Portland General Electric

2025 All Source RFP Technical Specifications – Wind Projects

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APPENDIX M – WIND PROJECTS

TECHNICAL SPECIFICATIONS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

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ENGINEERING DOCUMENTS, DRAWINGS, AND OTHER DELIVERABLES

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	26Oct21	Issued for Implementation	1898 & Co.		JAL	Jared Lathrop
1	14Apr23	Update from 2021 version	1898 & Co.	PGE	CPA	Craig Armstrong
2	19Jun25	Update from 2023 version	1898 & Co./PGE	PGE	SPF	Sean Flak

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1.0 SUBMITTALS

1.1 GENERAL

Contractor shall supply all drawings, calculations and study reports, plans, specifications, and information to the Owner as part of the scope of Work. Documents and information shall include, but are not limited to, the deliverable list in M1-01-02-01 (Engineering Documents, Drawings, and Other Deliverables Table), in each case for the relevant technology (wind, solar, storage) as applicable. Items marked in the submittals table per the applicable technology (wind, solar, storage) shall be submitted for the Owner's review and approval prior to equipment purchase or construction.

All BIM design to create drawings contractor shall provide the BIM project files as part of the deliverables to include native format files and a Navisworks overall file with native file reader links

Within 60 days of the Effective Date, Parties shall identify and mutually agree upon all OEM equipment submittals and specifications which will be submitted to the Owner and those that the Owner will review. Conformed to construction record drawings (as-builts) shall be provided for selected drawings marked as Level C.

Contractor shall organize a face to face or real time meeting with the Owner prior to Construction to review design documents.

As the project progresses through engineering and construction, the Contractor shall provide to the Owner the current revision of the drawings and documents according to the normal project communication distribution to be decided upon during project kickoff. These distributions shall be provided in electronic copy in native file format.

Upon completion of any drawing or document revision(s), Contractor shall submit the drawing(s) or document(s) within 2 days to the Owner.

1.2 DOCUMENT SUBMITTAL REQUIREMENTS

1.2.1 Drawings

Drawings requested by the technical specifications are to be sent as directed therein. Drawings associated with this Contract shall be in the English language and United States Customary system of units.

Each submitted drawing shall be unique and shall be clearly marked with the name of the Project, facility name, facility designation, specification title, specification number, project equipment or structure nomenclature, component identification numbers, Owner’s name, revision number, and revision history.

Final as-built drawings, including Contractor drawings and vendor drawings, shall be submitted in electronic format on electronic storage device. Each form of media shall be clearly labeled for content and date.

Contractor shall submit all drawings in AutoCAD (.dwg) version 2024 format including bound files, XREF files, 3D models (saved out to Autodesk Plant 3D 2022 or approved equal), sheet drawing files, and Acrobat Adobe (.pdf) format. All color settings files (*.ctb), font files, block libraries, title blocks, and CAD Standards used on the Project shall follow M1-01-09 (PGE CAD and Numbering Standards). Exceptions shall be submitted to Owner in electronic format that is clearly labeled for content and date.

Two electronic files of all professional engineer (PE) stamped drawings approved for construction shall be submitted to PGE. One file shall be a scan of the PE-stamped and signed (approved) drawing original in (.pdf) format. The second file shall be an AutoCAD (.dwg) drawing file and shall include as-built updates.

Contractor shall create and maintain a master drawing list including, as a minimum, drawing number, revision letter/number, revision date, drawing title, Discipline, Document Status, Document type, Plant System, and cross-reference listing for associated vendor drawing numbers, and date submitted to PGE for review. See below for a list of preferred terms.

Contractor shall provide to the Owner an initial copy of the master drawings list prior to issuance of any project drawings at the start of the project. The Master Drawing list will be updated and included with every drawing transmittal. Master drawing list must be compatible with Microsoft Excel. Final electronic master drawing list and program shall be submitted to Owner in electronic format and clearly labeled for content and date.

1.2.2 Design Masters

Contractor shall produce applicable drawings per Owner's standard Design Masters. In addition to standard design requirements, Design Masters dictate scope, size, symbology, nomenclature, and level of information required in a drawing. Contractor to request latest version of Design Masters from Owner prior to initiating any design. AutoCAD format files can be provided. The following apply:

- High Voltage Lines RAS
- GSU Transformers Unit Aux Transformers
- Standby Transformer Metering and Protective Relaying One Lines Three Lines
- DC Metering and Protective Relaying Schematics Panel Layout Drawings
- Wiring Diagrams
- Piping & Instrumentation Diagrams
- Bill of Materials
- Medium Voltage Switchgear and Generator Breaker Three Lines DC Control Schematics
- SCADA Block Diagram SCADA DC Power Schematic
- SCADA Panel Layout Drawings SCADA Wiring Diagrams SCADA Bill of Materials
- COMMS Fiber Plant Diagrams
- COMMS Rack Layouts AC/DC Power, Grounding
- MW Tower, Waveguide Diagrams

1.2.3 Other Requirements

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

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

All design submittals (including product sheets, mix designs, verification procedures, installation procedures, testing procedures, etc.) shall be approved by the applicable engineer of record prior to submitting to Owner. An approval stamp from such engineer(s) of record shall be included on the submittal to indicate such approval.

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.

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, and native copies of all drawings and layouts. As-Built Drawings shall be created in the latest version of AutoCAD, or in the version of AutoCAD utilized by Owner, as applicable. As-Built Drawings shall comply with PGE Exhibit M1-01-09.

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 state where the Project is located. Such professional engineer(s) shall be registered in the applicable discipline for the drawings being signed and sealed.

1.3 DOCUMENT IDENTIFICATION

Documents submitted by the Contractor for review shall be clear and legible and shall bear the Project Name in addition to the following:

1. Purchase order number
2. Project Facility – Unit Number – System number
3. Contractor's reference drawing number
4. Document revision status
5. Owner's documentation number (less submittal number)

This information shall be placed on the documents in or near the title block

Documents submitted shall be assigned an Owner documentation number assigned by the originator using the convention below. This number shall appear on the copy returned to the Contractor and shall be transferred by the Contractor to the Contractor's original, so that the document number will appear on subsequent submittals.

Correspondence including emails shall contain the Project Facility – Unit Number – System number, specification number, and equipment identification number.

All correspondence between Owner and Contractor shall be sequentially numbered as follows and provided in the subject line of emails:

AAA-BBB-SSSS-YYYY.X

Where:

- AAA denotes the company originating the correspondence. BBB denotes the company receiving the correspondence. SSSS denotes the specification number
- YYYY denotes the correspondence sequential number
- X denotes the revision number of the correspondence beginning with zero.
- Resubmittals shall bear the original submittal number and append a number sequentially as follows.
- AAA-BBB-SSSS-YYYY.1 AAA-BBB-SSSS-YYYY.2
- etc.

The Project Documentation Coordinator [x] for Owner; [ ] for Contractor) is responsible for assigning the correspondence number and maintaining their respective company transmittal log.

All correspondence shall be distributed electronically.

1.4 DOCUMENT REVIEW AND APPROVAL

The Contractor and Owner shall participate in 30%, 60%, 90%, Issued for Construction (IFC), and As Built design and model reviews for each engineering package / discipline. Refer to M1-01-02-01 (Engineering Documents, Drawings, and Other Deliverables Table) for specific details.

Where drawings or other documents are required, these documents shall be submitted for review in accordance with the Contractor's drawing submittal schedule. Drawings, specifications, and performance data submitted will be reviewed for adherence to the specification, suitability of design, equipment selection, conformance to design criteria, interfacing data, and for general information regarding plant operating characteristics. They shall include erection diagrams and other details, such as interface connections. Identification numbers shall be used to identify items on the documents. The sequence of submission of documents shall be such that information is available for an effective review of each document when it is received. Information on drawings shall be checked by the Contractor for accuracy before submission for review.

Owner will update the Master Document List indicating the documents have been reviewed and will email the transmittal to Contractor.

All documents and drawings submitted by Contractor for the first cycle will be reviewed by Owner and returned with comments within 20 Business Days after receipt of the documents or as agreed to between Owner and Contractor. For subsequent review cycles, a 15 Business Day cycle will be followed or as agreed to between Owner and Contractor.

Contractor documents will be considered received after documents have been posted and Owner has received email notification of the posting.

Contractor may request, in writing, expedited review for specific documents and drawings. All requests will be considered.

1.4.1 Documents / Drawings

Documents, including drawings and electronic models, submitted for review shall be provided in the document's original (native) format with another copy in .pdf format. A separate file shall be provided for each unique document number. Multiple sheets with one unique document number can be submitted as one file.

All revisions shall be noted in redline format, where applicable. All drawing revisions shall be clouded.

1.4.2 Status Level Convention

Upon completion of a review, the reviewer will rename the document by appending one of four Status Levels at the end of the document file name. The status level assignments shall be as follows:

- S1 = No Exception Taken. Contractor May Proceed with Fabrication or Construction
- S2 = Revise as Noted and Resubmit. Contractor May Proceed Based on Making Revisions Noted.
- S3 = Does Not Meet Specification Requirements. Revise and Resubmit. Hold Fabrication.
- S4 = For Information Only.
- Status Level S1: Documents and drawings that receive status level S1 are approved.

- Status Level S2 and S3: Documents and drawings that receive status level S2 or S3 shall be resubmitted, with comments incorporated in the next revision. Documents and drawings resubmitted for review shall clearly show changes made to them from previous revisions. All changes on drawings shall be clearly designated with revision clouds or shall include a revision list on the drawings. Revision clouds from previous revisions shall be removed. Changes on other documents shall be circled or a separate list of changes to the documents shall be provided. If a separate list of changes to the documents is provided it shall be named as the original document with "_COMMENTS" appended to the end of the file name. Any comments not incorporated must be noted and explanation given, in writing, for the exclusion.

1.4.3 File Naming Convention

Reviewed documents returned to Contractor will utilize the Contractor assigned file name, but be modified to indicate comments were appended as follows:

For Documents:

Return Document File Name:

Supplier File Name_Rev_PGE_S#.pdf For Drawings:

Supplier Drawing #_Sheet_Rev_PGE_S#.pdf

1.4.4 Resubmittal Naming Convention

Resubmittals shall bear the original submittal number and append a number sequentially. Following initial submittal of a document or drawing by Contractor, that document or drawing shall not be resubmitted until Owner comments have been received and incorporated by Contractor.

1.5 DOCUMENT TRANSMITTALS

All correspondence that transmits data, documents, drawings and other information that is considered a contract deliverable (or affects the design, construction, commissioning or operation of the project), is to be transmitted with a transmittal letter. An email with transmittal number in subject line and transmittal letter attached shall be issued to alert Owner that documents/drawings were submitted. Informal correspondence can be transmitted via email or other means and will not require a transmittal number.

Document transmittals shall be in accordance with a specified project schedule.

Submittals shall be in accordance with the following:

- Prints shall be sharp, clear, and suitable for direct reading. The prints shall be black line reproducible on bond paper. Scanned submittals are not permitted.
- Hardcopy documents shall be folded, collated sets mailed flat in a regular mailing envelope. Electronic formats of documents shall be submitted on a secure document management system (SharePoint or other as approved by PGE) and shall be adequately protected to prevent damage during shipment.
- Drawing or engineering databases shall be included in the document transmittals with programs to access and maintain the information and must be compatible with Microsoft Excel.

1.5.1 Spare Parts List

The vendor shall provide a recommended Spare Parts list for regular equipment maintenance. The Spare Parts list shall be submitted in Microsoft Excel spreadsheet format.

1. Entries into the electronic parts list shall conform to the following:

Description using the Noun, Modifier, Characteristic 1, Characteristic N, Standards Requirements:

2. Example description of an existing item in PGE's for – 36 IN 5/8 double arming bolt

BOLT, DOUBLE ARMING, 5/8 IN X 36 IN, SQUARE HEAD, WITH 4 SQUARE NUTS, HOT DIP GALVANIZED PER ASTM A153, MADE IN ACCORDANCE WITH ANSI C135.1, PER ASTM A36, 12,400LB MINIMUM TENSILE STRENGTH

Description Element	Identify by answering the question:	Descriptor	Abbreviation Spelled out
Noun	What is it?	BOLT,	
Modifier	What kind?	DOUBLE ARMING,	
Dimensions	What size?	5/8 IN X 36 IN	
Characteristic	What is specific about this item?	SQUARE HEAD	
Characteristic	What is specific about this item?	WITH 4 SQUARE NUTS,	This is more of a requirement
Standard Requirements	Standard to adhere to?	HOT DIP GALVANIZED PER ASTM A153,	Specific Standard
Standard Requirements	Standard to adhere to?	MADE IN ACCORDANCE WITH ANSI C135.1,	Specific Standard
Standard Requirements	Standard to adhere to?	PER ASTM A36,	Specific Standard
Characteristic	What is specific about this item?	MIN TENSILE STRENGTH OF 12.400 LBS	This is more of a requirement

1.5.2 Dimensions Descriptors

Dimensions shall be spelled out to avoid confusion for the ordering party, the vendor, or Owner. Standard dimension descriptors should be adopted as follows:

Abbreviation	Description
DIA	Diameter
L	Long
W	Width, wide
D	Deep, depth
IN	Inches
FT	Feet
TPI	Thread per inch
TPM	Thread per millimeter

Universally accepted numeric descriptors of dimensions are to be used also. For example: Bolt, 1-1/2 IN-18x36 IN L

- 1-1/2 IN = Diameter
- 18 = Threads per inch
- 36 = Length

1.5.3 Standards Requirements Reference

Requirements based on particular standards shall be included in the following format:

Standard Abbreviated	Specific Standard Number
ASTM	A153
ANSI	C135.1
ASTM	A36

1.5.4 Special Characters

Information NOT to be Included in the Item Description:

1.5.4.1 Manufacturer's Name

There are places in PGE Owner PeopleSoft and Maximo software systems that are designated to keep this information.

1.5.4.2 Manufacturer's Model Number

There are places in PGE Owner PeopleSoft and Maximo software systems that are designated to keep this information.

1.5.4.3 Vendor's Name

Vendor's Catalog Number Slang terms to describe items

Terms used in the trades shall not be used as item descriptors unless those terms are universally used by all manufacturers and throughout the industry.

Example: bell insulator is a lineman's term for a suspension insulator or dead end insulator. Manufacturers recognize this item as suspension insulator, not as bell insulator.

1.5.5 Use of Special Characters in Descriptions

Item Descriptions may contain any of the following characters:

Description	Character
Comma	,
Period	.
Hyphen	-

Item descriptions must not contain any of the following special characters as they interfere with the Maximo to PeopleSoft interface.

Description	Character	Description	Character
Quotation Mark	"	Dollar Sign	$
Ampersand	&	Percentage	%
Apostrophe	'	Asterisk	*
Less Than	<	Pound Sign	#
Greater Than	>	Exclamation Point	!
Question Mark	?	At Sign	@
Equal	=	Caret	^

Description	Character	Description	Character
Plus	+	Backslash	\
Underscore	_	Square Brackets	[ ]
Vertical Bar	|	Round Brackets	( )
Grave Accent	`	Curly Brackets	{ }
Tilde	~		

1.5.6 Instruction Manual

The Contractor shall furnish draft and final instruction manuals for the unloading, storage, installation, operation, and maintenance of the equipment. The manuals shall be delivered as specified in the Contract. The electronic versions of the manuals shall be word searchable PDF format, fully indexed and shall not be protected. The index shall link to the pages referenced in the index and the bookmarks shall coincide with the required tabs in the paper form.

1.5.7 Content

Manuals shall include the table of contents and index tabs (if multiple volumes are required, a table of contents listing materials included in each volume shall be supplied for each volume) specific to the furnished equipment. All pages shall be sequentially numbered.

1.5.8 Design

Description of the equipment and systems, including accessory components, including nameplate ratings, illustrations showing elevations, cross section, and all details of the equipment with all parts named, and numbered. This includes inverter manufacturer name, technology type, model data, nameplate ratings, technology type and settings.

When multiple model numbers are shown on the drawings, the equipment supplied for the project shall be clearly identified.

Specifications, test data, and all performance curves specified in the technical specifications.

- Outline drawing - final. Assembly drawings - final.
- All fluid systems schematics and piping diagrams. Electrical wiring diagrams.
- Motor Information Sheets.
- Electric Actuator Information Sheets.
- Control Panel Arrangements, including interior equipment arrangements identifying the individual components.
- Program, software, and firmware configuration, modeling, editing, and troubleshooting guides.

1.5.9 Installation

- Instructions for receiving, inspection, storage, and handling of equipment prior to installation.
- Installation instructions including step-by-step alignment and calibration procedures.
- Online and offline inspection procedures.
- Lists of trips and alarms, complete with set points.
- Calibration Data Sheet for each adjustable instrument included in the scope of supply.
- List of acceptable lubricants, insulating fluids, flushing fluids, hydraulic fluids, and fluid additives.

1.5.10 Operation

Complete and detailed operating instructions, including safety precautions, startup procedures, shutdown procedures, normal operation procedures, non-standard event procedures, and all regulatory required freeze protection requirements and philosophy of operation. Operating procedures and instructions shall provide the operator with information when and how to operate the equipment, including precautions, limitations and set points. Procedures listed in step-by-step sequence shall include preoperational checkout, startup, normal, remote, or emergency modes of operation, and stopping or shutting down part or all of the subject equipment.

Troubleshooting charts and tables shall be used to list likely evidence of malfunction and what could be responsible. The effect of loss of normal power and effect of electricity supply frequency drop shall be addressed.

1.5.11 Maintenance

Detailed minor and major maintenance instructions, including description, maintenance checklist, step-by-step instructions for replacing the major components, use of special tools furnished, including but not limited to the following:

- Preventive Maintenance Schedule for all equipment with servicing procedures including instructions for dismantling and/or replacing components and routine electrical and mechanical procedures, tests, and checks for cleaning, lubricating and otherwise caring for equipment. These procedures shall include calibration and maintenance of interlocks and other safety features. The Preventive Maintenance Schedule shall be provided in an MS Excel® spreadsheet (or another consolidated database, if approved).

Step-by-step procedures for all anticipated equipment repairs. Troubleshooting guide.

Illustrated parts breakdown including parts list including American Society for Testing and Materials (ASTM) designation (if applicable), and a list of recommended spare parts. Complete replacement parts list shall include manufacturers' part number for ordering, description, the quantity used, and the applicable item number, and drawing references.

- Recommended six (6) month layup procedure.
- List of maintenance tools furnished with the equipment.
- Safety provisions.
- Torque values for critical bolts.
- Field disassembly and assembly.
- Field overhaul of specific components.
- Tube plugging instructions including plug dimensions and recommended material.
- Overhaul instructions.
- Control system troubleshooting instructions.
- Inverter Based Resource inverter data
- Lubrication instructions including system flushing.

The above listed requirements are the minimum requirements; however, requirements that are clearly not applicable to the equipment may be deleted with Owner’s approval. Additional information that is necessary for proper operation and care of the equipment shall also be included.

The electronic versions of the O&M manuals shall be word searchable PDF format, fully indexed and shall not be protected. The index shall link to the pages referenced in the index and the bookmarks shall coincide with the required tabs in the paper form. Manuals exceeding 100 MG file size will be broken into smaller parts and labeled accordingly (e.g.

XXXXXX_Manual_Part_1_of_X.PDF)

The descriptions shall not be general, applicable to any type and size of Contractor's equipment, but shall be specific with (whenever possible) references to drawings submitted by Contractor.

Manuals which contain information on multiple manufacturer models shall have the model used at Project highlighted.

1.5.12 Equipment Storage

The Contractor shall furnish complete and accurate storage records for any equipment, materials, or other Work that was previously produced, manufactured, constructed, or otherwise produced and that will be incorporated into the Project. For the avoidance of doubt, this shall include any transformers, wind turbines, or other equipment that was previously manufactured for tax qualification purposes (e.g., PTC).

Storage documentation to be provided shall include visual inspection and testing records.

1.6 PROJECT CLOSEOUT DOCUMENTATION

At the conclusion of the Work and prior to Final Completion, the Contractor shall compile and submit a complete Project Closeout Documentation Package. This package shall serve as a comprehensive reference record of the Project and shall include, at a minimum:

- All deliverables required under this Contract and listed in the Deliverables Table (Ref: M1-01-02-01), organized and clearly indexed.
- Any supplemental documentation developed in the course of project execution that is not specifically itemized in the Deliverables Table but is relevant to the Owner’s future operations, maintenance, regulatory compliance, or asset management. This may include:
    - Project correspondence logs or change order records
    - Meeting minutes, submittal logs, and RFIs
    - Lessons learned or post-construction review summaries
    - Final construction photos and progress documentation
    - Any other project execution records beneficial to long-term ownership

The Project Closeout Documentation shall be:

- Delivered in both electronic (searchable, bookmarked PDF and native editable formats) and hard copy format (if requested by Owner),
- Clearly organized by section and labeled for ease of navigation, and
- Submitted to Owner for review and acceptance prior to Final Completion.

This compilation is intended to supplement, not replace, the specific deliverable requirements identified in other sections of the Specifications.

KEY

Level A:	Contract Documentation - Documentation submitted prior to execution of the Agreement
Level B:	Construction Documentation - Documentation to be submitted prior to the commencement of Work on Site or issuing of any completion certificate
Level C:	As-built Documentation - As-built drawings and other record documentation to be submitted after the issuing of any completion certificate
Owner Approval:	Must be submitted for the Owner's review and approval prior to equipment purchase or construction

Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Certification	3rd party structural design certificate	Third-party Registered Professional Engineer's Certificate confirming the suitability of the Wind Turbine foundation(s) and that they are in accordance with the As-built drawings.			X			
Certification	Acceptance certificates	All completed Acceptance Certificates for Works prior to Substantial Completion milestone			X	X		
Certification	Calibration certificates	Copies of calibration certificates for all instrumentation mounted on all met stations/masts, provided by recognized independent agencies and done in accordance with the appropriate calibration standards.		X			4 weeks after met station installation	
Certification	Capacity and Availability test report	Upon satisfactory completion or upon failure of the Capacity and Availability Test, as the case may be, the Contractor will issue an Acceptance Test Certificate to that effect.			X	X		
Certification	Civil Works concrete and grout design supporting information	Contractor shall provide evidence from field, production or trial tests to justify the design of the concrete or grout mix proposed.		X		X	3 months after Agreement execution	
Certification	Electrical safety certificates	Electrical Safety Certificates for all electrical works to Applicable Laws, Regulations and Standards		X		X	Prior to energization	
Certification	Electrical system certificates of compliance	All electrical certificates of compliance			X			
Certification	Factory acceptance test reports	Copies of test certificates for all routine factory tests applied to all major items included in the Work, including Wind Turbines, and electrical system components including, but not limited to, switchgear, power transformers, instrument transformers, protection relays and revenue metering systems.		X			8 weeks prior to start of relevant site work	
Certification	Factory acceptance test reports for electrical components	FAT certificates to be provided by Contractor shall include, but not necessarily be limited to, the following components: • Transformers, including: o Substation main power MV/HV transformer/s o Auxiliary MV/LV transformer/s o Wind Turbine MV/LV transformers o Reactive plant transformers (if applicable) • Instrument transformers (i.e. CTs, VTs) • Reactive plant equipment (if applicable) • HV and MV switchgear and switchboards • LV distribution boards (AC and DC) • Cabling (HV, MV, LV and fiber optic) • HV and MV surge arrestors • Protection relays • Metering systems (revenue, check and power quality) • UPS systems • Stand-by diesel generator, and • Switchroom batteries and chargers		X			Prior to delivery to Site	

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Level A:	Contract Documentation - Documentation submitted prior to execution of the Agreement
Level B:	Construction Documentation - Documentation to be submitted prior to the commencement of Work on Site or issuing of any completion certificate
Level C:	As-built Documentation - As-built drawings and other record documentation to be submitted after the issuing of any completion certificate
Owner Approval:	Must be submitted for the Owner's review and approval prior to equipment purchase or construction

Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Certification	Factory acceptance test reports for wind turbine components	FAT certificates to be provided by Contractor shall include, but not necessarily be limited to, the following components: • Rotor • Blades • Gearbox (where applicable) • Step-up transformer • Generator • Yaw system • Main bearings • Service crane • Wind Turbine tower • Service ladder • Service lift • Fall arrest and safety systems		X			Prior to delivery to Site	
Certification	Performance test report	Report summarizing test as specified. Upon satisfactory completion or upon failure of the Performance Test, the Employer will issue an Acceptance Test Certificate to that effect.			X	X		
Certification	Permanent on-site buildings	Permanent building designs shall be independently checked and approved by a certified structural engineer		X			6 weeks prior to building work	
Certification	Power Curve Test Report and Certificate	Upon satisfactory completion or upon failure of the Power Curve Test, as the case may be, the Consultant shall issue to Owner a report and a Performance Test Certificate to that effect.			X			
Certification	Protection settings signoff	Written endorsement by the interconnection provider in respect of all protection settings of the Project		X			1 month prior to beginning of relay testing	
Certification	Reinforcement specifications and testing certificates	Certificates confirming manufacturers and processors of steel reinforcement hold a valid certificate of approval.		X			6 weeks prior to start of relevant work	
Certification	SCADA system warranty and results	Documentary evidence that the SCADA system is sufficient for recording and analysis of the data for the warranty tests; and confirmation and detailed report of how the SCADA system stores data and provides values to enable availability calculations.		X			6 weeks prior to start of relevant work	
Certification	Type test certificates	Type Test Certificates for any piece of Plant or Equipment		X			8 weeks prior to start of relevant site work	
Certification	Wind Turbine certification	Type certification or design assessment of the Wind Turbine applicable to the proposed Wind Turbine configuration	X			X	Agreement close	
Certification	Wind Turbine geotechnical certification	Geotechnical certification from a qualified geotechnical engineer confirming design founding conditions in the base of the excavation prior to pouring the foundation or blinding.		X			6 weeks prior to start of relevant work	

KEY

Level A: Contract Documentation - Documentation submitted prior to execution of the Agreement
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Level C: As-built Documentation - As-built drawings and other record documentation to be submitted after the issuing of any completion certificate
Owner Approval: Must be submitted for the Owner's review and approval prior to equipment purchase or construction

Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Design	Civil works	30% Design including the following: • Buildings and structures • Roads • Crane pads • Site drainage • Earthwork and compaction • Met mast foundation/footings • HV/MV substation foundation/footings • Site landscaping • Site restoration/reclamation		X		X	3 months after Agreement execution	
Design	Civil works	60% Design: An updated version of 30% Design with revisions and additional detail where applicable: • Detailed foundation design drawings required. • ALTA survey map		X		X		
Design	Civil works	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Civil works	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		
Design	Civil works	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility.			X			

KEY

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Owner Approval: Must be submitted for the Owner's review and approval prior to equipment purchase or construction

Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Design	Electrical collector system	IFC Design: An updated version of 90% Design with revisions and additional detail where ap		X		X	3 months after Agreement execution	
		• Wind Power Plant collector system SLD, showing connection to Wind Turbine step-up MV/LV transformers, all junction boxes, ground reference transformers (if applicable) and Wind Turbines; protection SLD to be incorporated or provided separately						
		• Cable route layout for collector system, including details of creek and road crossings approximate in-line joint locations (if applicable). Diagram shall include GPS coordinates of Wind Turbines and meteorological masts						
		• MV Protection Schematics • MV CB Control Schematics • LV Air CB Schematics • UPS Schematic • Battery Charger Schematic • Distribution Board schedules • Cable schedules (HV, MV and LV) • LV systems and auxiliary generator schematics • As-built MV Switchroom GA drawings, including MV and LV switchboards, protection panels, SCADA, battery / UPS, chargers, etc. • Wind Turbine transformer kiosk GA drawings (if applicable), including LV cabling between Wind Turbine and transformer kiosk • Earthing drawings						
Design	Electrical collector system	60% Design: An updated version of 30% Design with revisions and additional detail where applicable. Detailed foundation design drawings required.		X		X		
Design	Electrical collector system	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Electrical collector system	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		

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			A	B	C			
Design	Electrical collector system	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility including the following: • A GIS database which shall include all as-built cable routes recorded in a minimum of 10 meter steps and in-line joints (if installed). • MV Protection Schematics • MV CB Control Schematics • LV Air CB Schematics • UPS Schematic • Battery Charger Schematic • Distribution Board schedules • Cable schedules (HV, MV and LV) • LV systems and auxiliary generator schematics • As-built MV Switchroom GA drawings, including MV and LV switchboards, protection panels, SCADA, battery / UPS, chargers, etc. • As-built Wind Turbine transformer kiosk GA drawings (if applicable), including LV cabling between Wind Turbine and transformer kiosk			X			
Design	Fire Protection System documentations and drawings	Including as a minimum: • Fire Risk Evaluation/Fire Protection Design Basis Document • Complete and detailed design drawings for each system. Drawings shall clearly indicate all wiring and equipment that is supplied or installed by Contractor. Drawing shall call out any design and material requirements (manufacture and code/standard). Contractor is responsible for reviewing materials and designs as part of the overall fire protection system, to ensure compliance with codes, standards and manufacturers' requirements. • Site fire protection plan drawings • Hydraulic calculations • Room integrity test results for clean agent suppression systems • Detailed control panel drawings • Detailed communication drawings		X		X	3 months after Agreement execution	
Design	Fire Protection System documentations and drawings, as builts	Including as a minimum: • Operation and Maintenance manuals shall be provided. • Complete all required documentation and obtain necessary inspection required for the fire protection systems to be operated. Signed and filled out test forms shall be provided for each system provided. • As built drawings			X	X		
Design	Meteorological station	30% Design drawing and specification of the following: • Information on the Met Masts installations including number of Permanent Met Masts	X			X	Agreement close	

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Design	Meteorological station	60% Design including the following (if applicable): • An updated version of 30% Design with revisions and additional detail where applicable • Mast general layout • Instrumentation specifications and calibrations; • Proposed locations and non-wake-affected sectors • Earthing and lightning protection • Mast instrumentation & mounting arrangements • Aviation warning markings (e.g. marker balls) • Enclosures and cabling • Fencing/protection • UPS • Power supply and SCADA connection		X		X		
Design	Meteorological station	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Meteorological station	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		
Design	Meteorological station	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility.			X			
Design	Permanent on-site buildings	30% Design including but not limited to the following: • Layout • Elevation drawings • Structural • Architectural • Fire rating • Hold down	X			X	Agreement close	
Design	Permanent on-site buildings	60% Design: An updated version of 30% Design with revisions and additional detail where applicable. Detailed foundation design drawings required.		X		X		
Design	Permanent on-site buildings	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Permanent on-site buildings	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		
Design	Permanent on-site buildings	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility.			X			

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			A	B	C			
Design	Pre-engineered metal buildings (if applicable)	Including, but not limited to: • Detailed shop and erection drawings and product data • Foundation loads, anchor bolt setting diagrams, and details of required anchorage to concrete foundations • All calculations used in the development of building and anchor bolt design and of fabrication drawings		X		X	1 week after Agreement execution	
Design	Substation	30% Design including the following (as applicable): • Substation general arrangement drawing • Main power transformer(s) • Protection equipment and switchgear specifications • LV systems including battery and UPS capacities/back-up time • Revenue and power quality meter specifications • Single line diagram (SLD) of substation, including main power transformer, reactive power compensation resources; protection SLD to be incorporated or provided separately		X		X	3 months after Agreement execution	
Design	Substation Civil	30% Design including the following (as applicable): • Geotechnical investigation • Thermal resistivity measurement of soil •topographic or ALTA survey		X		X		
Design	Substation Structural	30% Design Not Applicable						
Design	Substation Oil Containment	30% Design Not Applicable						
Design	Substation Below Grade Electrical	30% Design including the following (as applicable): •Electrical resistivity measurement (soil model) •Conduit Plan		X		X		
Design	Substation Above Grade Electrical	30% Design including the following (as applicable): •General Layout •Future General Layout		X		X		

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Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Design	Substation Control and Protection	30% Design including the following (as applicable): •One line schematic •Network block diagram •station service one line diagram •control enclosure layout •relay rack elevations •list of materials (relay rack items) •pilot scheme diagram		X		X		
Design	Substation	60% Design including the following: • An updated version of 30% Design with revisions and additional detail where applicable • Submittals as required in Appendix M1 Attachment 05 Exhibit 03 – Substation Design and Construction Specification.		X		X		
Design	Substation Civil	60% Design including the following: • An updated version of 30% Design with revisions and additional detail where applicable •Grading plan and details •Foundation Plan and details •Yard surfacing plan and detail •Preliminary calculations • Submittals as required in Appendix M1 Attachment 05 Exhibit 02 – Substation Engineering Specification.		X		X		
Design	Substation Structural	60% Design including the following •Structure ID Plan •Structure drawings •Fire wall design (preliminary)		X		X		
Design	Substation Oil Containment	60% Design including the following •Oil Containment Plan and Details		X		X		
Design	Substation Below Grade Electrical	60% Design including the following: • An updated version of 30% Design with revisions and additional detail where applicable •Conduit Plan •Conduit and Vault details •Grounding Plan •Grounding details •Grounding Calculations • Submittals as required in Appendix M1 Attachment 05 Exhibit 02 – Substation Engineering Specification.		X		X		

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			A	B	C			
Design	Substation Above Grade Electrical	60% Design including the following: • An updated version of 30% Design with revisions and additional detail where applicable •Plan Views •All elevations and section views (without material callouts) •Bus connection details •Lighting Plan •List of Materials (Major Equipment Only) •Rigid bus calculations •Lighting Calculations • Submittals as required in Appendix M1 Attachment 05 Exhibit 02 – Substation Engineering Specification.		X		X		
Design	Substation Control and Protection	60% Design including the following: • An updated version of 30% Design with revisions and additional detail where applicable •All schematics (including vendor control schematics) •AC/DC panelboard wiring diagrams •List of nameplates (relay racks) •AC/DC station service calculations • Submittals as required in Appendix M1 Attachment 05 Exhibit 02 – Substation Engineering Specification.		X		X		
Design	Substation	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Substation Civil	90% Design: An updated version of 60% Design with revisions and additional detail where applicable •List of materials •Rebar schedule •Anchor bolt schedule •All calculations and reports		X		X		
Design	Substation Structural	90% Design: An updated version of 60% Design with revisions and additional detail where applicable •Structure calculations		X		X		
Design	Substation Oil Containment	90% Design: An updated version of 60% Design with revisions and additional detail where applicable •Oil Containment calculations		X		X		
Design	Substation Below Grade Electrical	90% Design: An updated version of 60% Design with revisions and additional detail where applicable •List of materials •Conduit Schedule •Conduit Fill Calculations		X		X		
Design	Substation Above Grade Electrical	90% Design: An updated version of 60% Design with revisions and additional detail where applicable •List of materials •List of nameplates		X		X		

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			A	B	C			
Design	Substation Control and Protection	90% Design: An updated version of 60% Design with revisions and additional detail where applicable •Wiring diagrams •List of materials •List of nameplates •Cable Schedule		X		X		
Design	Substation	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		
Design	Substation	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility.			X			
Design	SCADA and communications network	30% Design including the following: • Information on the communications system, including specifications and drawings • Information on the SCADA system, including specifications and drawings • Fiber optic network drawings • Fiber optic splicing drawings, fiber optic distribution panel drawings • Complete list of all the data points and operational parameters applicable to the Contractor's proposed SCADA system. • Documentation describing how the availability and performance is calculated, stored and analyzed in the SCADA system.		X		X	3 months after Agreement execution	

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			A	B	C			
Design	SCADA and communications network	60% Design including the following (if applicable): • An updated version of 30% Design with revisions and additional detail where applicable • I/O connections drawings • Network used to communicate (transmission medium, network topology, communication protocols and fault tolerance) • Interfaces • Network layout • Point addressing scheme • Grounding requirements • Redundancy and UPS • Sensor locations and sensor orientations • Remote access • Viewing and display • Data collection and storage • Control • Reporting • Software and licenses • Comprehensive user manual explaining the operation and use of all the functions • Hardware manuals for all hardware and computers systems • Documentation including manuals, quality control, installation, commissioning and testing procedures		X		X		
Design	SCADA and communications network	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	SCADA and communications network	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		
Design	SCADA and communications network	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility including the following: • Detailed architecture, interfacing and component product identification • Network Data Communication, detailed wiring diagram • Fiber optic network • Interfacing • Power supply – SCADA distribution board SLD			X			

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Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Design	Site layout/plans	Proposed Preliminary Layout including (as applicable): • Wind Turbines (including padmount transformers) • Landowner boundaries • Public roads • Access roads • Inverter stations • Cable routes • Laydown areas • Meteorological stations • Substation • Transmission line • Borrow pits • Batch plant(s) • Permanent and temporary buildings	X			X	Agreement close	
Design	Site layout/plans	30% Design including the following (as applicable): • An updated version of Preliminary Layout with revisions and additional detail where applicable • Junction boxes • Ground-reference transformers • Foundations/footings • Crane pads/hardstands • Crane paths • Drainage and erosion control features • Spares, parts, tools and permanent storage • Temporary utilities, and • Fencing, gate, signage and label details		X		X	3 months after Agreement execution	
Design	Site layout/plans	60% Design: An updated version of 30% Design with revisions and additional detail where applicable		X		X		
Design	Site layout/plans	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Site layout/plans	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		
Design	Site layout/plans	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility.			X			
Design	Spare parts, tools, and permanent storage	30% Design including the following: • List of components and consumables that do not satisfy the Design Life for Work including additional information				X		
Design	Spare parts, tools, and permanent storage	60% Design: An updated version of 30% Design with revisions and additional detail where applicable. Detailed foundation design drawings required.		X		X		

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			A	B	C			
Design	Spare parts, tools, and permanent storage	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Spare parts, tools, and permanent storage	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		
Design	Interconnection/Gen-Tie lines	15% Deliverable Memorandum (M1-05-05 Section 1.4)		X		X		
Design	Interconnection/Gen-Tie lines	30% Design including the following (if applicable). Reference M1-05-05 and the 230 kV DCD: • Survey, as applicable		X		X	3 months after Agreement execution	
Design	Interconnection/Gen-Tie lines	60% Design. Reference M1-05-05 and the 230 kV DCD:		X		X		
Design	Interconnection/Gen-Tie lines	90% Design including the following (if applicable). Reference M1-05-05 and the 230 kV DCD: • Includes Final Vendor Drawings • Geotechnical Report, as applicable		X		X		
Design	Interconnection/Gen-Tie lines	IFC Design including the following (if applicable). Reference M1-05-05 and the 230 kV DCD:		X		X	6 weeks prior to start of relevant work	
Design	Interconnection/Gen-Tie lines	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility. Reference M1-05-05 and the 230 kV DCD:			X		6 weeks after Substantial Completion of Work	
Design	Wind Power Plant Collection System Cable Route Layout and associated design drawings	Layout and associated design drawings including, but not limited to: • MV cable route diagram, including details of creek and road crossings • Trench layout diagrams, showing cross-section of all buried cable configurations • LV cable route diagrams between the Wind Turbines and transformer kiosks (if applicable)		X		X	3 months after Agreement execution	
Design	Wind Turbine foundations	30% Design including the following: • Design basis document prepared by the foundation designer, outlining standards, methods and approach to be used in the foundation design. • Wind Turbine standard foundation design • Proposed foundation design types used for costing estimate based on preliminary assessment of Wind Power Plant • Foundation design, construct & test philosophy • General arrangement drawings		X		X	3 months after Agreement execution	
Design	Wind Turbine foundations	60% Design: An updated version of 30% Design with revisions and additional detail where applicable. Detailed foundation design drawings required.		X		X		
Design	Wind Turbine foundations	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Wind Turbine foundations	IFC Design: An updated version of 90% Design with revisions and additional detail where applicable		X		X		

