnel occupancy and equipment operation.

(3) Minimum ventilation rates shall be provided in normally-occupied areas in accordance with the Applicable Standards and other requirements. In the absence of local codes, ASHRAE Standard 62 requirements shall be met. A minimum of five (5) air changes per hour of ventilation or recirculation air shall be provided for effective mixing during heat removal ventilation or air conditioning of normally occupied spaces.

(4) The air conditioning for control and electrical equipment shall be designed to meet the filtration levels as defined by ASHRAE Standard 52.

(5) Interior cooling loads for the SCADA room shall be based upon actual equipment to be installed and ASHRAE Standard requirements. This air conditioning unit shall be ceiling mounted.

(6) HVAC systems shall be designed to maintain the indoor conditions listed in Table 10 (*HVAC Design Requirements*) herein.

(a) Where redundancy is indicated in this table, only the major active components require backup equipment; static components such as ductwork do not require duplication.

(b) Noise criteria are indicated as NC levels or decibels. Noise criteria values are as indicated in the ASHRAE Handbook series for acoustical design criteria. Decibels are sound pressure levels, A-weighted, to a reference of 0.0002 microbar at 5 feet from the equipment as measured in a free field with a single reflecting plane.

(c) Maximum design temperatures represent the average building temperature. Cooler temperatures may occur near the ventilation inlets and higher temperatures may occur at relief and exhaust points.

Table 10: HVAC Design Requirements

Area	Outdoor Ambient Design	Indoor							
		Design Temp.							
		Winter (°F)	Summer (°F)	Humidity Control (%RH)	Particulate Filtration Efficiency (%)	Pressuri-zation	Redundancy (Note 3)	Noise Criteria	System Configuration
Control Room	Note 1	65	65	30-65	High	Positive	2 x 100%	NC 45	AC for personnel comfort and equipment requirements
Offices Break room Restrooms Conference rooms Contractor parts storage Utility Closet	Note 1	70	72	30-65	ASHRAE STD-62	Positive	None	NC 45	AC for personnel comfort and equipment requirements
Maintenance shop	Note 1	60	90	N/A	30	Positive	None	NC-55	Evaporative cooler for personnel comfort (Note 2)

Note 1: Site design temperatures.

Note 2: Evaporative cooler shall be designed for a minimum of 85% effectiveness. Air handler shall include a heating element.

Note 3: Redundancy is included to specify the amount of redundancy required (e.g., 2x100% requires a primary system with a 100% backup system), and None requires only a primary system.

(7) Air velocities in ducts and from louvers and grills shall be sufficiently low to maintain acceptable noise levels in areas where personnel are normally located.

(8) Thermal insulation with vapor barrier shall be provided on ductwork surfaces with a temperature below the dew point of the surrounding atmosphere to prevent vapor condensation. All ductwork used for air conditioning purposes shall be insulated; ductwork used for ventilation purposes shall not require insulation.

(9) Exhaust fans for restrooms and locker room shall be furnished and installed. Exhaust systems shall be provided above the roof for toilet, shower and locker room areas and shall be controlled by occupancy sensors. Outdoor ventilation air shall be based on normal room occupancy or local codes, whichever is more stringent.

(10) Functional louvers at building workshop area shall be provided.

13.5.6 Insulation systems / thermal and moisture protection:

(1) Caulking and backer board, as recommended by the manufacturer and to seal exterior and interior joints at expansion joints, frames of doors, windows, and other wall openings, shall be furnished and installed.

(2) Roof insulation shall be such that an *R* value of at least 30 is achieved. Thermal blocks shall be included within the roof system.

(3) All building walls shall be insulated. Wall insulation shall be such that an *R* value of at least 19 is achieved. All interior office walls shall be insulated with 3.5-inch fiberglass batt insulation for sound control.

(4) Miscellaneous insulation for filling voids at roof eave, roof peak, door frames, window frames, and other similar areas shall be furnished and installed.

13.6 Electrical Requirements

13.6.1 General requirements:

(1) O&M Building power shall be 240-Volt, single-phase (or Owner-approved equal)

(2) All convenience outlets shall be on 20A circuits.

(3) All equipment and materials shall bear UL label.

(4) Underground conduit shall be PVC and shall conform to the specifications for conduit set forth herein.

(5) All transformers shall be installed exterior to the building.

13.6.2 Communication cabling:

(1) A complete telephone and data network system shall be provided including all distribution jacks, cable, and wireless systems.

(2) Internet service shall include (i) high-speed internet service (Wi-Fi) throughout the building and (ii) broadband internet service up to the wall jacks. T1 service shall be provided (or the fastest available speed from the local service provider).

