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

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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.

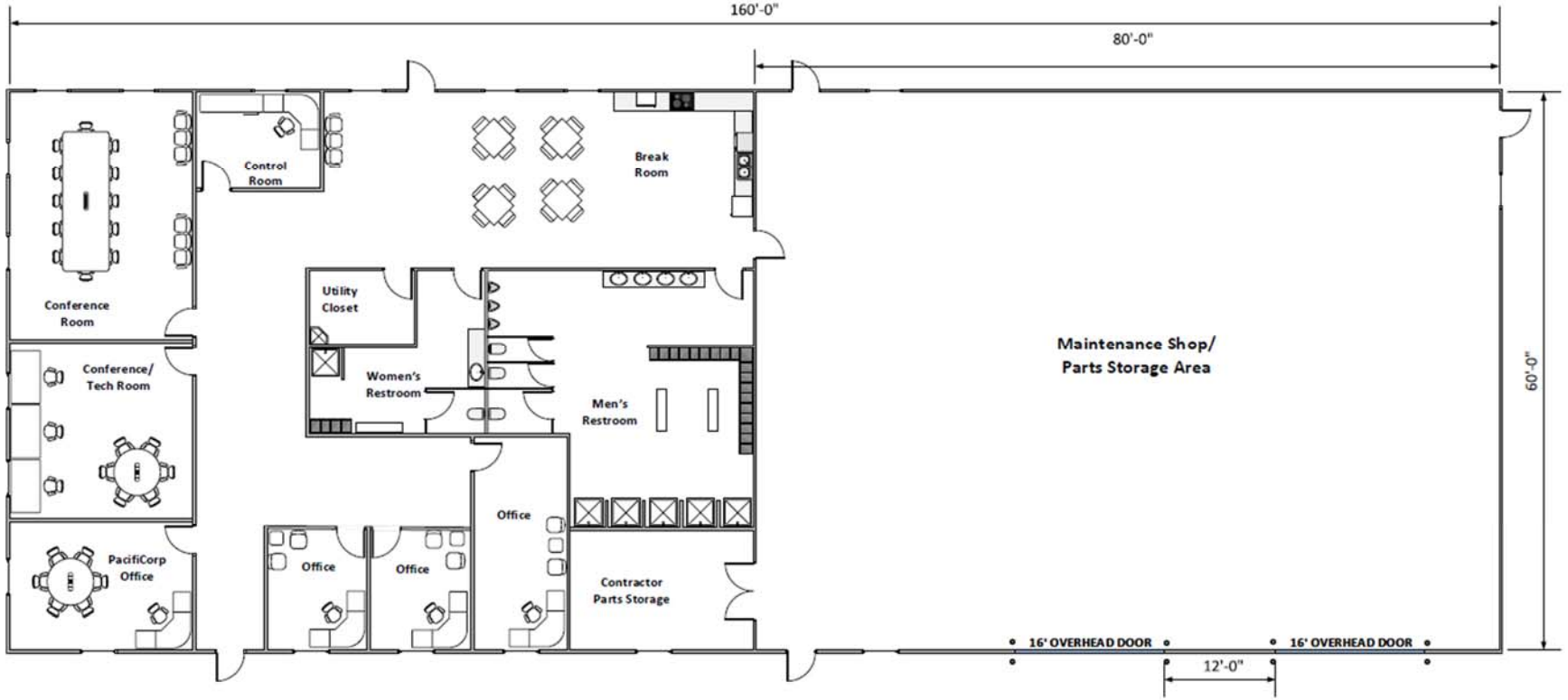
(7) All conductors #10 AWG and smaller shall be solid conductor. All conductors #8 AWG and larger shall be stranded conductor.

(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.