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			A	B	C			
Design	Wind Turbine foundations	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility.			X			
Design	Wind Turbine general descriptions and diagrams	30% Design including the following: • Nacelle • Hub (including electrical and hydraulic systems as applicable); • Blades • Tower sections including internals (platforms, ladders, hatches, control cabinets and safety equipment) • Gearbox (if applicable) • Generator including bearings, cooling system • Mechanical braking system • Hydraulic systems • WTG Electrical cabinets • Cooling system • Condition monitoring system • Safety equipment • Service lift • Single line diagram of the Wind Turbine(s) , in sufficient detail to show all protective devices, overvoltage protection, isolation and earthing facilities • Wiring diagrams (three-wire) for all main power and auxiliary circuits in the Wind Turbines • Wind Turbine earthing drawings • Wind Turbine MV system interface drawings, showing MV switchgear and Wind Turbine Transformer • Control system block diagram of the Wind Turbines		X		X	3 months after Agreement execution	
Design	Wind Turbine general descriptions and diagrams	60% Design: An updated version of 30% Design with revisions and additional detail where applicable		X		X		
Design	Wind Turbine general descriptions and diagrams	90% Design: An updated version of 60% Design with revisions and additional detail where applicable		X		X	6 weeks prior to start of relevant work	
Design	Wind Turbine general descriptions and diagrams	IFC Design Package: An updated version of 90% Design with revisions and additional detail where applicable		X		X		
Design	Wind Turbine general descriptions and diagrams	As-built Design: Design changes after the release of the IFC Design Documents and to document the design of the as-constructed facility and to include a complete Bill of Materials at least 3 levels deep where applicable for all major components, i.e. manufacturer info of wind turbine, gearbox, high speed bearings, sun gear, etc.			X			
Licenses	Software licenses	All licenses, software keys, hardware keys (dongles) and the like for all software included in the Works.			X			
List	Sub-contractors list	List of all sub-contractors to be included as approved sub-contractors.	X			X	Agreement close	

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			A	B	C			
Manuals	O&M Manuals	Draft, comprising Overview and Manuals from key equipment suppliers; equipment maintenance requirements		X		X	120 business days prior to commissioning activities	
Manuals	O&M Manuals	Complete and final O&M Manuals, including but not limited to (as applicable): • Overview of the Plant Works • All relevant specifications • All details for the safe and effective use, operation and maintenance of the complete Plant Works • Procedure to mitigate grease contamination from oil leaks or other contaminants that can enter blade bearing. • System description • Safety Plan with Supporting Lock-out-tag-out procedures • Equipment startup procedures • Equipment shutdown procedures • Equipment warning and trip setpoints • Normal system operations controls • Abnormal system operations controls • Equipment fault codes • Troubleshooting guides • Maintenance intervals and tasks; including: • Procedures • Tools • Inspection criteria, as required • Systems Descriptions describing normal and abnormal control for system components • Condition monitoring intervals and tasks; including: • Inspection procedures • Inspection criteria			X		30 business days prior to commissioning activities	
Manuals	SCADA system documentation	The SCADA system shall be supplied with three sets of comprehensive, complete and up-to-date documentation packages relevant to all the hardware and software supplied. This shall include but not limited to (as applicable): • A comprehensive user manual explaining the operation and use of all the functions • Detailed descriptions of the underlying theory and calculations employed especially with regard to availability and power curve measurements. These shall include complete details of any data processing carried out by the Wind Turbine controllers • A complete electrical wiring diagram showing connections to the controller and the communications links • Hardware manuals for all hardware and computers systems • An administrator manual for system administration and configuration • Quality control, installation and commissioning documentation			X			

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			A	B	C			
Permits	Permits	Permits including but not limited to: • SWPP 1200c ~~(NPDES and Sediment and Erosion control)~~ • Building Permit • Development Permit • Zoning Permit • Easements • Property Rights • Land Use Permit • Wastewater Permit • Removal/fill Permit ~~• Septic~~ ~~• WPCF~~		X		X	5 business days upon obtaining	
Plan	Capacity test plan	Method Statement describing the Contractor's proposal to perform Capacity Test and Availability Test in accordance with the requirements set in the Specifications. • Details of the equipment to be used • Any deviations • The methodology for dealing with those deviations • Details of the site calibration procedure		X		X	6 months after Agreement execution	
Plan	Civil works, concrete procedure	A procedure for on-Site concrete batching, including as a minimum: • Source of materials • Transport plan • Quality control If Contractor proposes to utilize a pre-existing off-Site batch plant, details shall be provided on the concrete supplier including: • Quarry materials suppliers and any additives required • How the delivery of concrete to site is to be managed Contractor shall additionally provide a method statement for forming cold joints should concrete supply be disrupted.		X		X	2 months after Agreement execution	
Plan	Critical Lift Plans	Plan shall clearly identify precautions for all critical lifts; coordination plans, including pre-lift meetings, with all participating personnel; and sample documentation/checklists for all critical lifts.		X		X	Prior to mobilizing to Project Site	
Plan	Document control plan	The document control plan shall address how documents are transmitted, named, reviewed, tracked, and edited.		X		X	2 weeks after Agreement execution	
Plan	Emergency response plan	Emergency response procedures and information		X			1 month prior to accessing Site	

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			A	B	C			
Plan	Environment Management Plan	Including, but not limited to: ~~• NPDES permit~~ • Hazardous Materials Management Plan • Waste Management Plan • SPCC Plan • Noxious weeds management plan • Cultural resources plan • Stormwater plan • Drinking water plan		X		X	1 month after Agreement execution	
Plan	Environment Management Plan	Operations Phase SPCC Plan		X		X	Prior to Substantial Completion	
Plan	Geotechnical Execution Plan	The name, office location, and qualification statement for proposed geotechnical engineer. The proposed scope of subsurface investigation, including number, location, and depths of borings; anticipated plan for laboratory testing; and detailed descriptions of additional site investigation techniques, including thermal and electrical resistivity or other necessary testing.		X		X	Prior to initiating subsurface investigations	
Plan	Grounding and bonding plan	Plan and details, including fence as applicable		X		X	6 weeks prior to start of relevant work	
Plan	Hazardous Material Management plan	Plan includes spill and recovery procedures.		X		X	1 month prior to accessing Site	
Plan	HSE management plan	Updated and final. This shall include a comprehensive list of all HSE laws and Applicable Standards applicable to the Work		X			1 month prior to accessing Site	
Plan	Typical commissioning plan	Proposed installation and commissioning plan	X			X	Agreement close	
Plan	Installation and commissioning plan, Commissioning Test Manual	Procedure describing pre-commissioning and commissioning tests on all items in preparation for completion of individual Section of Works and to reach Substantial Completion.		X		X	30 days before start of commissioning	
Plan	Loss of grid power procedure	Provide procedures to achieve the aim of ensuring the Work is able to withstand periods without grid electrical power.	X			X	Agreement close	
Plan	Project management plan	Proposed Project Plan including: • List of key personnel with CVs • Project organization diagram • Project schedule including all milestone dates for completion of Work	X			X	Agreement close	

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			A	B	C			
Plan	Project management plan	Including: • Construction project manager and key team members (including curricula vitae) • Project organization diagram • Communication plan • Permits, licenses, certifications and agreements required • Procurement and sub-contracting plan • Project schedule and payment milestones (as defined in Appendix 01 Exhibit 01 Annex 04 Milestone Payment Schedule) • Resource loading plan • Environment, health and safety plan including description of HSE system and associated certificates • Quality control / quality assurance plan (including equipment inspections and factory acceptance tests) • Management of Owner and other external interfaces • Change control plan – including change order process • Escalation matrix – how and when to escalate issue for resolution		X		X	30 days after Agreement execution	
Plan	Project quality plan	Proposed Quality Management Plans applicable to: • Design of the Work • Manufacture of the Work • Transportation and storage of the Work • Installation and erection of the Work • Testing, commissioning, and Substantial Completion of the Work • Shall include, where appropriate, references for FATs of major components • Description of quality management system and associated certificates		X		X	45 days following NTP	
Plan	Project quality plan	Update and final Project specific quality management plan		X			1 month following Owner comments	
Plan	Project schedule	The Schedule shall include, but not be limited to, the following: • Schedule Basis Memorandum • Engineering activities (i.e. engineering studies, calculations, and designs) • Procurement activities • Material and equipment deliveries • Construction activities • Tie-ins to existing plant systems • Equipment factory tests • Interfaces with Owner and other external interfaces • Major milestones • Milestone payments, if applicable • Startup and commissioning activities • Testing activities		X		X	8 weeks after NTP	

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Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Plan	Site Specific Safety and Health Plan	Including elements as specified in Appendix M1 • Resumes of Safety Professional •EHS&S Staffing needs •PPE and Safety Equipment •Medical Services/Facilities •Accident Free Process Implementation •Drug/Alcohol Background Screening •Competent Person Process •Project Safety Status Reporting •Division of responsibility •Environmental Control Plan •Staff Security Plan/Needs •Lock-out/Tag-out procedure •Site permit-to-work/hot work permit requirements •Communication plan (site signage, etc.)	X			X	Agreement close	
Plan	Wildfire Mitigation Plan	Including elements as specified in M1-01-01 •Wildfire mitigation through facility design •Inspection of facility components •Vegetation management •Fire weather monitoring •Emergency response				X	Agreement Close	
Plan	Solid Waste Recycling/Recovery plan	Plan for solid waste recycling and recovery.		X		X	1 month prior to accessing Site	
Plan	Storm Water Pollution Prevent Plan (SWPPP) or Sediment and Erosion Control Plan	As required		X		X	1 month prior to accessing Site	
Plan	Testing, inspection and test plans	Proposed testing plan including but not limited to: • Proposed commissioning procedures including but not limited to: o the Commissioning Tests o the Acceptance Tests o the Performance Tests o SCADA • Details of any Tests on Completion that may threaten the safety of the Plant		X		X	2 months prior to start of relevant work	
Plan	Tower Rescue Plan	Per M2-01-01		X		X	Prior to beginning turbine erection	
Plan	Training program	Details of training program required to support the off-site and in-field training of Owner's personnel.	X			X	Agreement close	
Plan	Training program	Hard and electronic copies of all training material.			X			
Plan	Transportation plan	Procedure for delivery to Site for main transformer, inverter stations and other critical equipment and oversize loads		X		X	1 month prior to Site mobilization	
Plan	Transportation plan	Proposed shipping and access routes and major onsite access plan	X			X	Agreement close	
Plan	Turbine Manufacturing Schedule	Per M2-01-01, Section 10.2.1		X		X	As noted in M2-01-01	
Plan	Wind performance test plan	Draft of Project Equipment Performance test	X			X	Agreement close	

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			A	B	C			
Plan	Wind performance test plan	Power Performance Testing Procedure describing the procedure to be undertaken by the Power Performance Testing consultant to measure the power curves of the selected Wind Turbines. • Details of the equipment to be used • Any deviations between the actual conditions for the Power Performance Testing and the requirements specified by the Power Performance Testing Procedure • The methodology for dealing with those deviations • Details of the site calibration procedure		X			2 months prior to start of relevant work	
Plan	Wind performance test plan	Updated and final version		X			1 month prior to start of relevant work	
Plan	Work plans	Procedures for execution of all Work including details of number of personnel and vehicles that will be on site at all the different phases of the Project		X		X	2 months prior to start of relevant work	
Report	As left settings	Alarm set points, complete I/O database including description of each I/O			X			
Report	Civil work geotechnical investigation report	Geotechnical investigation of HV/MV substation, access roads, hardstands, underground cabling, Wind Turbine & Met Mast foundation/footing sites.		X		X	2 months after Agreement execution	
Report	Civil works 3rd party structural design report	Third-party Registered Professional Engineer's Report confirming the suitability of: • The permanent buildings • Any other structures as required to be certified under the local building and/or structural codes		X			6 weeks prior to start of relevant work	
Report	Civil Works Civil/Structural design report	The design report shall contain, as a minimum, all method statements, design inputs, design calculations, specifications, design drawings, cross sections, layouts and studies regarding: • Borehole logs and relevant geotechnical test results for the HV/MV substation • HV/MV substation foundations/footings; • Met Mast foundations/footings • Crane hardstands • Access roads • Permanent buildings (including structural, architectural, fire rating and hold down details) • Site drainage • Site landscaping • Site restoration		X		X	3 months after Agreement execution	
Report	Document register	Proposal defining the contract drawings and documents in the form of a document register	X			X	Agreement close	
Report	Document register	Update of document register.		X				
Report	Electrical balance of plant power system studies and design calculations reports	Updated Electrical Design Report following any design changes during construction.			X			

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			A	B	C			
Report	Electrical studies	Include Easypower/Aspen software model, relevant calculations and complete system one line diagram, where applicable. Electrical studies including, but not limited to the following: • Auxiliary power study • Coordination study • Arc flash hazard study • Insulation coordination • GSU transformer sizing • DC/UPS sizing • Grounding calculation • Harmonics study • Subsynchronous resonance study (if applicable) • Field effect study		X		X		
Report	Electrical studies	Update and final report			X		One month prior to Substantial Completion	
Report	Electrical system optimization report	Final optimization of power cable and overhead conductor size		X			6 months after Agreement execution	
Report	Equipment list	List of all equipment		X				
Report	Equipment maintenance records	Maintenance records for equipment			X			
Report	Failure Modes and Effects Analysis	Provide for critical supplied systems and assets: • Known / common failure modes • Potential failure modes and historical/expected mean time between failures • Severity on operation relative to the system provided • Methods of detection based on vendor supplied Preventive Maintenance (PM) or Predictive Maintenance (PdM) Procedures • Improvements due to design modifications, additional PM or PdM measures or optional equipment.		X		X	3 months after Agreement execution	
Report	Final substantial completion test reports	Completed installation and commissioning checklists, including commissioning test results, for the entire Plant electrical Works, including, but not limited to, MV/HV Transformer/s, auxiliary transformers, Reactive Plant (if applicable), protection systems and switchgear, transformers and switchgear, MV cables, fiber optic cables, metering, LV equipment, auxiliary generator, in-line cable joints (if applicable), earthing connections, terminations and joints.			X			

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Report	Foundations Civil/Structural design report	Including but not limited to the following: • Design loads for all structural components • Design calculations including all assumptions • Demonstration of suitability of all structural components in extreme wind conditions and over the design life • Wind tunnel test results • Modal analysis results • Detailed foundation specifications • Concrete and Grout Design and the mix proposed as described in this document • Borehole logs and relevant geotechnical test results for each Wind Turbine site • All partial safety factors • Decision trees • Reinforcement specifications and testing, and • Conclusions		X		X	3 months after Agreement execution	
Report	Foundation Inspection Report	Per M2-01-01, Section 4.2.4		X		X	With each Foundation Completion Certificate	
Report	Geotechnical investigation report	Comprehensive geotechnical investigation, including and as applicable: • Inverter Station • MV/HV Substation • Access Roads • Hardstands • Underground Cabling • Met Station footing sites • Other permanent structures or buildings including the O&M facility • Soil Resistivity (Electrical and Thermal) Surveys		X		X	2 months after Agreement execution	
Report	Grid connection documentation	Update to all required grid connection documentation.			X			
Report	HSE report	Final HSE report and risk register			X			
Report	HV/MV electrical system design report	Design of proposed electrical systems including, but not limited to: • Single Line Diagrams (SLD) for MV/HV Substation, reactive plant and collector system, incorporating protection (or provided separately) • Earthing general arrangement (GA) drawings and schematic diagrams • Substation GA drawings, including overall GA drawing, MV switchroom GA drawings (including MV and LV switchboards, protection panels, SCADA, battery / UPS, chargers, etc.), lightning mast locations • Schematic diagrams and distribution board schedules for MV switchroom equipment, LV supplies and metering • Details of equipment redundancy • Electronic copies of all studies, models, rating evaluations, etc. performed for the above requirements. Specific software and version information to be provided by Owner.		X		X	6 months after Agreement execution	

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Report	Hydrology and flood study	To confirm the design for flood requirements for a 1 in 100-year flooding event.		X		X	Prior to relevant design work	
Report	Installation and commissioning reports	The results of all inspections, checks and tests carried out, together with any subsequent analysis. Including but not limited to protective relay calibration tests, trial of equipment operation summary, and manufacturer field service reports.			X		Within 30 business days of commissioning	
Report	Lightning protection study	Detailed assessment of lightning risk to personnel and Works in accordance with Applicable Standards.		X		X	2 months prior to start of relevant work	
Report	Master drawing list	Table of all drawings including drawing number, revision letter/number, revision date, drawing title, discipline, document status, document type, plant system, and cross-reference listing for associated vendor drawing numbers, and date submitted to PGE for review.		X		X	As drawings are submitted	
Report	Meeting minutes	Meeting summary and reports		X	X		3 days following meeting	
Report	Met station/mast installation report(s)	An installation report for each mast including, but not limited to: • Details of installer • Installation date • Grid coordinates of mast (including details of coordinate system and datum) • Elevation of mast above sea level • Mast and equipment details including, but not limited to: o Mast dimensions o Instrumentation types, serials numbers and installation heights and positions o Dimensions and orientations of all booms and arms installed on the mast o Data logger configuration and details o Commissioning details o Reference photos		X			1 month after installation	
Report	Met station/mast maintenance log(s)	Each installed mast shall have a maintenance log detailing all work carried out on the individual mast. The maintenance log shall be such that can be used by Owner for the continuing operation of the mast over its Design Life.			X			
Report	Mounting structure preliminary study	Preliminary design information including footing design, construct & test philosophy; general arrangement drawings	X			X	Agreement close	
Report	Project schedule	Update as monthly progress reporting showing status, variance, constraints, actual versus planned progress.		X	X	X	monthly	

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			A	B	C			
Report	Project status report	Weekly template provided by Owner. Monthly report to include, as a minimum, for that month: • Safety statistics, issues, and events • Summary of events including equipment delivery dates and status • Major activities accomplished during past month and those planned for the coming month • Project schedule update • Milestone payment schedule status • Earned Value Quantities Report (EVQR) • Contract progress S-curves • Contract overall man-hours S-curves • Contract overall staffing histograms • Contract overall craft histograms • Key quantity S-curves • Risks, delays, and quality concerns		X	X	X	monthly and weekly	
Report	Project workbook	List of Project documentation			X		Prior to Final Completion	
Report	Punch list	Documentation listing and detailing any and all minor non-conformances and proposed rectification not required to be completed prior to Substantial Completion.			X			
Report	Quality assurance package	Complete sets of quality assurance documentation for each of the defined construction milestones referenced in the Specifications (commonly recorded via construction job books).			X			
Report	Reactive Plant Voltage Regulation & Reactive Power Control Design Report	Voltage regulation and reactive power flow control and coordination study to demonstrate the proposed methods of integration and coordination of voltage and reactive power control devices.		X			3 months after Agreement execution	
Report	Risk assessment report	Risk Assessment Analysis		X		X	30 days after Agreement execution	
Report	Risk assessment report	Periodic submission of risk report showing updates and control measures		X			As updated	
Report	Special tools and vehicles	List of all the tools, vehicles or voice communications equipment required for the safe and effective operation and maintenance of the Plant stating whether the Employer is required to purchase this equipment or not.	X			X	Agreement close	
Report	Special tools and vehicles	Update to special tools and vehicles list		X			6 months after Agreement execution	
Report	Storage records	Storage records for any equipment, materials, or other work that was previously produced, manufactured, or constructed, per Section 1.5.11 of Attachment M1-01-02.		X		X	Prior to shipment from original storage location	

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			A	B	C			
Report	Test reports	The results of all inspections, checks and tests carried out, together with any subsequent analysis including documentation of all Acceptance, and Performance Tests (if complete) and applicable certifications. The final commissioning test summary shall be prepared and document the results of all commissioning tests. • Any mutually agreed upon deviations from the Commissioning Test Manual procedures • Instrument calibration sheets and certificates • Test data, including corrected test data • Field notes (weather conditions, observations, etc.) • Test calculations • Any deficiencies or issues identified during, or as a result, of testing • Conclusions • Signatures of Contractor and Commissioning Manager			X	X	Within 5 days after test completion	
Report	Topographic survey, pre-construction	See Appendix M1 Attachment 02 Exhibit 01 – General Civil Requirements		X			2 months after Agreement execution	
Report	Topographic survey, post construction	See Appendix M1 Attachment 02 Exhibit 01 – General Civil Requirements			X			
Report	Transformer field inspections and tests	Upon delivery to the Site, transformer supplier shall perform and record the following: • Check impact recorder • Check blocking • Check transformer tank and fittings • Inspect bushings • Internal inspections - moister, coil supports, etc. • Check all parts have been delivered • Perform field tests and compare to FAT • Check all accessories • Provide all additional field inspections, adjustments, and tests recommended by the transformer manufacturer.			X		Within 5 days of delivery	
Report	Interconnection line civil/structural design report	Foundation and structure design for every pole location, including but not limited to the following: • Design loads • Design calculations including all assumptions • Demonstration of suitability of all structural components in extreme wind conditions and over the design life • Detailed foundation specifications • Concrete and grout mix design proposed • Borehole logs and relevant geotechnical test results • All partial safety factors • Decision trees • Reinforcement specifications and testing		X		X	3 months after Agreement execution	
Report	Interconnection line earthing verification report	Earthing Verification Report, which verifies through measurement of the as-built earthing systems, that the HV Transmission Line will be safe for the lifetime of the Facility. This shall include measurements of step and touch potentials.		X			2 months prior to energization	

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Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Report	Interconnection line other documentation	Including, but not limited to the following: • Electrical design report, including conductor selection (size, current rating, resistance, number of circuits, type, strength, etc.), insulation, loading, clearances, conductor sagging, etc. • Earthing study and earthing design drawings • Specifications for all components, including conductors, insulators, optical ground wire (OPGW) and hardware. • Equipment data sheets for all engineered equipment items to be provided as part of the Facility. Data sheets shall include a concise description of performance rating, materials, and design data. • Calculations to confirm audible noise, radio frequency interference, electric field and magnetic fields satisfy the regulatory requirements and Applicable Standards. • Work method statements, ITPs (inspection and test plans) and commissioning plans for all HV transmission line works, including concrete testing, foundations, pole assembly, pole erection, conductor and OPGW stringing, jointing and terminations • Test Procedures (functional and Acceptance and Reliability test procedures for acceptance. • Pole schedule • Line schedule • Minimum clearances for maintenance capability • Lists of special tools furnished with the equipment for erection and maintenance to be provided by Owner • Requirements for storage and protection of equipment upon receipt and following installation, but prior to start up • Spare parts list (after design) • Earthwork specifications • Concrete specifications • Structural steel specifications • OPGW/Fiber optic cable specifications • Engineered Equipment Specifications • Grounding Calculations and Details • Signage		X		X	3 months after Agreement execution	
Report	Interconnection line stringing test report	Compress sample mid span joints, as well as phase conductor dead/end assemblies for each wire type used on the project			X	X	Prior to stringing commences	
Report	Interconnection line, post construction	Documentation including, but not limited to the following: • Operation and maintenance manuals for all Contractor-supplied equipment; • Sectional drawings showing materials and construction; • QA/QC books • System Turn Over Packages (TOP) • Test Reports			X	X		

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Report	Transportation study	A report that details the proposed access roads to be used together with any off-Site road improvement required and conditions of transportation. Off-Site road improvements shall include road cross sections and construction details. Pre-delivery condition survey of the transport route to the Site access point.		X		X	1 month prior to site mobilization	
Report	Transportation study	Condition survey of the transport route to the Site access point post-delivery of all major loads & equipment.			X			
Report	Wind electrical balance of plant power system studies and design calculations reports	Electrical Design Report(s) with detailed calculations indicating method, assumptions and outcomes of design and dimensioning of all elements in the EBoP, having regard to the potential output of the Wind Turbines, the characteristics of the Work, Owner's reliability and availability requirements and prudent industry practices. The Electrical Design Report shall include without limitation: • Load flow study, including voltage levels at all buses, cable rating calculations and loss calculation at zero, partial and full loads, and annualized losses in percentage of annual energy • Fault study showing minimum and maximum fault levels at all buses • Soil Electrical Resistivity Survey results, in sufficient number of locations to allow design of the entire Wind Power Plant earthing system • Earthing study, based on justifiable assumptions and proving conclusively that the Site shall be safe for the lifetime of the Facility, addressing transferred potentials and step and touch voltages • Protection study and protection settings report, showing compliance with Owner's requirements and other relevant requirements • Harmonics and flicker study • Insulation co-ordination study • Reactive Power and Voltage Control Report		X			8 months after Agreement execution Initial relay calculations/coordination study 6 months prior to start of relay testing (in **addition** to 8 months schedule above)	

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			A	B	C			
Report	Wind SCADA Design report	Details of Wind Turbine interfacing, Wind Power Plant and Wind Power Plant HV/MV substation and 33kV equipment with design inputs, design criteria, design outputs comprising: • Systems Architecture Diagram showing all components in block form, specifically identifying redundant elements and interfaces • System platform details including details of software OS & hardware for SCADA platform including details of redundant elements and expected availability • Data map and interfacing details • Identification of all data points, interfacing points, including how the interconnection and interfacings are to be provided as described in this document • Fiber optic architecture		X		X	8 months after Agreement execution	
Report	Wind Turbine noise report	Noise assessment detailing the predicted Wind Power Plant noise at stakeholder and non-stakeholder receiver locations.	X			X	Agreement close	
Report	Wind Turbine site specific statement of compliance	Including the following: • Site specific statement of compliance for the design assessment from a Certification Body which demonstrates that the combined system of Wind Turbine and Wind Turbine towers is designed to withstand the Site conditions for the full Design Life. • All reports associated with the site-specific statement of compliance for the design assessment.		X			Once received	
Report	Wind Turbine site suitability report	Provision of evidence and a statement of site suitability if conditions are outside type certified conditions	X			X	Agreement close	
Specifications	Civil works specifications	Where not covered by the Site Layout, an outline of proposed BoP/BOS Civil Works, including but not limited to: • Overview, specifications • Details of reinforcement • Site testing	X			X	Agreement close	
Specifications	Contractor specifications	Including the following: • Standards as identified by Contractor as being relevant to the Work • Equipment suppliers detailing locations, and where major components of the Work shall be manufactured	X				Agreement close	
Specifications	Electrical control documentation	Vendor data sheets for main electrical components in the Wind Turbines, including generator, main circuit breaker and converter/inverter (if present)		X		X	Duration of Agreement	
Specifications	Grid connection documentation	All required information to assist Owner in its application for Grid Connection.	X	X		X	Duration of Agreement	
Specifications	Grid connection documentation	Including: • Generating System Design Data Sheets • Contractor shall supply a completed performance standard template stating the proposed level of compliance to each access standard in accordance with the TSP's GPS		X			Duration of Agreement	

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			A	B	C			
Specifications	HV/MV transformer specifications	Proposed substation transformer specification which shall include at a minimum the following details: • Transformer layout • Ratings and Design Life • Auxiliary Supply • Radio Interference • Short Circuit Withstand Capacity • Earth Tremors • Insulation Levels • Noise Levels and Vibration • Temperature Rise Limits • Magnetizing Current and Flux Density • Transformer Core and Windings • Transformer Losses • Transformer Construction • Transformer Tank • Transformer Oil and Valves • Oil Conservator Tank • Cooling Equipment • Temperature Measuring Equipment • Gas and Oil Actuated Relay • Pressure Relief Devices • Gaskets and Flanges • Marshalling Box • Auxiliary and Control Wiring • Terminations • Bushings • Surge Diverters • Degree of Polymerization (DP) • Inspection and Testing • Shipping	X			X	Agreement close	
Specifications	Manufacturer storage specifications	Manufacturers' storage and protection requirements/recommendations for all equipment and materials should be provided to Owner prior to delivery		X		X	1 month prior to delivery	
Specifications	Material safety data sheets	As required		X			As received	
Specifications	Other plant equipment as applicable (e.g. transformer, switchgear, cables, DC combiner box, met station)	The following documents shall be submitted by the Contractor. • Datasheet • Track records • Type test certificates to Applicable Standards and test reports • Accelerated test certificates (if available) • Warranty terms	X			X	Agreement close	

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			A	B	C			
Specifications	Permanent on-site buildings	Functional description and preliminary design specifications including: • Layout • Elevation drawings • Structural • Architectural • Fire rating • Hold down	X			X	Agreement close	
Specifications	Reinforcement specifications and testing specifications	Reinforcement specifications, testing, FATs		X			6 weeks prior to start of relevant work	
Specifications	SCADA and communications network	Functional description and preliminary design specifications including: • Information on the communications system, including specifications and drawings • Information on the SCADA system, including specifications and drawings	X			X	Agreement close	
Specifications	SCADA instrumentation specifications	Copies of calibration sheets for all sensors/transducers as appropriate in accordance with the appropriate calibration standards. Sensors/transducers shall include those mounted on: • Temporary and Permanent Wind Turbine met masts • Switchgear • Monitored equipment • Statcom equipment, and • Power Quality Metering			X			
Specifications	Substation specifications	Functional description and preliminary design specifications including: • Substation general arrangement drawing • Reactive power compensation resources (if applicable) • Reactive power compensation support and voltage control philosophy • Protection philosophy • Primary and secondary system key equipment specifications • HV and MV switchgear, neutral earthing resistors or neutral earthing transformers (if applicable)	X			X	Agreement close	
Specifications	Welding procedure specifications	Document demonstrating welding procedure shall meet all requirements of the AWS D1.1 code		X		X	6 weeks prior to start of relevant work	
Specifications	Wind collection system specifications	Functional description and preliminary design specifications including: • Primary and secondary system key equipment specifications, including step-up Wind Turbine transformer • Optimization of power cable and overhead conductor size	X			X	Agreement close	

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Specifications	Wind collection system specifications	Detailed specification and design drawings: • Cable specifications and schedules for all HV, MV, LV, earthing and fiber optic cabling (including MV/HV substation and collector system) • Full technical specifications for all termination kits, jointing kits, lugs and connectors to be used in the primary power circuits of the Wind Power Plant and in the earth network • In-line cable jointing kits		X		X	3 months after Agreement execution	
Specifications	Wind Turbine foundations concrete and grout specifications	Including minimum strength required for any concrete or grout forming part of the wind turbine foundation design		X		X	3 months after Agreement execution	
Specifications	Wind Turbine instrumentation specifications	Specification and calibration certificates where applicable of the following Wind Turbine instruments: • Nacelle anemometers • Nacelle wind vanes • Thermometers and other temperature measurement devices such as thermostats • Yaw and pitch sensors or transducers • Accelerometers • Main drive train vibration sensors and collection system • Tower sway/vibration sensor and collection system • Other condition monitoring sensors		X			1 month prior to start of relevant work	
Specifications	Wind Turbine specifications	Specification(s) of wind turbines proposed for the Site including (for each proposed turbine type and operating mode): • Technical description and drawings of main components • Description of operational envelope and control system • Failure Modes and Effects Analyses • Maintenance schedule, included routine and major overhaul activity • Operational track record and performance including up-to-date installation figures for the proposed wind turbine model • Warranted power and thrust coefficient curves for the purpose of warranty calculations • Independently certified power curve measurement report • Warranted sound power levels and tonality for the purpose of warranty calculations • Independently certified noise measurement report • Independent Power quality measurement report • Confirm wind turbine meets the requirements of the applicable grid code	X			X	Agreement close	
Specifications	Wind Turbine specifications	Full technical description of all main components		X		X	2 months prior to start of relevant work	

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Level B: Construction Documentation - Documentation to be submitted prior to the commencement of Work on Site or issuing of any completion certificate
Level C: As-built Documentation - As-built drawings and other record documentation to be submitted after the issuing of any completion certificate
Owner Approval: Must be submitted for the Owner's review and approval prior to equipment purchase or construction

Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
Specifications	Wind Turbine transformer specifications	Functional description and preliminary design specifications including: • Transformer specifications, including MVA rating, nominal voltage rating, tap changer details, insulating medium, vector group, thermal ratings, temperature rise, fault ratings, insulation ratings, IP level, fire protection, corrosion protection, load and no-load loss guarantees, manufacturer and standards compliance. • Transformer design drawings, including enclosure, fittings, locations and bund details. • Transformer type test certificate and a fitness for purpose statement (considering environmental conditions, corrosion, cyclic loading, peak voltages and fire risk)	X			X	Agreement close	
Compliance	Capability to Meet Compliance with PRC-028	Contractor to ensure design of Inverter-Based Resources (IBR) capability to evaluate IBR ride-through performance during System disturbances and to provide data for IBR model validation. This includes the following: • Sequence of Event Recording; circuit breaker position for circuit breakers; When triggered by ride-through operation or tripping of an IBR unit - all fault codes, fault alarms, high and low voltage ride-through mode status and high and low frequency ride-through mode status. • Triggered fault recording data to determine the following electrical quantities for Elements; High-side of the main power transformer FR data; Collector feeder breaker FR data; Shunt dynamic reactive device FR data to show: • Phase-to neutral voltage for each phase; • Each phase current and the residual or neutral current; • Real and or Real and Reactive power expressed on a three-phase basis. • FR data capable of meeting the High-side of the main power transformer data; Collector feeder breaker data; Shunt dynamic reactive device FR data for the following: • A single record or multiple records that include a pre-trigger record length of at least two cycles and a total record length of at least 2.0 seconds for the same trigger point. • A minimum recording rate of 64 samples per cycle • A trigger settings for at least the following: Neutral (residual overcurrent, if applicable; AC phase overvoltage and undervoltage; Overfrequency and underfrequency		X			Agreement Close	

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Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
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		To have continuous dynamic disturbance recording (DDR) data and storage to determine the following electrical quantities for each main power transformer(s) it owns: • One phase-to neutral or positive sequence voltage on high-side of the main power transformer(s) • The phase current for the same phase at the same voltage corresponding to the voltage list above, or the positive sequency current • Real Power and Reactive Power flows expressed on a three-phase basis corresponding to each main power transformer(s) where current measurements are required • Frequency of any one of the voltage(s) listed above Generator Owner responsible for DDR data listed above, should have DDR data that meet the following: • Input sampling rate of at least 960 samples per second • Output recording rate of electrical quantities of at least 60 times per second Generator Owner should time synchronize all SER, FR, and DDR data to meet the following: • Synchronization to Coordinated Universal Time (UTC) with or without a local time offset • The IBR unit synchronized device clock accuracy with +/- 100 milliseconds of UTC. For all other devices, synchronized device clock accuracy within +/- milliseconds of UTC A Generator Owner shall provide all requested SER, FR and DDR data to its Transmission Planner, Planning Coordinator, Transmission Operator, Balancing Authority, Reliability Coordinator, Regional Entity, or NERC according to the following specs: • Data shall be retrievable for the period of 20 calendar days and should be provided within 15 calendar days of a request, unless an extension is granted • SER data shall be provided in ASCII CSV format • FR and DDR data shall be provided in either CSV format with appropriate headers or in electronic files that are formatted according to C27.111, IEEE Standard Common Format for Transient Data Exchange (COMTRADE), revision C37.111-1999 or later • Data files shall be names to conform with C27.232, IEEE Standard for Common Format for Naming Time Sequence Data Files (COMNAME), rev C37.232-2011 or later						

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Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
	Capability to Meet Compliance with PRC-029	Ensure the design and operation is such that each Inverter-Based Resource meets or exceeds the Ride-through requirements according to the "must Ride-through zone" specified, except in the following conditions: • The IBR needed to electrically disconnect in order to clear a fault: • The voltage at the high-side of the main power transformer went outside an accepted hardware limitation; • The instantaneous positive sequency voltage phase angle change is more than 25 electrical degrees at the high-side of the main power transformer and is initiated by a non-fault switching event on the transmission system, or • The Volts per Hz (V/Hz) at the high-side of the main power transformer exceed 1.1 per unit for longer than 45 seconds or exceed 1.18 per unit for longer than 2 seconds **Ensure the design and operation is such that each voltage performance for each IBR adheres to the following during a voltage excursion**, unless a documented hardware limitation exists • While the voltage at the high-side of the main power transformer remains within the continuous operation region, each IBR shall Continue to deliver the pre-disturbance level of Real Power or available Real Power, whichever is less Continue to deliver Reactive Rower up to its Reactive Power limit and according to its controller settings Prioritize Real Power or Reactive Power when the voltage is less than 0.95 per unit, the voltage is within the continuous operating region, and the IBR cannot deliver both Real Power and Reactive Power due to a current limit or Reactive Power limit, unless otherwise specified through other mechanisms by an associated Transmission Planner, Planning Coordinator, or Transmission Operator. • While voltage at the high-side of the main power transformer is within the mandatory operation region as specified, ensure IBR shall exchange current, up to the maximum capability to provide voltage support, on the affected phases during both symmetrical and asymmetrical voltage disturbances, either under Reactive Power priority by default; or Real Power priority if required through other mechanisms by an associated Transmission Planner, Planning Coordinator, Reliability Coordinator, or Transmission Operator • While voltage at the high-side of the main power transformer is within the permissive operation region as specified, ensure IBR to operate in current blocking mode if necessary to avoid tripping. Each IBR should follow the requirements for the mandatory operation region If an IBR enters current blocking mode, it shall restart current exchange in less than or equal to five cycles of positive sequence voltage returning to a continuous operation region or mandatory operations region		X			Agreement Close	

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Category	Deliverable:	Description:	Level			Owner Approval	Owner Proposed Schedule	Contractor Proposed Schedule
			A	B	C			
		• Should have capabilities to restore Real Power output to the pre-disturbance or available level (lesser of) within 1.0 seconds Contractor to ensure the design and operation is capable of IBR meets or exceeds Rid-through requirements during a frequency excursion Contractor to document any known hardware imitations that prevent the IBR from meeting Ride-through criteria						
	Capability to meet compliance with PRC-030	Contractor to ensure design is capable of identifying any complete facility loss of output, or changes in Real Power output that are at least 20 MW and at least 10% of the plant's gross nameplate rating occurring within a 4-second period.		X			Agreement Close	
	Capability to meet compliance with EOP-012	Contractor to ensure any generating units that begin commercial operation on or after 10/1/2027, and that has a calculated Extreme Cold Weather Temperature at or below 32 degrees Fahrenheit, and that self commits or is required to operate at or below a temperature of 32 degrees Fahrenheit, shall: • Ensure freeze protection measures to protect Generator Cold Weather Critical Components that operate at the Extreme Cold Weather Temperature with sustained concurrent twenty (20) mps wind speed for a period of not less than twelve (12) continuous hours, or the maximum operational duration for intermittent energy resources if less than twelve (12) continuous hours		X			Agreement Close	

APPENDIX M1
ATTACHMENT 01
EXHIBIT 05

PROJECT MANAGEMENT AND CONTROLS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	11Dec17	Issued for Implementation	DNV-GL	DS	CPA	Craig Armstrong
1	14Apr23	Update from 2021 Version	PGE		CPA	Craig Armstrong
2	19Jun25	Update from 2023 Version	PGE		SPF	Sean Flak

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1.0 PROJECT CONTROLS

1.1 GENERAL

The Contractor shall provide a project management plan, detailed project schedule, milestone or progress payment schedule, progress reports, and other information necessary for the completion of the facility on time and within budget. The scope of this shall include all work in all phases of the project for which the Contractor is responsible.