(3) Phone service shall include at least one (1) four-line phone system up to the wall jacks.

13.6.3 Interior grounding:

(1) Grounding shall be in accordance with NFPA 70/NEC. All feeder and branch circuits shall have a green-colored insulated equipment ground conductor in addition to any metallic conduit being bonded to the equipment grounding system.

(2) Ground fault protection shall be installed in receptacles in warehouse and workshop where power tools are used, and in restrooms and other locations as required by NFPA 70/NEC.

13.6.4 Exterior grounding:

(1) The facility shall have a #4/0 AWG bare copper ground counterpoise with 0.75-inch by 10-foot copper-clad steel ground rods. The counterpoise will be connected to service entrance equipment, derived source transformer secondary neutrals, telecommunications main ground bus bar, and all building columns.

13.6.5 Lightning protection:

(1) The building shall have an array of air terminals, roof conductors, and down conductors. The lightning protection system shall be interconnected to the ground counterpoise system. Requirements for the building's lightning protection system shall be as determined and recommended by NFPA 780.

13.6.6 Exterior lighting:

(1) Exterior lighting shall be provided by building-mounted, metal-halide light fixtures at facility personnel and overhead doors. Additional building-mounted lights shall be provided to illuminate walkway and parking area. LED lights are preferred if minimum required illumination levels can be met. In lieu of LED lights, metal halide lights shall be used. Lighting levels shall meet the intensities indicated in the IES handbook and NFPA 70/NEC.

(2) Exterior lighting shall be controlled by lighting contactors with hands-off auto selector switches and photocells and should be equipped with vandal-resistant lenses.

(3) Lighting shall be provided to cover the building faces evenly and shall be directed inward from the property line.

(4) Area lighting shall supplement existing street lighting (if any) to provide a maximum level of illumination from a minimum number of fixtures. The system shall be designed to illuminate the entire area evenly, including doorways, structures, and all opening into the structures.

(5) Pedestrian and vehicle entrances that are actively used are to be provided with sufficient illumination to permit recognition of individuals and examination of credentials. All vehicle entrances must be lit so that the entire vehicle, occupants, and contents can be adequately viewed. Doorways and other recesses must be lit to eliminate shadows.

(6) Alternate circuitry must be used in the power circuits so that the failure of any one lamp does not leave a large portion of either (i) the site perimeter or (ii) critical or vulnerable areas in darkness.

13.6.7 Emergency egress lighting:

(1) The facility shall use fluorescent fixtures with internal battery backup ballast for emergency egress locations such as corridors, hallways, and fire exits.

(2) Exit signs shall be illuminated LED type located at fire exits and required locations.

13.6.8 Interior lighting and receptacles:

(1) Lighting levels shall meet the intensities indicated in the IES handbook and NFPA 70/NEC. The facility shall use the following types of fixtures:

(a) 1-inch by 4-inch industrial fluorescent fixtures with guards with at least two (2) lamps in storage areas and SCADA room, respectively.

(b) 2-inch by 4-inch fluorescent fixtures with parabolic louvers with at least three (3) lamps with dual level switching in office areas, break room, and conference room, respectively.

(c) 2-inch by 4-inch high bay I-beam fluorescent fixtures with four (4) T5 high-output linear fluorescent lamps in workshop area.

(2) Fluorescent fixtures shall be equipped with high-efficiency electronic ballasts. Classified area lighting fixtures shall be designed to meet requirements of NFPA 70/NEC, Article 500.

(3) A lighting control system shall be used to control fixtures in office areas. The lighting control system will have local low voltage switches for local control. Offices will be locally switched and have motion sensors to shut off the circuit automatically when the room is unoccupied.

(4) Install receptacle outlets as specified in accordance with NFPA 70/NEC.

13.6.9 Power distribution system:

(1) Service entrance conductors shall be installed to tie into the main distribution panel and terminated and tested by Contractor. The MDP in the building shall be service-entrance rated.

(2) Feeders shall extend from the MDP to serve general power panel boards

(3) Panel boards and associated feeders shall be sized for 20 percent (20%) spare capacity. Panel boards shall contain space for 20 percent (20%) additional spare circuit breakers.

(4) Building electrical service shall include a manual transfer switch and pad-mounted generator. The backup service shall be sized equal to the utility service and provided with sufficient fuel to operate for a minimum of five (5) days without refueling. A propane generator is preferred over diesel.

13.6.10 Wiring and conduit:

(1) Each length of PVC conduit furnished with coupling on one end and metal or plastic thread protector on the other end. Sizes of conduit, fittings and accessories as indicated, specified or as required by Applicable Standards or in accordance with NFPA 70/NEC requirements.