1.2 KICK-OFF MEETING

As a first step, Contractor shall organize a kick-off meeting with Owner and subcontractors, with the following objectives:

1. Learn about the Project, update timeline, and short-term and medium term priorities and discuss other key points and expectations
2. Introduce the team that will be working on the project and their roles and responsibilities
3. Establish document control method (see Section 1.3)
4. Identify time and frequency of conference call
5. Identify main point(s) of contact and discuss communication protocols and timeframes for response
6. Discuss any risks to the project and potential mitigation measures
7. Discuss escalation procedures
8. Discuss contract administration

Contractor shall have project managers and any other representative in attendance during the kick-off meeting.

1.3 DOCUMENT CONTROL

Contractor and Owner shall discuss and agree upon a document control plan. The document control plan shall address how documents are transmitted, named, reviewed, tracked, and edited in compliance with the requirements in Appendix M1 Attachment 01 Exhibit 02 – Engineering Documents, Drawings & Other Deliverables. A cloud-based document management system shall be set up that Contractor and Owner can effectively use.

1.4 PROJECT MANAGEMENT PLAN

Contractor shall develop a project management plan for the management and execution of all phases of the Work within 30 days of contract execution, and shall address as a minimum:

1. Construction project manager and key team members (including curricula vitae)
2. Project organization diagram
3. Communication plan
4. Permits, licenses, certifications and agreements required
5. Procurement and sub-contracting plan
6. Project schedule and payment milestones
7. Resource loading plan
8. Site-Specific Environment, health and safety plan
9. Quality Management System plan

10. Management of Owner and other external interfaces
11. Outage Management Plan
12. Change control plan – including change order process
13. Escalation matrix – how and when to escalate issue for resolution
14. Project Transition/Handoff Plan
15. Comprehensive Contruction Plan

Contractor shall identify project manager(s), project scheduler, cost controller, risk matrix manager, and documentation manager for the Project.

1.5 SCHEDULE

The Contractor shall submit a Level 4 project schedule no later than eight (8) weeks following the issuance of Notice to Proceed (NTP). This schedule shall provide a detailed, resource-loaded breakdown of construction activities to support execution and field coordination of the Work, including task-level durations, sequencing, and logic ties across all scopes of work (e.g., civil, structural, electrical, commissioning).

The Level 4 schedule shall:

- Include crew-level detail sufficient for weekly planning and coordination,
- Clearly identify critical path activities and float,
- Reflect realistic productivity assumptions and any constraints identified to date,
- Incorporate major procurement, subcontractor mobilization, and construction activities
- Include reasonable allowances for normal delays such as inclement weather, holidays, and site access limitations
- Track Substantial Completion dates for each individual Circuit or system

It is understood that certain schedule activities may remain provisional or dependent on external factors such as receipt of environmental permits, completion of required studies, interconnection approvals, or other regulatory authorizations. In such cases, the Contractor shall:

- Clearly identify any pending dependencies within the schedule,
- Use logical placeholders with tentative durations where needed,
- Update and refine affected activities as information becomes available.

The Schedule shall include, but not be limited to, the following:

1. Engineering activities
2. Procurement activities
3. Permitting
4. Material and equipment deliveries
5. Construction activities
6. Tie-ins to existing plant systems
7. Equipment factory tests
8. Interfaces with Owner and other external interfaces
9. Outage windows

10. Major milestones
11. Milestone payments, if applicable
12. Startup and commissioning activities
13. Testing activities
14. Contractor and Subcontractor data submittals and Owner's review cycles
15. Post-Substantial Completion items including as-built drawings and Punchlist items

Along with the detailed Level 4 schedule, the Contractor shall furnish a Schedule Basis Memorandum. The Schedule Basis Memorandum shall include, but not be limited to, the following:

1. Project description
2. Project scope
3. Schedule methodology
4. Project work breakdown structure (WBS)

All Functional and Capacity Test activities shall be clearly coded to match the Commissioning Plan and allow progress tracking. The final accepted schedule shall become an Attachment to the Agreement. All schedule submittals shall be delivered in native Primavera P6 format (or other format approved by the Owner), PDF format, and hard copy.

[1] As defined by AACE International (Association for the Advancement of Cost Engineering)

   a. Key milestones and interface milestones
   b. Schedule duration basis (i.e. time estimates)
   c. Schedule assumptions (e.g. workweek, resources and equipment availability)
   d. Project schedule settings (i.e. activity type, duration type, default scheduling options)
   e. Summary of activities on the critical path
   f. Execution strategy summary for engineering, procurement, construction, installation, testing and commissioning

2. Risk and opportunity analysis
   a. Summarize key risks that could delay the schedule
   b. Summarize strategies to mitigate key risk
3. Major constraints
   a. Key dates and constraints
4. Scheduling team
   a. Names and roles

The Schedule shall be resource loaded and be of sufficient detail to assure adequate planning and execution of the work, such that, in the judgment of Owner, it provides an adequate basis for monitoring and evaluating the progress of the work. This plan shall include and highlight all non-contractor interface points with the Owner, vendors or other external entities that could impact the Contractor's Schedule and execution plan. Owner will assume overall schedule integration to assure linkage of those non-contractor interfaces within the Schedule. The Contractor shall update their project Schedule monthly, after the Notice to Proceed, as part of the monthly progress reporting. Owner reserves the right to request weekly schedule updates as needed. The Contractor shall prepare, after mobilization, a rolling three-week Gantt chart schedule, updated weekly, for review at each progress and coordination meeting.

The Contractor shall use Oracle/Primavera P6 scheduling software, or Owner approved alternate software, that is based on network logic and will display the schedule critical path. Schedule performance shall be measured against a fixed project baseline schedule approved by the Owner. Initial schedule submittal and monthly updates shall be in PDF format along with the native file from the scheduling software.

A written schedule analysis shall be prepared as part of the monthly progress reporting. The analysis shall include Schedule status, variance, and constraints, including actual versus planned progress as indicated by the initial baseline Schedule (and any updates thereof), with reference to the major milestones and Schedule. All Schedules shall be configured to calculate data as follows:

1. Retained logic
2. Total float calculations based upon finished data
3. Contiguous scheduling
4. Start-to-start lags calculated from actual start dates
5. Percent completion and remaining completion not linked

All updates shall comply with the following requirements unless specifically altered in writing from Owner:

1. Contractor's construction schedule shall be carried out to support the overall project Schedule and key milestones identified in the Engineering, Procurement and Construction Contract
2. It shall be the Contractor's responsibility to maintain the progress of its Work in accordance with the Schedule
3. The Contractor, at its option and at no cost to Owner, shall develop additional schedule procedures it deems necessary to control and manage its work

All Schedules required by this specification are subject to Owner review and acceptance. Owner shall reject any Schedule or report that fails to show timely completion of the Work or any contract milestone date, or otherwise indicates unrealistic performance.

1.6 PROJECT STATUS REPORTING

The Contractor shall prepare and provide, at a minimum, a monthly and weekly progress report to the Owner. The monthly report content requirements are listed below. A weekly report template will be provided by the Owner and will include daily weather records and reporting major activities during the past week and those planned for the next three weeks. Weekly major activity reporting shall cover equipment delivery dates and status. Weekly project schedule updates shall be provided in each weekly meeting. An alternate template may be used upon Owner approval. The monthly report shall be transmitted the Owner (through an approved document management system) by the 5th day of the month following the month being reported, commencing upon notice to proceed. The weekly report shall be issued to the Owner by 4:00 pm, local time, every Friday, commencing upon notice to proceed.

The monthly report shall include, as a minimum, for that month:

1. Safety statistics, issues, and events
2. Summary of events including equipment delivery dates and status
3. Major activities accomplished during past month and those planned for the coming month
4. Project schedule update
5. Milestone payment schedule status
6. Earned Value Quantities Report (EVQR)
7. Contract progress S-curves
8. Contract overall man-hours S-curves
9. Contract overall staffing histograms
10. Contract overall craft histograms
11. Key quantity S-curves
12. Risks, delays, and quality concerns

The Contractor shall also prepare and submit to the Owner the Semi-Annual Construction Report as required by the applicable Site Certificate or state or local governmental siting process during the construction and commissioning phases only. Contractor shall prepare other permit required reports, as applicable.

1.6.2 Earned Value Quantities Report (EVQR)

This is a tabular report where contract quantities are reported showing quantities completed on monthly basis. This is the report that shows actual % complete, productivity, earned value, etc. on a monthly basis. Contractor is required to finalize the format and submit with contract quantity data within 4 weeks of award of contract/notice to proceed.

1.6.3 Contract Progress S-Curves

This is a graph showing the cumulative and period plan, actual, and forecast progress on a weekly basis. The plan progress curves should be derived from the resource loaded Schedule and is to be submitted within 4 weeks of award of contract/notice to proceed. Thereafter when the work starts, the actual progress as derived from the EVQR should be plotted on the same graph against the plan. The Schedule is to be updated with the actual progress on a monthly basis. The forecast progress curve should be derived from the Schedule thus updated accordingly.

1.6.4 Contract Overall Man-Hours S-Curves

This is a graph showing the cumulative and period plan, actual, and forecast craft hours on a weekly basis. The plan craft hours curves should be derived from the craft hour loaded Schedule and are to be submitted within 4 weeks of award of contract/notice to proceed. Thereafter when the work starts, the actual craft hours spent as derived from the EVQR should be plotted on the same graph against the plan. The Schedule is to be updated with the actual craft hours on a monthly basis. The forecast craft hours curve should be derived from the Schedule thus updated.

1.6.5 Contract Overall Staffing Histograms

This is a bar graph showing the overall weekly staffing (e.g. craft, home office team, management, etc.) planned, actually employed, and forecast (if different from plan). This should be derived from the resource loaded Schedule.

1.6.6 Contract Overall Craft History

This is a bar graph showing the overall weekly craft manpower planned, actually employed, and forecast (if different from plan) broken down into various crafts. This should be derived from the craft hour loaded Schedule. A composite bar graph is acceptable for 1.4.4 and 1.4.5.

1.6.7 Key Quantity S-Curves

This is a graph showing the cumulative quantities plan, actual installed, and forecast to be installed on a weekly basis. Key quantities should be selected for this graph. Some of the key quantities (will differ from contract to contract) are excavation, back filling, concrete poured, structural steel, underground piping, aboveground piping, cable trays, cables, equipment to be installed, instruments, electrical terminations, etc. The plan curves should be derived from the quantity loaded Schedule and is to be submitted within 4 weeks of award of contract/notice to proceed. Thereafter when the work starts, the actual progress as derived from the EVQR report should be plotted on the same graph against the plan. The Schedule is to be updated with the actual progress on a monthly basis. The forecast progress curve should be derived from the Schedule thus updated. Since this process as mentioned above is required to continue on a monthly basis, Contractor is requested to plan the scheduling process in a way that the monthly updating of the Schedule with actual progress is managed well within the Contractor's capability.

1.6.8 Contract Deliverables Log

This is a log of the required deliverables from the Contract. The deliverables log will be created by the Owner within 30 days of the notice to proceed, then tracked and updated by the Contractor on a monthly (or more frequent) basis.

1.7 ON-SITE STATUS & COORDINATION MEETINGS

During design, construction, startup and commissioning, the Contractor will hold a weekly on-site meeting that includes their key field personnel and the Owner project team. The purpose of these meetings is to review the weekly status report and to discuss current status, the three-week rolling schedule, coordination issues, and any significant concerns or problems that require action.

Commencing a month after project notice to proceed, Contractor will hold a monthly meeting that includes their key personnel and the Owner project team. The purpose of these meetings is to review the monthly progress report and to discuss current status, the Schedule, coordination issues, health and safety issues, and any significant concerns or problems that require action.

Additional project meetings to facilitate construction and communication may be required as well.

1.8 RISK ASSESSMENT

The Contractor shall furnish a Risk Assessment Analysis for their scope of work identifying major risks, probability of occurrence, possible impact, and actions that can be taken to mitigate any adverse effects. A Risk Matrix template is available from the Owner. The assessment shall be completed within 30 days of contract execution and updated monthly or more often as conditions or events warrant and submitted to the Owner. Specific risk items that were/are active during the previous month or next three months shall be included in the monthly report.

APPENDIX M1
ATTACHMENT 01
EXHIBIT 07

SECURITY AND COMPLIANCE

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	26Oct21	Issued for Implementation	1898 & Co.		JAL	Jared Lathrop
1	14Apr23	Update from 2021 version	1898 & Co.	PGE	CPA	Craig Armstrong
2	19Jun25	Update from 2023 version	1898 & Co. / PGE	PGE	SPF	Sean Flak

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1.0 GENERAL

In addition to specifications outlined herein, Contractor shall comply with the requirements provided in M1-05-04 (Communication, SCADA, and Metering Facilities). Additional requirements based on project type (wind, solar, or energy storage) shall comply with the respective requirements in M2-01-01 (Wind Plant Specifications), M3-01-01 (Solar Photovoltaic Plant Specifications), and M4-01-01 (Energy Storage Technical Specifications).

Contractor shall take all necessary precautions for the safety and security of its employees, Subcontractors, agents, owner representatives and visitors on the jobsite and prevent accidents or injury to individuals on, about, or adjacent to the Site. Contractor shall develop and provide, for the site specific work being performed, their Site Environmental, Health & Safety, and Security Plan no later than 6 weeks after Limited Notice to Proceed which is to be approved by the Owner. Contractor shall ensure that the Plan complies with all federal, state and local regulations and any project specific requirements. Owner shall have 15 business days to review and comment on such Plan submitted by the Contractor; provided, however, that Contractor shall remain solely responsible for performing such Work in accordance with this Agreement. If Owner provides any comments with respect to the Plan to Contractor, then Contractor shall consider Owner's comments and incorporate changes into the Plan, or otherwise address, and resubmit the revised Plan to Owner. Such resubmission of the Plan shall not be considered a Change In Work. Contractor shall perform the Work in accordance with the accepted Plan. Contractor shall not perform any Work on the Site prior to final acceptance of the Plan. In addition, Contractor shall erect and properly maintain at all times, as required by the conditions and progress of the Work, all safeguards and warnings for the protection of its employees and the general public that are reasonably prudent or required by Applicable Law.

Contractor shall conduct regular inspections required to ensure that safe working conditions and equipment exist. Contractor accepts sole responsibility for: (a) providing a safe place to work for its employees and for employees of its Subcontractors working at the Site and agents, and (b) ensuring the adequacy of and required use of all safety practices, procedures and equipment.

Contractor shall orally notify the Owner of any serious accident or near miss occurring on the Site or in connection with the Work within 24 hours of occurrence. A fatality occurring on the Site or in connection with the Work must be communicated to the Owner within 8 hours of its occurrence. Contractor shall document any serious accident or near miss occurring on the Site or in connection with the Work and shall furnish Owner Representative with a copy of the written investigation report within 72 hours of any accident or injury to any of the employees or agents of Contractor or any and all Subcontractors utilized in the performance of the Work.

Contractor shall immediately notify Owner of any governmental agency (OSHA, Fire Dept., Health Dept., etc.) complaint and/or inspection of the Site. Contractor shall provide to Owner at least monthly, project-related safety performance data to include at a minimum recordable injuries and illnesses, days away from work injuries and illnesses (lost time), recordable and days away from work rates, and performance to project health and safety goals.

Contractor shall be responsible for all security services (which shall consist of 24- hour services) required for the performance and completion of the Work prior to the occurrence of Project Substantial Completion. Prior to the occurrence of Project Substantial Completion, Owner shall have no responsibility for the security of Contractor's equipment, or any of its Subcontractor's equipment stored at the Site during the performance of the Work including construction of appropriate fencing. When designing, procuring and implementing any securities services, and during the performance of all security services pursuant to this paragraph, Contractor shall cooperate and cause its Subcontractors performing work at the Site to cooperate with Owner.

2.0 SCADA CYBER SECURITY

In this section, the term “SCADA” specifically refers to the plant control system. This is not intended to influence or dictate requirements for the substation or Transmission System Operator.

Contractor shall incorporate all security appliances in the collector substation control house and Owner’s security center into the SCADA system. SCADA system to be compliant with NERC Critical Infrastructure Protection (CIP) and Owner’s internal standards.

In the event Owner is responsible for maintaining the SCADA system and/or performing day- to-day operations at the site, Owner shall determine which security applications are used to conform with internal requirements. If Owner is not performing any day-to-day maintenance the operator shall have say of specific applications, but the requirements still apply.

2.1 PATCH MANAGEMENT

Contractor will include a patch management system capable of deploying patches for all software, hardware, and integrated third-party applications within the SCADA system.

Contractor will evaluate, test, and provide appropriate patches to all devices and software within the SCADA system or any other provided system.

Contractor will install patches on all systems according to industry best practices to reduce operational risk due to cyber incidents. At minimum, patches should be installed on an annual basis.

2.1.1 Anti-Virus & Whitelisting

Contractor will supply an anti-virus and whitelisting system capable of managing all assets within the SCADA system.

Contractor will install whitelisting software on all Windows and Unix-based endpoints within the SCADA system and have a procedure to keep the system in restricted (blocking) mode while the system is operating.

Contractor will install anti-virus software on all Windows-based endpoints and provide ongoing definition updates according to industry best practices to reduce operational risk due to cyber incidents. At minimum, definitions should be updated on a monthly basis.

Contractor will provide a list of all applications that need to be whitelisted on all provided equipment.

2.1.2 Backup and Restoration

Contractor will provide a backup system capable of taking operating system backups of all SCADA equipment for the purposes of rapid restoration in the event of a system failure or cyber incident.

Contractor will install backup and restoration software on all Windows and Unix-based devices within the SCADA system. The system must be configured to take automated backups and Contractor must have a procedure for validating backup validity.

Other devices within the SCADA system and support systems (such as networking devices) must be configured to have their configurations, firmware, and any other applicable configuration files pulled automatically on a scheduled basis.

Backups may be stored locally to the site; however, offsite backup must be maintained for incident recovery. The offsite backup must be regularly updated, at minimum once per year or after any major software upgrade.

2.1.3 Security Logging

Contractor will provide a log management system capable of collecting, analyzing, and alerting on logs generated by all SCADA system devices.

All Windows, Unix, and Syslog-capable devices within the SCADA system must be configured to send logs to the log management system.

Log management system must be continuously monitored by a Security Operations Center (SOC) using industry best practices for log correlation and incident reporting.

Contractor must inform PGE of any event or incident that could detrimentally affect the operations of the SCADA system within 24 hours of when it was detected.

Contractor will provide a log management system capable of collecting, analyzing, and alerting on logs generated by the SCADA system.

2.1.4 Vulnerability Management

SCADA Contractor will provide a mechanism for alerting Owner in the event of a vulnerability or exploit that affects the SCADA system within 10 working days after discovery.

SCADA Contractor will disclose the existence and reasons for any identified backdoor codes.

2.2 SYSTEM MANAGEMENT

In the event Owner is responsible for maintaining the SCADA system and/or performing day-to-day operations at the site, the following requirements apply. If Owner is not performing any day-to-day maintenance, this section does not apply.

2.2.1 Device Management

Contractor will turn over management of all servers, applications, application and networking devices within the SCADA system or any other provided system to the Owner at the conclusion of the SAT. This will include all Administrator privileges.

Contractor must provide validated patches for the system for all provided equipment for operational life of this equipment.

Contractor will provide information on all required communications through the firewalls prior to the factory acceptance test.

Contractor will properly harden all devices including uninstalling unused software components and disabling unnecessary services and ports prior to the site acceptance test.

Contractor will provide documentation detailing all applications, utilities, system services, scripts, configuration files, databases, and all other system requirements during the site acceptance test.

2.2.2 Account Management

Contractor will supply or integrate with an Owner-provided domain controller to manage all authentication within the SCADA system and all support systems.

All systems technically capable of LDAP or RADIUS authentication will be configured and connected to the aforementioned domain controller

All default and guest accounts must be removed prior to the factory acceptance test.

Contractor will supply a list of accounts which need to be active on the SCADA system along with justification for each.

All accounts within the SCADA systems and support systems will adhere to least privilege permission schemes.

All passwords will adhere to Owner's password policy.

Contractor will notify Owner within 24 hours of an employee, who has access to the SCADA system or any support system, quits or is terminated with cause.

Contractor will notify Owner within 3 days when an employee, who has access to the SCADA system or any support system, retires or changes position, or otherwise no longer needs access to the system.

No local accounts will be enabled within the generation SCADA system.

Contractor will provide all password change procedures/requirements during the site acceptance test.

2.3 SCADA NETWORK DESIGN

2.3.1 Network Segmentation

The individual SCADA system components must be logically segmented from each other. The following networks shall remain separate where technically feasible:

1. Domain Controllers
2. SCADA Servers
3. User workstations
4. Controllers/PLCs
5. Auxiliary Systems
6. Monitoring systems
7. Terminal/VPN Servers
8. Independent strings/loops of remote devices

Contractor will provide and enforce ACLs and port security address lists for all communications between subnets.

Contractor will provide and document secure network architecture where higher security zones originate communications to less secure zones.

All unencrypted protocols (FTP, telnet, HTTP, etc.) shall be disabled in lieu of their encrypted counterparts (SFTP, SSH, HTTPS, etc.).

2.3.2 Wireless Communications

Wireless technologies such as microwave, cell, Bluetooth, Wi-Fi (802.11x), ZigBee, WirelessHART, or other wireless technologies shall not be used within the SCADA system.

2.3.3 High Availability and Redundancy

All critical systems, to be jointly determined by Owner and Contractor, shall have redundant hardware and software operating in a high- availability mode.

To the extent allowable by the SCADA OEM, Contractor will install all SCADA servers in virtualized environment. This virtual environment must tolerate the failure of any single component (Server, SAN Controller, network switch, etc.). The system must also be able to tolerate least 2 simultaneous disks failures (e.g. RAID 6). Contractor shall configure alerts to the operator in the event of any failure.

2.3.4 Network Space

In the event Owner is responsible for maintaining the SCADA system and/or performing day-to-day operations at the site, the following requirements apply. If Owner is not performing any day-to-day maintenance, this section does not apply.

Owner will provide Contractor with banks of IPs that can be used for devices within the SCADA system or other support systems.

Contractor will provide Owner with a list of devices with associated IP address prior to the factory acceptance test.

2.3.5 Security Design Workshops

In the event Owner is responsible for maintaining the SCADA system and/or performing day-to-day operations at the site, the following requirements apply. If Owner is not performing any day-to-day maintenance, this section does not apply.

Owner, Contractor, and any pertinent subcontractor (including SCADA Contractor) will have at minimum 5 security design workshops lasting no less than one hour each.

These interactive meetings will allow the Contractor to present the methods used for conforming to the requirements of PGE Cyber Security Policies and Procedures and relevant compliance requirements.

The minimum topics that will be covered in these workshops are:

1. Review of requirements
2. Presentation of hardware and software products to be used.
3. Implementation plan
4. Long term system maintenance, operation, and support requirements
5. Network design and requirements

2.4 REMOTE ACCESS

All remote access traffic must be fully encrypted.

All remote access where a user interfaces with any part of the SCADA system or support system will require multi-factor authentication.

Under no circumstances will the SCADA system or any support system have direct access to the internet.

All remote access to the control system network must be performed through a VPN.

VPN connections must have logging, alarming, and monitoring to protect SCADA system from unauthorized modification or use.

2.5 INCIDENT RESPONSE/DISASTER RECOVERY

Contractor shall provide existing Incident Response and Disaster Recovery plans for the SCADA network.

Contractor shall work with the Owner to address deficiencies in Contractor's Incident Response and Disaster Recovery plans.

2.6 SITE ACCEPTANCE TEST

Prior to the site acceptance test the Contractor shall:

- Ensure all devices are patched to their most current level.
- Provide current configuration files for all devices.

Firewall rules, as well as all other access control mechanisms, will be enabled throughout the duration of the SAT.

All Firewall rules and router ACLs will be verified at the SAT.

Remote access and remote access restrictions must be tested as part of the SAT.

2.7 PHYSICAL SECURITY

Contractor shall provide a lockable or locking enclosure for all control system components.

All physical security networks must be separate from SCADA networks.

3.0 GENERATION PHYSICAL SECURITY SYSTEM

The physical security scope described herein is intended to define minimum infrastructure and performance standards for generation site protection. Final design will vary depending on site-specific conditions, including facility layout, surrounding land use, permitting constraints, and Owner preference.

Contractor shall include in their proposal a complete physical security system that meets the functional requirements of this specification and assumes a site of typical size and layout for a utility-scale [solar/wind/storage] facility.

The Contractor shall account for the following:

- Variability in perimeter design based on siting (e.g., rural, industrial, or residential adjacency), which may affect fence height, type (e.g., expanded metal vs. CMU), and visual/noise screening.
- Scaling of underground conduit lengths, camera pole quantities, and lighting zones depending on the facility footprint.
- Security provisions for all site access points, buildings, and secured areas as identified in this specification.

All assumptions used in developing the proposed physical security layout and costs shall be clearly identified in the Contractor's proposal. Final scope and quantities will be confirmed during detailed design in coordination with the Owner.

3.1 GENERAL DESIGN

Contractor shall provide the necessary below grade, and above grade infrastructure for PGE's security system that includes, but is not limited to the following requirements:

A centralized point for the security system and cabling to be housed and secured, either on a concrete foundation and an outdoor rated 4 post communications rack with a heating and cooling system, or adequate wall space of 8' X 8' in an indoor location or an indoor rated 4 post communications rack mounted in a temperature controlled secured room to be provided by Contractor.

All underground conduits provided by the Contractor and will be a minimum of 2" PVC routed from the centralized location to the appropriate point and stubbed up and capped with an 8" X 8" Non-metallic weatherproof enclosure unless otherwise specified.

There will be (1) conduit provided by the Contractor from the centralized area to the closest point on the fence line stubbed up 24" – 30 "for the Fence Detection System. If the Fence line is more than 2,600' in length, another conduit will also be needed and will be identified during design for placement.

There will be (1) conduit provided by the Contractor from the centralized location to wherever the PGE communication equipment is housed to provide a communications pathway for the security system. If both systems are housed internally inside the same rack or building, it is acceptable to use cable tray if it is available in leu of conduit.

For each gate either personnel or vehicle there will be (1) conduit provided by the Contractor under each gate stubbed up 24”-30” and 12”-20” for both edges of the gate.

For each gate either personnel or vehicle there will be (1) conduit provided by the Contractor for the access control and Intrusion detection systems back to the centralized security location.

There will be enough camera locations within the project’s exterior within the footprint of the fence line to view the entire area without obstruction. This may require the Contractor to install footings and poles. PGE’s preference for these poles is a 16’-20’ non-metallic pole.

All internal locations may have camera coverage depending on type of work location:

1. Substation Control House – 100% coverage
2. Switchgear building – 100% coverage
3. Communications Room – 100% coverage
4. Control system Room – 100% coverage
5. All others to be determined during design process

All building external doors shall have a Contractor provided pathway for a camera that is mounted to the building to cover the entrance of the external door that goes to the centralized security system.

For all buildings there will be a location for at least (1) intrusion detection keypad and (1) access control card reader typically mounted near the main entry point and will require the Contractor to provide the pathway though the building and to the centralized security system location and mounting boxes for the equipment.

For all external doors to any building, the Contractor will provide pathway and mounting boxes for the needed security requirements, which will include at a minimum, but is not limited to door contact, REX, electronic locking mechanism, and card reader.

For all internal building doors, there will be a discussion during design on whether to secure any doors with a security system, the one exception to this is an internal communications room will require access control and this pathway through the building and to the centralized security system, and mounting boxes will be provided by Contractor at a minimum to meet the same requirements as an external door.

All keyways on all doors must be capable of housing an E-Lock core made by Assa- Abloy

All doors with access control must have electrified door lever sets with integrated request to exit devices and power door hinges.

3.2 SITE LIGHTING

1. Site lighting shall be provided at the following locations:
   a. All plant vehicle and pedestrian entrances
   b. Entry doorways to all buildings
   c. Parking areas
   d. Substation or switchyard
2. Site lighting shall include light fixture, mounting poles, lighting controls, etc., as applicable.
3. Light fixtures shall be suitable for outdoor locations in wet locations. Light fixtures shall be light emitting diode (LED) type.

4. All site lighting equipment shall be UL listed.
5. Lighting control shall consist of a HAND-OFF-AUTO switch. Photocells shall be used for automatic control.
6. Photocells shall be weatherproof, swivel adjustable, with built-in time delay to prevent accidental turnoff by momentary brightness.
7. Photocells shall be rated at 1800 VA, 120 volts ac.
8. Photocells shall be field adjustable from 1 ft/c turn-on to 15 ft/c turn-off.
9. Site lighting fixtures shall be installed in accordance with the equipment manufacturer's installation instructions.
10. Lighting fixtures shall be installed plumb and level and aimed as specified on the drawings, as applicable.
11. For storage projects, other applicable requirements in M1-05-03 (Substation Design and Construction Specification)

3.3 SECURITY FENCING PERIMETER WITH GATES

foot high mini-mesh or expanded metal fencing with 3 barbed wire strands, as specified below or as approved by Owner

1. Fence fabric shall be 1" mesh, #9 gauge wire, Class 2 Zinc-coated steel.
2. End, corner, angular, and pull posts shall be type 1, 2.375 inch nominal outside diameter and be hot dipped galvanized with a minimum average zinc coating of 1.8 oz./ft.2 (0.55 kg/m2) meeting ASTM F-1083 for standard weight (Schedule 40) galvanized pipe.
3. Tension wire shall conform to ASTM A-824 Type I, Aluminum-coated, 0.40 oz/ft2 (122g/m2) or Type II Zinc-coated Class 2, 1.20 oz/ft.2 (366g/m2)
4. Post tops shall consist of ornamental tops or combination tops with barbed wire supporting arms, as required. When so required, or when a top rail is to be provided, the top shall be provided with a hole suitable for the through- passage of the top rail. The post tops shall fit over the out-side of posts and shall exclude moisture from posts.
5. Tension bars shall not be less than 3/16 inch (4.76mm) by 3/4 inch (19.05mm) and not less than 2 inches (50mm) shorter than the normal height of the fabric with which they are to be used. One tension bar shall be provided for each end and gate post, and two for each comer and pull post.
6. Ties or clips of adequate strength shall be provided in sufficient number for attaching the fabric to all line posts at intervals not exceeding 15 inches (380mm); and not exceeding 24 inches (610mm) when attaching fabric to top rail or tension wire.
7. All emergency egress points at the site need to meet the same physical security requirements as any other door/gate at the site and must have access control card readers and intrusion detection points. These entry/exit points must allow for free egress from the site, but they must be built to not allow the mechanism that allows free egress to be actuated from the non-secure side of the door/gate
8. Powered, keycard-controlled sliding or swinging gate
    a. One for access to O&M building entrance/parking area
    b. One for access to storage/laydown area
    c. Both of widths large enough to provide easy ingress to the facility for a full- size tractor trailer combo

4.0 SUBSTATION PHYSICAL SECURITY

The Project Substation shall meet the same physical security requirements as the rest of the site and as noted in this specification.

The Project Substation shall have access detection, control, and monitoring provisions to ensure that Owner is able to capture, record and monitor all personnel, authorized or unauthorized that enter the site area and must be compatible with Owner's existing security system. Contractor shall coordinate the preferred access control methodology with Owner along with additional provisions such as video monitoring and motion detection.

5.0 NERC AND WECC COMPLIANCE

Contractor shall proactively consider NERC and WECC Compliance in the Project. New facilities connecting to the Bulk Electrical System (BES) require significant coordination with affected entities and specific planning and timely milestones will be required. The Contractor will establish a schedule to ensure adherence to any standard issued by the North American Electric Reliability Corporation (NERC) or the Western Electric Coordinating Council (WECC) allowing for or applicable to the commissioning and operation of the Project.

Below are the current Standards the Contractor is expected to comply with. The Standards listed are subject to change and the Contractor will need to communicate specific planning and timely milestones to Owner to ensure all regulatory compliance obligations are met.

1. **CIP-002-5.1a R1 – BES Cyber System Categorization:** Contractor will provide information, as needed, for Owner to determine BES impact of the Project's generation resources and associated Cyber Systems.
2. **CIP-003-9 R2 – Low Impact Cyber Security Plan:** Contractor will coordinate with Owner to implement controls that ensure low impact BES Cyber Systems are protected according to the following sections of Attachment 1 of the Standard, as applicable:
    a. Section 1: Security Awareness
    b. Section 2: Physical Security Controls
    c. Section 3: Electronic Access Controls
    d. Section 4: Cyber Security Incident Response
    e. Section 5: Transient Cyber Asset and Removable Media Malicious Code Risk Mitigation
    f. Section 6: Vendor Electronic Remote Access Security Controls
3. **EOP-005-3 R4 – System Restoration:** Contractor will coordinate with Owner to ensure any planned BES modifications that would change Owner's System Restoration Plan are reflected in the System Restoration Plan and submitted to RC West for approval prior to commercial operation.
4. **EOP-012-2** – **Extreme Cold Weather Preparedness and Operations:** Contractor to ensure generation units meet the specifications for extreme cold weather requirements. This includes freeze protection measures to protect Generator Cold Weather Critical Components. Any units in commercial operation after October 1, 2027 that have a calculated Extreme Cold Weather Temperature at or below 32 degrees fahrenheit, will be required to operate not less than twelve (12) continuous hours, or the maximum operational duration for intermittent energy resources if less than twelve (12) continuous hours, during times of sustained concurrent twenty (20) mph wind speeds.
5. **FAC-001-4 R1 & FAC-002-4 R2 – Facility Interconnection Requirements** – Contractor will comply with PGE's *Facility Connection Requirements for Generating Resources*.

6. **FAC-008-5 – Facility Ratings:** Contractor to provide facility rating documentation including applicable equipment ratings and facility rating methodology of installed components
7. **IRO-010-5 & TOP-003-6 – Data Specifications & Collection:** Contractor will provide, as requested, information necessary to meet IRO-010 and TOP-003 Data Specifications.
8. **MOD-025-2 R1 and R2 – Real/Reactive Power Verification:** Contractor to perform a staged real and reactive power capability verification within 12 calendar months of commercial operation.
9. **MOD-026-1 R2 and R4 – Excitation System or Volt/Var Model Verification:** Contractor to perform generator excitation control system or plant volt/var control function model verification and provide Owner with verified model within 365 calendar days of commissioning date.
10. **MOD-027-1 R2 and R4 Turbine/Governor, Load Control, and Active Power/Frequency Model Verification:** Contractor to perform turbine/governor and load control or active power/frequency control model verification and provide Owner with verified model within 365 calendar days of commissioning date.
11. **PRC-005-6 R1, R2, R3, R4, and R5 – Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance:** Contractor to perform and document commissioning testing for protection systems (including protective relays, associated communications systems, voltage and current sensing devices, station batteries and DC control circuitry), as well as Sudden Pressure and Automatic Reclosing relaying components prior to commercial operation. Also requires in-service checks on protective relays after energization.
12. **PRC-019-2 R2 – Coordination of Generator Unit or Plant Capabilities:** Contractor to verify coordination of voltage regulating system controls, (including in-service limiters and protection functions) with the applicable equipment capabilities and settings of the applicable Protection System.
13. **PRC-024-3 R1 and R2 – Frequency and Voltage Protection Settings:** Contractor to verify and document generator frequency and voltage protective relaying does not trip the applicable generating unit(s) within the “no trip zone” of PRC-024 Attachment 1 and Attachment 2. Once PRC-029 is fully implemented, IBR will be removed and PRC-024 will only include synchronous condensers.
14. **PRC-025-2 R1 – Generator Relay Loadability:** Contractor to verify generator relay settings are in accordance with PRC-025-2 – Attachment 1.
15. **PRC-027-1 – Coordination of Protection Systems for Performance During Faults**: Contractor to develop new settings for BES elements so that the Protection Systems operate in the intended sequence during Faults. Contractor to verify coordination of Protection Systems installed to detect and isolate faults on the BES so that they operate as intended sequence during Faults.
16. **PRC-028-1 – Disturbance Monitoring and Reporting:** Contractor to verify generation units have the necessary disturbance monitoring capabilities to evaluate IBR ride-through performance to meet PRC-028-1 criteria.. This applies to BES IBR’s and Non-BES IBR’s that either have or contribute to an aggregate nameplate capacity of >20 MVA connected to a voltage >60kV.
17. **PRC-029-1 – Frequency and Voltage Ride-through Requirements**: Contractor to verify ride-through and performance requirements for IBRs and the design and operation of the generation units meet PRC-029 criteria. Contractor to provide inverter control system settings capable of ride-through requirements. This applies to BES IBR’s and Non-BES IBR’s that either have or contribute to an aggregate nameplate capacity of >20 MVA connected to a voltage >60kV.