(2) Terminate all conduit runs with insulated bushings.

(3) Provide all fittings necessary for a complete installation.

(4) Lighting branch circuits, telephone circuits, fiber optic cables and intercommunications circuits shall be routed in separate conduit systems.

(a) Lighting circuits shall be routed in electrical metallic tubing for indoor concealed areas, rigid conduit for outdoor areas, and PVC tubing or Schedule 40 PVC conduit for underground.

(5) Threaded, galvanized, rigid steel conduit or intermediate metal conduit shall be PVC tape wrapped or coated for underground use and will be used in all exposed, outdoor and hazardous locations.

(6) All conductors shall be copper.

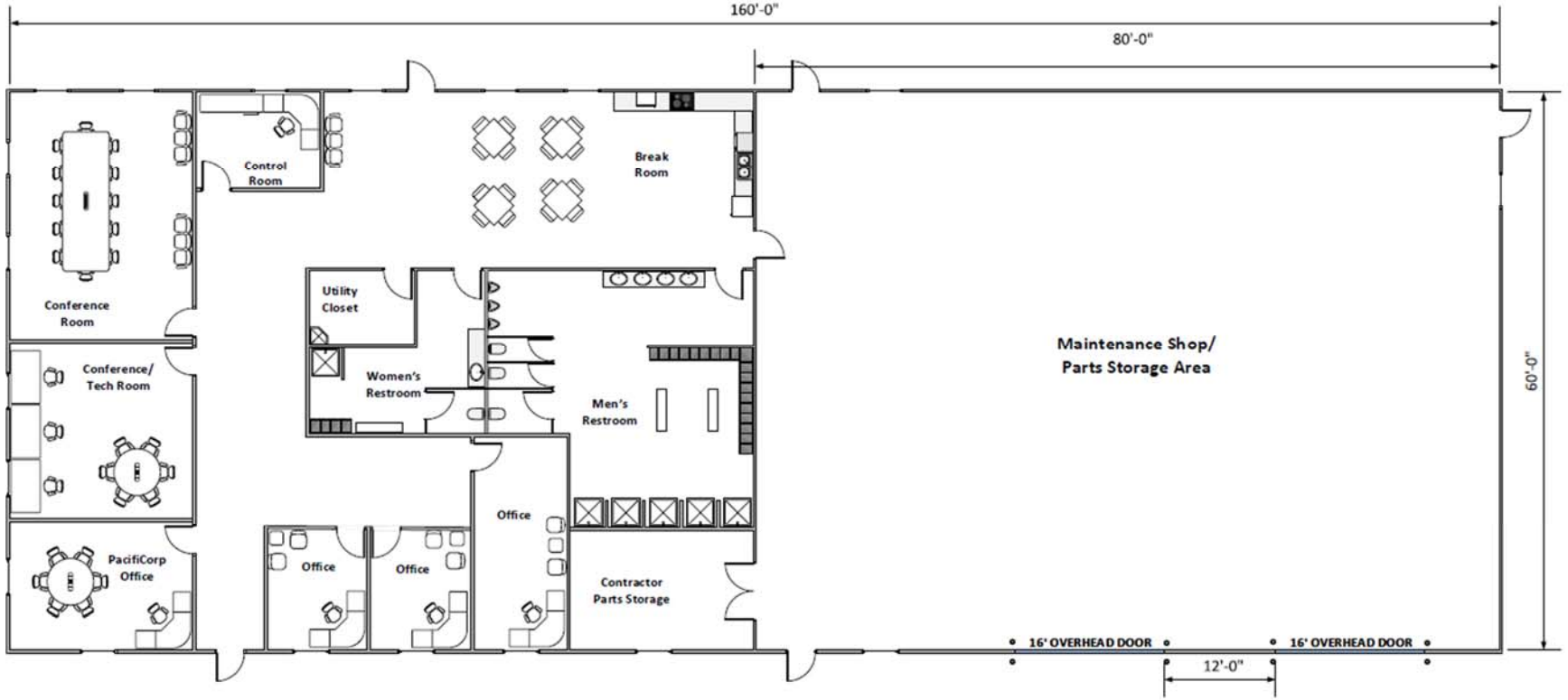
(7) All conductors #10 AWG and smaller shall be solid conductor. All conductors #8 AWG and larger shall be stranded conductor.

(8) All feeder and branch circuit wire shall be single conductor and have THWN/THHN insulation.

(9) All electrical enclosures mounted outdoors shall be NEMA 3R (minimum).

(10) Isolate emergency lighting circuit conductors from all other wiring.

Figure 1: Indicative Operations and Maintenance Building Layout



14.0 WIND TURBINE SPECIFICATIONS

14.1 General Provisions

14.1.1 The Wind Turbine, including all components, shall be capable of operating at rated capacity in a safe, reliable, and continuous manner and without undue maintenance under the meteorological conditions (e.g., temperature, air density, wind speed, salinity) of the Project and Project Site.

14.1.2 All exterior surfaces of the Wind Turbine shall be white or light gray in color.

(1) RAL 9010 (pure white) or RAL 7035 (light gray) are acceptable colors.

(2) A non-glare finish shall be used.

(3) Touch-up paint shall be provided as reasonably necessary to repair any damage to Wind Turbine equipment that occurs during the transportation, offloading, erection, and/or commissioning of the Wind Turbines.

14.1.3 The Wind Turbine (including the tower and nacelle) shall have no external markings unless explicitly listed herein.

14.1.4 Wind Turbines shall be supplied with the first fill of all grease, oil, and other lubricants and consumables in the Wind Turbine equipment (or filled at the Project Site following delivery).

(1) Gearbox oil shall be AMSOIL or Owner-approved equal.

14.1.5 Turbine Supplier shall validate the Wind Turbine equipment incorporated into the Work is new, unused, of good quality, consistent for use in wind generation facilities, and complies with the Requirements.

14.1.6 All Functional Groups shall be interchangeable, regardless of the suppliers or manufacturers of the Functional Group, including if such Functional Groups are furnished by different suppliers or manufacturers. For purposes this exhibit, a "**Functional Group**" shall mean a rotor blade set; hub; pitch system; main shaft; main bearing; generator; gearbox; mechanical brake; high-speed shaft coupling; internal crane; power converter; medium-voltage transformer; service lift (if elected by Owner); internal tower wiring and cabling; controller; auxiliary system; wind vane; anemometer; yaw system; cooling system; hydraulic system; tower section; switchgear; ground controller; or uninterruptible power supply, respectively.

14.2 Design Working Life

14.2.1 The design working life of the Wind Turbine equipment shall be a minimum of 20 years.

14.3 Type Certificate

14.3.1 The Wind Turbine shall hold current certification of compliance with IEC WT 01 / IEC 61400-1 / IEC 61400-22, either in the form of a Type Certificate or an A-Design statement of compliance (collectively, the "**Certificate**").

14.3.2 The Certificate shall be from an approved certifying entity:

(1) Germanischer Lloyd.

(2) Det Norske Veritas.

(3) TÜV NORD Group.

(4) Owner-approved equal.

14.4 Site Suitability

14.4.1 Proposals shall include an assessment of suitability of the proposed Wind Turbine at the Project Site. This assessment shall include a representation from Contractor confirming the suitability of the Wind Turbine for the Project Site and its ability to withstand the Project Site conditions for a period of at least 20 years. Contractor's requirements for wake sector management (if any) shall be included in the suitability assessment.

14.5 Component Suppliers

14.5.1 Quality control and assurance programs, both of the Turbine Supplier and their component suppliers, shall meet ISO 9001 requirements.

14.5.2 Proposals shall include a listing of all potential component suppliers that will furnish the following components for the Project. This list shall include the names of the proposed component suppliers and the country of origin for each.

(1) Rotor blades.

(2) Gearbox (if applicable).

(3) Generator.

(4) Main shaft.

(5) Hub.

(6) Controller.

(7) Power converter.

(8) Tower.

(9) Pitch system, including actuators and accumulators (as applicable).

(10) Yaw system, including motors.

(11) Mechanical brake.

(12) Transformer (if applicable).

14.6 Rotor and Blades

14.6.1 The rotor shall be of three-bladed cantilevered construction.

14.6.2 The rotor shall be mounted upwind of the tower.

14.6.3 The rotor shall have a horizontal-axis orientation.

14.6.4 Reserved.

14.6.5 Blades shall have an integrated lightning protection system, in accordance with IEC 61400-24 and as prescribed in Section 14.25.1 of these Specifications.

14.6.6 Rotor blades shall be manufactured by an experienced component supplier in an ISO 9001 certified facility.

14.7 Hub

14.7.1 The hub shall allow access to any internal components or operating mechanisms, such as pitch bearings and blade roots.

14.8 Generator

14.8.1 Owner reserves the right to review available generator types (e.g., induction, permanent magnet generator) offered by Contractor for the purpose of specifying the type to be installed in the Wind Turbine.