18. **PRC-030-1 – Unexpected Inverter-Based Resource Event Mitigation**: Contractor to verify generation units have the capabilities to identify unexpected IBR change of power output. This applies to BES IBR's and Non-BES IBR's that either have or contribute to an aggregate nameplate capacity of >20 MVA connected to a voltage >60kV.
19. **VAR-001-5 E.A. 15 and E.A. 17 – Voltage and Reactive Control:** Contractor to verify that generating equipment uses voltage set point, and complies with external voltage control loop specification established by these requirements.
20. **VAR-002-4.1 (All) – Generator Operation for Maintaining Network Voltage Schedules:** Contractor to comply with operation and notification requirements during testing and upon initial commercial operation.
21. **VAR-501-WECC-4 (All) – Power System Stabilizer (PSS)**: Contractor to comply with all PSS settings, testing, and operational requirements established by this Standard.

APPENDIX M1
ATTACHMENT 01
EXHIBIT 09

PGE CAD AND NUMBERING STANDARDS
[CONTENT TO BE PROVIDED AT TIME OF CONTRACTING]

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	15Oct21	Issued for Implementation	DNV-GL	DS	CPA	Craig Armstrong
1	14Apr23	Update from 2021 Version	PGE		CPA	Craig Armstrong
2	19Jun25	Update from 2023 version	1898 & Co./PGE	PGE	SPF	Sean Flak

APPENDIX M1
ATTACHMENT 02
EXHIBIT 01

GENERAL CIVIL REQUIREMENTS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	26Oct21	Issued for Implementation	1898 & Co.		JAL	Jared Lathrop
1	14Apr23	Update from 2021 Version	1898 & Co.	PGE	CPA	Craig Armstrong
2	15Dec23	Update from 14Apr23 rev	PGE	PGE	CPA	Craig Armstrong
2	19Jun25	Update from 2023 version	1898 & Co./PGE	PGE	SPF	Sean Flak

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1.0 GEOTECHNICAL INVESTIGATION

1.1 GENERAL

The Project shall have a site-specific design level geotechnical investigation completed to evaluate subsurface conditions and provide recommendations for design and construction of all foundation systems supporting project infrastructure including but not limited to electrical collection system, electrical transmission line, substation, operation and maintenance facilities, and project civil infrastructure including roads and drainage facilities.

The geotechnical investigation shall also include an appropriate document review of the regional geological information, including review of geological and geotechnical hazards.

1.2 DOCUMENT REVIEW

1. A document review shall be conducted consisting of available geotechnical and geologic documentation, which at a minimum includes the following:
2. Historical and current aerial imagery
3. Regional geologic maps
4. Soil survey reports
5. Groundwater hydrology data and maps
6. Landslide hazard maps (as applicable)
7. Karst hazard (sinkhole) maps (as applicable)
8. Mine subsidence maps (as applicable)
9. Seismic hazard maps
10. Field photographs
11. Other geologic/geotechnical hazard maps (as applicable)
12. Other applicable geotechnical and geologic mapping

1.3 GEOLOGIC/GEOTECHNICAL HAZARDS

All geologic/geotechnical hazards that may affect the project shall be included in the geotechnical study and report, with recommendations for mitigation as applicable.

Geologic/geotechnical hazards shall include, at a minimum:

1. Seismic hazard and seismic effects (ground shaking, soil liquefaction, cyclic softening, earthquake induced landslide, surface fault rupture, seismic settlement, etc.)
2. Landslide and slope instability
3. Flooding and debris flow
4. Land subsidence/mining
5. Expansive soils
6. Collapsible soils
7. Corrosive soils
8. Excessive settlement
9. Karst/sinkhole hazards
10. Frost heave
11. Any other geological/geotechnical hazards that may affect the project

1.4 GEOTECHNICAL EXPLORATION

The scope of the geotechnical investigation shall be consistent with the corresponding industry standards of practice and the recommendations shall be adequate for use in design and construction of the Project. The number and depth of soil borings, as well as field testing required to confirm design assumptions and requirements, shall comply with M4-01-01 (Energy Storage Technical Documents). . Sufficient rock core samples shall be obtained from each boring including coring from the point at which competent rock is encountered and until the appropriate boring depth is achieved (at a minimum).

1.5 GROUNDWATER CONSIDERATIONS

Effects of groundwater shall be accounted for in the foundation design and considered in construction of the project. Monitoring of groundwater levels shall be taken over a sufficient period to capture seasonal fluctuation in groundwater levels. The geotechnical engineer shall determine the design groundwater level, which shall take into account seasonal fluctuation as well as long term groundwater levels, and shall account for any buoyancy effects resulting from the design groundwater level.

1.6 GEOTECHNICAL LABORATORY TESTING

Laboratory testing shall be conducted on samples from soil borings gathered during the subsurface exploration program to determine engineering properties for design of the proposed foundations. Laboratory testing on samples collected during the exploration program shall be sufficient to characterize all soil types and layers that may have an impact on the foundation design.

The following tests shall be included, as appropriate, in the soil laboratory testing program to support foundation design and electrical design activities:

1. Moisture content per ASTM D2216 and unit weight per ASTM D7263 (all relatively undisturbed samples).
2. Atterberg Limits per ASTM D4318.
3. Grain size analysis per ASTM D422.
4. Soil shear strength per ASTM 3080 (unconfined, triaxial, direct shear, vane shear, etc.).
5. Consolidation/settlement characteristics per ASTM D2435.
6. Compaction characteristics per ASTM D698 (Minimum Compaction: 95% of the maximum dry density as determined by ASTM D698. Moisture Content: Within ±2% of the optimum moisture content determined by the same test – or as approved by Owner).
7. Hydrocollapse (as appropriate).
8. Corrosion characteristics per ASTM D4972 and USEPA methods (Sulfate, chloride, pH, resistivity, etc.).
9. Minimum resistivity.
10. Soil Thermal resistivity including dry-out curves including 0% moisture per ASTM D5334. Quantity of test sites shall depend on site plans and geology.
11. Soil Electrical resistivity using the “Wenner Four Probe Method” in accordance with ANSI/IEEE Std 81: 1983 - IEEE Guide to Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of Ground Systems. Unless otherwise approved, the probe spacing shall be equally spaced with spacings of 2 ,5, 10, 15, 20, 30, 40, 50, 80 and 100 ft. Quantity of test sites shall depend on site plans and geology.
12. Unconfined compressive strength per ASTM D2166.
13. Unconsolidated-undrained triaxial compression per ASTM D2850.
14. Other laboratory testing as appropriate.

1.7 GEOTECHNICAL ANALYSES AND RECOMMENDATIONS

Geotechnical engineering recommendations shall be provided in the geotechnical report for the following for incorporation into design of the project:

1. Foundation design parameters (including factors of safety and uplift resistance)
2. Design groundwater level and recommendations for construction dewatering
3. Earthwork recommendations, subgrade preparation, compaction requirements, final grading, and testing requirements
4. Mitigation measures for unsuitable soils (expansive soils, collapsible soils, etc.)
5. Seismic parameters in accordance with local codes and standards
6. Mitigation measures for soil corrosion of concrete and buried metal
7. Recommendations for mix design of concrete in contact with on-site soils
8. General recommendations for civil work and facilities
9. Recommendations for site drainage (slopes)
10. Recommendations for foundations supporting site buildings
11. Recommendations for substation foundations
12. Recommendations for transmission line foundations, as applicable
13. Recommendations for gravel and paved roads
14. Frost heave loading (adfreeze), if applicable
15. Trenching and backfill recommendations
16. Recommendations for earth-retaining structures (e.g., retaining walls), as required
17. Any other pertinent geotechnical recommendations for the project as identified by the Geotechnical Engineer of Record

2.0 CIVIL WORKS

2.1 GENERAL

The design shall suit the requirements for construction access for long loads, heavy equipment and cranes, as well as ongoing access for operation and maintenance facilities. Design and construction of civil works shall comply with agreements between Owner and local authorities, as well as between Owner and OEM Supplier, and be designed per the project requirements and OEM Supplier’s project site requirements.

Site entrance, access roads, site drainage, ancillary structures, and general project layout shall follow the recommendations in the hydrology study to control storm water runoff and prevent flooding of roads, equipment inundation and erosion of soils. A hydrology study based on the storm events noted in Section 2.7 below flood inundation event shall be performed to describe the hydrology of the Site and any impacts that the hydrology may play in the design of the site layout. Drainage shall be provided by Contractor and designed to prevent flooding, inundation of equipment and erosion.

Additional requirements are outlined in M4-01-01 (Energy Storage Technical Documents).

All roads and tracks shall be designed in accordance with the geotechnical engineer’s recommendations appropriate to the site, climatic conditions and their period of use. Treatment of cut and fill slopes and installation of drainage shall be in accordance with applicable state and local standards and regulations. All fences, gates, cattleguards, and entrances shall be in accordance with applicable standards and permits, and shall be of a standard type and similar in all aspects with the type commonly used in the local area unless otherwise specified. All fencing and gates shall comply with the requirements set forth in M1-01-07 (Security and Compliance).

Requirements for formwork, reinforcement, concrete works and batching plant, materials strength, shall be in accordance with applicable state and local codes, standards and guidelines, and shall comply with the requirements in M4-01-01 (Energy Storage Technical Documents).

Restoration shall be in accordance with the Permits and planning and environmental constraints on the Project. All crossings shall be in accordance with utility and county agreements.

2.2 CONCRETE WORKS AND BATCHING PLANT

Contractor shall provide a detailed method statement for quality control and concrete batching and transport.

Concrete shall be transported, placed, compacted and cured in accordance with Applicable Standards.

Concrete mix design, cement, aggregate, admixtures, and trial batch test result shall be provided for owner approval prior to concrete placement. A successful break test showing the minimum specified compressive strength(s) shall be provided prior to concrete placement.

If an on-site portable batch plant is used, the following shall apply:

1. Contractor shall provide and maintain on-Site storage of cement, aggregates and all other materials required for concrete production.
2. Contractor shall provide and maintain a concrete batching plant(s) with all equipment, facilities, approvals and permits that are required for the associated batching plant(s).
3. Contractor shall remove from plant from site within 30 days of final concrete pour utilizing plant.

If an off-site batch plant is utilized, the following shall apply:

1. Travel times to the primary and backup batch plants shall be provided for owner approval
2. A transportation plan for off-site concrete batch plants shall include an allowance for potential traffic impact on transportation time, for owner approval

A backup shall be provided for critical items including the batching plant (on site or alternate location), concrete delivery and placement equipment (conveyor belt or pump).

Prior to pouring, Contractor shall install all grounding elements and cable ducts (tapes, electrodes, etc.). Exothermic (Cadweld, etc.) welding of grounding elements to reinforcing steel shall not be permitted.

A concrete placement plan shall be prepared in accordance with a Contractor-provided mass concrete placement plan. Unformed concrete finish on the surface of the concrete shall be screeded and finished neatly to be uniform and non-slip when wet.

Adequate precautions shall be implemented in finishing to prevent plastic shrinkage cracking. Methods to be used for plastic shrinkage cracking shall be provided to Owner prior to placement of concrete.

A hot and/or cold weather concreting plan shall be prepared in accordance with ACI 305R and ACI 306R, as applicable to anticipated project site temperatures.

2.3 CONCRETE AND GROUT STRENGTH

As a minimum, concrete and grout shall have a minimum 28 day compressive strength of 4000 psi, or greater as specified by the foundation designer.

Concrete constituents shall meet the requirements listed in Table 1, below:

Table 1 Concrete Material Standards

Material	Requirement
Water	Clean, Potable, free from acid/alkali, oil, petroleum products, organic material or other deleterious substances
Portland Cement	ASTM C150, Type I, II, or V or ASTM C1157, Type GU, MS, or HS
Coarse Aggregate	Gravel, crushed gravel or crushed stone, in accordance with ASTM C33
Fine Aggregate	Washed natural or manufactured sand, in accordance with ASTM C33
Concrete Curing Compound	ASTM C309 and C1315
Admixtures:	
Air Entrainment	ASTM C260
Water-reducing	ASTM C494 Type A
Retarding	ASTM C494 Type B
High Range, water reducing	ASTM C494 Type F
High range water-reducing and retarding	ASTM C494 Type G
Fly Ash	If allowed by engineer of record, fly ash may be used to replace up to 20% of cementitious material content by weight in accordance with ASTM C618 Class F; Class C fly ash shall not be used without Owner approval.

Grout materials shall be non-shrink cementitious (ASTM C1107) or epoxy material.

The concrete or and grout strength shall be defined by the characteristic compressive strength at age 28 days.

Sampling and testing of concrete shall be in accordance with ACI 318, ASTM C172, ASTM C31, ASTM C39, ASTM C172, ASTM C231, ASTM C143 and ASTM C1064.

Sampling and testing of grout material shall be in accordance with ASTM C579.

Sampling and testing concrete is be carried out by an accredited materials testing laboratory.

Maximum water/cement ratio: 0.45

Defective concrete shall be repaired by chipping out unsatisfactory material and placing new concrete.

2.4 OFF-SITE ROAD IMPROVEMENTS

Contractor shall establish any off-site road or public highway improvements that are required to:

1. Comply with agreements between Owner and the local Authorities
2. Permit full access for the project
3. Permit delivery of all plant and equipment required for the project, and
4. Permit delivery and supply of all other plant items, construction materials and equipment required to complete the Power Plant.

Contractor, with respect to the Work, shall be responsible for obtaining any relevant encroachment permits or other permits or authorizations and reaching any relevant agreements required with Government Authorities and third parties.

Contractor shall maintain off-site roads in as good or better than original condition throughout construction.

2.5 SITE ENTRANCE AND ACCESS ROADS

Contractor, with respect to the Work, shall be responsible for obtaining any relevant permits or authorizations and reaching any relevant agreements required with Government Authorities and third parties in relation to access:

1. Except where explicitly agreed as being within Owner's scope
2. Except in the case of approvals or agreements with landowners which shall be obtained through Owner

Contractor shall be responsible for establishing the extent to which improvements are required to any existing and new site entrance and access roads to facilitate the Project.

Contractor shall be responsible for establishing the site entrance and access roads to facilitate the Work including, but not limited to:

1. Delivery and installation of Project equipment and components in accordance with the equipment manufacturer's requirements.
2. Crane and heavy equipment access for the installation of Project components.
3. Two-way traffic for construction access
4. All-weather emergency vehicle access to work areas and site locations

Access road geometry shall conform to the following criteria, the Project component requirements, and permit requirements:

1. Road width shall be a minimum of 16 feet
2. Road cross-fall gradient shall be between 1 and 3 percent
3. Maximum road longitudinal gradient shall be 8 percent
4. Turn radii shall be as specified by the Project equipment supplier
5. Maximum vertical crest and dip on roads as specified by the Project equipment supplier.

Access roads shall be clear of overhead obstructions.

The Site entrance and access roads shall furthermore be designed to facilitate access including crane or heavy equipment access, for the ongoing operation and maintenance of the Power Plant, including turnarounds throughout the Site.

Contractor shall repair the Site roads and access roads to the design requirements at the end of the construction, but site access for crane access and delivery of large components cannot be diminished.

Particular attention shall be given to cutting, storing and reinstating topsoil and vegetation in order to encourage regeneration of vegetation.

Treatment of cut and fill slopes and installation of drainage shall be in accordance with applicable state and local standards and regulations.

All roads and tracks shall be designed in accordance with the geotechnical engineer's recommendations appropriate to the Site, Climatic Conditions and their period of use including, but not limited to:

1. Subgrade strength
2. Hydrology
3. Flooding
4. Frost
5. Snow
6. Bearing strength

Proof rolling shall be performed on all access roads in presence of qualified, competent, practicing geotechnical engineer or qualified representative.

2.6 UNDERGROUND CABLE RUNS

Underground conduit and cable runs, including SCADA communication cables and earth conductors, shall be located at an appropriate depth to meet Applicable Standards, Owner's requirements as set forth in the Agreement and this document, and industry best practices.

Where appropriate, conduits shall be laid during access road construction in order to avoid disturbing reinstated ground. All underground cable must be contained within conduit, except for bare grounding conductors. Direct buried cable is not allowed.

Possible surface reduction from future road maintenance shall be considered when selecting the cable burial depth at road crossings.

Cables shall be installed in accordance with Applicable Standards including requirements for mechanical protection, warning and locating tape, and depths of burial.

All trenches are to be backfilled and compacted on completion and original levels restored to a minimum level of compaction and tested as specified by the Geotechnical Engineer. No surplus soil piles or stockpiles are to be left on the Site.

Cables shall be installed via trenching; blasting and plowing are not permitted excavation methods.

Native material excavated from the trench shall be used for the bedding/cover material as much as practicable, subject to the requirements listed above, local ordinances, and the need to ensure thermal stability. All trench bedding and/or backfill materials shall be screened and visually inspected for materials in excess of two (2) inches, with any backfill within 12 inches of cable being free of sharp objects, rocks, and other debris larger than 0.5 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. In areas where topsoil is present, the topsoil shall be preserved during excavation and replaced following installation of the backfill.

Reseeding shall be undertaken by Contractor once trenches are backfilled and topsoil replaced.

Variations in underground cable installation depths, due to road/creek crossings and the typically rigid structure of direct burial machines, shall be considered in the cable sizing calculations and the selection of cable depth derating factors.

Cable runs within the MV/HV substation shall be installed in precast concrete trenches and/or Schedule 40 PVC conduits with a radius not less than 60" for conduit 5" or larger, or radius not less than 36" for conduit 2-4" in diameter. Conduit size / fill ratio shall be in accordance with ANSI / NFPA 70, at a minimum.

Direct buried cables leaving a trench to pass through ground surface shall be protected by a PVC conduit bend and concrete haunch, or other rigid frame acceptable to Owner.

Contractor shall be responsible for reinstatement of all fences, walls, watercourses, roads and embankments crossed by the cables to the satisfaction of Owner and in accordance with all Applicable Permits.

Suitable cable marker posts shall be installed to indicate the route and depth of all underground power cables at each change of direction and on each side of each corresponding road or rail crossing, fence crossing, pipeline, utility crossings, property lines, wetlands, and streams.

1. The markers shall include cable voltage details and telephone numbers of both the asset Owner and the appropriate dig-safe agency.
2. Landowners shall also be provided with these phone numbers and the as-built cable route details and drawings.

Electronic cable marking tape shall be installed along the length of all buried power cable.

An appropriate cable locating device shall be provided to enable the location of underground cables, splices, and electronic markers. GPS-located marker balls are preferred for this purpose.

When fiber cables are installed in a trench, the fiber cable shall be placed in conduit, Pest Duct (required for all non-armored cable), 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. Fiber optic shall be separated from any power cables when co-located in a trench.

2.7 FENCES, GATES, ENTRANCES, CATTLEGUARDS

All fences and entrances shall be in accordance with Applicable Standards and Applicable Permits.

All fences, gates, entrances, and cattleguards shall be of a standard type and similar in all aspects with the type commonly used in the local area unless otherwise specified.

Contractor shall determine and comply with the requirements of all Government Authorities.

All fencing and gates shall comply with the requirements set forth in M1-01-07 (Security and Compliance).

2.8 DRAINAGE

Drainage shall be provided by Contractor and shall prevent erosion, consistent with:

1. Federal, state and local laws and regulations
2. The design assumptions and criteria of the foundations, and other elements of the Civil Infrastructure
3. The absolute requirement to maintain adequate soil cover over the equipment foundation
4. Pollutant discharge and other environmental permitting restrictions on construction and the finished Project
5. Consideration of the safety of personnel and wildlife through the construction work

Batters and steep slopes that are disturbed in the course of the Project shall have a suitable means of stabilization applied.

Erosion control measures shall be installed in accordance with federal, state and local standards and regulations.

Appropriate means of energy dissipation shall be incorporated into the site drainage. Additionally, Contractor shall provide drainage that shall accommodate:

1. A 20-year 24-hour return period flood event for the road and drainage infrastructure, and
2. A 100-year 24-hour return period flood with sufficient freeboard for the Project infrastructure, substation and permanent buildings.

Drainage infrastructures shall include culverts or low-water crossings installed / constructed where required to pass existing storm water concentrated flows. Culvert pipe ends, swales, and ditches shall be designed and constructed to control concentrated flow velocities and minimize erosion and siltation.

The natural drainage patterns of the Site shall be maintained and ponding shall be prevented, other than explicitly where small scale ponding is specifically designed to minimize erosion during drainage. Any pre-existing drains which are damaged in the Work shall be restored.

Access road and crane pad drainage shall be integrated and prevent water flow on the roads. All roads and pads shall have a minimum side slope of 1% to promote drainage.

Water pooling under the inverter and step-up transformer pads (if required) shall be prevented. To comply with this requirement, Contractor shall consider raising the ground level prior to installing the transformer kiosks.

Excavations shall be fully drained prior to any construction work within them.

A hydrology study shall be performed to describe the hydrology of the Site and any impacts that the hydrology may play in the design of the site layout. Drainage shall be provided by Contractor and designed to prevent flooding and erosion, consistent with:

1. Federal, state and local standards, laws and regulations
2. Recommendations from the hydrology study
3. Pollutant discharge and other environmental permitting restrictions on construction and the finished Project
4. Consideration of the safety of personnel and wildlife through the construction work

2.9 DISPOSAL OF EXCESS MATERIAL

Surplus soil and excavated materials may be disposed of on-Site to the extent this is consistent with Applicable Permits and planning and environmental constraints on the Project.

Other wastes including chemical waste shall be removed from the Site and disposed in an appropriately registered facility in accordance with federal, state and local laws and regulations. If immediate removal is impractical the wastes are to be temporarily stored in accordance with the Laws and applicable standards.

All permits and authorizations required for the temporary storage of waste on site shall be obtained by Contractor.

No litter, unsuitable materials, or construction related waste is to be left on the Site. Contractor shall remove all waste, including that of which is generated within temporary facilities.

2.10 RECLAMATION, RESTORATION, AND LANDSCAPING

Contractor shall reclaim all areas which have been disturbed during the Work by replanting and indigenous seeding, including conformance with the requirements of any Permits, the SWPPP, and any Project Agreements. All Work areas shall be restored to their pre-construction condition, at a minimum. A site specific Landscaping Plan must be submitted to the owner for review and approval in which after the landscaping work is complete, the contractor is required to maintain the project site landscaping in accordance to the approved plan until final site acceptance by PGE and project completion.

1. Contractor shall remove all tools, equipment, surplus materials (including unused or useless materials), waste materials, temporary work (including temporary erosion control features), temporary buildings, temporary facilities (including batch plants, rock crushers, and office trailers), and rubbish from the Site prior to final completion, and shall cause any facilities used by Contractor during the performance of the Work to be restored to the same or better condition that such facilities and the Site were in on the date the Contractor commenced work at the Site, ordinary wear and tear excepted.
2. All drains and ditches shall be cleaned at completion of the construction Work, including removal of soil and debris from culverts, and leave the Site in a neat and presentable condition wherever construction operations have disturbed the conditions existing at the time of starting the Work.
3. Preserve and/or restore to their pre-construction condition all land and water resources adjacent to construction areas. Such work shall include restoration of all terraces to their pre-construction condition.
4. Notwithstanding the following paragraph (a), laydown areas (including the laydown yard), roadway shoulders, and roadway turning radii shall be decompacted and reclaimed, including proper grading, aggregate touchup, and seeding with an approved mixture. For the avoidance of doubt, such areas shall not be reclaimed until applicable erection/installation activities have been completed.
5. Re-dress all road surfaces within the Site such that the final cross section meets the Contract specifications, including those presented herein, and such that all roadway surfaces are graded for draining and low spots are removed.
6. Seed all cut / fill slopes utilizing an approved seed mixture. Seeding shall occur during a time / season when the probability of successful seed germination is maximized; hydro-seeding is acceptable for slopes.
7. Fill all depressions and water pockets caused by construction operations and remove all obstructions within waterways.
8. Spread surplus fill on-site in areas and depths approved by Owner.
9. Spread recovered aggregate from laydown yard within approved disturbance limits at Owner-approved locations including but not limited to on access roads, and/or the operations and maintenance building yard.
10. Collect large rocks or boulders unearthed during excavation as part of the Work but not utilized in the construction of the Project and store at an Owner- approved location at the Site.

The seed mix and plant species are to be approved by Owner prior to re-seeding.

Reclamation shall be in accordance with the Permits and planning and environmental constraints on the Project.

3.0 WILDFIRE MITIGATION PLAN

3.1 WILDFIRE MITIGATION PLAN PRIOR TO CONSTRUCTION (PRE)

3.1.1 Update Applicable Sections of Construction WMP

To finalize this Construction WMP prior to construction of the facility, the following sections will be updated:

- Update Section 3.1 based on final facility design including a brief description of areas within the site that are subject to high wildfire risk, fire prevention features at the site, such as roads dimensions, setbacks, fire breaks, entry/exit locations, location of water truck(s) and fire protection equipment locations.
- Update Section 3.2 and include in this WMP the facility site maps described in Section 3.2.
- Update Section 3.3 with fire department, Contractor, and operational manager contact information and emergency response procedures.
- Update section 3.6 to describe vegetation management and areas that will be managed to be vegetation-free, noncombustible space, or gravel surface.

3.2 DEVELOP DRAFT OPERATIONS WMP

Prior to construction of the facility, a Draft Operations WMP will be developed to address wildfire risk at the site during operations of the facility. The Draft Operations WMP would be finalized prior to operations of the facility based on the as-built facility layout. Coordination of the Draft Operations WMP shall be the responsibility of the contractor to facilitate with sign-off by Portland General Electric prior to facility commissioning. The Operations WMP will include a description of wildfire risk at the site and will identify wildfire mitigation measures including:

- Wildfire mitigation through facility design
- Inspection of facility components
- Vegetation management
- Fire weather monitoring
- Emergency response

3.3 PRIOR TO CONSTRUCTION TASK LIST (PRE)

Prior to construction of the facility, the activities in Sections 2.1 and 2.2 will be completed.

3.4 TRAINING (PRE):

The Contractor will organize and hold an on-site training that includes the Certificate Holder, contractors and construction personnel, inviting specialty contractors, local fire department(s), participating and adjacent landowners, emergency management office personnel, ODOE, and any other emergency management agency. The training will cover:

- Description of construction phasing;
- The type, location, and proper use of fire protection equipment;
- Fire protection equipment usage and maintenance requirements;
- The location(s) of water source(s) and proper usage, storing and maintenance for the pump, hose nozzle; and water hose;
- Overview of smoking policy and locations;

- Overview of procedures and restrictions of construction maintenance activities during Fire Season and Red Flag Warnings designated in this Plan;
- Rescue, Alarm, Contain and Extinguish RACE procedures including:
  - Rescue anyone in danger (if safe to do so);
  - Alarm – call the control room, who will then determine if 911 should be alerted;
  - Contain the fire (if safe to do so); and
  - Extinguish the incipient fire stage (if safe to do so).
- Provide information and encourage attendees to sign up for the County's emergency management notification system.

3.5 SOLAR MICROSITING OR WIND TURBINE AREA SITE MAP(S) SUBMISSION (PRE)

The Contractor will update site maps from Section 3.1 and concurrently submit to local fire departments and Portland General Electric.

- Construction Wildfire Mitigation Plan (CON)
- Summary of Solar Component or Wind Turbine Description with Design Features and Location of Fire Protection Equipment

Construction Phasing

The Contractor(s) will maintain vegetation within the Solar Micrositing or Wind Turbine Area and will also maintain a defensible space clearance along Facility features. Defensible space will be free of combustible vegetation or other materials. Roads and parking areas will be maintained to be free of vegetation tall enough to contact the undercarriage of the vehicle.

- During construction clearing, grubbing, and grading, the contractor will create noncombustible space for at least 10 feet within the fence line and another minimum 10-foot limits of disturbance buffer outside the fence line for a total of a minimum of 20 feet of noncombustible buffer around the perimeter of the site. No fuel containers shall be in the vehicles that exit the right-of-way except the five-gallon container that is required for the water truck pump.
- Smoking shall only be allowed in designated smoking areas at the Facility.

Facility Site Map(s):

The Construction WMP includes facility site maps that identify:

- The phasing for construction of facility features and components;
- Location and dimensions of facility roads;
- Location of vegetation free, noncombustible, defensible spaces;
- The location of facility access points;
- A description and the location of emergency access procedures, including how emergency responders and/or adjacent landowners may access site for fire protection equipment or to extinguish an on-site fire when personnel will not be onsite;
- The type and location of fire protection equipment on site;
- The location(s) of water source(s) that will be on-site during construction.

The facility site maps shall include the proposed Solar Micrositing or Wind Turbine Area, access roads, gen-tie line, BESS, laydown yards, project substation, and inverter locations, if in scope. As discussed above, locations of specific access points and gates will depend on final configuration of the solar areas and related infrastructure.

The final Construction WMP will include a site map detailing specific access points, location of fire protection equipment, and location of water sources.

3.6 SPECIFICATIONS FOR FIRE PROTECTION EQUIPMENT

The following fire suppression equipment will be carried in vehicles conducting maintenance activities and stored on-site at the O&M building at all times:

- Fire Extinguisher: Dry chemical. 2A:10BC (5 pound), properly mounted or secured;
- Pulaski;
- Hand Shovel: Round point. 26 to 28 in "D" Handle, blade - 12 inches long and 10 inches wide;
- Collapsible Pail or Backpack Pump: 5-gallon capacity;
- During fire season (designated Fire Season or June to October each year) water truck(s)/water source, water buffalo, or tank with minimum 500-gallon capacity must be on site, per Portland General Electric's review. The water truck or water supply shall include the following, unless approved by PGE:
- Pump should be maintained ready to operate and capable to provide a discharge of not less than 20 gallons per minute at 115 psi at pump level. Note: Volume pumps will not produce the necessary pressure to effectively attack a fire start. Pressure pumps are recommended.
- Provide enough hose (500 feet minimum) not less than 3/4" inside diameter to reach areas where power driven machinery has worked.
- Water supply, pump, and at least 250 feet of hose with nozzle must be maintained as a connected, operating unit ready for immediate use.

All internal combustion engines must be equipped with exhaust systems, mufflers and screens, or include an appropriate spark arrestor; and must be kept in good operating condition. All combustion engines (including but not limited to off road vehicles, chainsaws, and generators) will be equipped with a spark arrester that meets U.S. Forest Service Standard 5100-1.

All power-driven machinery will be kept free of excess flammable material which may create a risk of fire.

3.7 CONTACT INFORMATION AND EMERGENCY RESPONSE PROCEDURES

The Contractor shall secure and document local fire department and county emergency management contact information, as required. The Contractor shall document fire department response times to the site.

Contractor primary contact and contact of construction contractor manager(s) shall be provided to Portland General Electric at beginning of project or if there is any change in Project Management.

Construction contractor manager(s) contact information will be provided in the final Construction WMP.

Contact 911 in the event of:

- A fire or emergency on-site that cannot be addressed by personnel on-site and requires the assistance of fire or emergency medical personnel;
- A fire ignition on-site that spreads out of the fence line;
- Any fire off-site that does not have emergency responders on site.

- To the extent that construction personnel can safely assist and/or provide equipment to help extinguish off-site fires until emergency responders are on site, it is encouraged to do so to assist in the spread of the fire, loss of life, property and damage to the environment.

3.8 USE OF VEHICLES AND POWER-DRIVEN MACHINERY AT SITE

The following best management practices (BMPs) to minimize fire risk from vehicle travel, equipment use, and fueling activities will be implemented at the site during construction:

- The movement of vehicles will be planned and managed to minimize fire risk.
- The contractor(s) will be responsible for identifying and marking paths for all off-road vehicle travel. All off-road vehicle travel will be required to stay on the identified paths. No off-road vehicle travel will be permitted while working alone. Travel off road or parking in vegetated areas will be restricted during fire season as designated in this Plan.
- Areas with grass that are as tall or taller than the exhaust system of a vehicle must be wetted or mowed before vehicles travel through it.
- Workers will be instructed to shut off the engine of any vehicle that gets stuck, and periodically inspect the area adjacent to the exhaust system for evidence of ignition of vegetation. Stuck vehicles will be pulled out rather than “rocked” free and the area will be inspected again after the vehicle has been moved.
- The contractor(s) will designate a location for field fueling operations at the temporary construction yards. Any fueling of generators, pumps, etc. shall take place at this location only.
- Fuel containers, if used, shall remain in a vehicle or equipment trailer, parked at a designated location alongside a county right-of-way. No fuel containers shall be in the vehicles that exit the right-of-way except the five-gallon container that is required for the water truck pump.
- All power-driven machinery will be kept free of excess flammable material which may create a risk of fire.

3.9 FIRE WEATHER MONITORING AND RESTRICTIONS DURING FIRE SEASON

Definitions:

Non-Fire Season – Approximately October - May

Fire Season – Approximately June-September, formally designated by the Oregon Department of Forestry (ODF). Under ORS 478.960 (4), a Fire Chief can establish Fire Season within a Fire District when ODF, under ORS 477.505, declares Fire Season. Begins seasonal restrictions for public and industry.

Fire Weather Watch - A fire weather watch is issued when there is a high potential for the development of a red flag event. A watch is issued 18 to 96 hours in advance of the expected onset of criteria. Intent of a fire weather watch is to alert forecast users at least a day in advance for the purposes of resource allocation and fire fighter safety. A watch means critical fire weather conditions are possible but not imminent or occurring.

Red Flag Weather Warning - A red flag warning is used to warn of impending or occurring red flag conditions. Its issuance denotes a high degree of confidence that weather and fuel conditions consistent with local red flag event criteria will occur in 48 hours or less. Specific Red Flag criteria differ for each situation and district in Oregon. Be extremely careful with open flames and other activities that emit sparks.

Hot Work - Any cutting, grinding, welding, or other activity that creates spark or open flame.

Fire Watch Service -

Fire watch shall:

- Be physically capable and experienced to operate firefighting equipment.
- Have facilities for transportation and communications to summon assistance.
- Observe portions of the facility where equipment activity occurred during the day.

Upon discovery of a fire, fire watch personnel must: First report the fire, summon any necessary firefighting assistance, describe intended fire suppression activities; then, after determining a safety zone and an escape route that will not be cut off if the fire increases or changes direction, immediately proceed to control and extinguish the fire, consistent with firefighting training and safety.

Fire-Prevention Measures and Restrictions Associated with Fire Season:

Certificate holder shall maintain a log when construction activities are impacted by Fire Restrictions during Fire Season as designed in this Section. The log will include:

- The date;
- Industrial Fire Precaution Level (IFPL);
- Description of actions taken, including if any measures were taken to reduce wildfire risk that are not identified in this Plan.

Non-Fire Season

- All hot work must be conducted on roads or on non-combustible surfaces.
- Smoking in designated areas only.
- Fire Season
- All hot work (any cutting, welding, or other activity that creates spark or open flame) must be conducted on roads or on non-combustible surfaces.
- Federal and State IFPL restrictions need to be followed during construction, if applicable.
    - IFPL waivers can be requested and the restrictions within the waivers need to be followed.
- Water source meeting specifications in this Plan will be on site during fire season.
- Following the completion of hot work, the Certificate Holder or contractor(s) must maintain a fire watch for 60 minutes to monitor for potential ignition.
- Fire watch shall be on duty during any breaks and for one hour after all power-driven machinery used by the operator has been shut down for the day.
- Smoking in designated areas only.

Fire Weather Watch

- No hot work permitted.
- Driving and parking only permitted on graveled surfaces.
- Fire watch shall be on duty during any breaks and for one hour after all power-driven machinery used by the operator has been shut down for the day.
- No smoking on site.

Red Flag Weather Warning

- No hot work permitted.
- On-site personnel must be aware of Red Flag Warning.
- Driving and parking only permitted on graveled or paved (non-combustible) surfaces.
- Fire watch shall be on duty during any breaks and for one hour after all power-driven machinery used by the operator has been shut down for the day.
- No smoking on site.

Table 1: Fire Prevention Measures During Fire Season Summary

Requirement	Non-Fire Season	Fire Season	Fire Weather Watch	Red Flag Warning
Fire weather advisory	Not required	Not required	Not required	On-site personnel must be aware of Red Flag Warning.
On-site water source	N/A	As specified in Section 4.2	As specified in Section 4.2 and 4.3.	As specified in Section 4.2 and 4.3.
Hot work	Only permitted on roads or on non-combustible surfaces.	Only permitted on roads or on non-combustible surfaces; fire watch required for 60 minutes after completion	Not Permitted	Not Permitted
Fire Watch Service	Not required	During breaks and for 60 minutes after all power-driven machinery has been shut down for the day.	During breaks and for 60 minutes after all power-driven machinery has been shut down for the day.	During breaks and for 60 minutes after all power-driven machinery has been shut down for the day.
Driving and Parking	As described in Section 4.5.	As described in Section 4.5.	Only permitted on roads or on non-combustible surfaces and Section 4.5.	Only permitted on roads or on non-combustible surfaces and Section 4.5.
Smoking	Designated areas only	Designated areas only	Not permitted	Not permitted

3.10 VEGETATION MANAGEMENT

3.10.1 Vegetation-free, Noncombustible Space, and Vegetation Standards

Vegetation within the fence line and below the solar arrays will be maintained in accordance with the approved Revegetation and Reclamation Plan for the facility.

- Vegetation will be limited to a height of 3-12" inches during the rainy season (November-May) and cut down and cleared to a minimum 3” during the dry season (June-October), with a minimum clearance of 12 inches from electrical equipment.

- Vegetation near, at, or taller than the maximum height shall be removed or mowed.
    - Mowing must be done in advance of fire season or in accordance to any fire restrictions.
- At no point shall vegetation come in contact with electrical equipment.
- Any vegetation removed from the site will be disposed of and not stored onsite.
- Certificate Holder and contractors will prevent the accumulation of combustible “burn piles” on site.

The following areas will be managed to be vegetation-free, noncombustible space, or gravel surface:

- 16 foot wide service roads within solar fence line - all weather compacted soil or graveled
- 20 feet of noncombustible buffer around the perimeter of the site
- Fenced areas around the collector substation, operations and maintenance structure, and meteorological stations will be graveled, with no vegetation present
- Mnimum 3 foot buffer of non-combustable material between vegetation and electrical equipment outside the fence line.
- All newly constructed roads will be graded and graveled to meet load requirements for all equipment
- Vegetation along service roads will be managed by mowing or other vegetation removal to a minimum vegetation clearance of 10-ft on either side of the service road with a height of 10-12" during the rainy season (November-May) and 1-3" during the dry season (June-October).

Vegetation in these areas will be managed by the following techniques:

- Mowing
- Clearing

4.0 CONSTRUCTION TRAINING(S)

4.1.1 Safety Training

Once a year after construction begins, organize and hold an on-site training with certificate holder and construction personnel, inviting equipment manufacturers, specialty contractors, local fire department(s), participating and adjacent landowners, emergency management office personnel, ODOE, and any other emergency management agency that covers:

- The location of electrical facility components and the fire safety measures associated with each component that have been constructed;
- Description of remaining construction phasing;
- The type, location, and proper use of fire protection equipment;
- Fire protection equipment usage and maintenance requirements;
- The location(s) of water source(s) and proper usage, storing and maintenance for the pump, hose nozzle; and water hose;
- Overview of smoking policy and locations;
- Overview of procedures and restrictions of construction activities during Fire Season, Fire Weather Watches, and Red Flag Warnings designated in this Plan;
- Rescue, Alarm, Contain and Extinguish (RACE) procedures including:

- Rescue anyone in danger (if safe to do so);
- Alarm – call the control room, who will then determine if 911 should be alerted;
- Contain the fire (if safe to do so); and
- Extinguish the incipient fire stage (if safe to do so).

- Provide information and encourage attendees County's emergency management notification system.

APPENDIX M1
ATTACHMENT 04
EXHIBIT 01

GENERAL ELECTRICAL STUDY REQUIREMENTS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	26Oct21	Issued for Implementation	1898 & Co.		JAL	Jared Lathrop
1	14Apr23	Update from 2021 Version	1898 & Co.	PGE	CPA	Craig Armstrong
2	19Jun25	Update from 2023 version	1898 & Co./PGE	PGE	SPF	Sean Flak

TABLE OF CONTENTS

1.0 SCOPE

1.1 GENERAL

This specification covers the technical requirements for electrical system studies. The Contractor shall provide electrical system studies for the entire project, including arc flash hazard, load flow, short circuit, relay coordination, insulation coordination, DC/UPS sizing and grounding calculations.

The electrical system studies shall be prepared by the Contractor's qualified engineers or by an approved consultant. The coordination study and analysis shall be signed and sealed by a registered Professional Engineer. The Contractor is responsible for providing all pertinent information required by the preparers to complete the study.

1.2 STANDARDS AND DOCUMENTS

Calculation and documentation shall be performed in accordance with the applicable standards in M4-01-01 (Energy Storage Technical Specifications).

2.0 SOFTWARE AND MODELING REQUIREMENTS

Electrical system studies (3.1) shall be performed utilizing Easypower software (Contractor shall confirm acceptable software version with Owner). Systems or components considered as part of the Bulk Electric System (BES) shall be modeled using Aspen OneLiner (Contractor shall confirm acceptable software version with Owner). Contractor shall follow Owner's modeling and naming conventions. Examples of BES components are collector circuits, substation, and switchyard equipment. The Easypower/Aspen model shall include a complete system one line diagram with the following minimum requirements:

1. Utility source information including calculated maximum and N-1 three-phase and single line-to-ground short-circuit current values and X/R ratios.
2. Bus nodes with ampacity and voltage ratings, and available short circuit current.
3. Transformer ratings with all MVA ratings, voltage ratings on all windings, positive and zero sequence impedance ratings of each winding connection (primary- secondary, secondary-tertiary, primary-tertiary), load tap changer ratings, de- energized tap changer ratings, and inrush currents.
4. Cable and iso-phase bus size, type, impedance, and cable lengths within 10 feet of actual (through the 480 V level).
5. Circuit breaker or protective device make and model, frame ampacity, trip plug rating, and protective settings.
6. Motor circuit protectors make and model, ampacity, and protective settings.
7. Motor loads including horsepower, voltage, full load amps, and locked rotor amps.
8. Variable speed drives and protective settings.
9. Generators, including all nameplate information. Modeling of inverter-based generation as a synchronous generator is not permitted.
10. Neutral grounding resistor/transformer size and ratings.
11. 480 V panelboards including all branch circuit information.
12. Protective relay make, model, and protective settings.
13. DC/UPS chargers, inverter, batteries, disconnects, and panelboards.
14. 120/208 V panelboards including all branch circuit information.

15. As agreed upon by Owner, below a certain KVA, any loads fed from a single distribution panel, including aggregated power sources, can be lumped together as an individual element within the model.

In addition, Contractor shall provide RMS power flow and transient stability models in PSS/E or PSLF format and EMT models in PSCAD format.

3.0 DESIGN CALCULATIONS

3.1 ELECTRICAL STUDIES

3.1.1 Load Flow

Prepare a load flow study in PowerWorld to determine the steady state loading profile of the project electrical system. Alternatively, PSS/E or PSLF formatted files can be provided.

Review the load flow study results and provide a listing of electrical equipment that shows overload, based on National Electrical Code loading requirements

Present the data conclusions of the load flow study in a table format. Include the following:

1. Bus identification
2. Bus nameplate ampacity
3. Operating voltage
4. Load Current

3.1.2 Reactive Power

Prepare a reactive power study to determine the reactive power capability of the project including additional reactive power compensation equipment to meet interconnection requirements as necessary to supplement site generation equipment reactive power capability, if applicable. Study shall include determination of voltage step due to capacitor switching to confirm compliance with power quality requirements including flicker. The study shall identify reactive compensation required to meet the project requirements, including the interconnection agreement requirements for power factor and voltage regulation, and including any capacitor bank and/or reactor requirements. This study shall include combinations of (a) active power (no load to full load at ten percent (10%) increments); and (b) voltage (0.95 to 1.05 pu) at the point of interconnection, or more stringent as necessary to meet project requirements, including the interconnection agreement and compliance with FERC Order 827.

A pre-construction reactive compensation study and an as-built reactive compensation study, respectively, shall be submitted.

3.1.3 Thermal Ampacity

Prepare a thermal ampacity study to determine the underground MV and LV cables are adequately sized for the worst-case load current. Study shall include modeling of all trench and bore configurations including supporting assumptions of soil rho, native or non-native backfill, temperature, and compaction.

This study shall include all medium-voltage cable and low-voltage cable (from the turbine to the pad-mounted transformer). The final report shall include a table showing cable ampacity and percent loading per cable section corresponding to the Project one- line diagram. Cable ampacity shall not cause the operating temperature of cable insulation to exceed 105C or temperature limits as specified in this study, whichever is less. All external heat sources shall be considered, including parallel circuits. Thermal design shall account for actual field soil samples, maximum ambient temperature as defined by historical weather data, and backfill requirements (native or engineered).

3.1.4 Electrical Losses

Prepare an electrical losses study to determine the total power losses and annual energy losses from generation unit to point of interconnection. This study shall be sufficient to demonstrate that the, as defined in the Contractor scope of work, is not being exceeded, and shall be based upon project-specific cabling and transformer specifications, Project site-specific soil conditions, project site-specific operating data, and other similar considerations. A pre-construction annual energy loss study and an as-built energy loss study, respectively, shall be submitted. The energy loss calculation shall include supporting assumptions and breakdown of subsystem loss contribution.

The loss study shall be based on IFC drawings and be revised following construction to include any material changes to the EBoP in as-built drawings.

3.1.5 Short Circuit

Prepare a short-circuit study for electrical equipment provided for the project.

The Contractor shall request from the Owner the available fault ratings of the source utility connection. The Owner shall provide the fault ratings no later than 28 days upon receiving the request from the Contractor.

Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate the motor contribution in determining the momentary and interrupting ratings of the protective devices. Short circuit analysis shall be run at a collection system pre-fault voltage of nominal voltage of 105%. In addition, the report shall consider all short circuit scenarios when the bus ties are closed and when the bus ties are open. This study shall include maximum and minimum fault current results for three-phase, single phase-to-ground, phase-to-phase, and double phase-to-ground faults at each of the collection system circuits, the project substation, and the interconnection line.

Collection power cables and grounding conductors shall be sized to appropriately withstand maximum fault currents for the duration that is specified in the interconnection agreement or other requirements as provided in the scope of work contract, whichever is greater.

The short circuit study shall be utilized in Contractor’s electrical designs to support a coordination study and equipment specifications.

Fault current results in this study will also include direction fault current data which may be used in the coordination study.

Analyze the short-circuit calculations, and highlight equipment determined to be underrated regarding fault duty as specified. Propose approaches to effectively protect the underrated equipment.

Present the data conclusions of the short-circuit study in a table format. Include the following:

1. Device identification
2. Operating voltage
3. Device rating
4. Calculated short-circuit current (symmetrical and asymmetrical)

3.1.6 Motor Starting Study (if required)

Prepare a static motor starting study for electrical equipment provided for the project. The motor starting study shall evaluate the capability of the auxiliary power system to start the largest motor load on the MV and LV systems at normal operating voltage (100%) as well as the minimum operating voltage (95%) with transformers at nominal tap.

Cases shall also be run for startup (back fed from system no generator online) and normal (generator online).

The report should confirm that the motor terminal voltage does not dip below the minimum starting motor terminal voltage of 80%.

Present the data conclusions of the Motor Starting study in a table format. Include the following:

1. Device identification
2. Operating voltage
3. Motor terminal voltage during starting

3.1.7 Coordination Study

The Contractor shall provide a selective coordination study using Aspen OneLiner for any elements considered part of the Bulk Electric System (BES) or Easypower (if preferred) for non-BES and auxiliary power elements (Easypower to be populated with Aspen OneLiner results) with an organized time-current analysis of each protective device in the project. The coordination study scope shall include protective devices including the entirety of the project substation, collection system, generators, and switchyard as applicable. This study shall provide detailed calculations, one-line and three-line diagrams, fuse curves, coordination curves, protected equipment data, and relay set points. This study shall also consider and coordinate with the interconnection utility's reasonable requirements. A narrative philosophy statement shall be submitted, as well as a review of the short-circuit model data for the BES elements, and review of the developed settings to be submitted for comment before completing the coordination study and the proposed settings shall be shared with relevant stakeholders (e.g., OEM) for implementation prior to energization. Contractor shall be responsible for obtaining approval from the utility for the proposed relay settings and coordination with the Utility's protection and control scheme.

The coordination study shall consider maximum and minimum fault current results as determined by the short circuit study.

Contractor shall communicate with the interconnecting switchyard/substation owner to coordinate remote-end line relay settings between the interconnecting switchyard/substation and the project substation.

Prepare the coordination curves to determine the required settings of protective devices to ensure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between series devices, including the utility company upstream device. Plot the specific time-current characteristics of each protective device in such a manner that upstream devices are clearly depicted on one sheet.

After developing the coordination curves, highlight areas lacking protective coordination. Present a technical evaluation with a discussion of the logical compromises for best coordination.

The following information shall also be provided on the time coordination curves:

1. Device identification
2. Voltage and current ratio for curves
3. 3-phase and 1-phase ANSI damage points for each transformer
4. Transformer inrush points
5. No-damage, melting, and clearing curves for fuses
6. Cable damage curves
7. Maximum short-circuit cutoff point
8. Minimum short-circuit cutoff point

Develop a table to summarize the settings for the protective devices. Include the following in the table:

1. Device identification
2. Relay CT ratios, tap, time dial, and instantaneous pickup
3. Circuit breaker sensor rating, and all protective elements as specified in the protection and control drawings
4. Fuse rating and type

3.1.8 Arc Flash Hazard Study

An arc flash hazard analysis shall determine the arc flash boundary, the incident energy at the working distance, and personal protective equipment that people within the arc flash boundary shall use. These results shall be provided for all reasonably operated enclosures and corresponding buses at major substation equipment, collection system, transformers (including pad-mounted), switchgear (as applicable), operations and maintenance building, and other major components, as applicable.

The Contractor shall perform an Arc Flash Hazard Study in ArcPro or ASPEN (as supported) for all BES and collector circuit elements, or Easypower (if preferred, for supported balance-of-plant/auxiliary elements only) as identified. Arc flash calculations for equipment operating between 208 VAC and 15kVAC shall be conducted in accordance with IEEE 1584. The following modeling requirements shall apply:

- In addition to IEEE 1584 recommended scenarios, scenarios shall include maintenance mode selection of switchgear protective relays.
- As identified in NPFA 70E Article 130 the Arc Flash Boundary shall be the distance at which the incident energy equals 5 J/cm2 (1.2 cal/cm2).

Develop a report to summarize the arc flash hazard information at electrical equipment rated 120 volts or greater. The report shall provide the following information for each piece of electrical equipment:

1. Available incident energy and the corresponding working distance
2. Minimum required level of PPE to meet incident energy calculations
3. Highest Hazard/Risk Category (HRC) for the equipment
4. Nominal system voltage
5. Arc flash boundary
6. Electrode configuration used to determine arc flash results

3.1.9 Insulation Coordination

Contractor shall provide an insulation coordination study to ensure the insulation coordination requirements of IEEE C62.22 have been satisfied within the project's electrical design, including proper application of surge arresters to safeguard electric power equipment within the collection system circuits, substation, and interconnection line against hazards of abnormally high voltage surges of various origins. This study shall also confirm any system modifications required to adequately limit transient overvoltage on the collection system circuits, including determination of the transient overvoltage levels on the collection system circuits after feeders have been isolated from the project substation due to a line-to-ground fault or lightning strike, and determination of the maximum energy required to be absorbed by each surge arrester on the collection system circuit feeders Contractor shall provide calculations which verify that each equipment's basic insulation level, basic switching impulse level, and chopped wave withstand rating are acceptable. Contractor shall also provide protective ratio calculations and verify that insulation coordination has been met as defined in the most recent revision of IEEE standard C62.22 or superseding equivalent.

3.1.10 Transformer Sizing

Transformer sizing calculations, including medium-voltage and main power transformers, shall be provided prior to procurement of any power transformer.

3.1.11 DC/UPS Sizing

A DC and UPS sizing calculation shall be provided to verify that the DC and UPS systems are adequately sized for the project. The Contractor shall provide the initial calculation prior to procurement of the equipment. The supplier of the equipment shall also submit a battery sizing calculation to validate the project specific battery. This study shall determine if the minimum voltages are maintained as specified and required by equipment vendors. The DC system shall be sized to accommodate future loads for ultimate switchyard configuration.

The calculation shall include:

1. A UPS Load List (indicating a load factor and diversity factor)
2. A DC Load Cycle
3. A battery sizing calculation per IEEE 485 (including 10% design margin and 125% aging factor)
4. Battery Charger sizing calculation

3.1.12 Grounding Calculation

Grounding calculations shall confirm that the grounding systems be provided at the substation and each generation location to assure that a person in the vicinity of grounded facilities is not exposed to the danger of critical electric shock. The grounding calculations shall be performed in CDEGS software and provided to Owner for review. The calculations must establish:

1. Touch and step potentials are within tolerable safe limits in accordance with IEEE 80.
2. Ground grid resistance is low enough to limit the ground potential rise (GPR).

In addition to IEEE 80 recommended practices, the following requirements shall be followed:

1. Most conservative body weight shall be assumed (50 kg).
2. A minimum of 3000 Ohm-meter surface rock to be installed. Surface rock to be 4” in depth with an appropriately compacted base later of ¾” minus and no felt separating the layers.
3. As-built crushed rock depth shall be recorded and updated in the calculation.

CDEGS software shall conform to the following:

1. Software Version: Contractor shall verify acceptable version with Owner.
2. Multi-layer soil model in RESAP
3. Grounding Plan in SESCAD
4. Step and Touch Potentials in MALZ
5. This study shall consider clearing time in the event of a breaker failure for the purpose of determining if the grounding design (e.g., ground potential rise) is acceptable.

3.1.13 Harmonics Study (if required)

A harmonics study shall confirm that the generation plant harmonics output does not exceed limits required by generator interconnection requirements, IEEE 2800, and IEEE 519. This study shall provide recommendations for the use of harmonic filters, equipment, and methods as necessary to meet these requirements and provide the Total Rated Distortion (TRD). A pre-construction harmonic analysis report (performed at 90 percent design) and an as-built harmonic analysis report, respectively, shall be submitted.

3.1.14 Subsynchronous Resonance Study (if required)

A subsynchronous resonance study shall confirm no subsynchronous resonance issues or mitigation is required. EMTP software shall be used (Owner to approve software version).

3.1.15 Effectively Grounded Study

An effectively grounded study shall confirm that the project is considered effectively grounded, as defined in IEEE C62.92.1.

3.1.16 Auxiliary Power Study

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

3.1.17 Bus Structural Analysis Study

A substation bus structural analysis study shall confirm that the structural design in the project substation including bus, insulators, bus structures, and foundations, and based upon the most stringent combination of wind, fault current, and ice load factors, as defined in the applicable standards and other applicable requirements are acceptable.

3.1.18 Substation Bus Design Study

A substation bus design study shall perform an analysis of the buses, disconnect switches, and separately mounted current transformers within the project substation to confirm that the ampacity, structural integrity, vibration, and required mechanical and electrical ratings are in accordance with the methods and recommendations of IEEE 605. Bus design, including gust factor, exposure height factor, importance factor, and corona considerations, shall be in accordance with the procedures and data given in IEEE 605.

3.1.19 Substation Lightning Study

This study shall provide direct stroke protection analysis for lightning at the project substation based upon project site-specific determinations for thunderstorm days, thunderstorm duration, isokeraunic levels, exposure, and other similar factors. The direct stroke protection system design shall include analysis using (a) the rolling sphere method of the electrogeometric model given in IEEE 998 for high-side equipment and (b) the fixed angle method for low-side equipment. The direct stroke protection system design shall be in accordance with the procedures, data, and methods given in IEEE 998.

3.1.20 Substation Lighting Study

This study shall provide lighting illumination calculations for the project substation to determine the illumination levels within the new substation that will be achieved with added luminaries.

3.1.21 Field Effect Study

Provide Field Effect study for transmission line. Calculations shall be made for measurement heights of 1 meter above ground surface in areas accessible to the public, within the ROW. Electric Field Strength shall be calculated for the line voltage as well as any under build. Magnetic Field Strength shall be calculated at full rated ampacity, with balanced phase currents.

4.0 NERC COMPLIANCE

The project shall be designed to comply with all applicable NERC requirements, including provision of the studies and criteria set forth in M1-01-07. Studies shall be completed prior to synchronizing. Contractor shall provide models for studies as listed in subsections c, d, e, f, and g prior to synchronizing, but these models will be verified during project commissioning.

5.0 REPORTS AND DELIVERABLES

5.1 APPROVAL REPORTS AND SOFTWARE FILES

The Contractor study preparer shall analyze the electrical system studies, prepare, and submit an approval report for each study that is required. Each report shall include executive summary, assumptions, methodology, analysis, and conclusion sections.

Analysis sections shall summarize the results of each study and reports any deficiencies found with suggested corrections that should be made. Each report shall be submitted with the native software files and any referenced files for the Owners use in reviewing.

The Contractor shall provide Owner completed study reports for approval prior to proceeding with study results in accordance with Appendix M1 Attachment 01 Exhibit 02 – Engineering Documents, Drawings & Other Deliverables.

One month prior to construction completion, the Contractor shall provide the Owner two hard copies and two electronic copies of the completed electrical system as-built studies, including native software files, in accordance with Appendix M1 Attachment 01 Exhibit 02 – Engineering Documents, Drawings & Other Deliverables. The Owner shall be given 14 days to review the as-built electrical system studies and software files and provide review comments to the Contractor.

5.2 FINAL REPORTS AND SOFTWARE FILES

Upon receipt of the Owner's review comments, the Contractor shall incorporate comments into a final electrical system study report. 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 state where the Project is located. Such professional engineer(s) shall be registered in the applicable discipline for the reports being signed and sealed.

For the coordination study, after commissioning is complete, the Contractor shall verify the study protective device settings corresponding to the device settings in the field and resolve any conflicts.

The Contractor shall provide the Owner two hard copies and two electronic copies of the final electrical system studies in accordance with Appendix M1 Attachment 01 Exhibit 02 – Engineering Documents, Drawings & Other Deliverables. The Contractor shall also provide the Owner with a copy of the native data files for their use. Native data files for generation facilities shall include:

1. Detailed Load Flow / Dynamic (RMS) Model: PSLF or PSS/e model of the entire facility
2. Detailed Transient Stability Model: PSCAD model of the entire facility
3. Aggregate Load Flow / Dynamic (RMS) Model: PSLF model from NERC testing would satisfy this requirement

APPENDIX M1
ATTACHMENT 04
EXHIBIT 02

GENERAL TRANSFORMER SPECIFICATION

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	26Oct21	Issued for Implementation	1898 & Co.		JAL	Jared Lathrop
1	14Apr23	Update from 2021 Version	1898 & Co.	PGE	CPA	Craig Armstrong
2	6/17/2025	Updated for 2025 Version	PGE	PGE	PNK	Paul Kruger

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1.0 GENERAL

This specification covers the general design, construction, and operating requirements for oil-immersed outdoor station type power transformers, Wind turbine pad-mounted step-up transformers and ground reference transformers.

2.0 POWER TRANSFOMERS

Main Power Transformers (MPT) and Generator Step Up Transformers (GSU) shall follow, to the greatest extent possible, the requirements outlined in PGE Standard:

- SDS-M010 (in Section M1-04-02-01 via secure website)
- SDS-M011 (in Section M1-04-02-02 via secure website)

PGE Standards referenced in this specification will be made available to bidders via a secure website following execution of the RFP Non-Disclosure Agreement (NDA).

The Contractor shall submit their transformer specification to the Owner for review and approval before purchasing a power transformer.

For Main Power Transformers associated with collector stations, interconnecting at 230kV, the following specifications are preferred:

- (HV, MV) Continuous MVA Ratings: 96/128/160MVA (full tapping range)
- Tertiary winding MVA Ratings: The tertiary windings shall be rated at least 35% of the main HV & MV windings' ONAN / ONAF / ONAF MVA ratings.
- Number of Windings: 2 (HV, MV) + 1 (13.8kV) Stabilizing TV Winding
- Winding Connection (HV/LV/TV): Ynynd1 (Wye-gnd/Wye-gnd/Delta corner ground)

3.0 WIND TURBINE PAD-MOUNTED STEP-UP TRANSFORMERS

Pad-mount transformers associated with wind turbines shall follow the requirements outlined in "Wind Farm Electrical Technical Specification for Wind Pad Mount Transformers."

4.0 GROUND REFERENCE TRANSFORMERS (GRT)

The "GROUND REFERENCE TRANSFORMER (GRT) SPECIFICATION" is included as part of the specification for reference. The Contractor should utilities this when developing specifications for this class of transformer.

APPENDIX M1
ATTACHMENT 05
EXHIBIT 02

SUBSTATION ENGINEERING SPECIFICATIONS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	6/17/25	Issued for Implementation 2025	PGE	PGE	PNK	Paul Kruger

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1.0 GENERAL INFORMATION

In the event of any conflict or discrepancy between this exhibit (including any attachments hereto) and any other Requirement, the more stringent or higher quality Requirement shall take precedence over the less stringent or lesser quality Requirement at Portland General Electric's discretion.

1.1 OVERALL SCOPE OF ENGINEERING

Contractor shall supply all engineering design services required for the XXXX Project unless otherwise noted in this specification. The engineering design shall comply with all documents in the Contract, including this specification, all provided Owner standards, and meet or exceed all applicable Industry Standards. The Owner standards are provided in XXXX and a list of Industry Standards is listed below in *Section 1.1*.

This Engineering Specification describes the minimum requirements for the Substation design. It is the Contractor's responsibility to ensure that all necessary drawings and calculations are developed to accurately represent and support the design. Contractor shall also develop all drawings and calculations necessary to support the permitting for this Project.

All engineering drawings shall be developed in AutoCAD using Owner provided Drafting Standards.

Contractor shall supply all required engineering calculations and studies for Owner review and Approval as required in this specification. In addition, any Contractor identified calculations necessary for the engineering design of the Substation shall also be submitted for Owner review and Approval. Calculations must clearly state all assumptions used to support the results. All submitted calculations shall use the software described in *Section 1.3* or elsewhere in this specification. When not specified, software used to support engineering calculations shall be Contractor choice with written Owner Approval.

The Substation Engineering Specification shall be used for developing the Substation design, however does not comprise the full scope of services required by the Contractor. The full extents of these additional services are described in the EPC Administrative Requirements specification.

1.2 STANDARDS AND APPLICABLE LAWS

1.2.1 PGE Standards, Practices, and Design Masters

Consultant shall supply all engineering design services based on the most updated versions of the PGE standards and design masters at the start of design. The current version of the standards have been provided with this Specification.

1.2.2 Industry Standards and Applicable Laws

The following industry standards published by the following industry organizations, associations or groups are part of the Project requirements and when referred to by title or basic designation only are applicable to the extent indicated by the specific reference.

Reference to (a) Industry Standards or (b) Applicable Laws shall mean the standards or laws adopted and published as of the release date unless specifically stated otherwise.

The Industry Standards or Applicable Laws referenced (including addenda, amendments, and errata) shall govern in all cases where references thereto are made except where they conflict with the requirements of the Project. A conflict shall be brought to Owner's attention for an Owner decision on which standard(s) or law(s) will govern.

If the Contractor becomes aware after the release date of a change in an Industry Standard or Applicable Law affecting the design or work to be performed, the Contractor shall promptly advise Owner of such change.

Reference Abbreviation	Name
AA	Aluminum Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISE	Association of Iron and Steel Engineers
ANSI	American National Standards Institute
API	American Petroleum Institute
AREMA	American Railway Engineering and Maintenance Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CMAA	Crane Manufacturer Association of America
CRSI	Concrete Reinforcing Steel Institute
EIA	Electronic Industries Alliance
EPA	Environmental Protection Agency
HMI	Hoist Manufacturer's Institute
IBC	International Building Code
ICEA	Insulated Cable Engineers Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
ISO	The International Organization for Standardization
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
OSSC	Oregon Structural Specialty Code
SAE	Society of Automotive Engineers
SDI	Steel Deck Institute
SSPC	Structural Steel Painting Council
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories, Inc

Contractor shall use ANSI standard units of measure on all submittals to Owner. Vendor drawings that contain other systems of measurement are acceptable if they also provide the equivalent ANSI units of measure.

1.2.3 List of Standards

In addition to Owner provided standards, the following table is a list of standards to be utilized throughout this Project. The latest edition of each standard is to be utilized unless otherwise noted.

Standard Reference	Title
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 336.3R	Suggested Design and Construction Procedures for Pier Foundations
ACI/MSJC 530	Building Code Requirements for Masonry Structures
AISC 360	Specification for Structural Steel Buildings
ANSI/ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASCE 113	Substation Structure Design Guide
ANSI/IEEE 525	Guide for the Design and Installation of Cable Systems in Substations
ANSI/IEEE 80	Guide for Safety in AC Substation Grounding
ANSI/IEEE C2	NESC National Electrical Safety Code
ANSI C37.2	Standard Electrical Power System Device Function Numbers, Acronyms and Contact Designations
ANSI/IEEE C37.21	Standard for Control Switchboards
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel
ASTM A143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A385	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM F436	Standard Specification for Hardened Steel Washers
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A615	Standard Specification for Deformed and Plain Billet Steel for Concrete Reinforcement
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992	Standard Specification for Structural Steel Shapes
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ICEA S-94-649	Extruded Insulation Power Cables Rated 5 kV though 46kV
ICEA S-108-720	Extruded Insulation Power Cables Rated Above 46 kV through 345 kV
AEIC CS8	Specification for Extruded Insulation Power Cables and Their Accessories Rated 5 kV Through 46kV
AEIC CS9	Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46 kV Through 345kV
IEEE 1300	Cable Connections for Gas Insulated Substations
IEEE 1264	Guide for Animal Deterrents for Electrical Power Supply Substations
IEEE 1818	Guide for the Design of Low-Voltage Auxiliary Systems for Electric Power Substations

Standard Reference	Title
IEEE 367	Recommended Practice for Determining the Electric Power Station Ground Potential Rise and Induced Voltage from a Power Fault
IEEE 450	Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations
IEEE 484	Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations
IEEE 485	Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations
IEEE 605	Guide for Design of Substation Rigid-Bus Structures
IEEE 693	Recommended Practice for Seismic Design of Substations
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 979	Guide for Substation Fire Protection
IEEE C37.99	Guide for the Protection of Shunt Capacitor Banks
IEEE C57.13	Requirements for Instrument Transformers
IEEE C57.13.3	Guide for the Grounding of Instrument Transformer Secondary Circuits and Cases
NEMA 250	Enclosures for Electrical Equipment
NFPA 70	National Electrical Code

1.3 DESIGN SOFTWARE

The following table is a list of required design software for this Project. See the individual sections for further explanation for the use of each software package. Any other software packages and must be Approved by Owner prior to their use. Contractor shall coordinate with Owner for which versions of each software package are acceptable. In general, the latest version available is preferred.

Software Function	Software Name
Word processing	Microsoft Word
Spreadsheets	Microsoft Excel
Database	Microsoft Access
Design Drawings	AutoCAD
Grading Design	AutoCAD Civil 3D
Drilled Piers Foundation Design	Ensoft Lpile
Structural Design	RISA 3D
Vehicular Access	AutoTURN
Cable Ampacity	CYMCAP
Cable Pulling	Pull-Planner
Grounding Analysis	CDEGS
Lighting Analysis	Visual Lighting
Sag-Tension Calculations	SAG10

1.4 SUBMITTAL REQUIREMENTS

Contractor shall follow the Owner's submittal process described in M1-01-02.

1.4.1 Record Drawings

During Construction, Contractor shall keep accurate written records of all design changes that deviate from the Issued for Construction drawings, referred to as As-Builts (or Redlines). All changes shall be marked on the Issue for Construction drawing set as designated by the Contractor for this purpose. These drawings and documents must always remain on site. Supplemental detailed sketches may be included with this set when there is insufficient space to document in the drawing.

Prior to Project Substantial Completion, Contractor shall supply scans of all final As-Builts to the Owner for their use. The scans must be sufficient quality, so the field marks are legible to the Owner. Contractor shall be readily available to respond to any questions from the Owner to clarify any As-Builts. The original As-Builts shall be left in the Control Enclosure in one stack, in drawing number order, and clearly designated as the As-Builts set for the Owner.

Contractor shall update and resubmit any models, studies, or calculations that are affected by the As-Builts changes.

Owner shall update all other drawings and documents for incorporating the As-Builts.

Contractor shall verify Owner has copies of all final versions of CAD drawings, Calculations, and Studies submitted by the Contractor prior to Project Substantial Completion.

2.0 MAJOR SUBSTATION EQUIPMENT

2.1 GENERAL

Contractor shall specify and procure all major substation equipment using PGE approved Vendors.

Contractor shall review each Major Equipment manufacturer's design, and provide comments and recommendations to ensure apparatus conforms to the Substation engineering design. All recommendations shall be coordinated with and Approved by the Owner. Owner shall be provided all design reviews for an opportunity to review.

The Contractor shall be responsible for attending the Factory Acceptance Testing (FAT) for all the equipment procured. The Owner may also attend at their discretion. Contractor shall coordinate with Owner for the FAT schedule.

2.1.1 Transformers

Transformers shall comply with Owner Specification M1-04-02.

2.1.2 Circuit Breakers

2.1.2.1 General

The interrupting and continuous duty of the breakers shall not exceed 85% of their rating

2.1.2.2 High Voltage Circuit Breakers

High voltage circuit breakers shall comply with Owner Specification SDS-M030

Mounting provisions shall be formed-steel supports that mount the breaker to a foundation and provide height adjustment.

2.1.2.3 Medium Voltage Circuit Breakers

High voltage circuit breakers shall comply with Owner Specification SDS-M036

Mounting provisions shall be formed-steel supports that mount the breaker to a foundation and provide height adjustment.

The low voltage compartment shall contain the protective relays, controls, and meters for the circuit breaker.

2.1.3 Circuit Switchers

High voltage circuit switchers shall comply with Owner Specification SDS-M034.

2.1.4 Disconnect Switches

Disconnect switches shall comply with Owner Specification SDS-M050

The substation shall include the use of manually-operated disconnect switches. Feeder switches which are located between a feeder and a bus on the generation- side of a power transformer shall be worm gear or swing handle in type. Switches which separate a generator-side substation bus and a power transformer shall be group-operated and worm gear in type. Disconnect switches on the line-side bus of the power transformer shall be group-operated, and a disconnect switch which separates the interconnection line from the substation shall also be group-operated.

2.1.5 Switchgear

Switchgear shall comply with Owner Specification SDS-M047

2.1.6 Instrument Transformers

Instrument transformers shall comply with Owner provided detailed specifications and ratings at time of contract award.

2.1.7 Control Enclosures

Control enclosures shall comply with Owner Specification SDS-M025

Any exposed wall within 50’ and line of site to a power transformer shall be two-hour fire rated per the National Fire Protection Associate (NFPA) guidelines.

Contractor shall be responsible for acquiring all Control Enclosure permits.

Contractor shall be responsible for coordinating delivery and installation of the Control Enclosure per the instructions of the Vendor.

For drawing submittal requirements, refer to Section 1.4.

Relay racks shall comply with PGE Design Master Drawing, MSTR-4800.

2.1.8 Reactors

Reactor banks shall be sized and incorporated into the protect electrical design as necessary to comply with project requirements, including the Interconnection Agreement and FERC Order 827. Sizing of each device shall comply with the Contractor-prepared Reactive Compensation Study as specified in M1-04-01 (General Electrical Study Requirements).

2.2 SUBSTATION ELECTRICAL ARRANGEMENT

The Contractor shall be responsible for the Substation design based on the performance standards laid out in the RFP. This will, at minimum, require verification of compliance with Owner and Industry Standards and Construction Specifications, as well as incorporation of all final Major Equipment drawings.

The electrical clearances for the air-insulated equipment within the Substation shall comply with Owner Standard S-130-04 and IEEE 1427.

The Contractor shall verify the clearances of live parts to grounded metal objects and designated roadways within the Substation. The Substation electrical arrangement shall consider personnel and vehicular accessibility and safety. For recommended electrical working clearances, refer to Owner Standard S-130-04.

In addition to the requirements in the previous paragraph, any overhead bus tie between Switchgear shall allow for drive access of Owner vehicles for maintenance. There shall be a large span between the rated distribution voltage bus supports for this purpose. The height of the bus shall be 21 feet in order to maintain electrical clearances for maintenance vehicles and allow for Owner standard bus support structures to be used. If there are compelling engineering reasons to increase the bus height, Contractor shall provide justification to Owner for Approval, but the height of the bus shall not be less than 21 feet.

Contractor shall ensure the equipment layout design can be safely installed while the existing Substation is energized, if applicable. Contractor shall be responsible for coordinating temporary design modifications required to accommodate the construction sequencing.

The electrical phasing within the Substation shall be dictated by the primary bushing orientation of the power transformer(s). The H1 bushing of the power transformer(s) shall be designated A-phase, H2 as B-phase, and H3 as C-phase. Contractor shall coordinate and ensure incoming transmission lines are the proper phasing.

2.3 RIGID BUS AND CONDUCTOR

The Contractor shall be responsible for designing all electrical connections between major electrical equipment, including any overhead bus tie between switchgear and underground capacitor bank circuits. The electrical clearances of all equipment, rigid bus, and flexible conductors shall comply with Owner Standard S-130-04.

Mechanical loading for rigid bus shall comply with the latest version of IEEE 605. Fault ratings used for bus calculations shall use maximum single line to ground and three phase faults using values provided by Owner. Contractor is responsible for requesting fault ratings in a timely manner that will not cause a delay to the agreed upon schedule. In addition to IEEE 605, the vertical deflection of bus shall be limited as follow:

3” maximum, with design ice & wind on ice.

1.5” maximum, with design wind.

Contractor shall prepare a full set of bus span calculations and submit to Owner as described in *Section 1.4*.

All rigid bus shall be 3” or 5” IPS tubular aluminum, Schedule 40, 6063-T6 or 6061-T6 aluminum alloy, and shall comply with Owner Standard S-131-06. All bus terminal fittings and splices shall be welded. However, fixed and slip rigid bus supports may be either bolted DMC “PLK” or welded hook-type fittings.

Contractor shall use flexible conductor connections between high and low rigid bus runs. Welded A-frames or rigid bus transitions shall not be used.

Elevation changes in the bus to account for grade changes shall be done using flexible jumpers. Bus bends shall not be used without Owner Approval.

Design of overhead strain bus exceeding 40’ in length shall be based on Owner Standard S-130-10. Strain bus spans shall be designed with consideration to vehicular access and equipment maintenance. All spans of strain bus shall be analyzed using SAG10, with worst-case sag conditions shown in graphic and tabular forms within the Substation drawings.

Fittings shall develop the full strength of the conductor and shall be capable of carrying the full current capacity of the conductor.

All Aluminum Conductor (AAC) shall be used for all bare current-carrying flexible conductors within the Substation. Aluminum Conductor Steel Reinforced (ACSR) conductor may be used for connections to instrument transformers, surge arresters, and for smaller conductor sizes that may benefit from the additional reinforcement found in the steel core.

The ampacity of flexible conductor connections shall be at least equal to the equipment being connected. At no point shall the flexible connections be the constraint within the current-carrying path. For tapped positions such as transformers, it is acceptable to size flexible conductor connections according to 150% of the full-load current. The ampacity of flexible conductor connections shall be determined based on Owner Standard S-131-15.

For electrical equipment energized at the nominal transmission and distribution operating voltage, the following flexible conductor arrangements shall meet these minimum requirements:

Required Ampacity	Conductor Arrangement
1200 Amps	1-1590 AAC “Coreopsis” per phase
2000 Amps	2-1590 AAC “Coreopsis” per phase
3000 Amps	2-2250 AAC “Sagebrush” per phase
< 900 Amps (Voltage Transformers, Surge Arresters, etc for voltages greater than 115kV)	1-795 AAC “Arbutus” per phase
< 500 Amps (Voltage Transformers, Surge Arresters, etc. for voltages 115kV and below)	1-336.4 ACSR “Linnet” per phase

Aluminum swage fittings shall be used for AAC and ACSR cable connections. Bolted cable terminals are shall not be used for current carrying conductors on the transmission system (57 kV or greater). They may be used for non-current carrying connections on the transmission system and connections to 13 kV breakers (open air).

All flexible conductor connections shall be designed with seismic considerations. Electrical connections to all major equipment terminals shall be made with flexible jumpers and designed with sufficient slack to allow for seismic movement. Alternative designs including connections made with rigid bus, laminated expansion bands, or expansion terminals shall not be used without written Owner Approval.

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.

For bolting hardware requirements, refer to MSTR-9090-1.

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.

Contractor shall provide electrical connection details for all rigid bus, conductor, and major electrical equipment connections within the Substation Above Grade drawing set.

2.4 CONDUIT AND VAULTS WITHIN SUBSTATION

Contractor shall develop a conduit and cable trench system based on the Conceptual General Layout, Owner Standard S-146-00, and guidelines specified below. Considerations to the planned future site expansion, if applicable, shall be incorporated into the design and construction. Contractor shall consider equipment maintenance access and minimize road crossings when developing the cable raceway design. Conduit shall not be routed under equipment foundations.

All installed cable trench and conduit shall be sized for planned future Substation yard expansion. Spare conduits from cable vaults shall be stubbed, capped, and clearly marked in the field and on the drawings for future construction. In addition to these, Contractor shall also supply spare conduits between cable vaults that are being installed.