14.8.2 The generator shall be a three-phase, variable speed, alternating current generator.

14.8.3 The generator shall have a rated frequency of 60 Hertz.

14.8.4 The generator shall operate at the manufacturer's standard voltage level.

14.8.5 The generator shall have a rated power of no less than 1,000 kilowatts and no greater than 4,000 kilowatts at the Project Site air density.

14.8.6 The generator shall be of minimum protection class IP54.

14.8.7 The generator and its internal components shall be manufactured to NEMA Class H insulation.

14.8.8 The generator shall be enclosed in a weatherproof nacelle.

14.8.9 The generator windings shall be of copper or all-welded aluminum.

14.8.10 The generator shall operate with a step-up transformer with a high-side voltage of 34.5 kilovolts.

14.8.11 The generator nameplate shall contain the applicable information according to IEEE C50.12.

14.8.12 Generators shall be manufactured by an experienced component supplier in an ISO 9001 certified facility.

14.9 Gearbox

14.9.1 No more than one (1) gearbox shall be used in a single Wind Turbine.

14.9.2 Production testing of the gearbox shall have been performed prior to final acceptance.

14.9.3 The gearbox shall be manufactured by an experienced component supplier in an ISO 9001 certified facility.

14.9.4 Note: if the Wind Turbine does not include a gearbox (e.g., direct drive topology), this Section 14.9 in its entirety is non-applicable.

14.10 Pitch System

14.10.1 The Wind Turbine shall include a pitch system for controlling the movement of rotor blades.

14.10.2 The pitch system should be capable of pitching blades independently.

14.10.3 The pitch system shall be capable of feathering the blades a full 90 degrees.

14.10.4 The pitch system shall include either hydraulic or electric actuation for pitch drives.

(1) Pitch systems employing hydraulic actuation shall include adequate spill containment or an absorption system.

(2) Pitch systems employing hydraulic actuation shall incorporate an appropriate filtration system.

(3) Pitch systems employing electric actuation shall include back-up power for failsafe operation.

14.10.5 Rotor blades shall be automatically pitched on a regular basis during non-operational periods to ensure a consistent distribution of lubricants.

14.11 Braking System

14.11.1 The braking system shall include both mechanical and aerodynamic brakes.

14.11.2 The braking system shall be capable of bringing the rotor to a complete stop from any operational condition and for parking the Wind Turbine.

14.11.3 The braking system shall be capable of preventing rotor rotation at wind speeds up to at least the rated survival speed.

14.11.4 The braking system shall include the necessary failsafe redundancy and be designed to function even if its external power supply fails.

14.11.5 The braking system shall include a manual emergency stop function.

14.12 Yaw System

14.12.1 The yaw system shall be self-orienting.

14.12.2 The yaw system shall be capable of allowing 360 degrees of nacelle rotation.

14.12.3 The yaw system shall be capable of slewing at a rate of at least 0.5 degrees per second.

14.12.4 The yaw system shall include the necessary failsafe redundancy to permit the Wind Turbine to slew out of the wind in the event of an external power supply failure.

14.12.5 The yaw system shall include an appropriately-sized torque limiter.

14.13 Nacelle

14.13.1 The nacelle shall provide adequate working space for service and maintenance activities.

14.13.2 The nacelle interior shall be sufficiently lit to provide adequate visibility for service at any hour.

(1) Nacelle lighting shall meet OSHA requirements for working environments.

(2) Lighting shall incorporate an uninterruptible power supply capable of supplying back-up power for at least one (1) hour.

14.13.3 The nacelle shall incorporate natural ventilation.

14.13.4 The nacelle shall include spill containment suitable to contain 110 percent of all grease, gear oil, coolant, and other liquids or lubricants stored in nacelle components.

14.13.5 A hatch shall be positioned in the floor or rear of the nacelle for raising or lowering equipment.

14.13.6 The nacelle floor shall have anti-slip surfaces.

14.13.7 Nacelles shall be assembled by an experienced component supplier in an ISO 9001 certified facility.

14.14 Tower

14.14.1 The Wind Turbine shall be mounted on a tapered, tubular, watertight, tower. No supporting (e.g., guy) wires shall be used.

14.14.2 The tower shall be constructed of steel or concrete.

14.14.3 Reserved.

14.14.4 The tower shall be accessible through a lockable door at the base of the tower.

(1) Doors shall be protected by an intrusion alarm integrated into the SCADA System.

(2) Permanent metal stairs, including concrete pads for the stair support columns and stair landing for each Wind Turbine, shall be provided if the access door is above grade level.

14.14.5 The tower interior shall be sufficiently lit to provide adequate visibility for service at any hour.

(1) Tower lighting shall meet OSHA requirements for working environments.

(2) Lighting shall be installed at the base of the tower, at all platforms within the tower, and at the top of the tower below the nacelle.

(3) Lighting shall incorporate an uninterruptible power supply capable of supplying back-up power for at least one (1) hour.

14.14.6 Welded service platforms, or other means to allow access to all components, shall be included within the tower.

(1) Duplex, interior, 120-volt alternating current, 20-amp GFI power receptacles shall be installed at the base of the tower, at all platforms within the tower, and at the top of the tower below the nacelle.

(2) Floors of all platforms shall have anti-slip surfaces.

14.14.7 A ladder shall be included in the tower for internal ascent.

(1) The tower ladder shall reach from the base of the tower to the nacelle.

(2) The tower ladder shall be made of aluminum or steel.

(3) The tower ladder shall meet all OSHA standard requirements for safety and construction.

(4) Lights shall be mounted along the ladder route inside the tower to provide adequate lighting of the tower interior.

(5) An OSHA-compliant fall arrest system shall be included that is compatible with the tower ladder. The fall arrest system shall be designed and manufactured according to the latest versions of the following standards, at a minimum: EN 353-1, EN 362, EN 363, CAN/CSA Z259 and ANSI Z359.1. The fall arrest system shall be understood to include rail, guide seat, and runner.

14.14.8 Tower drawings shall clearly show maximum foundation loading and shall specify bolt torque requirements for connections.

14.14.9 The tower shall incorporate natural ventilation, either through louvers in the tower door or other suitable means.

14.14.10 Tower sections shall be connected using flange connections.

14.14.11 The tower shall be manufactured by an experienced component supplier in an ISO 9001 certified facility.

14.15 Climb Assist

14.15.1 A climb assist system shall be included in the Proposal as optional equipment; if a climb assist is standard equipment in the proposed Wind Turbine model, the Proposal shall indicate as much. The following specifications shall apply to any climb assist that may be provided.

14.15.2 The climb assist shall be compatible with the standard tower ladder.

14.15.3 The climb assist shall provide a reduced carrying weight of at least 75 pounds (34 kg).

14.15.4 The climb assist shall meet all OSHA standard requirements for safety and construction.

14.16 Service Lift

14.16.1 A service lift system shall be included in the Proposal as optional equipment; if a service lift is standard equipment in the proposed Wind Turbine model, the Proposal shall indicate as much. The following specifications shall apply to any service lift that may be provided.

14.16.2 The service lift shall be an electrically-driven man-lift capable of lifting two workers and light parts from the base of the tower to the nacelle.

14.16.3 The service lift shall have a minimum lift capacity of 500 pounds (227 kg).

14.16.4 The service lift shall meet, at a minimum, the requirements of ASME A17.1, ASME A120.1, and OSHA standard requirements for safety and construction.

14.16.5 The service lift shall have interior lights.

14.16.6 The service lift shall have an access door that can be secured from within the lift.

14.16.7 The service lift shall include external controls at the base of the tower to enable movement of the lift without an operator inside.

14.16.8 The service lift shall have controlled descent capability to enable descent at a controlled rate during power interruption.

14.16.9 The tower ladder shall be accessible from the service lift in the event of power interruption during tower ascent or descent.

14.17 Service Hoist

14.17.1 An electrically-powered service hoist shall be included in the nacelle, capable of lifting parts from ground level to the nacelle.

14.17.2 The service hoist shall have a minimum lifting capacity of 1,000 pounds (453 kg).

14.18 Power Converter

14.18.1 The Wind Turbine shall include a partial- to full-power convertor capable of supplying power at constant frequency and voltage from the generator to the step-up transformer.

14.19 Thermal Conditioning System

14.19.1 A cooling system (active or passive, as appropriate) suitable for Project Site elevations and temperatures shall be included for the following, at a minimum:

(1) Generator.

(2) Power converter.

(3) Hydraulics.

(4) Gearbox (as applicable).

(5) Medium-voltage transformer (as applicable).

(6) Nacelle.

14.19.2 Liquid cooling systems shall be self-contained.

14.20 Lubrication System

14.20.1 Oil shall be maintained at a cleanliness level of at least ISO 4406 15/12.

14.20.2 The gearbox shall be lubricated with oil regularly and automatically.

14.20.3 A backup lubrication system shall be included for failsafe operation.

14.20.4 The following, at a minimum, shall be regularly lubricated with grease from an automatic lubrication unit:

(1) Blade bearings.

(2) Main bearing.

(3) Generator bearings.