If applicable, GIS foundation will have cast-in-place cable trench for GIS cabling and shall be effectively coordinated with the Vendor’s requirements. A cable vault shall be installed to interface with the conduit duct bank and GIS trench system. The cast-in-pace trench shall include:

- Drainage

- Embedded ground pads in the sidewall
- Turnouts for the premade cables supplied by Vendor

Conduit for the distribution feeders shall be designed to interface with distribution vaults located outside of the Substation. Contractor shall be responsible for conduit installation inside the Substation and up to five (5) feet beyond the fence. Contractor shall stub, cap and clearly mark these conduits in the field and on the drawings for Owner use.

Distribution vaults and distribution duct banks located outside of the Substation to be designed by others. Additional information shall be provided by Owner after award of Contract. The conduit design shall not impede installation of planned future switchgear and other equipment. Underground medium voltage cable crossings shall be minimized as much as possible. Conduits shall not cross under any foundations.

Fiberglass sweeps and couplers shall be utilized for applications requiring conduits greater than four (4) inches.

Contractor shall be responsible for supplying conduit with pull rop or mule tape for Owner's Communications and Security designs within the Substation.

Conduits on the Conduit Plan shall be indicated with Quantity, Size, and Material (e.g. 2-3" PVC). All conduits shall have a unique number assigned and listed in the Conduit Schedule. Contractor shall create a conduit schedule for all conduits within the Substation using Owner CCS database. See Supporting Documentation in Section 7 for more details.

Conduit penetrations of the foundations shall not be used without written Owner Approval. When required, they shall be clearly defined in the Conduit Detail and Foundation detail drawings.

Contractor shall provide conduits for control and power cables to each of the Major Equipment based on the following minimum requirements:

Equipment	Conduit Arrangement
Transmission Gas Circuit Breaker	2- 3" PVC
Gas Circuit Switcher	1- 3" PVC
Power Transformer	3- 3" PVC
Transmission & Distribution Capacitor Banks	1- 2" PVC
Instrument Transformers (VT, CT)	1- 2" PVC

All Communications fiber optic cables shall be installed inside innerduct using 4" PVC conduit. Conduits with innerduct tubing for fiber optic cables shall not contain any other types of cables, but may include 3-1" innerducts if doing so does not exceed Industry Standard installation practices.

13 kV and 34.5 kV Underground Distribution Duct Banks

- Refer to Section 2.5 for details

Contractor shall provide conduit details for all Major Equipment. Any required conduit details shall be created by the Contractor.

2.5 SUBSTATION GROUNDING

Contractor shall be responsible for developing the Grounding Plan based on the General Layout and future expansion of the Substation. A grounding analysis must be conducted using CDEGS software to verify the performance requirements of the ground grid. All design methods and calculations shall comply with or exceed the requirements of the latest version of IEEE 80 and Owner Standard S-140-00.Contractor shall also evaluate the impact of the ground grid design on any other nearby utilities such as sewer and water.

Contractor shall be responsible for performing resistivity measurements following the requirements outlined in Owner Standard S-140-50 and verifying the accuracy of the results. Owner to provide fault data and specify the safety margin used for the specific analysis.

Contractor Shall perform a current injection continuity check of the ground mat following installation. If these results do not comply with the finalized ground grid calculations as defined in M1-04-01-General_Electrical_Study_Requirements, then Contractor will, at their expense and at Owner's approval, make adjustments to the ground grid construction to meet applicable ground grid requirements.

The Below Grade ground grid conductor size shall be 250 kcmil soft drawn copper with 19-#9 copper-clad steel stingers used for equipment grounding. All Below Grade grounding connections shall be copper swage fittings. Ground rods shall be ¾" diameter copper-clad steel, and of 8' length. 16' lengths (two coupled 8' rods) are acceptable if required for IEEE 80 compliance. The use of exothermic grounding connections shall not be used without prior written Owner Approval. Above Grade grounding connections to structures and equipment may be made with compression or bolted fittings.

Contractor shall provide grounding details for all Major equipment within the Substation Design Drawings. Refer to the Design Masters for Owner grounding detail standards. Any required grounding connection details shall be created by the Contractor.

2.6 13 KV AND 34.5 KV UNDERGROUND DISTRIBUTION CABLES

Contractor shall be responsible for designing and installing the conduits and duct banks for the Medium Voltage (MV) underground cables within the substation. For the distribution feeder duct banks, the Contractor design shall extend to five (5) feet beyond the Substation fence. Contractor shall stub, cap and clearly mark these conduits in the field and on the drawings.

The duct bank and conduit design must consider the operating parameters of the cable, cable bending radius limitations, pulling tensions, sidewall pressures, and coordination of other underground facilities and foundations within the Substation. Minimum conduit size shall be 6" PVC schedule 40. Fiberglass conduit may be used if PVC does not meet the engineering requirements. Contractor shall supply section views of the duct bank design with sufficient detail to be able to adequately review.

Conduit fill shall meet the recommendations of IEEE 525.

Contractor shall be responsible for installing and procuring materials for all MV cable terminations inside the Substation. All terminations shall be 3M cold shrink type and with weather sheds for outdoor terminations.

Medium Voltage cables and terminations shall comply with Owner Standards LD32020 ,LD32021, LD32023, and LD32024.

2.7 UNDERGROUND MEDIUM VOLTAGE SWITCHGEAR BUS TIE

For projects with a planned or installed underground switchgear bus tie, the Contractor shall verify the current buildout will not impede the ability to install the Underground Bus Tie. Contractor shall provide a proof of concept design that adequately demonstrates that any future Underground Bus Tie between switchgear can be installed without the use of extraordinary construction methods.

The Contractor shall perform a thermal modeling and ampacity study for all distribution ties within the Substation. This model and an accompanying analysis report shall be submitted for review with the 60% and 90% Below Grade Design. Analysis report shall provide thermal concrete and thermal backfill specifications if applicable.

Contractor shall provide all engineering drawings and supporting calculations required to adequately demonstrate the construction of the Underground Bus Tie and ability to meet all specification requirements. These shall include but are not limited to:

- Above Grade Elevations and Construction Details
- Bus Tie Termination Structure and Foundation(s) design
- Cross section views of the Duct Bank detailing feeder spacing, depth and dimensions with respect to the Substation Baselines and/or other foundations.
- Thermal Concrete and Thermal Backfill specifications
- Vault details (if applicable)
- Pulling Tension Calculations
- Cable Ampacity Calculations
- Medium Voltage Cable Material specification

2.8 ANIMAL MITIGATION

Contractor shall install animal mitigation using Owner Approved materials per Owner Standard S-130-50

All post insulators used to support 13 kV bus and other 13 kV connections shall be rated for 34.5 kV minimum.

The metalclad switchgear Equipment Specification includes Owner standard animal mitigation requirements for the rooftop supports and entrance bushings. These ratings shall not be modified by the Contractor.

2.9 LIGHTNING PROTECTION

Lightning protection shall be designed in accordance with IEEE 998.

Fittings for shield wire dead ends, splices, and taps shall conform to the following:

- Shield wire dead-end fittings shall be compression type with bolted jumper connection. Shield wire insulators shall be located as indicated.
- Compression sleeves for shield wire tension splices shall be used which will develop at least ninety percent (90%) of shield wire strength.

Overhead shield wires installed on the take-off towers and lightning masts shall be provided for protection from direct lightning strikes. The shield system shall be adequately tied into the project substation ground grid.

Steel masts for direct stroke protection shall be round tapered seamless extruded or spun aluminum tubes.

- The overall height of the masts above grade shall be determined from the direct stroke protection study, as defined by requirements set forth in M1-04-01 (General Electrical Study Requirements.
- Masts shall have a single uniform taper from top to bottom.
- Each mast shall be capped with a suitable finial.

- Each mast shall be equipped with an internal vibration dampening device.
- The design of masts shall have a safety factor of two (2) based on the allowable

3.0 SURVEY

3.1 SURVEY

The Contractor shall perform a topographical survey of the substation site extending 100 feet in all directions beyond the proposed site boundary. The survey shall be represented on a single continuous map with one (1)-foot contour intervals. All data shall be supplied in state plane coordinates per the applicable local datum.

Establish the baseline monuments and gather all planimetric data within the impact zone of the substation. Locate section and/or quarter corners and property corners that lie within or adjacent to the site and can be located after a reasonable search. Monument property corners for use by construction Contractor in establishing locations for construction.

Plot and identify the substation baselines and baseline monuments. Show all planimetric features within the substation boundary as identified in the topographic survey. Include the location of roads, fences, trees, drainage features, railroads, canals, buildings, foundation remains, existing power and/or communication lines (all structures), and other permanent features. All points shall conform to the provided feature code list.

Perform subsurface utility survey to tie in underground facilities that parallel or cross the proposed property and distribution centerline. Request and coordinate underground utility locations. Obtain, review and incorporate the underground electric, telephone and other communications, water, sewer, gas, storm drain and other underground facility maps into the final survey. Locate subsurface utilities using soft digs to expose and identify the location of subsurface facilities in critical areas, where apparent conflicts exist with the proposed project.

The Contractor shall provide an option for ground based LIDAR for surveying the Substation site, as well as the area for the distribution circuits. This shall be provided as an optional item with complete scope of work and deliverables clearly defined. Contractor shall coordinate with PGE prior to utilizing this method to conduct the survey.

The Contractor shall supply the following to PGE as part of this project:

- Technical specification for PGE’s review and comment prior to commencing the work.
- Final survey drawings stamped and certified by a Professional Land Surveyor licensed in the state of Oregon.
- Compile all planimetric mapping and survey data into one (1) electronic AutoCAD plan view drawing file.
- Provide one (1) AutoCAD topographic survey file georeferenced to the planimetric mapping.
- Prepare XYZ feature coded points file in comma delimited ASCII text format, suitable for upload into CAD software.

3.2 GEOTECHNICAL INVESTIGATION

The Contractor shall be responsible for performing all necessary field investigations and laboratory testing to prepare a geotechnical report for the substation development as well as any necessary investigations for the distribution system. The Contractor is also responsible for preparing a site-specific scope of work and technical specification for this activity and providing it to PGE for their review and comment prior to commencing the work.

The geotechnical investigation is to include at a minimum:

- Site grading recommendations

- Cut/fill material and installation recommendations
- Infiltration rate information
- Foundation design recommendations
  - Including Lpile parameters
- Chemical reactivity information
- Retaining wall recommendations
- Electrical resistivity measurements
- Thermal resistivity properties
  - Including dry-out curves determined through laboratory testing

The report shall be stamped and certified by a PE licensed in the state of Oregon and two (2) hard copies, as well as an electronic (.pdf) file, shall be provided to PGE for record keeping purposes. All field activities shall also be under the direction of a PE.

3.3 PERMITTING

The site development design shall comply with the local governing jurisdiction's permitting requirements.

3.4 SITE DEVELOPMENT

Contractor shall perform the necessary design functions to properly prepare a site development design that meets the approved local governing jurisdiction's Land Use Permit).

The design shall incorporate all necessary Federal, State and local development codes and standards that pertain to the site. General site design parameters include:

- Design shall meet the recommendations of the Geotechnical Report prepared specifically for the Substation. This includes (at a minimum) fill material and compaction, excavation and disposal recommendations, retaining wall design parameters, recommended cut and fill slopes, stormwater design parameters, and pavement design.
- Design shall utilize the Owner provided Survey.
- Consider cut-and-fill quantities and balance, if possible.
- Substation grade and all access roadways shall be designed to AASHTO HS-20 loading requirements and the subgrade shall be per the geotechnical recommendations.
- Substation finish grade slope shall be between 0.5-2%.
- Preferred design shall be sheet flow across the Substation grade and discharged per approved jurisdictional requirements.
- Show details for the drainage facilities such as drainage ditches, water diversions, culverts, and other significant drainage control features.
- All piping materials, if required, shall be non-metallic (e.g., reinforced concrete pipe, high-density polyethylene (HDPE)).
- All collection and treatment structures and devices shall meet jurisdictional requirements.

- All vehicle access shall be coordinated with Substation General Layout and the Contractor shall verify and provide evidence that accessibility is maintained to the Substation equipment as well as ingress and egress to the Substation. An access exhibit shall be prepared utilizing AutoTURN®. Contractor shall provide vehicle model for written Owner approval to be used during the analysis. The Owner shall provide the appropriate sized vehicle to use in this analysis after award of Contract.

Contractor shall prepare all required site design calculations (e.g., retention/detention, discharge rates and volumes, piping, infiltration) required to support the design.

Landscaping and Irrigation design and construction shall be as required by local jurisdiction and Owner approval.

Contractor to coordinate construction schedule of activities with the Owner and receive approval prior to beginning construction of any of the Site Development activities.

3.5 YARD SURFACING

The finished grade yard surfacing shall consist of either Yard Finish Rock or Road Finish Rock except as required for Land Use Permits and/or the Oil Containment.

Yard Finish Rock is defined as the surfacing rock installed as part of the grounding system for the protection against touch potential hazards.

Road Finish Rock is defined as the surfacing rock intended for use in drive areas and sections outside of areas where touch potential hazards may exist.

Contractor shall follow the minimum requirements described in Owner Design Master Standard MSTR-0160-1.

Contractor shall also follow all step and touch potential mitigation requirements and recommendations as described in the Grounding Analysis Report. See *Section 2.*4 for additional details on the Grounding Analysis.

Contractor shall follow material and compaction requirements in Owner Construction Specifications Section 2160, Section 2170, and Section 2120.

Contractor shall immediately notify Owner of any conflicts between these requirements and shall work with the Owner to reach a resolution.

3.6 FENCE AND GATES

3.6.1 Fence

Fence and gates shall be 8’-0” tall of either chain-link or expanded metal fabric with an additional 1’-0” of barbed wire unless shown otherwise on drawings provided by Owner.

Design shall adhere to the requirements described in Owner Design Masters MSTR-0150 series drawings. For barbed wire and grounding details, Contractor shall follow the guidelines in MSTR-9240-1.

3.6.2 Gate

Gates shall be 30’ wide. Gate swing shall be toward the Substation. Note that the Grounding Design shall be compliant for a 30’ gate that swings outward toward the access road in case the gate is ever changed in the future. See *Section 2.4* for additional details on the Grounding Design.

Design shall adhere to the requirements described in MSTR-0150 series drawings. For barbed wire and grounding details, Contractor shall reference MSTR-9240-1.

3.6.3 Gate and Fence Signs

Contractor shall procure and install appropriate gate and fence signs per Owner Design Masters MSTR-9800 series.

3.7 FOUNDATIONS

All foundations shall be designed and detailed in accordance with Owner standards and applicable design codes (e.g., Oregon Structural Specialty Code, ACI 318). For specific loading requirements see Owner Standard S-123-10. Coordinate alternative requirements with Owner as necessary where locally adopted codes are newer than the referenced standard. Foundation design shall adhere to all geotechnical recommendations and properly take into account construction feasibility for site specific requirements and factors of safety.

Owner preferred foundation systems are slab on grade (mat), drilled piers or spread footings for equipment support structures and slab on grade (mat) foundation for the Substation equipment (e.g., switchgear, transformer, GIS). No other foundation types shall be used without prior Owner written approval. All foundations shall be coordinated with the necessary conduit, cabling and grounding requirements for each piece of equipment. Special care shall be taken when detailing the foundations to ensure proper fit-up and clearance is achieved and coordinated with the Vendor specific information.

Drilled pier design shall be per ACI 336 and utilizing Lpile by Ensoft, Inc., latest version. Spread footing and slab on grade design shall follow ACI 318 requirements. All foundation design shall incorporate the specific equipment Vendor requirements and tolerances. All loading requirements supplied by the Vendors shall be utilized to ensure conformance with delivery terms of the equipment.

Foundations shall be designed to meet the required strength considerations for both concrete capacity and soil strength. Limit foundation deflections as required by the Vendor for the supported equipment. Maximum allowable deflections are:

- Drilled Piers = ½” (top of pier)
- Slab on grade = 1” max vertical settlement, ½” max differential settlement
- Spread Footings = 1” max vertical settlement and ½” horizontal deflection at the top of stem

All equipment anchorage installed shall conform to the design requirements of ACI 318-11; Appendix D, or the equivalent code section where newer codes have been adopted. Vendor loading shall be utilized when available to determine anchorage system. The anchorage system can be cast-in-place, post installed adhesive or welded, and shall meet the recommendations of the Vendor when provided. Post-installed mechanical anchors may only be used in applications where water can drain from the anchor hole to avoid issues with freezing. Contactor shall coordinate with Owner and justify system used.

Contractor shall provide a Foundation Plan indicating the location of each foundation. Dimensions shall be provided to the center of the foundation on at least two sides. Tops of Concrete and Foundation Schedule shall also be *included on the Foundation Plan*.

Each unique foundation shall have a detail(s) and assigned drawing numbers following the guidelines in MSTR-0000-2

If project required existing foundation removals, Contractor shall develop a Foundation Removal Plan adequately documenting all existing foundations to be removed.

Transformer foundation design shall be coordinated with the necessary oil containment system. See *Section 3.8* for oil containment information.

All doorway entrances to the Control Enclosure shall require stair entrance foundation. Adjacent door entrances may share a double stair foundation. The stair foundation shall be large enough to install a galvanized or stainless steel guardrail and allow for the doors to be opened to at least 105 degrees. For additional guardrail details, refer to the Structural *Section 3.7*.

Foundation design shall comply with governing jurisdiction.

Contractor shall prepare a full set of calculations stamped and certified and certified by an Oregon licensed Professional Engineer (PE) to the Owner for their use.

3.8 STRUCTURAL

All equipment support structures shall be designed and detailed per the requirements the Oregon Specialty Code, latest edition, and all other necessary design codes (e.g. AISC, ACI, NESC, etc.). Design shall also meet the minimum requirements of ASCE 113. Contractor shall take into account the specific loading produced by each equipment type and adhere to the specific requirements to ensure serviceability is maintained.

Contractor shall comply with Owner Standard S-125-10 for specific loading combinations and deflection requirements. Equipment support structures shall be constructed of structural steel in accordance with AISC 360. Foundations shall be comprised of reinforced concrete in accordance with ACI 318. All structures shall be detailed for fit to ensure ease of installation.

Preferred material for the equipment support structures is HSS sections designed per AISC 360. Any deviations shall require written Owner approval.

Contractor may use an Owner standard structure when feasible for the application. Refer to MSTR-0500 through MSTR-599 for all available standard structures. If none of the standards are suitable for the application, Contractor shall design a new structure(s) with similar level of detail as the standards utilizing all Owner preferences. Each unique structure shall have its own drawing number assigned for the structural details.

Contractor shall also provide a Structural Location Plan indicating the location of each structure based on a modified version of the Foundation Plan. Each structure shall be identified on the plan and in the legend based on the drawing number assigned for the structural details. Drawing numbers are typically assigned based on the type of structure following the guidelines in MSTR-0000-2.

Contractor shall coordinate with Owner to ensure Line Termination Structure, or “Dead-End”, supports the tension loads of the incoming transmission lines.

All stairway entrances to the Control Enclosure shall include guardrails meeting the design and detailing requirements of the International Building Code and ASCE 7.

Contractor shall prepare a full set of calculations stamped and certified by an Oregon licensed Professional Engineer (PE) to the Owner for their use.

3.9 OIL CONTAINMENT

All oil filled equipment (OFE) having a volume greater than fifty-five (55) gallons shall have an oil containment system installed to satisfy all regulatory requirements.

The Contractor shall use a non-permeable liner surrounding each OFE with a separation fabric for durability and perimeter berm. Refer to the “Shield Area” on Owner Design Standard MSTR-0400. The Shield Area(s) shall drain to a containment pit with an oil/water separator sized to contain a minimum of 110% of the largest single OFE within the Substation (see “Pit Area” on MSTR-0400). The Shield Area shall be sized and sloped to provide adequate containment around the OFE using the distances from equipment on MSTR-0400 as minimum values. The site-specific Shield Area size will vary by layout and equipment size and should be coordinated with the Owner.

Pipes connecting the Shield Area to the Pit Area and pipes discharging from Pit Area shall be sized and sloped to provide adequate drainage. Refer to MSTR-0401 for standard details. Final discharge piping shall daylight above grade.

If the Owner standard oil containment system is not feasible for this Project, Contractor shall coordinate with Owner for alternative solutions.

The Contractor shall ensure all environmental regulations and requirements are met for this project. Any discharge from the site shall be per governing jurisdiction. Adequate erosion control measures shall be provided at any discharge points (e.g. drainage trench as shown on MSTR-0401, Sheet 2, Detail “D”, or rip-rap as required).

3.10 FIRE WALLS

Firewalls between multiple power transformers, and between power transformers and other protected equipment, shall be required as recommended in the National Fire Protection Association (NFPA) 850.

Fire ratings for fire walls shall be as recommended by NFPA 850. The composition of the wall shall be such that they are removable for maintenance operations, and when re-installed shall maintain the necessary fire rating. Owner’s preferred product is TruFireWalls by Oldcastle Infrastructure. Contractor shall seek Owner approval for alternate vendors.

Fire wall design shall incorporate the physical arrangement of the Substation and support, if needed, any bus work or any other equipment. The structural design of the wall and foundations shall satisfy the necessary design codes for the site (i.e., Oregon Structural Specialty Code).

The minimum physical dimensions of the fire wall shall be one (1) foot beyond any oil containing parts and shall break line of sight between protected equipment. This requirement is for both vertical and horizontal dimensioning.

Space shall be allocated in the design to accommodate future equipment and firewall installation.

Contractor shall prepare a full set of drawings and calculations (or provide vendor drawings and calculations) stamped and certified by a PE licensed engineer in the state of Oregon to Owner for their use.

4.0 STATION SERVICE

4.1 AC STATION SERVICE

Contractor shall determine the Substation AC load requirements for the initial buildout of the Substation loads as well as account for planned future loads. Contractor shall install all equipment and materials necessary to complete the AC station service unless otherwise noted.

Contractor shall calculate the AC Substation Load including estimated loads for planned future expansion for determining the size of the Normal and Alternate Station Service Transformers. These calculations shall be submitted for review with the 60% and 90% Control and Protection design.

Minimum station service transformer size for both Normal and Alternate sources shall be 25kVA. Typical transformer sizes used by Owner are 25kVA, 50kVA, 75kVA, 100kVA, and 167kVA.

The high size fuse protection for each station service transformer shall be coordinated and sized appropriately by the Contractor.

The station service transformer for the Normal source shall be one of the following:

- A single phase, 120/240V secondary, transformer sourced from the main distribution bus. If determined that the station service transformer size is 50 kVA or less, this may be provided by the switchgear Vendor, if applicable, inside the Auxiliary cubicle. If it is greater than 50kVA, it shall be a padmount located near the Control Enclosure or an overhead can mounted near the distribution bus. Switchgear Vendor shall then provide means for Kirk Key interlock system and a location to terminate a medium voltage power cable.
- A single phase, 120/240 V secondary, double bushing, overhead transformer can sourced from the tertiary of one of the power transformers.

The station service transformer for the Alternate source shall be single phase, 120/240V secondary, transformer and sourced from a local distribution line as determined by the Owner. If the determined station service transformer size is 50kVA or less, the source may be pole mount located by the distribution line source, although voltage drop needs to be considered as part of this decision. If it is greater than 50kVA, the station service transformer must be padmount and located near Control Enclosure.

Pad mount station service transformers shall meet the Owner Specification L10003 except that the primary terminals shall not include loop-feed terminations as referenced in the specification Part 4.4.1.

Contractor shall make all efforts to limit underground station service cable crossing with medium voltage distribution feeders.

Both Normal and Alternate sources shall connect to an automatic transfer switch (ATS) located inside the Control Enclosure. Each source shall first terminate on a service disconnect switch located on the exterior of the Control Enclosure. The switches shall be located as close as possible to the ATS. Contractor shall provide the rating requirements for the ATS and disconnect switches to the Control Enclosure Vendor in the Equipment Specification.

Power conductor size and ampacity shall be coordinated with circuit protection devices. Conductor size shall be determined for 125% of connected load at the design basis maximum outdoor ambient temperature. Within the Project Substation, below-grade power cable conductor size shall be determined in accordance with the methods in IEEE 835.

For AC station service equipment located inside or mounted on the outside of the Control Enclosure, Contractor shall follow equipment rating and manufacturer guidelines specified below . Contractor shall verify all equipment ratings and adjust the Equipment Specification as needed for a functional AC distribution system.

Contractor shall be responsible for specifying the number of AC panelboards required and providing wiring diagrams that show all Substation loads and breaker ratings, while making provisions for future loads and spares. Breaker ratings shall meet the coordination and fault interrupting requirements as determined by a system study and NEC requirements. Refer to MSTR-5501-1 for typical layout drawing.

Rating Requirements

- 600 VAC
- Minimum 225A continuous frame rating
- Minimum 22 KAIC interrupting main and branch circuit breakers. Contractor shall verify Short Circuit Fault rating is adequate with the AC Station Service Calculations.
- Solid Neutral
- 120/240V single phase three wire (240V) or two wire (120V)
- UL 50 & 60, NEMA PB-1 compliant
- All panelboards must have Main Breakers.
- Minimum 42 pole branches
- ACP1 shall be bottom fed. Other AC Panelboards may be top fed or bottom fed
- Shall be accessible to cable tray system
- NEMA 1

The number of panelboards must accommodate all installed and planned future Substation AC loads. The Control Enclosure AC panelboards must also include the following spare branch circuits: six (6) 2-pole 30A, four (4) 1-pole 20A branch circuits. No poles shall be left blank. In other words, each pole shall be connected to a 2-pole or 1-pole branch breaker. Branch circuit cables designed and/or installed by Contractor shall be minimum #10 AWG.

Each AC Panelboard shall be drawn on its own drawing number per Owner standard. Contractor shall not use Vendor provided panelboard drawings for the Control Enclosure but may use the switchgear Vendor provided panelboard drawings. The drawing number assigned for the AC panelboards are described in MSTR-0000-1.

The AC Panelboard drawings are wiring diagrams and shall show full connection details, but there are no corresponding schematics for these drawings. Therefore, any Control and Protection schematic that references an AC panelboard shall reference the wiring diagram numbers.

On the main AC panelboard drawing, ACP1, wiring shall also be shown for the ATS, Normal and Alternate disconnect switches, and Normal and Alternate station service transformers. If the source of one of the station service transformers comes from the tertiary winding of a power transformer, this would then be shown on a Miscellaneous Three Line Wiring Diagram instead (see MSTR-6800-1).

The main AC panelboard, ACP1, must sub-feed all other AC panelboards in the Substation including the outdoor equipment. ACP1 shall also supply the battery chargers, battery trailer connection panels, and power transformers. Appropriately sized spare branch circuits shall also be supplied for the planned future expansion.

All Control Enclosure AC panelboard branch circuits installed by a Vendor or Contractor shall be shown in the AC Panelboard wiring and directory. Cable numbers must be assigned to all cables designed by Contractor even if it is Vendor installed. Examples would be Emergency Lights, AC power to SCADA rack, etc. If a cable is designed and installed by a Vendor, a cable number does not need to be assigned. Examples would be indoor receptacles, HVAC, exhaust fans, etc.

4.2 DC STATION SERVICE

This Project shall require one or two redundant 125 V DC vented lead acid battery bank systems (Primary and Backup). Contractor will analyze the Substation DC load requirements, including the operation of protective equipment, circuit breakers, motor operated disconnects, etc.

Contractor shall provide Owner calculations following the methods described in the latest version of IEEE 485 and Owner Standard S-135-10 that demonstrates adequate battery sizing, taking into account all planned future loads. These calculations shall be submitted for review with the 60% and 90% Control and Protection design.

DC Station Service System shall be ungrounded.

Contractor shall determine the Substation DC load and install all equipment and materials necessary to complete the DC station service.

Except for the battery banks, the DC station service equipment shall follow equipment rating and manufacturer guidelines specified below and in the Control Enclosure Equipment Specifications. Contractor shall verify all equipment ratings and adjust equipment specifications as needed for a functional DC distribution system.

Each battery bank shall have its own battery charger(s). If battery charger size for a single bank exceeds 50A, then two parallel chargers shall be used to meet the calculated ampacity requirements. For additional details, refer to Owner Standard S-135-10 .

Battery bank rack shall meet the seismic requirements specified in Owner Standard S-135-10.

Each battery bank shall require a minimum 200A, 250 VDC rated fused safety switch mounted on the output of the battery. Contractor shall verify safety switch and enclosure ratings.

The Control Enclosure shall have a separate room for each battery bank from the relay rack area. Each room shall have a single door entrance from the outside.

Contractor shall provide a battery trailer connection panel for each battery bank.

This Project shall have a Group A, B, and C DC distribution and protection system (see also Owner Standard S-135-10).

- Group A
  - DC loads connected to Primary battery bank
  - Transmission breaker Trip Coil 1/Close Coil circuits
  - Primary protective relays for transmission system
  - Every relay scheme, breaker scheme, and Comm racks, if applicable, shall be connected to its own 30A DC branch circuit breaker
  - DC Panelboards shall be named DCP21 (Main), DCP22, etc.
  - If possible, locate the breaker control branch circuits on a separate panelboard from the protective relay branch circuits

- Group B
  - DC Loads connected to Backup battery bank
  - Transmission breaker Trip Coil 2 circuits
  - Backup protectives relay for transmission system
  - Every relay scheme and breaker scheme shall be connected to its own 30A DC branch circuit breaker
  - DC Panelboards shall be named DCP41 (Main), DCP42, etc.
  - If possible, locate the breaker control branch circuits on a separate panelboard from the protective relay branch circuits
- Group C
  - DC loads that can be transferred between either battery bank via DC transfer switch.
  - Any DC powered device or function that does not have a fully redundant primary and backup version (e.g. SCADA, Switchgear Relays, Emergency DC Lights, DC Motor Operators, Transformer DC Control Schematics, etc.)
  - Each relay, device, and/or control scheme shall be connected to its own DC branch circuit breaker
  - Panelboards shall be named DCP61 (Main), DCP62, etc.
  - Transformer DC schemes and Emergency DC Lights shall be supplied from DCP61

DC panelboards shall be provided by Control Enclosure and switchgear Vendors. Contractor shall be responsible for specifying the number of panelboards required and providing wiring diagrams that show all Substation loads and breaker ratings, while making provisions for future loads and spares. Breaker ratings shall meet the coordination and fault interrupting requirements as determined by a system study and NEC requirements. Refer to Owner standard MSTR-5521-1 for typical panelboard layout.

Minimum Panelboard Requirements

- Shall meet Owner Standard S-135-10
- 42 poles with 2-pole branch breakers installed for every available position.
- Minimum 10 KAIC DC interrupting main and branch circuit breakers.
- All Panelboards shall have main breakers.
- May be top fed or bottom fed
- Shall be accessible to cable tray system
- NEMA 1

All non-sub feed DC branch circuits shall be rated for 30A and wiring shall be minimum #10 AWG.

All Main DC panelboards (DCP21, DCP41, and DCP61) located in the Control Enclosure shall include minimum four (4) 100A branch breakers for sub-feeding planned and future DC panelboards. Main DC panelboards shall have a 225A main circuit breaker. All subfed DC panelboards shall have a 100A main circuit breaker.

The DC panelboard drawings are wiring diagrams and shall show full connection details, but there are no corresponding schematics for these drawings. Therefore, any Control and Protection schematic that references a DC panelboard shall reference the wiring diagram drawing numbers.

Wiring diagrams for the battery banks, safety switches, DC junction boxes, battery trailer connection panel and battery chargers shall be shown on the respective main DC panelboard wiring diagram.

4.3 STATION SERVICE ONE LINE SCHEMATIC

Contractor shall be responsible for developing a Station Service One Line Schematic. The diagram shall show connections between major station service equipment along with cable sizes, including but not limited to station service voltage transformers, protective fuses, main breaker ratings, ATS, AC and DC panelboards, battery chargers, battery banks, etc. Branch breakers designated for future AC or DC panelboards shall also be shown.

4.4 YARD LIGHTING

Contractor shall develop a Lighting Plan using Visual™ software based on the General Layout and Owner Standard S-137-10. Lighting shall consist of background lighting automatically controlled by a photocell (controls and photocell provided by Control Enclosure Vendor) and activity lighting that is activated at a gate control switch or the lighting control panel located in the Control Enclosure. The Lighting Plan shall also show lighting cable numbers and the associated control circuit.

Substation lights shall only be LED.

The standard requires each Substation to have a gate controlled light switch per gate. Contractor shall note that the Lighting Control standard (MSTR-4400-2) is designed for two gate switches. The design must be adjusted to allow for appropriate manual control of the yard lights at the gate switch and the Control Enclosure when there is a deviation from Owner standards.

Contractor shall comply with the governing entity regarding requirements for Substation Lighting.

Only fiberglass light poles shall be used for mounting light fixtures. If light poles cannot achieve Owner standard illumination and the requirements of the governing entity, Contractor shall propose alternatives for written Owner approval. Location of luminaires and light fixtures shall not result in requiring any outage to maintain or replace. The determination of whether an outage would be required for maintenance shall be made solely by the Owner.

Lighting control cabinet and photocell control wiring to be provided by the Control Enclosure Vendor. Contractor shall install yard cable interfaces for yard lights and yard lighting control. For a typical lighting control circuit, refer to MSTR-4400-2.

Photocell control shall also include a manual cutout toggle switch and Security System cutout per MSTR-4400-2. Background lights shall also be controllable by the Security System. Contractor shall ensure the lighting control cabinet allows for ease of installation of security wiring.

Cables for LED luminaire power supply shall be shielded and grounded at both ends. For more details refer to Owner Standard S-144-20.

4.5 YARD RECEPTACLES

Contractor shall install 50A 600V Twist-Lock, 3-Pole 4-wire receptacles such that at least one receptacle is within 75 feet of likely parking locations near the equipment. Minimum two (2) shall be installed with each receptacle on its own AC panelboard branch circuit. Additional receptacles may be daisy-chained, with both circuits having equal or near equal number of receptacles on each branch.

Receptacle shall be rated for outdoor use and have a weather proof cover.

For the purposes of the AC Load Analysis, no more than two receptacles shall be in use simultaneously.

5.0 CONTROL AND PROTECTION SCHEMATICS AND WIRING

5.1 GENERAL

Contractor shall be responsible for developing the Control and Protection schematic and wiring design for the Substation.

Reference Section 1.4 for which drawings and documents are required for each submittal.

Contractor shall verify all Schweitzer Engineering Laboratories (SEL) relays furnished are equipped with the correct firmware and Owner standard specifications. When issuing a P.O. for SEL relays, Contractor shall specify Portland General Electric (Owner) is the end user. Contractor shall verify Owner's Special Spec is applied. Owner's Special Spec number is 33.

Contractor shall be responsible for the design and installation of all SCADA and protective relay device settings.

Vendor Drawings:

- Vendor supplied drawings shall not be used in the One Line Schematic, Three Line Schematic, Network Block Diagrams, or Control Enclosure AC/DC panelboard wiring diagrams. These drawings must be created or updated by the Contractor using Owner Design Master and CAD standards. The Vendor supplied version of these drawings shall still be verified by the Contractor for accuracy.
- When Vendor supplied drawings are used, Contractor shall modify as required to show the interconnections to external devices using Owner CAD and design standards. Any revisions to these drawings, including field wiring changes, cable installations, and other modifications are considered drawing revisions and shall be documented according to Owner CAD standards. Contractor shall not utilize vendor designed CAD blocks or styles without Owner approval.
- Drawing references provided by the Vendor shall be updated to reference the Owner drawing numbers as required. These updates shall not be shown as revisions.
- Contractor shall apply standard Owner border and convert to Owner standard CAD platform (as required) for all used Vendor supplied drawings in the Design Drawings.

5.2 METERING

Revenue meters shall be installed at the project substation and downstream plant to account for gross and net generation, as well as station service and auxiliary loads. Each revenue meter shall be sourced from high accuracy, revenue grade current and voltage transformers, and shall comply with the requirements shown in the Interconnection Agreement and any power purchases agreement(s). Actual revenue meter locations and instrument transformer specifications shall be determined by PGE metering personnel.

SCADA meters shall be installed on each medium-voltage (34.5kV) collection system circuit feeder.

5.3 PROTECTIVE RELAYS

Revenue Protective relaying shall provide secure and selective isolation of equipment when necessary during faults, abnormal or hazardous operating conditions.

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.

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.

Protective relaying design and equipment selection shall be provided in accordance with applicable Requirements, including, but not limited to, the results of the Coordination study as defined in M1-04-01 (General Electrical Study Requirements), applicable standards and prudent electrical industry practices.

All protection device settings shall be provided for Owner's review no later than 60 days prior to the system energization date.

Programming of devices shall be provided in electronic format straight from the device.

Relay settings shall, to the extent applicable and possible, follow Owner's standard template and protection practices in effect at the time settings are developed. Contractor shall request the latest standards from Owner prior to starting work.

Contractor will provide Inverter control system settings capable of ride-through requirements.

Owner will review and approve the final design prior to procurement of equipment.

The local utility shall require review and confirm line protection and signal exchange requirements. Owner shall facilitate such reviews.

Protection shall be provided for all breakers, bus, transformers, 34.5-kV lines, high- side lines, capacitors, and inductors.

The relaying schemes shall monitor and respond to over-currents, phase faults, ground faults, and other system abnormalities. Protection schemes to be utilized shall include, but not be limited to, line impedance/differential, bus differential, transformer differential, breaker failure, backup relaying, switch into fault, and sync check.

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.

High-side lines shall include primary and backup relaying.

Main step-up transformer protection shall include primary and backup relaying and monitor for oil and winding temperature.

Observe IEEE 1050 for protective instrument grounding.

Owner shall approve the model and firmware version of all relays prior to procurement by Contractor. SEL must be informed that Owner is the end user of the relays to apply Owner's Special Specification requirements, including standard firmware. Model and firmware shall follow the owner's standard in effect at time of purchase. Field firmware updates may be required if a critical service bulletin is released between purchasing and commissioning.

5.3.1 Control and Protection Design Requirements

5.3.1.1 One Line Schematic

Contractor shall prepare the One Line Schematic per Owner Design Master to ensure scheme coordinates effectively with the system and equipment.

One Line Schematic should show equipment identified by standard ANSI device function numbers; instrument transformer and equipment ratings; current transformer (CT) and potential transformer (PT) connections to the protective relaying with solid lines; and protection, control, and metering functions with dashed lines. A legend for the major relay equipment shall also be provided. The appropriate Major Equipment (circuit breakers, transformers, PTs, etc.) should have an associated equipment identification letter for wiring purposes per Owner Standard Position Letter Exclusions. Note – these letter exclusions shall also be followed when developing wiring tags.