14.21 Condition Monitoring System

14.21.1 Critical Wind Turbine components shall be monitored by a condition monitoring system for the purpose of targeting predictive maintenance and proactively monitoring failures.

14.21.2 On-line vibration diagnostics shall be carried out, at a minimum, on the following:

(1) Main bearing.

(2) Gearbox.

(3) Generator.

14.21.3 A baseline for vibration data shall be established on every Wind Turbine using no less than three (3) months of data at the beginning of life on every Wind Turbine.

(1) Limits shall be set in the SCADA monitoring system for warnings and alarms using these baseline vibration characteristics. These limits shall be actively monitored.

(2) In the event that vibration limits are exceeded, the Wind Turbine shall be automatically shut down in a safe and reliable manner and left in a safe configuration so inspection may be performed.

(3) Vibration data and statistics of the Wind Turbine shall be retrievable from the SCADA System interface.

14.22 Meteorological Equipment

14.22.1 Each nacelle shall be supplied with primary and secondary anemometers capable of measuring wind speeds.

(1) Anemometers shall be redundant and the Wind Turbine capable of operating with only one anemometer available.

(2) Reserved.

(3) Ultrasonic or three-cup anemometers are acceptable.

(4) Heaters should be included for anemometers.

14.22.2 Each nacelle shall be supplied with primary and secondary wind vanes capable of measuring wind direction. The vanes shall be redundant and the Wind Turbine capable of operating with only one vane available.

14.22.3 The supplied anemometers and wind vanes shall provide control and display data for the system.

(1) The anemometers shall provide information for system shutdown in the event of excessive wind speeds.

(2) The anemometers shall provide information for system start or restart when wind speeds are within an acceptable range.

(3) The wind vanes shall provide information for yawing of Wind Turbines.

14.23 Switchgear

14.23.1 The Wind Turbine shall include all relaying and switchgear required to assure safe and proper connection and disconnection with the Collection System Circuits, including uninterruptible power supply for safe shutdown upon loss of grid power. The switchgear shall include all enclosures, fittings, disconnect switches, fuses, breakers, and other similar or related items as necessary to adequately protect and isolate the Wind Turbine equipment.

14.23.2 The switchgear shall consist primarily of a main circuit breaker, along with associated equipment.

14.23.3 All equipment and its installation shall meet, at a minimum, applicable NEMA, ANSI, and IEC standards. In the case of conflict between standards, the more stringent shall apply.

14.23.4 The switchgear shall be gas-insulated using SF6.

14.23.5 The switchgear shall be provided in a dedicated steel enclosure and be readily accessible for inspection and maintenance.

14.23.6 The circuit breaker compartment shall have a hinged door and dead front construction.

14.23.7 No exposed buswork or cable connection shall be present with the breaker door open.

14.23.8 The switchgear shall be located in the nacelle or the base of the tower at ground level.

14.24 Tower Wiring and Cabling

14.24.1 The internal tower wiring and cabling shall be provided in a sufficient quantity to transfer electrical power between the Wind Turbine nacelle and the down-tower switchgear, including all necessary slack and splicing quantities.

14.25 Wind Turbine Obstruction Lighting

14.25.1 The Wind Turbine shall be provided with aviation obstruction lights, including mounting assemblies, GPS controller, and photocell as required by the Federal Aviation Administration and all other Applicable Standards, including US DOT-FAA Advisory Circular No. AC 70/7460-1K: *Obstruction Marking and Lighting*.

14.25.2 Wind Turbine aviation obstruction lights shall be programmed to blink in unison, including with those aviation obstruction lights that are installed on the meteorological towers.

14.25.3 Aviation obstruction lighting equipment shall be designed for continuous operation.

14.25.4 Aviation obstruction lights shall be FAA Type L-864 (single, red, flashing configuration).

14.25.5 Obstruction lighting shall incorporate an uninterruptible power supply capable of supplying back-up power for at least one (1) hour.

14.26 Lightning Protection

14.26.1 The Wind Turbine shall be furnished with lightning protection designed in compliance with, at a minimum, the requirements of IEC 61400-24 and IEC 62305.

14.26.2 Lightning protection equipment should include, at a minimum, the following on every Wind Turbine:

(1) Franklin rods on nacelle.

(2) Lightning receptors on hub, nacelle, and each rotor blade.

(3) Internal steel mesh in nacelle to act as Faraday cage.

(4) Fire-retardant materials within nacelle composition.

(5) Earthing system, including down-conducting system with clear electrical path to ground.