5.3.1.2 Three Line Schematic

Contractor shall prepare Three Line Schematic and Schematic Details to show the interconnections of the instrument transformers, metering, relaying, and control circuits per Owner Design Master standards. Layout of the Three Line Schematic should match as closely as possible with the One Line Schematic and General Layout.

5.3.1.3 Protective Relaying Control Schematics

Contractor shall prepare the protective relaying control schematics per Owner Design Master standards to the extent applicable and possible.

Switchgear protective relaying schemes, if applicable, shall be prepared by Vendor and verified by Contractor that they meet Owner Design Master standards and specifications to the extent applicable and possible.

5.3.1.4 Breaker Control Schematics and Wiring

Contractor shall review all breaker Vendor supplied drawings and verify accuracy of drawings and accordance with the Control and Protection design for this Project. In general, all breaker Vendor supplied schematic and wiring diagrams shall be placed in the Design Drawings with Owner standard borders. Contractor shall coordinate with Owner which drawings shall be included in the Design Drawings after approval drawings are received.

5.3.1.5 Transformer Control Schematics and Wiring

Contractor shall review all transformer Vendor supplied drawings and verify accuracy of drawings and accordance with the Control and Protection design for this Project. All transformer Vendor supplied schematic and wiring diagrams, including drawings from the LTC Vendor, shall be placed in the Design Drawings with Owner standard borders. Contractor shall coordinate with Owner which drawings shall be included in the Design Drawings after approval drawings are received.

Transformer alarms are monitored by electronic equipment mounted on the transformer with communication over fiber. For standard transformer alarm and tripping functions, refer to the Owner Standard S-110-30.

5.3.1.6 Capacitor Bank Switch Control Schematics and Wiring

The Capacitor Bank protective relaying schematics shall be provided by the Vendor. Contractor shall verify the design meets Owner Design Master standards and specifications.

Contractor shall design Capacitor Bank control wiring diagrams using Owner provided Design Master or reference to be provided after award of Contract.

5.3.1.7 SCADA

Contractor shall prepare the Network Block Diagram per Owner Design Master for the basis of the Substation SCADA design. Owner utilizes a distributed input/output (IO) system with modules mounted on the relay racks or electrical equipment for device status and alarms. Distributed IO devices, relay communications and Irig-B are connected to gateway and ethernet switch devices located on a main SCADA/HMI rack.

5.3.1.8 Network Block Diagrams

Develop drawings showing all the Substation automation devices. Drawings shall indicate all Substation network connections to relays, meters, IO, and other devices. Other information shall include cable types, communication protocols, and IP addresses.

Ethernet and Irig-B connections for the GIS (if applicable) are not included in the Conceptual Design. Contractor shall update the design per the Vendor supplied drawings and submit with the 60% Control and Protection design for review. If this information is available prior to Contractor start date, these drawings may be updated by Owner and issued as an addendum. Contractor shall still be responsible for verifying the accuracy of these drawings.

IP addresses shall only be listed in the Network Block Diagram. These shall be provided by Owner no later than the 60% design review comments.

5.3.1.9 Pilot Scheme Block Diagram

Develop drawing showing line differential (87L) and MBTT communication paths.

5.3.1.10 SCADA/HMI Control Schematic

Develop schematic showing the DC power connections to all devices located on the main SCADA rack. Contractor shall reference Owner Design Master MSTR-4110-1 for additional details.

5.3.1.11 Relay Alarm and Status Schematics

Schematics for the distributed IO devices shall be included as part of the relay Control and Protection schematics based on the relay rack the device is located on. Refer to the Owner Design Master standards.

IO device schematics located in switchgear and GIS, as applicable, shall be provided by the Vendor and verified by Contractor that they meet Owner Design Master standards and Equipment Specifications. Contractor shall use vendor supplied IO schematics as part of the Control and Protection Design Drawings.

The status alarms for all GIS equipment, as applicable, shall be collected at the GIS IO devices located in the Local Control Cabinets (LCC) instead of the relay rack IO.

IO devices located on the protective relay racks shall still be used for trip and close control functions of the circuit breakers. Only one IO device shall be used for control for each circuit breaker. The breaker controlled shall be the same as the 52CS control switch located on the same rack.

5.3.1.12 Transformer Status and Alarms

Shall be connected by the transformer vendor to digital monitoring device mounted in the transformer control cabinets. Alarms are communicated back to the SCADA via fiber.

Schematic for transformer alarms shall be included in vendor design drawings.

5.3.1.13 Station Service One Line Schematic

Refer to Section 4.1 for additional details

5.3.1.14 Control Enclosure Drawings

- Contractor shall review all Control Enclosure vendor supplied drawings for accuracy of drawings and accordance with the Substation design for this Project. Contractor shall apply the standard Owner drawing border and drawing numbers for vendor supplied Electrical Drawings except for AC and DC Panelboards. Contractor shall modify drawings as required to show the interconnections to external devices.
- Contractor shall ensure all equipment and devices not installed by Control Enclosure Vendor are added to the layout and elevation drawings (e.g. relay racks, comm racks, DC equipment, desk, battery banks, door swing, etc.). All must be properly dimensioned at the appropriate scale.

5.3.1.15 Relay Rack Layouts

Contractor shall provide relay rack and elevation details for relaying shown on the conceptual Single Line Diagram.

All rack mounted devices shall be shown to scale with reference to a list of materials number. Rack layouts should also show a unique nameplate for the rack, major devices and test switches. Drawings shall be set-up logically and coordinate with the Control Enclosure layout. relay rack fabricator shall be responsible for the panel steel and construction drawings. These fabrication drawings do not need to be included in the Design Drawings.

5.3.1.16 Wiring Diagrams and Requirements

Owner Design Masters have been provided for various types of racks. If additional standards are available at time of award, they shall be then provided to Contractor. Contractor may request reference drawings for racks not currently shown in the standards; however, these drawings are not guaranteed to match the project.

5.3.1.17 DC Panelboard Cables

All cables originating from the DC Panelboard to a relay rack shall be terminated at the bottom of terminal block TB2 column as shown in the Engineering References.

All cables originating from the DC Panelboard to a Comm Rack shall reach to the bottom of the rack plus 2 feet. The cables are to be coiled on the cable tray directly above the Comm Rack.

Contractor shall not install additional wires on the same side of the terminal block as the DC panelboard cables.

5.3.1.18 Sliding Link and Knife Disconnect Terminal Blocks

The specified States terminal blocks have sliding links that allow for the isolation of one terminal from another. Some specified Phoenix Contact terminal blocks have a Knife Disconnect that also allow for isolation of one terminal from another.

Maintenance and testing may use this feature to isolate certain circuits without test switches, typically involving Digital Inputs of the protection relays for the States blocks, and SCADA alarms for the Phoenix Contact blocks.

Terminal blocks capable and intended to be used for this type of isolation are represented by a half-shaded square terminal block in the control or relay schematic. The rack wiring design utilizing these terminal blocks must allow for the isolation of the circuits from the DC positive and/or negative source upon operation.

Relay rack terminal blocks without the ability to isolate or are not intended to be used for isolation are represented by a circle with an 'X' inside.

Both terminal block symbols represent States or Phoenix Contact terminal blocks on the relay rack.

Circuits that utilize the States sliding link function shall be wired at the top of the terminal block TB2 column. The primary relay circuits shall located be above the backup relay circuits.

5.3.1.19 Control Wiring

Control wiring shall be connected to the remaining terminal blocks available in TB2.

For Ring Bus relay protection, it is likely there won't be enough terminal blocks for all control and DC cable wiring on terminal block TB2. In this case, Contractor shall use the bottom terminal blocks of TB3 as required.

5.3.1.20 Current Transformer (CT) Wiring

CT circuits terminated on a relay rack shall be connected to the top terminal blocks of TB3.

CT cables in the wiring diagrams shall be shown with a thicker line weight compared to other cables. Refer to Owner CAD standards.

CT neutrals shall be grounded in a single location at the first termination inside the Control Enclosure.

For standalone Current Transformers, all windings and taps shall be wired to the CT junction box. For equipment with bushing CTs or GIS CTs, all CT windings and taps shall be wired to the equipment cabinet or LCCs respectively.

When cables are used, each CT, or set of three phase CT's intended to be grouped for the same function, shall have its own dedicated cable and shall not be combined in the same multiconductor cable as any other circuit.

For multi-ratio CTs, only the tap used shall be wired from the equipment cabinet or CT junction box to the protection equipment.

Unused CTs shall be shorted and grounded at the equipment cabinet or CT junction box.

CT cables shall be at least 4 conductors even for single phase circuits. In the unlikely case that more than four conductors are needed, Contractor shall justify and request approval from Owner. Generally, this is only considered when double conductors are needed to reduce burden.

5.3.1.21 Voltage Transformer (VT) Wiring

VT circuits terminated on a relay rack shall be connected below the CT circuits on TB3.

Contractor may "daisy-chain" VT circuits from rack to rack. If space is available, Contractor shall connect a jumper to another terminal block for continuing the circuit to another rack. In other words, do not connect two cables to the same terminal block as long as space is available.

If there is not enough terminal block space, two VT cables connected to the same terminal block is acceptable.

Secondary winding VT neutrals shall be grounded in a single location at the first termination inside the Control Enclosure. Unused secondary winding VT neutrals shall be grounded at the fuse junction box.

For standalone Voltage Transformers, all windings and taps shall be wired to the fuse junction box. For GIS Voltage Transformers, all windings and taps shall be wired to the LCC.

When cables are used, each VT winding, or set of three phase windings intended to be grouped together, shall have its own dedicated cable and shall not be combined in the same multiconductor cable as any other circuit. When multiple taps on the same winding are used, each tap shall require a dedicated cable per the same requirements.

Only windings and taps used shall be wired from the equipment cabinet or fuse junction box to the protection equipment.

Cables shall be at least 4 conductors even for single phase circuits. In the unlikely case that more than four conductors are needed, Contractor shall justify and request approval from Owner.

5.3.1.22 Wire Names

Wire Names (or Tags) are a unique identifier that represents an electrical node.

In general, each Wire Name should be unique for the entire Substation, though this may not be the case for Vendor supplied equipment

Wire Names shall be shown in both schematics and wiring diagrams. Refer to Owner Design Masters for how that should be depicted in the drawings.

Refer to Owner Standard S-144-60 for how to apply physical labels for cables and switchboard wiring.

5.3.1.23 Conductor Selection

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.

5.3.1.24 AC and DC Panelboard Wiring Diagrams

Refer to Section 4.0 for details.

5.3.1.25 Miscellaneous Three Line Wiring

Shall describe the wiring for standalone Instrument Transformers (Voltage Transformers, Metering CT's, etc.). Refer to additional guidelines provided in MSTR-6800-1.

The Normal and Alternate station service transformer wiring may be shown on this drawing if there is insufficient space on the ACP1 panelboard wiring diagram.

5.3.1.26 Metaclad Switchgear Drawings

Contractor shall review all switchgear Vendor supplied drawings and verify accuracy of drawings and accordance with the Control and Protection and Station Service design for this Project.

Contractor shall organize and update outline drawings, schematics, wiring diagrams, etc. similarly to previous projects. This second digit in the drawing number shall be based on the switchgear number.

5.3.1.27 GIS Circuit Breaker and Motor Operated/Ground Switch Control Schematics and Wiring (if applicable)

Contractor shall review all GIS Vendor supplied drawings and verify accuracy of drawings and accordance with the Control and Protection and Station Service design for this Project.

Contractor shall follow guidelines in Owner Standard MSTR-0000 for GIS drawings to include in the design package and drawing number assignments. Contractor shall propose GIS drawing numbers, drawing titles, and drawing list for Owner review and submit with the 60% and 90% design submittals.

Contractor shall apply Owner Design Master standards for the breaker control schematics as best as possible. Contractor shall seek clarification from Owner for any questions regarding how to apply the standards to GIS equipment.

The Trip 1/Close and Trip 2 circuits shall require separate battery source (Group A and Group B respectively).

The Motor Operator DC control circuits are considered Group C loads (Refer to DC Station Service in Section 4.0, Part 3.0).

All DC circuits shall require its own 30A branch breaker, though the Contractor shall verify each branch breaker meets the load requirements.

All GIS cables from the LCC to Control Enclosure shall be shielded and grounded at both ends unless otherwise required by GIS Vendor. Cables from GIS equipment to LCC should be provided by Vendor. If not, Contractor shall follow requirements by GIS vendor.

All vendor supplied cables shall have a cable number assigned per Owner standard and included in the Cable Schedule.

5.3.1.28 Additional Wiring Requirements

Conductors associated with the Trip Coil 2 and VDC monitoring shall be on a separate multiconductor cable from Trip Coil 1 and Close circuit associated conductors. This applies only for outdoor cables. Rack to rack cables are not required to adhere to this restriction.

Contractor shall supply spare conductors and/or cables to outdoor equipment to account for planned future expansion. Spare conductors on VT, CT, or power supply cables shall not be considered for the purposes of meeting this requirement.

Contractor shall also provide some spare cable conductors to each major outdoor equipment for potential future or replacements for broken wires. An example might be to use a 7/C#10 cable instead of a 4/C#10 cable for one of the equipment cables. Spares for this purpose shall only be added to control cables (i.e. not CT, VT, AC power, or DC power cables). Contractor shall coordinate with Owner before and during the design reviews for an acceptable number of spare conductors.

All spare conductors shall be #10 AWG.

AC Power circuits shall not be combined in the same multiconductor cable as any other type of circuit. All AC power multiconductor cables shall be four conductors for #10 AWG or at least three conductors when larger than #10 AWG.

Two conductor cables shall only be used for DC power circuits from the DC panelboards.

For raceway requirements, refer to Owner Standard S-146-00.

Aluminum conductors shall not be used for any 600V rated cable or conductor. All 600V cables and conductors shall meet the specifications in Owner Standard S-144-20. Refer to Section 6.0 for additional details on cable materials.

All rack to rack cables, except for Network, Irig-B, and communications circuits, shall be multiconductor cables.

5.3.1.29 Supporting Documents

Drawing List, List of Materials, List of Nameplates, and Cable Schedule

5.3.1.30 Studies and Calculations

AC and DC Station Service Calculations and battery sizing.

- Refer to Section 4.0 for additional details

Voltage Drop Calculations

- Contractor shall submit voltage drop calculations that demonstrate no circuits (except Trip and Close coils) exceed 5% voltage drop from station service transformer secondary or battery terminals to the load terminals for steady state loads. For loads with inrush current such as transformers and motors, Contractor shall follow NEC and other applicable industry standards for adequately sizing cables for these loads.
- Alternatively, for steady state voltage drops greater than 5%, Contractor may demonstrate that the terminal voltage is within tolerance of the operating voltage of the device, though Owner still reserves the right to reject this approach and Contractor shall meet the voltage drop requirements stated above.
- Contractor shall demonstrate that the terminal voltage at each breaker Trip and Close coils exceed the minimum operating range during a trip or close event. Contractor shall calculate this assuming lowest possible Battery Bank voltage allowed in the battery bank sizing calculation (typically 105 VDC). Owner reserves the right to request larger cable sizes during the review periods for calculated voltages barely exceeding the minimum requirements.

Conduit Fill Calculations

- Contractor shall demonstrate no conduits exceed maximum fill as defined in the latest version of the National Electric Code (NEC).
- Contractor may use query available in Owner Microsoft Access file template used to generate the Cable and Conduit Schedules for the purposes of this calculation. The template shall be provided after award of Contract.

6.0 MATERIALS

6.1 GENERAL

This section provides guidance on material selection not covered elsewhere in the specification. Regardless of any standard, document, verbal or written communication, etc., it is the Contractor's responsibility to ensure all materials selected meet or exceed their intended function.

When available and suitable for the application, Contractor shall use materials specified in the Owner Standard Design Masters or the Substation Standard Material List. Contractor shall request written Owner Approval for any substitutions.

If required material parts are not within the Design Masters or material database, the contractor shall select a part with a similar form-factor to existing entries within the database and preference to the same vendors. All such materials shall require cutsheets be provided to Owner and written approval from Owner prior to use.

For material submittal requirements, refer to the Supporting Documentation in Section 6.1.

6.2 CABLES AND CONDUCTORS

All insulated control and power cables and conductors rated up to 600V shall follow Owner Standard S-144-20. Insulated medium voltage (1,000-35,000V) cables such as those used for station service transformers and distribution capacitor banks shall comply with T&D Standard LD32020 or LD32023.

In addition to the requirements in Standard S-144-20, multiconductor cables smaller than #10 AWG for Current Transformer, Voltage Transformer, Circuit Breaker Trip and Close, AC Power, and DC power shall not be used in any circumstances. This requirement does not apply to internal rack SIS wires.

Contractor shall appropriately size cables for ampacity per the latest version of the National Electric Code. Contractor shall also size cables to limit voltage drop as described in Section 5.0, Part 3.0(R).

For outdoor installations, all 600V rated multiconductor insulated cables and single conductor cables smaller than 1/0 shall be shielded with shields grounded at both ends. Cables with indoor terminations only are not required to be shielded unless otherwise specified.

All copper Ethernet connections shall use CAT-6 cable. CAT-6 cable shall not be used in underground conduit or trench. The only exception (if applicable) shall be for Ethernet connections between GIS LCC cabinets and the LCC cabinet housing the Network Switch. These shall be Cat-5E, Outdoor, direct burial rated, Commscope #5NF4. This cable shall only be used for this specific application.

All other Ethernet connections located in outdoor conduit and trench systems shall be Multimode Fiber. All fiber optic cables within the Substation shall be installed with 1" orange innerduct tubing. For additional requirements, refer to Owner Standard S-146-00. All fiber cable connectors shall be ST unless otherwise specified.

All outdoor fiber optic cables shall be 2 Pair or 6 pair. Contractor shall supply at least one spare fiber pair for each cable.

Contractor shall provide fiber link loss calculations which verifies that each individual fiber segment's attenuation as determined by attenuation per splice, connector, and fiber length does not exceed maximum attenuation requirements as defined by Owner. Contractor shall be responsible for designing and installing fiber such that it does not exceed the maximum attenuation as determined by fiber link loss calculations.

Irig-B distribution cable shall be installed per the Conceptual Network Block Diagram. Twisted Shielded Pair cable shall follow Section 4.7 in standard S-144-20.

6.3 STATION POST INSULATORS

Polymer-equivalent ANSI standard strength insulators shall be used for 115 kV and 230 kV Substation bus systems. High strength ANSI station post insulators shall only be used when bus span calculations indicate that the use of standard strength insulators will prohibitively shorten bus spans. Refer to Owner Standard S-131-30 for station post insulator requirements within Owner Substations.

Polymer-equivalent ANSI TR 210 (standard strength) insulators shall be used for Substation bus systems operating at 34.5kV and below. High strength ANSI TR 231 station post insulators shall only be used when bus span calculations indicate that the use of standard strength insulators will prohibitively shorten bus spans.

6.4 UNDERGROUND DUCT SYSTEMS

Underground duct system materials furnished under these specifications shall be new and undamaged and shall conform to the following requirements:

Duct	Polyvinyl chloride, Type DB in accordance with NEMA TC-6 for concrete encased duct, Schedule 40 Type TC-2 for direct buried duct.
Couplings	Plastic, for use with duct previously specified and "Duct-to-steel" adapters as required, including joint cement.
Spacers	Plastic high impact, interlocking, base and intermediate type.
Factory bends	PVC, for long radius sweeps. Rigid and sweep galvanized steel (concrete encased) 90 degree bends with 36-inch minimum radius.
End bells	Plastic.
Plugs	Plastic, high impact, tapered to fit end bell provided.
Duct binder	Hemp or sisal twine.
Riser termination	Rigid hot-dip galvanized mild couplings steel.
Riser bends	Rigid steel conduit elbows, factory or field made, 36-inch 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.
Duct terminators	Formax type with 3-inch separation as indicated on the drawings.
Manhole materials	Shall be as specified and indicated on the drawings.

6.5 LIGHTNING ARRESTERS

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.

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.

Equipment surge arrestors shall be station class, metal-oxide type surge arrestors for outdoor use and polymer housing. Surge arrestors shall be shatterproof.

yield stress for the mast material in accordance with the latest ASCE specifications governing design of structures. (f)The horizontal deflection at the top of each free-standing mast shall be limited to L/20 of its height above foundation. (g)

Each mast shall be installed on a concrete foundation with galvanized steel anchor bolts. Foundations, bolts, and welding shall be in accordance with the applicable structural requirements. (h) Each mast shall be provided with two grounding pads located 12 inches above the foundation.

7.0 SUPPORTING DOCUMENTATION

7.1 GENERAL

All materials shall adhere to Owner provided standards and requirements set forth in this specification. All materials shall be Approved by Owner.

Contractor may select any software to develop List of Materials but must be submitted as .PDF for all submittals.

Every sheet of the List of Materials shall have the Document Number, Description, and project AWO number listed at the top.

For review submittals, Contractor shall also submit .PDF datasheets for all materials included in the List of Materials, except for Major Equipment, and sorted by Material Identification number. Contractor shall not provide paper copies of these for submittals.

Minor commodity construction materials such as bolts, washers, Unistrut, rigid galvanized steel conduit, etc. do not require material identification and are not required to be included in the List of Materials, but datasheets shall be provided for all such materials that are intended to be used in construction. Datasheet shall be digitally modified to include a description for the intended use of the material and drawing number(s) they apply. Contractor shall seek clarification from Owner if unsure a material is considered a minor commodity item.

7.2 ABOVE GRADE LIST OF MATERIALS (9900)

Format of List of Materials shall include Item Identification number; Quantity listed in Each, Feet, Lot, etc. as applicable; Owner Maximo database number if applicable; Material description with enough information to uniquely identify; Vendor name; Material Part Number.

For Major Equipment (GIS, Transformer, Disconnect Switches, Metalclad Switchgear, Breaker, Control Enclosure, Capacitor Banks and Switches) the material description shall also include the device five-digit Asset Number (to be provided by Owner after award of Contract) and name of the device as described in the One Line Schematic (e.g. WR2, W377, etc.).

Material List shall include:

- Major Equipment
- Material associated with the high voltage and medium voltage equipment installations (rigid tubular bus, flexible jumpers, station service transformers, bus fittings, insulators, cable connectors, junction boxes, medium voltage cables, etc.)
- Lighting
- See also Owner Standard S-146-00

7.3 OUTDOOR ARRANGEMENT LIST OF NAMEPLATES (9902)

Contractor to provide as an Adobe .PDF or Microsoft Word document. Template to be provided by Owner after award of Contract.

Shall include nameplates for all Major Equipment with an equipment number assigned (breakers, transformers, disconnect switches, capacitor banks, etc.), the outdoor control cabinets and junction boxes, and phase labels for the rigid bus spans. Contractor shall be responsible for fabricating and installing these nameplates. Each nameplate shall be assigned a unique number and labelled in a single location in the Design Drawings.

Nameplates shall follow guidelines and specifications detailed in MSTR-9800-1, -2 and MSTR-9801. In addition to the List of Nameplates document, Contractor also shall submit representative examples true to scale and color for Owner Approval.

Contractor shall create and install Asset Number nameplates for Major Equipment.

Contractor shall seek clarification from Owner if there is a question whether a certain nameplate is required.

7.4 CONTROL AND PROTECTION LIST OF MATERIALS (9911)

Format of List of Materials shall include Item Identification number; Quantity listed in Each, Feet, Lot, etc. as applicable; Owner Maximo database number if applicable; Material description with enough information to uniquely identify; Vendor name; Material Part Number; and part location (Rack, Equipment Cabinet, etc.).

Material List shall include:

- Relay rack and all mounted materials
- Battery bank and mounting rack
- 600V Control and Power cables
- Ethernet, Fiber, Innerduct, Coax and other cables used in the SCADA network and Irig-B distribution design
- Any other materials in the Control and Protection design to be installed by Contractor not already included by Major Equipment Vendor or accounted for in the Above Grade or Below Grade List of Materials.
- Contractor shall seek clarification from Owner if unsure which list a material should be included.

7.5 CONTROL AND PROTECTION LIST OF NAMEPLATES (9912)

Contractor to provide as an Adobe .PDF or Microsoft Excel document. Template to be provided by Owner after award of Contract.

Shall include nameplates for all relay rack and front mounted devices. Each nameplate shall be assigned a unique number identifier and labelled in a single location in the Design Drawings, almost always the relay rack layout. If the device is not represented in this drawing, the nameplate identifier shall be listed above the device in the wiring diagram.

Relay rack nameplates are to be fabricated and installed by relay rack Vendor. For projects with Instantaneous Enable/Disable switches (50EN) the Contractor shall adhere to nameplate requirements in MSTR-4803-1 for that device.

Nameplates for switchgear, GIS, Major Equipment cabinets, and Control Enclosure electrical equipment shall be provided by the Vendor except for items described in *Part E* below.

All devices with a SCADA identification must have a nameplate that matches the device name in the Network Block Diagram (e.g. XXXX-W65-11A). Contractor shall verify all such devices have this nameplate as described. If Vendor does not provide this nameplate, Contractor shall fabricate and install.

7.6 BELOW GRADE LIST OF MATERIALS (9920)

Format of List of Materials shall include Item Identification number; Quantity listed in Each, Feet, Lot, etc. as applicable; Owner Maximo database number if applicable; Material description with enough information to uniquely identify; Vendor name; Material Part Number

Material List shall include:

- Conduits
- Ground Mats
- Major Grounding System materials (copper grid, ground rods, DMC ground grid connectors, stingers, etc.)
- Vaults and covers (including for any station service padmount vaults)
- Cable trench if applicable
- Contractor shall seek clarification from Owner if unsure which list a material should be included.
- See also Owner Standard S-146-00

7.7 CABLE AND CONDUIT SCHEDULES (9930 AND 9931)

All Conduit and Conductor (or Cable) schedules shall be developed using Owner Conduit and Conductor Schedule Database. Template of this database to be provided after award of Contract.

Conduit Schedule shall include all conduits within Substation yard, with unique identification number, location, and length. Shall also include all conduits for distribution feeders, security, and communications. Conduits stubbed out for future use shall be stated as such in the Conduit Schedule and described with its designated application if applicable.

Conduit Schedule shall also include a list of all cables in each conduit, including cable size and purpose (control, AC power, SCADA, etc.). Seek clarification from Owner regarding any questions about Cable Purpose.

Cable Schedule shall include all cables, with unique identification number, ‘From’ and ‘To’ locations, drawing numbers for each termination, cable size, quantity, and routing through each conduit or trench. Medium voltage cables are not assigned cable numbers and do not need to be included. Communications cables used for remote communication are also not included.

Cable and Conduit Schedules shall indicate all entries as black if Revision 0. Otherwise, changes or new additions should be indicated in cyan or red and existing as black. Contractor may also use color to differentiate Vendor installed cables and field installed cables. This mainly applies for projects where relay racks are shipped with the Control Enclosure and the vendor has pre-installed some or all rack to rack cables. In this instance, field installed cables should be indicated in cyan and vendor installed cables indicated in black. Contractor shall provide a digital note explaining the color differences at the top of first sheet if this applies.

Note that same Access file is used for both Cable and Conduit schedules. The schedules are produced with built-in queries.

7.8 DRAWING LIST

Contractor shall follow the guidelines in MSTR-0000 Sheets 1 and 2 for drawing number and title selection. All drawing numbers and drawing titles shall be Approved by the Owner.

Contractor shall submit a .PDF Drawing List for each transmittal. Contractor may utilize Microsoft Word or Excel to generate Drawing List, but the format used must follow the example provided in the Conceptual Design. Template from Owner is also available upon request after award of Contract.

Drawing List shall also include all supporting documents with a drawing number (e.g. XXXX-9900).

Each discipline as described in *Section 1.4* shall have its own Drawing List as part of each design transmittal.

For this Project, Contractor shall submit a Void Drawing List with the Issue for Construction transmittal following the same format as the Drawing List. This list will include existing Substation drawings that will no longer be in use. If any existing drawings are carried over to the rebuild design, then Contractor shall coordinate with Owner for assigning an appropriate drawing number and for document management. It is not expected for any existing drawings to be reused for this Project, but Contractor shall notify Owner if it is necessary to include any existing drawings in the new design.

Engineering Calculations, Reports, or Studies should not be included in the Drawing List. These should be listed separately in the Contractor transmittals.

APPENDIX M1
ATTACHMENT 05
EXHIBIT 03

SUBSTATION CONSTRUCTION SPECIFICATIONS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	26Oct21	Issued for Implementation	1898 & Co.		JAL	Jared Lathrop
1	14Apr23	Update from 2021 Version	1898 & Co.	PGE	CPA	Craig Armstrong
2	16Jun25	Updated for 2025 Version	PGE	PGE	PNK	Paul Kruger

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1.0 GENERAL

The purpose of these construction specifications is to summarize the minimum requirements for Contractor, which generally include the complete substation development, procurement, and construction.

The Substation Construction shall follow, to the greatest extent possible, the requirements outlined in the PGE Substation Standards referenced in this specification.

Refer to SECTION 2 for a list of the Substation Construction Specifications

The substation shall be constructed to a high level of reliability and the Contractor shall comply with the provisions of the National Electrical Safety Codes, Owner and Industry specifications and standards, and the applicable codes, standards, and regulations set forth in the Solar, Wind and Storage Specifications

The Project specific Project Description provides details specific to the Project.

Contractor shall be responsible for obtaining and maintaining all necessary permits and / or easements for the Work. Reference other Sections as applicable.

All access and site work shall comply with other Sections as applicable.

In the event of any conflict or discrepancy between this exhibit (including any attachments hereto) and any other Requirement, the more stringent or higher quality Requirement shall take precedence over the less stringent or lesser quality Requirement at Portland General Electric's discretion. In the event of a discrepancy between Owner versus Contractor responsibility in this exhibit and PGE Substation Specification NO. 6090, this exhibit shall take precedence.

The document is not intended to supersede Portland General Electric's standards.

2.0 TESTING AND ENERGIZATION

Prior to commencement of substation energization procedures, Contractor shall submit, and Owner shall approve, a substation energization plan that includes, but is not limited to, a step-by-step checklist that verifies changes in equipment status (i.e. circuit breaker open, disconnect switch closed) including lock-out tag-out procedures, safety precautions including a “STOP WORK” authority and an “ALL CLEAR” signal, coordination with the interconnecting switchyard/substation owners to energize the interconnecting switchyard/substation circuit breakers and interconnecting transmission line, and listing of key authorized personnel. This energization plan shall appropriately coordinate with any collection energization plans and procedures.

The Contractor shall submit a testing plan and schedule to the Owner for review and approval

The Contractor shall follow all requirements listed in the Owner Section 6090 in addition to all the requirements listed below

The Contractor shall submit all final test reports to the owner for review and acceptance.

2.1 WORK PERFORMED BY CONTRACTOR

Wire checkout and associated schematic yellow-lining of all control circuitry and instrumentation circuits, in accordance with the Circuit List, to confirm continuity of conductors and that those conductors originate and terminate at the locations designated in the circuit list or on the drawings.

All CT and PT electrical testing should be performed based on the requirements provided in Owner’s Standard Testing Procedures (STP) per PGE Substation Specification No. 6090, and the completed forms shall be returned to the Owner.

CT and PT circuit loop verification shall be performed via millivolt drop methodology as specified in Owner’s Standard Testing Procedures (STP) per PGE Substation Specification No. 6090. Measurement locations and values shall be documented and returned to Owner.

Functional testing shall include a demonstration that all equipment installed can be operated in accordance with their specification.

Circuit Breaker, Circuit Switcher, and Vacuum Interrupter electrical tests in Owner’s Standard Testing Procedures (STP) per PGE Substation Specification No. 6090. This includes Insulation Resistance, Contact Resistance, and Timing Tests.

Installation of Relay Settings after approval from the Owner.

Installation of SCADA equipment settings (RTU, Substation HMI, substation network switches, etc.) after approval from the Owner.

Perform Protective relaying testing (Acceptance and Functional) and provide the results to Owner for approval. AC Acceptance testing involves verifying all AC inputs of the relay conform to manufacturer’s specification. DC acceptance testing involves verifying relay I/O conform to manufacturer’s specifications. Functional testing involves testing the relay elements and protection and control logic. Temporary settings changes to facilitate functional testing may only be utilized after approval by the Owner.

Contractor shall verify expected relay and SCADA inputs (52a, BFI, control switch inputs to relay, etc.) Interrogating the relays and observing expected inputs. Contractor shall verify and exercise relay outputs contacts with relay commands to ensure proper function of the associated circuits (e.g. trip circuits, close circuits, lockouts, etc.) All circuitry and device input/output checkout shall be documented via yellow-lined as-built schematics. Contractor may have to verify substation data is correctly reported to Owner EMS. Contractor may have to verify Owner EMS substation controls operate as intended (e.g. trip circuits, close circuits, etc.)

2.2 WORK PERFORMED BY OWNER

Owner reserves the right to perform final commissioning of the protective relays.

Contractor shall provide Owner advanced notification of when the relays will be available for testing and a window during which the Owner can complete their final commissioning.

The window for Owner testing shall be after substantial competition but before energization.

The contractor shall inquire with the Owner ahead of testing to determine an appropriate amount of time to allocate for Owner testing.

The Contractor shall provide all other workers required to make adjustments, connect equipment, and correct deficiencies during the testing

End-to-End protection functional testing of the protection scheme on the tie-line or interconnect will be performed by the Owner.

3.0 SPECIFICATION LIST

PGE Standards referenced in this list will be made available to bidders via a secure website following execution of the RFP Non-Disclosure Agreement (NDA).

SPEC NO.	DESCRIPTION
SITE WORK	
2100	Erosion and Sediment Control Plan (ESCP)
2110	Clearing and Grubbing
2120	Site Grading
2130	General Excavation & Backfill
2140	Trench Excavation & Backfill
2150	Aggregate Base Course
2160	Yard Finish Rock
2170	Road Finish Rock
2180	Drain Rock
2190	Geotextiles
2200	Drilled Piers
2210	Asphaltic Concrete Paving
2220	Culverts
2230	Seeding and Erosion Control
2240	Soil Sterilization
CONCRETE	
3000	Reinforced Concrete
3010	Controlled Density Fill
3020	Concrete Repair
FENCING	
4000	Fencing and Gates
METALS	
5100	Structural Steel Fabrication
5110	Anchor Rods
5120	Structural Steel Erection
5130	Painting Structural Steel
5140	Hot Dip Galvanizing
ELECTRICAL	
6000	Station Equipment
6010	Bus, Connectors, and Shield Wires
6040	Control and Power Cable
6050	Pre-Cast Cable Trench & Vaults
6060	Conduits and Duct Banks
6070	Grounding System
6080	Yard Lighting and Power System
6090	Equipment Testing and Energization

APPENDIX M1
ATTACHMENT 05
EXHIBIT 04

COMMUNICATION, SCADA, AND METERING FACILITIES

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	26Oct21	Issued for Implementation	1898 & Co.		JAL	Jared Lathrop
1	14Apr23	Update from 2021 Version	1898 & Co.	PGE	CPA	Craig Armstrong
2	25Aug23	Rev 2, see redline changes throughout	Jeremy Morris	Craig Armstrong	CPA	Craig Armstrong
2	19Jun25	Update from 2023 version	1898 & Co. / PGE	PGE	SPF	Sean Flak

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1.0 GENERAL

1.1 SUMMARY

This Section summarizes the communications systems the Contractor shall provide as part of their proposal. The following specifications include detailed SCADA specification sections:

- M2-01-01 (Wind Plant Specifications)
- M3-01-01 (Solar Photovoltaic Plant Specifications)
- M4-01-01 (Energy Storage Technical Documents)

The SCADA section in those specifications includes the following:

1. General
2. Main SCADA Components
3. SCADA Device Requirements
4. Interfaces
5. Fiber Optic Network Design
6. Fiber Optic Installation
7. Fiber Terminations and Testing
8. Availability and Reliability
9. Cyber Security
10. Viewing and Display
11. Reporting
12. Support for Warranty Calculations
13. Remote Alerts
14. Time Base and Date Formats

This Section summarizes the communications systems not covered within those specifications.

The proposal shall address four aspects of the telecommunications design.

1. Intra-site Communications - the Network shall primarily be an Ethernet Fiber network to support intra-site data and voice communications needs.
2. Field Voice Communications System – to support Operations and Maintenance activities, a 2-way radio system should be deployed for voice communications.
3. Substation Interconnect - Contractor shall incorporate plans for the communications needs required to interconnect the facility to the bulk electric power system. This may include transfer trip and any of special or remedial protection schemes needed for the interconnection of the facility to the bulk electric power system. Contractor to install fiber facilities from interconnection substation to PGE point of interconnection as required by protection schemes. This design shall meet any requirements from the interconnecting utility, the Public Utility Commission, and/or the Independent System Operator for SCADA or Metering and Operations.

4. PGE Connectivity - to support remote monitoring and operation of the facility. This will include one or more data links back to PGE operations center. This shall include connectivity for both the Primary SCADA link as well as the plant operational data link serving plant operations such as sending operational and maintenance data to a historian, allowing remote access and control, and voice communications to the facility.
5. PGE Local Data Collection – a data collection system will be installed to interface directly with the local plant control system (OEM SCADA) for the purposes of data collection, aggregation, and reporting.

1.2 TELECOMMUNICATIONS APPROACH

The Contractor shall provide a bid that both meets these specifications and allocates a budget for the design, procurement, and construction of these telecommunications facilities. The site network and the interconnection requirements should be known and the design and costs of these facilities should be accounted for and well understood. The communications link to PGE will depend greatly on the location, size, and type of facility proposed, and therefore the Contractor shall propose a solution that meets these functional specifications. Contractor shall coordinate the communications systems for Substation and O&M Building to ensure compatibility and cost effectiveness and obtain owner's approval. During negotiations, this aspect of the design may be revised based on site specific conditions. An allowance for each of these four sections (Intra-site Communications, Substation Interconnect, PGE Connectivity, and Local Data Collection) shall be provided. The proposal price will not be revised if the ultimate solutions remains within these allowances.

1.3 TELECOMUNCATIONS FACILITES

The facilities shall consist of the following:

Communications during construction: The Contractor shall provide a communications network to be used during construction, and specifically communications services to the on-site trailers used during construction. A minimum of 10 Mbps Ethernet link shall be provided to each PGE trailer, along with (2) phone lines per trailer, which may be either VOIP or POTS. The Ethernet link shall only be dedicated to PGE and no other users.