14.26.3 All metallic components within the Wind Turbine shall be bonded to the Wind Turbine.

14.26.4 Rotor blades shall be designed to Lightning Protection Level ("LPL") I, in accordance with IEC 61400-24.

14.26.5 Unless demonstrated by a risk analysis that a lower level is adequate, the remaining components (other than rotor blades) shall be designed to at least LPL-II, in accordance with IEC 61400-24.

14.27 Corrosion Protection

14.27.1 All ferrous materials shall be supplied with coating systems adequate to protect it from corrosion for the design life (minimum 20 years) of the Wind Turbines at the Project Site location.

14.28 Extreme Weather Packages

14.28.1 The design temperature ranges for each Wind Turbine shall be in accordance with, at a minimum, the most recent edition of IEC 61400-1. The Wind Turbine shall employ hot weather and/or cold weather packages as necessary to maximize production opportunities.

14.29 Emergency Protection Systems

14.29.1 During power outages of any nature, the Wind Turbine shall have the ability to power down, feather blades properly, and orient the Wind Turbine appropriately to prevent damage by high winds.

14.29.2 Tower, nacelle, and obstruction lighting back-up power shall be provided for personnel and equipment safety during power outages.

14.30 Fire Protection

14.30.1 Fire protection should be designed to the NFPA 850 (Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations) standard.

14.30.2 Permanently-mounted fire extinguishers shall be included, at a minimum, in the nacelle and at the base of every tower.

14.30.3 Fire suppression equipment for the Wind Turbine should be included as an option in the Proposal. Owner reserves the right to install third-party fire suppression equipment at a later date.

14.31 Grid Compliance

14.31.1 The Wind Turbine shall provide a controlled and predictable power response from variations in wind and grid frequency.

14.31.2 The Wind Turbine shall be compliant with the following power quality and grid interconnection standards, at a minimum:

(1) Federal Energy Regulation Commission Order 661a Appendix G, “Interconnection Requirements for a Wind Generating Plant”.

(2) IEEE Standard 519, “Harmonic Limits”.

(3) ANSI C84.1, “American National Standard for Electric Power Systems and Equipment - Voltage Ratings”.

14.31.3 Zero-voltage ride through: the Wind Turbine shall be capable of remaining in service (i.e., connected to the grid) during a three-phase fault for a period of up to nine cycles (0.15 seconds) at zero voltage, as measured at the high-side of the step-up transformer.

14.31.4 Low-voltage ride through: not used.

14.31.5 High-voltage ride through: not used.

14.31.6 The Wind Turbine shall operate within a frequency range of 60 Hertz ± 2 Hz.

14.31.7 The Wind Turbine shall be capable of providing active power control through the following, at a minimum:

(1) Ramp rate control, permitting active power response up to ten percent (10%) of rated power per second.

(2) Delta control, permitting Wind Turbine to be operated at specified output level (delta) below available output level.

14.31.8 Reactive power control shall be provided by the Wind Turbine to assist with regulating grid voltages. The Project (inclusive of all Wind Turbines) shall maintain a power factor within the range of 0.95 leading to 0.95 lagging, as measured at the point of interconnection.

14.31.9 Total harmonic distortion shall be no greater than five percent (5%).

14.32 Testing and Quality Control

14.32.1 All testing described herein shall be performed by an independent, experienced third party.

14.32.2 All Wind Turbine equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

14.32.3 Wind Turbine testing shall include the following, at a minimum:

(1) All testing specified in the Applicable Standards.

(2) All testing reasonably recommended or required by the applicable equipment suppliers.

(3) Design testing / factory acceptance testing. (Note: results of all such testing shall be documented and made available for Owner review.)

(4) All exposed cable sections shall be visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

(5) Start-up, test, commission, and successfully achieve commissioning completion and substantial completion of all Wind Turbines and other Wind Turbine equipment, including the SCADA System and service lifts (if elected by Owner).

(6) Reliability test following commissioning completion:

(a) Minimum duration: 72 hours.

(b) Each individual Wind Turbine shall maintain a minimum availability level of at least 80 percent (80%), as calculated at the end of the test, and as determined using the availability calculation in the Project availability agreement.

(c) The Wind Turbines (considered in the aggregate) shall maintain a minimum availability level of at least 90 percent (90%), as calculated at the end of the test, and as determined using the availability calculation in the Project availability agreement.

(d) Each Wind Turbine shall remain in continuous operation throughout the test and be available to produce.

(e) Each Wind Turbine shall generate at least 10 MWh by the end of the test.

(f) No major mechanical or electrical issues shall occur on any Wind Turbine during the test.

14.32.4 Copies of testing reports shall be submitted to Owner within 10 days of completing such test. Testing reports shall include a summary of testing procedures and acceptance criteria.