Intra-Site Network: The Contractor shall provide a data network that extends from a central substation or O&M building to all equipment enclosures throughout the facility that house microcontroller equipment. This network shall be constructed such that it supports the following applications:

- Shall support the Real-time control for the operation of the plant.
- Shall support remote monitoring for the Owner to gather operational data from microprocessor- controlled equipment.
- Shall support monitoring of weather information.
- Shall allow the Owner to remotely access remotely configurable equipment to make settings changes and firmware upgrades.
- Shall support the use of Voice at each enclosure, desk, conference room, or security control point.
- Shall support the use of Video where required for security and operations of the plant.
- Shall include Wireless Access Points in Office locations.
- Offices and conference room areas will have multiple data/analog wall jack locations. Each location will have two CAT6 station cables home run back to the Communications room where it will terminate in the main distribution field (MDF) enclosure on a specified 110 patch panel.

The network shall be capable of meeting the following specifications:

- Use IP/Ethernet communications over a fiber and copper network.
- At least 60 Strands of single mode (SM) fiber shall be installed between all buildings as part of the project. Fiber shall be configured in a logical ring and where possible into a diverse optical ring.
- Category 6 copper shall be used for all connections between switches and equipment within a building.
- Use gigabit Ethernet Interfaces.
- Use VLANS for segmentation of traffic
- Use Quality of Service to Prioritize traffic flows
- Use Rapid Spanning Tree or other advanced ring convergence protocols.
- Support POE where phones or wireless access points are installed.
- Use managed equipment that support the following:
- Centralized authentication via RADIUS or TACACS
- Centralized logging via Syslog
- Use hardened network equipment rated for the environment in which it will be installed.

Interconnection to Bulk Electric Power System:

- Determine specific equipment required by the Utility/Transmission Owner and the System Operator, specifically relating to SCADA, metering, and telemetering due to the interconnection agreement as well as equipment required to complete the indicated control and protection requirements.
- Build any fiber, microwave, or leased facilities to PGE’s current communication standards in order to tie facility into bulk electric power system.
- Follow Western Electricity Coordinating Council (WECC) teleprotection standards.

PGE Communications Circuits:

- Contractor shall provide the following communication circuits, each with the respective parameters given. These communications circuits can be delivered over the one or more aggregate leased circuits if possible. These circuits may make use of a private data network or a leased facility from a common carrier. The Contractor’s proposal shall include the capital cost for construction, as well as the estimated monthly recurring cost if applicable. The Contractor shall make use of the PGE equipment listed below where such equipment is required:

Circuit Name	LOC A	LOC Z	Type	Capacity	Latency	Avail.	Circuit Description
O&M CORPORATE NETWORK	O&M	PGE WHQ	ETH	25 Mbps	100 msec	99.00%	CORPORATE NETWORK SERVICE
INTRA-SITE NETWORKING	SUBSTATION	O&M	ETH	1 Gbps	0.05 msec	99.00%	CORP NETWORK & SECURITY LAN
SUB REMOTE ACCESS LAN	SUBSTATION	PGE WHQ	ETH	1.5 Mbps	0.5 sec	99.00%	REMOTE ACCESS LAN FOR PROTECTION & AUTOMATION GROUP
SUB COMM TECH LAN	SUBSTATION	PGE WHQ	ETH	1.5 Mbps	0.5 sec	99.00%	REMOTE ACCESS LAN FOR COMM TECHS
PRIMARY AGC+SCADA	SUBSTATION	PGE WHQ	ETH	1.5 Mbps	0.5 sec	99.95%	ETHERNET/IP DNP 3.0 AUTOMATIC GENERATION CONTROL AND SCADA
SECONDARY AGC+SCADA	SUBSTATION	PGE WHQ	ETH	1.5 Mbps	0.5 sec	99.95%	ETHERNET/IP DNP 3.0 AUTOMATIC GENERATION CONTROL AND SCADA
METERING	SUBSTATION	PGE WHQ	ETH	64 kbps	0.5 sec	99.90%	METERING DATA
VOIP Phones	SUBSTATION	PGE WHQ	ETH	64 kpbs	.05sec	99%	Site Voice Communications

1.4 OTHER COMMUNICATIONS CIRCUITS/SERVICE

PGE will not be responsible for any Vendor's long-term ISP or phone system at the site.

1.5 TELECOMMUNICATIONS EQUIPMENT

In each major facility provide space for (4) adjacent Communications racks. For the Plant and Switchyard/Substation facilities, min. (2) adjacent racks with space for third rack, locate the Communications racks in the same room or adjacent to the relay/SCADA equipment racks. For the O&M Building or Administration Building, in addition to the Communications racks, provide (4) racks for IT Operations and (2) racks for Corporate Security Operations and (2) racks for SCADA System-Local Data Collection equipment. Locate the Communications racks in the same room or adjacent to racks dedicated for IT Operations and Corporate Security. Each room to include 4'x8' fire- rate plywood backboard (white). Cabinets shall be installed with 36" clearance in rear of cabinets and 42" in the front. 36" clearance must also be allocated on the sides of the cabinets unless adjacent to another cabinet or communications rack.

Provide a -48VDC power system capable of supplying the load with an 8- hour reserve time at each major facility.Sites 3hr drive from Portland require 24hr. battery reserve time. 12hrs if tied to emergency generator, and generator has at least 7days fuel.

Communications equipment shall be grounded per Motorola R56 standards in O&M and Administration Buildings. Grounding in the Switchyard/Substation shall follow IEEE 80 standard industry practices.

Provide a SATRAD-G2 satellite phone system with exterior antenna, rack mount equipment, and a dedicated desk phone.

Equipment specified for this project shall be of the same manufacturer and model as PGE uses in their existing communications systems:

1. Dual-post Rack – Chatsworth "Clear", 19" x 84"
2. Ethernet Switch – Cisco
3. VoIP Phone - Cisco

4. Wireless Access Point – Cisco
5. Service Aggregation Node – Nokia 7705-SAR-8 with support cards
6. Fiber Patch Panel – Clearfield FxMP-144 (144ct), with SC/UPC Connectors
7. ADSS Fiber Cable – OFS AT-3BE17NT-144-CMEA/TPDE (144CT SM) Single/Double jacket depending on span lengths. TPDE is not to be used for UG Installation and should be converted on Riser Pole or in vault.
8. OPGW Fiber Cable – AFL DNO-8234 (48-CNT)
9. Splice Cases – Tyco FOSC-450D
10. -48 VDC Fuse Panel – Amphenol GMT Dual Feed 10/10-position 125A
11. -48 VDC Charger Panel – Eltek Flat Pack FPSK591-ANL-VC shelf, min 24 hours battery recharging capability while under load
12. -48 VDC Battery (Plant or Switchyard/Substation) – C&D (flooded) or East Penn Deka Unigy II (VRLA) w/ one-piece base and interlocking cells, min 8 hours carry time
13. -48 VDC Battery (O&M or Admin Building) – C&D (flooded) or C&D TEL12-XXX series VRLA Rack Mount, East Penn Deka Unigy II (VRLA) w/ one-piece base and interlocking cells, min 8 hours carry time

2.0 SCADA SYSTEM-LOCAL DATA COLLECTION

2.1 GENERAL

Contractor will provide suitable space, power, and environment control to house the PGE equipment necessary to facilitate the collection of plant control system data.

In addition to the Telecommunications, IT Operations, and Physical Security communication racks, Vendor will also provide space for Owner to install (2) 30” x 42” x 84” fully-enclosed, lockable, 4-post network cabinet with venting doors. One being located within the O&M communication room and the other in the Switchyard/Substation.

Cabinets shall be installed with 36” clearance in rear of cabinet and 42” in the front. 36” clearance must also be allocated on the sides of the cabinet unless adjacent to another cabinet or communications rack.

Vendor shall supply and install fully redundant HVAC systems and humidity control in whatever location the houses the Data Collection Cabinets, with sufficient cooling for all equipment in that location.

Vendor shall provide (2) 30A, 240V circuit to each cabinet.

2.2 SCADA HARDWARE AND SOFTWARE REQUIREMENTS

If Owner will be responsible for day-to-day maintenance or control of the plant, then Owner shall have the final say on the plant SCADA system that is installed and how it is integrated with PGE’s existing systems.

1. If Owner will not be responsible for any day-to-day maintenance, then the Contractor, in coordination with OEM SCADA Vendor, shall:
2. Make available all datapoints within the OEM SCADA System to the Owner, including individual tower/panel/battery values, directly from the OEM SCADA System to PGE’s Data Collection system.
3. Ensure data values are available in the native resolution in which they were collected, up to 1Hz.
4. Configure the OEM SCADA system to allow Owner’s data collection system to pull all live, historical, and alarm data using one or more of the following methods:

- OPC UA
- OPC DA
- SQL
- Direct queries to controllers using native protocols.

5. All SCADA paths will be commissioned between devices prior to facility operation.

3.0 METERING AND TELEMETRY FACILITES

3.1 GENERAL

PGE requires one owner per Point of Interconnection.

3.2 DIRECT TELEMETRY REQUIREMENTS

PGE requires two communication paths for controlling and operating generation that is settled within its Balancing Authority Area:

- Direct, real-time telemetry (SCADA) from RTU (site) to RTU (PGE control center)

ICCP over WECC Operations Network (WON)

3.3 METERING REQUIREMENTS

Revenue meters shall be installed at the project substation and downstream plant to account for gross and net generation, as well as station service and auxiliary loads. Each revenue meter shall be sourced from high accuracy, revenue grade current and voltage transformers, and shall comply with the requirements shown in the Interconnection Agreement and and any power purchases agreement(s). Actual revenue meter locations and instrument transformer specifications shall be determined by PGE metering personnel.

SCADA meters shall be installed on each medium-voltage (34.5kV) collection system circuit feeder.

4.0 PROCESS DATA FOR PATTERN RECOGNITION

As a minimum, Contractor shall install instrumentation and make the process data available to access by Owner in the Plant's Control System for following systems and equipment (as applicable):

4.1 HYDRO TURBINE

1. Turbine Guide RTD
2. Lower Guide RTD
3. Upper Guide RTD
4. Thrust Bearing RTD
5. Lube Oil Pressure
6. Lube Oil Temperature
7. Gen Turbine Local Ambient Temp
8. Turbine Guide Bearing X VIBR
9. Turbine Guide Bearing Y VIBR
10. Upper Guide Bearing X VIBR
11. Upper Guide Bearing Y VIBR
12. Lower Guide Bearing X VIBR
13. Lower Guide Bearing Y VIBR
14. Wicket Gate Position
15. Wicket Gate Pressure
16. Cooling Water Pressure
17. Cooling Water Temperature
18. Forebay Level
19. Tailrace Level

4.2 WIND TURBINES

1. Pitch - Blade A/B/C Pitch Motor Current
2. Pitch - Blade A/B/C Pitch Motor Voltage
3. Pitch - Blade A/B/C Pitch Position
4. Pitch - Blade A/B/C Hydraulic Oil Accumulator Pressure
5. Pitch - Pitch Pressure Output From Hydraulic Power Unit
6. Pitch - Pitch Oil Temperature - Outlet Hydraulic Power Unit
7. Pitch - Pitch Oil Accumulator Temperature
8. Pitch - Pitch Controller Panel Temperature
9. Pitch - Pitch Bearing A/B/C Vibration
10. Hub - Hub Temperature
11. Hub - Ice Detection System
12. Main Bearing(S) - Main Bearing Temperature
13. Main Bearing(S) - Main Bearing Vibration
14. Main Bearing(S) Oil Lubrication System - In Line Metal Particle Counter
15. Main Bearing(S) Oil Lubrication System - Oil Filter Differential Pressure
16. Main Bearing(S) Oil Lubrication System - Oil Pump Amps

17. Main Bearing(S) Oil Lubrication System - Oil Temperatures - Inlet/Outlet Heat Exchanger
18. Main Shaft - Main Shaft Brake Pressure
19. Main Shaft - Main Shaft Brake Accumulator Pressure
20. Main Shaft – Shaft RPM
21. Gearbox – All Bearing Temperatures
22. Gearbox - Gearbox Lube Oil Pressure, Before Filter
23. Gearbox - Gearbox Lube Oil Pressure, After Filter
24. Gearbox - Planetary Vibration
25. Gearbox - High Speed Shaft Vibration
26. Gearbox - Intermediate Speed Shaft Vibration
27. Gearbox - Oil Temperature - Gearbox Sump
28. Gearbox Oil Lubrication System - In Line Metal Particle Counter
29. Gearbox Oil Lubrication System - Oil Filter Differential Pressure
30. Gearbox Oil Lubrication System - Oil Pump Amps
31. Gearbox Oil Lubrication System - Oil Temperatures - Inlet/Outlet Heat Exchanger
32. Generator - Winding Temperature 1/2/3
33. Generator - Generator Drive End Bearing Temperature
34. Generator - Generator Non-Drive End Bearing Temperature
35. Generator - Generator Drive End Bearing Vibration
36. Generator - Generator Non-Drive End Bearing Vibration
37. Generator - Phase A/B/C Voltage
38. Generator - Phase A/B/C Current
39. Generator - Power Factor
40. Generator - Heat Exchanger Water Inlet/Outlet Temperatures
41. Generator – Shaft Torque
42. Generator – Frequency (generator side)
43. Generator – Shaft RPM
44. Generator – Active Power
45. Generator – Reactive Power
46. Yaw - Yaw Position
47. Yaw - Yaw Brake Accumulator Pressure
48. Yaw - Yaw Brake Pressure
49. Yaw – Yaw Motor/Gear Temperature
50. Tower - Wind Speed Primary
51. Tower - Wind Speed Secondary
52. Tower - Wind Direction
53. Tower - Nacelle Temperature
54. Tower - Tower Base Temperature
55. Tower - Control Panel(s) Temperature
56. Tower – Converter Inside Compartment Temperature
57. Tower – Converter Coolant Pressure

58. Tower – Converter Coolant Temperature
59. Tower – Frequency (grid side)
60. Tower – Phase A/B/C Voltage (grid side)
61. Tower – Phase A/B/C Current (grid side)
62. Tower - Misc. Panel Cooling System - Inlet/Outlet Temperatures Of Cooling Media
63. Tower - Misc. Panel Cooling System - Inlet/Outlet Temperatures Of Panel Air At Cooler
64. Tower - Transformer Temperature MMM. Tower - Ambient Temperature
65. Tower – Air Density
66. Tower - Sway
67. Tower – Error Code(s)
68. Tower – Operational State
69. Main Breaker - Status
70. Main Breaker - Faults
71. Main Breaker - Temperature
72. Main Breaker - Fan Ampere
73. Meteorological Station - Air Temperature
74. Meteorological Station - Cell Temperature
75. Meteorological Station - Relative Humidity
76. Meteorological Station - Wind Speeds At 10 meter, 1/2 Hub Height, and Hub Height
77. Meteorological Station - Barometric Pressure
78. Meteorological Station – Air Density
79. Switchgear - Breaker Phase Currents
80. Switchgear - Breaker Phase Voltages
81. Switchgear - Breaker Status
82. Switchgear - Relay Fault Codes
83. Switchgear - Bolted Bus Connections Temperatures via Fiber Optics
84. Tower – Status Code

4.3 PV FIELD

1. Combiner Box - DC Output Voltage
2. Combiner Box - DC Output Current
3. Combiner Box - DC Current per String
4. Combiner Box - Combiner Box Interior Temperature
5. Inverter - DC Input Voltage
6. Inverter - DC Input Current
7. Inverter - AC Output Voltage
8. Inverter - AC Output Current
9. Inverter - AC Power
10. Inverter - AC Frequency
11. Inverter - AC Reactive Power
12. Inverter - Energy Totalizer

13. Inverter - Inverter Temperatures
14. Inverter - Inverter Status
15. Inverter - Faults/Alarms
16. Inverter - Ground Current
17. Inverter – Operational State
18. Meteorological Station - Air Temperature
19. Meteorological Station - Cell Temperature
20. Meteorological Station - Relative Humidity
21. Meteorological Station - Wind Speed
22. Meteorological Station - Global Irradiance
23. Meteorological Station - Plane of Array Irradiance
24. Meteorological Station - Solar Module Back Panel Temperature(s) - 10% of Modules
25. Switchgear - Breaker Phase Currents
26. Switchgear - Breaker Phase Voltages
27. Switchgear - Breaker Status BB. Switchgear - Relay Fault Codes
28. Switchgear - Bolted Bus Connections Temperatures via Fiber Optics

4.4 OIL-COOLED TRANSFORMERS

1. Active Power
2. Reactive Power
3. High Side Amps (by phase)
4. High Side Voltage (by phase)
5. Ground Current
6. Low Side Voltage (by phase)
7. Control Voltage
8. Control Panel Temperature
9. LTC Tap Position
10. Oil Pump Amps
11. Oil Pump Discharge Pressure
12. Fan Bank Amps
13. LTC Tank Oil Temperature
14. Main Tank Oil Temperature
15. Top Oil Temperature
16. High Voltage Winding Temperature
17. Low Voltage Winding Temperature
18. Nitrogen Pressure
19. Local Ambient Temperature
20. Moisture Percentage
21. Gas Analyzer H2
22. Gas Analyzer O2
23. Gas Analyzer N2

24. Gas Analyzer CO
25. Gas Analyzer CO2
26. Gas Analyzer CH4
27. Gas Analyzer C2H6
28. Gas Analyzer C2H4
29. Gas Analyzer C2H2
30. Gas Analyzer H2O
31. Infrared Camera Temperatures

4.5 DRY TRANSFORMERS

1. Active Power
2. Reactive Power
3. High Side Amps (by phase)
4. High Side Voltage (by phase)
5. Ground Current
6. Low Side Voltage
7. Low Side Amps
8. Control Voltage
9. Control Panel Temperature
10. Cooling Fan Amps
11. High Voltage Winding Temperature
12. Low Voltage Winding Temperature
13. Local Ambient Temperature

4.6 SWITCHGEAR / MOTOR CONTROL CENTERS

Control Panel

1. Control Panel Voltage
2. Control Panel Temperature

4160 VAC and Higher Bus

1. Connected Joints Temperature Via Fiber Optic Infrared Measurement

MCC Bucket

1. Load Amps
2. Load Voltage
3. Power Factor
4. Bucket Temperature
5. Cooling Fan Amps

4.7 HEAT EXCHANGERS

1. Inlet/Outlet Temperatures

2. Process Flows

4.8 PUMP / FAN MOTORS GREATER THAN 100 HP

1. Motor Stator Temperature
2. Local Ambient Temperature
3. Motor Amps
4. Motor Power Factor
5. Motor Voltage

APPENDIX M1
ATTACHMENT 05
EXHIBIT 05

GEN-TIE LINE REQUIREMENTS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	19Jun25	2025 RFP Spec	PGE	SPF	SPF	Sean Flak

1.0 GEN-TIE LINE

This specification defines the requirements for Gen-Tie Line facilities associated with utility-scale generation projects. A Gen-Tie Line, for the purposes of this specification, refers to any portion of the generation interconnection facilities that are owned, operated, or maintained by Portland General Electric (PGE) and are required to support the physical connection between the generation facility and the point of interconnection with the PGE transmission or distribution system. The Gen-Tie line typically begins at the high-voltage terminals of the project's main step-up transformer and terminates at the line-side connection point of the utility-owned disconnect switch at the point of interconnection, with exact start and stop points to be confirmed with the Owner during the design phase as they may vary by project. These requirements apply regardless of whether the Gen-Tie facilities are located on public or private property, and are intended to ensure compatibility with PGE standards, operational practices, and long-term maintenance.

1.1 INTRODUCTION

A. The purpose of this document is to summarize the minimum requirements for Contractor, which generally include the complete development, engineering, procurement, and construction of the overhead generation tie ("Gen-Tie") transmission line.

B. The Gen-Tie 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 and industry best practices.

C. Expected service life of Gen-Tie line is minimum 50-years.

D. Contractor shall be responsible for obtaining and maintaining all necessary permits and / or easements for the Work.

E. All access and site civil work for the Gen-Tie line shall comply with all local ordinances, Section M1-02-01, and these contract documents as applicable.

F. In the event of any conflict or discrepancy between this exhibit (including any attachment hereto) and any Requirement, the more stringent or higher quality Requirement shall take precedence over the less stringent or lesser quality Requirement at Portland General Electric's discretion.

G. The document is not intended to supersede Portland General Electric's standards.

1.2 ENGINEERING

A. Contractor shall receive explicit approval from Owner or Owner's representative(s) of the design of the Gen-Tie line prior to construction. Owner shall have unlimited access to such designs throughout the design process.

B. The following PGE Standards referenced in this specification will be made available to bidders via a secure website following execution of the RFP Non-Disclosure Agreement (NDA).

1. M1-05-05-01 57 and 115 kV PGE Standards
2. M1-05-05-02 Work Practices
3. M1-05-05-03 230 kV DCD
4. M1-05-05-04 Construction Specifications
5. M1-05-05-05 Design Drilled Pier and Direct Embed
6. M1-05-05-06 Geotech Investigation

7. M1-05-05-07 LiDAR57

C. 115 kV Transmission

1. Project shall be designed as per Portland General Electric (PGE) Standards and Work Practices.
2. Reference Attachment M1-05-05-01 for list of PGE Standards.
3. Reference Attachment M1-05-05-02 for list of PGE Work Practices.

D. 230 kV Transmission

1. Project shall be designed as per PGE 230 kV Design Criteria Document (DCD), PGE Standards and Work Practices. Reference Attachment M1-05-05-03 for PGE 230 kV DCD.

E. Drilled Pier and Direct Embed Foundations

1. Reference Attachment M1-05-05-05 for PGE drilled pier and direct embed design standards.

F. Communications

1. Reference Section M1-05-04 for Communications requirements.
2. Gen-Tie will require a minimum of one (1) communications cable. Additional cables may be required depending on NERC CIP or other requirements.
3. 57/115 kV Projects shall use All Dielectric Self Supporting (ADSS) cable(s) for communications.
4. 230 kV Projects may request PGE approval for use of Optical Ground Wire (OPGW) cable(s) for communications.
5. ADSS communications cables shall be designed outside the “Supply Space”. Exception to this requirement will require PGE approval.

G. Miscellaneous

1. Contractor shall provide a Field Effect Study for the Gen-Tie line. Calculations shall be made for measurement heights of one (1) meter above ground surface within the easement. Electrical field strength shall be calculated for the transmission line and any collocated or adjacent facilities.

1.3 PROCUREMENT

A. Refer to M1-05-07 for an approved vendor list and accompanying material specification(s) as applicable. PGE Standards also identify specific approved parts that shall be used where possible. In the case of conflicts, the stricter of the specifications shall prevail.

B. Conductor

1. Contractor shall utilize a standard PGE conductor for the Project. Reference PGE Standards for list of standard conductors.
2. All ACSS conductors shall use hardware rated for 250oC and clearances shall be designed for 250oC. PGE may choose to relax this requirement for 115 kV framed transmission.

C. 57/115 kV and ADSS Hardware

1. All 57/115 kV and ADSS materials shall be per PGE Standards and current PGE approved parts.
2. Transmission voltages below 115 kV shall be framed as 115 kV.

D. 230 kV and OHSW Hardware

1. All 230 kV assemblies shall be per current approved assemblies. Contractor may propose specific part substitution for PGE review and acceptance, but the general assembly shall stay the same.
2. Contractor is required to complete Project specific electrical design to validate PGE 230 kV assembly.
3. If 230 kV design requires modification to the standard assembly, Contractor shall propose new assembly design for PGE review and acceptance. Contractor shall keep the assembly as close as possible to current approved assemblies.

E. OPGW Hardware

1. If PGE approves OPGW for Gen-Tie Project, Contractor shall provide assembly drawings for PGE review. PGE has limited existing OPGW cable facilities to provide as examples.

F. Material Specification(s) and Vendor Drawings

1. For instances which PGE does not have specifications, Contractor shall prepare material / equipment specifications to define requirements and properties for the procurement of all permanently installed Gen-Tie line equipment and materials. The specifications shall be submitted to Owner for review prior to the procurement of applicable equipment.
2. Contractor shall submit manufacturer's approval drawings and / or product sheets (material cut sheets) for all permanently installed Gen-Tie line equipment and materials. PGE may elect to waive this requirement for standard materials / equipment procured from approved vendors.

G. Contractor shall provide a complete recommended spare parts list for the Gen-Tie line and include justification. List shall include recommended quantities, part / model numbers, nominal pricing and shelf life.

1.4 DESIGN DELIVERABLES

A. Reference M1-01-02-01 Documents and Deliverables Table for list of deliverables.

B. Contractor shall provide a 15% deliverable memorandum for PGE acceptance. PGE shall have ten (10) business days to review and provide comments. Contents of the memorandum shall include:

1. Proposed project routing and anticipated easement width(s).
2. Project vertical and horizontal datum.
3. Project conductor type; shall be as per PGE standard conductors.
4. Project communications cable type; shall be as per M1-01-05.

5. Project proposed framing; shall match PGE standards for 115 kV. PGE may provide sample framing from past Projects for 230 kV. Framing shall include proposed structure material types and planned foundation types for PGE approval. Framing shall include information on communications cable location.
6. Project proposed hardware assemblies; shall match PGE standards.
7. Engineering milestone schedule so that PGE can plan resources for design review.

C. Upon PGE acceptance of the 15% deliverable memorandum, the design may progress as defined in the 230 kV Design Criteria Document. Section 26 shall apply to overhead Gen-Tie Projects of all voltages.

D. PLS-CADD software shall be utilized to spot and perform detailed analysis and design of the Gen-Tie line. Copies of all PLS-CADD electronic design files shall be provided to owner at the deliverable milestones and in final form at the conclusion of the Project.

1.5 CONSTRUCTION

A. Refer to Attachment M1-05-05-04 for applicable construction specifications.

B. Construction of Gen-Tie line and all related facilities shall be performed by a qualified construction contractor who has demonstrated successful completion of similar projects. The contractor shall have verifiable experience in constructing transmission lines of comparable voltage, complexity and scale.

C. Installation of all Gen-Tie facilities shall be per manufacturer requirements and / or recommendations.

1.6 GENERAL

A. Geotechnical Investigation

1. Reference Attachment M1-05-05-06 for PGE geotechnical investigation standard.

B. Survey.

1. Project Datum (design and construction) shall be approved by PGE.
2. Post construction as-built shall include LiDAR survey as noted in Construction Specifications. LiDAR survey shall be as per industry best practices and Attachment M1-05-05-07.

C. Outages. Reference also Section M1-01-05.

D. Contractor shall develop a construction sequencing plan, early in the design process, that reduces the number of outages on PGE system.

1. Contractor shall develop overall Project schedule with consideration for outages.
2. 230 kV outages, with exact dates, shall be submitted for PGE review and approval (120) days ahead of outage.
3. 115 kV outages, with exact dates, shall be submitted for PGE review and approval (60) days ahead of outage.
4. 230 kV outages shall generally be: one (1) circuit, between mid-October and mid-May. If the seasonal restrictions cannot be met, Contractor shall plan on weekend outages only.

5. 115 kV outages shall avoid peak summer / winter months. Outages planned during peak times will be at Contractor's risk. PGE will retain the right to require Contractor to return lines to service during peak months, without compensation for additional work or lost time. Contractor will be provided 24-hour notice for lines that are required to be returned to service.

E. Energization. Reference also Section M1-01-05.

1. Contractor shall prepare construction sequencing plan and identify all outages necessary to complete the Work.

2. Contractor shall test, commission, start-up and place into successful operation the Gen-Tie line, including the electrical and communications infrastructure.

3. Contractor shall prepare energization plans and procedures for the Gen-Tie line. Energization plans shall be submitted to Owner for approval prior to use. Energization plans shall include both electrical and communications infrastructure. Refer to other Sections as applicable. Plans shall include, but not limited to, backfeed plans, soaking plans, testing plans and lock out tag out procedures.

4. Contractor shall expect extensive coordination with PGE.

APPENDIX M1
ATTACHMENT 05
EXHIBIT 06

APPLICABLE STANDARDS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

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Without limiting the information summarized herein, the purpose of this attachment is to summarize the applicable industry codes and standards for Contractor's Work.

1.1 GENERAL REQUIREMENTS

The Applicable Standards shall include (a) each of the standards and industry codes listed below and (b) each of the relevant standards and codes issued by the organizations listed below. For the avoidance of doubt, any standards or industry codes not identified herein but pertinent to the Work shall also apply.

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 implement tation.

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.

Any general standard or organization listed below 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.

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

1.2 APPLICABLE STANDARDS

1. Air Movement and Control Association ("AMCA")
2. Aluminum Association ("AA")
3. American Association of State Highway and Transportation Officials ("AASHTO")
4. American Bearing Manufacturer Association ("ABMA")
5. American Concrete Institute ("ACI")
6. Americans with Disabilities Act ("ADA")
7. American Institute of Constructors ("AIC")
8. American Institute of Steel Construction ("AISC")
9. American Iron and Steel Institute ("AISI")
10. Association of Iron and Steel Engineers ("AISE")
11. Association of Edison Illuminating Companies ("AEIC")
12. American Gear Manufacturer Association ("AGMA")
13. American Land and Title Association ("ALTA")
14. American National Standards Institute ("ANSI")
15. American Society of Civil Engineers ("ASCE")
16. American Society of Heating, Refrigeration, and Air Conditioning Engineers ("ASHRAE")
17. American Society of Mechanical Engineers ("ASME")
18. American Society of Nondestructive Testing ("ASNT")
19. American Society of Testing and Materials ("ASTM")
20. American Water Works Association ("AWWA")
21. American Welding Society ("AWS")
22. Avian Power Line Interaction Committee ("APLIC")
23. Bonneville Power Administration ("BPA") Master Specifications

24. Clean Air Act and Amendments (“CAA”)
25. Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (“CERCLA”)
26. Code of Federal Regulations (“CFR”)
27. Concrete Reinforcing Steel Institute (“CRSI”)
28. Crane Manufacturer Association of America (“CMAA”)
29. Clean Water Act (“CWA”)
30. Department of Transportation (“DOT”)
31. Det Norske Veritas Germanischer Lloyd (“DNV GL”)
32. Expansion Joint Manufacturer Association (“EJMA”)
33. Electric Power Research Institute (“EPRI”)
34. United States Environmental Protection Agency (“EPA”)
35. Federal Aviation Agency, Department of Transportation (“FAA”)
36. Federal Energy Regulatory Commission (“FERC”)
37. Federal Highway Administration (“FHWA”)
38. Federal Power Act (“FPA”)
39. FM Global (“FM”)
40. Hydraulic Institute (“HI”)
41. IAPMO Uniform Plumbing Code
42. Illuminating Engineering Society (“IES”)
43. Institute of Electrical and Electronic Engineers (“IEEE”)
44. Instrumentation Society of America (“ISA”)
45. Insulated Cable Engineering Association (“ICEA”)
46. International Building Code (“IBC”)
47. International Electrotechnical Commission (“IEC”)
48. International Federation for Structural Concrete (“FIB”)
49. International Fire Code (“IFC”)
50. International Network for Harmonised and Recognized Measurements in Wind Energy (“MEASNET”)
51. International Organization for Standardization (“ISO”)
52. International Society of Automation (“ISA”)
53. Applicable state requirements, including State Department of Transportation
54. Metal Building Manufacturers Association (“MBMA”)
55. Migratory Bird Treaty Act (“MBTA”)
56. MESA – Open Standards for Energy Storage
57. Manufacturer’s Standardization Society of the Valve and Fittings Industry (“MSS”)
58. National Association of Corrosion Engineers (“NACE”)
59. National Electric Code (“NEC”)
60. National Electrical Contractors Association (“NECA”)
61. National Electric Safety Code (“NESC”)
62. National Electrical Manufacturers Association (“NEMA”)

63. National Electrical Testing Association (“NETA”)
64. National Fire Protection Association (“NFPA”)
65. National Safety Council (“NSC”)
66. National Institute of Standards and Technology (“NIST”)
67. National Institute of Standards and Technology Internal or Interagency Reports (“NISTIR”)
68. North American Electric Reliability Corporation (“NERC”)
69. Occupational Safety and Health Administration (“OSHA”)
70. Post-Tensioning Institute (“PTI”)
71. Pipe Fabrication Institute (“PFI”)
72. Resource Conservation and Recovery Act (“RCRA”)
73. Scientific Apparatus Makers Association (“SAMA”)
74. Safe Drinking Water Act (“SDWA”)
75. Sheet Metal and Air Conditioning Contractors National Association (“SMACNA”)
76. Solid Waste Disposal Act (“SWDA”)
77. Society for Protective Coatings (“SPC”)
78. Telecommunications Industry Association/Electronic Industries Association (“TIA/EIA”)
79. Thermal Insulation Manufacturer Association (“TIMA”)
80. Toxic Substances Control Act (“TSCA”)
81. Underwriter’s Laboratories (“UL”)
82. United States Department of Agriculture (“USDA”)
83. Welding Research Council (“WRC”)
84. DNV OS C502, Offshore Concrete Structures
85. Electric Tarriff Rule 21 – Generating Facility Interconnections
86. Applicable Standards (Oregon Projects only):
87. Oregon Structural Specialty Code (based on the International Building Code)
88. Oregon Mechanical Specialty Code (based on the International Mechanical Code)
89. Oregon Electrical Specialty Code (based on the National Electrical Code)
90. Oregon Plumbing Specialty Code (based on the Uniform Plumbing Code)
91. Oregon Fire Code (based on the International Fire Code)
92. Oregon State Occupational Safety and Health Act
93. Oregon Health Authority
94. Oregon Occupational Safety and Health Act (OR-OSHA) - 29 CFR 1910, 1926

In addition to the other Applicable Standards noted above, the following shall also apply to all energy storage projects:

1. ANSI/IEEE C2, National Electric Safety Code
2. IEEE 519, IEEE Recommended Practices and Requirements for harmonic Control in Electrical Power Systems
3. IEEE 1815-2012, IEEE Standard for Electric Power Systems Communications— Distributed Network Protocol (DNP3)

4. IEEE 1547-2018, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
5. IEEE 1547.1, Standard Conformance Test Procedure for Equipment Interconnecting Distributed Resources with Electric Power Systems
6. IEEE 1547.2, Interconnecting Distributed Resources with Electric Power Systems
7. IEEE 1547.3, Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected with Electric Power Systems
8. ANSI Z535, Product Safety Signs and Labels
9. ANSI C57/IEEE, Transformer Standards, whenever applicable
10. ANSI C37/IEEE, Surge withstand capabilities, whenever applicable
11. UL 1642/IEC 62133, Applicable sections related to battery cell safety, where applicable
12. UL 1741, Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
13. NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response
14. UL 1642, Standard for Lithium Batteries
15. UL 1778, Underwriters Laboratories' Standard for Uninterruptible Power Systems for up to 600 Volts AC
16. UL 1973, Standards for Batteries for Use in Light Electric Rail Applications and Stationary Applications
17. UL 9540/9540A, Standard for Energy Storage Systems and Equipment / Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
18. Electric Tariff Rule 21, Generating Facility Interconnections
19. NISTIR 7628, Guidelines for Smart Grid Cyber Security
20. IEEE 1881, Standard Glossary of Stationary Battery Terminology
21. IEEE 519, Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
22. IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems
23. IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
24. IEEE 2030.3, Standard Test Procedures for Electric Energy Storage Equipment and Systems for Electric Power Systems Applications
25. EPRI 3002009313, Energy Storage Integration Council Energy Storage Test Manual 2016
26. IEEE 1881, Standard Glossary of Stationary Battery Terminology
27. Owner S-76, Below Grade Substation Standards
28. MESA, Open Standards for Energy Storage
29. NFPA 855, Standard for the Installation of Stationary Energy Storage Systems
30. OSSC, 2014 Oregon Structural Specialty Code
31. International Building Code, 2012 International Building Code
32. ACI-318, American Concrete Institute 318-11
33. AWS, American Welding Society D1.1 Structural Welding Code - Steel

34. OFC, 2019 Oregon Fire Code
35. IEEE 2800, IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources Interconnecting with Associated Transmission Electric Power Systems

APPENDIX M1
ATTACHMENT 05
EXHIBIT 07

APPROVED VENDORS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	19Jun25	2025 RFP	PGE	SPF	SPF	Sean Flak

APPROVED VENDORS AND SERVICE SUPPLIERS

This section provides a list of approved Suppliers for plant materials, equipment, and services. The Contractor may not deviate from this list prior to contract award but may do so after contract award only with prior written Owner approval.

In some categories, a Supplier has been identified as “Preferred” with an (*) in order to maintain the same Suppliers of equipment as PGE has utilized the Supplier for its generating fleet and has had favorable experiences.

The basis for the plant design should generally be the “Preferred” Suppliers in areas where common operating procedures, routine maintenance or spare parts can be affected.

In other areas, the Owner shall be notified and shall have the option to select an identified equipment “Preferred” Supplier via a Change Order if the “Preferred” Supplier is not the Contractor’s evaluated equipment bidder. The Owner would not expect to see a request for change order however unless there are significant cost differences from the “Preferred” Supplier.

Final major equipment supplier list is to be approved by Owner. If 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.

Contractor is expected to consider lead time of vendors, including Owner review and approval timeline of drawings and documentation, in their ordering schedule. Exceptions will not be granted because Contractor has failed to do so. All equipment must be designed for, and officially supported in, the United States market.

General Equipment Vendors (applicable to all project types)**:**

1) **Generator Circuit Breaker**
   a) Energy Storage
      i) ABB
      ii) GE Grid Solutions
      iii) Mitsubishi
      iv) Siemens
      v) HVB
   b) Wind
      i) *ABB
      ii) GE Grid Solutions
      iii) Mitsubishi
      iv) Siemens
      v) HVB
   c) Solar
      i) *ABB
      ii) GE Grid Solutions
      iii) Mitsubishi
      iv) Siemens
      v) HVB
2) **Generator Step-up Transformer (Substation Main Power Transformer)**
   a) Energy Storage, Wind, and Solar
      i) Hitachi, Varennes, Canada shop
      ii) Hitachi, Crystal Springs, MS shop
      iii) Hitachi, Bad Honnef, Germany shop

iv) Hitachi, South Boston, Virginia shop
v) Delta Star, Inc, San Carlos, CA shop
vi) Delta Star, Inc., Lynchburg, Virginia shop
vii) HICO, ChangWon, South Korea shop
viii) Hyundai, Montgomery, Alabama shop
ix) Hyundai, Ulsan, South Korea shop
x) Smit, Nijimegen, The Netherlands shop
xi) SPX Waukesha, Waukesha, Wisconsin shop
xii) EFACEC, Arroteia, Portugal shop
xiii) Siemens, Guanajuato, Mexico shop
xiv) GE Prolec, Monterrey, Mexico shop
xv) Shihlin, Taipei, Taiwan shop

3) Ground Reference Transformers

a) Energy Storage
i) ABB
ii) Cooper Power Systems
iii) GE
iv) Virginia Transformer

b) Wind
i) ABB
ii) Cooper Power Systems
iii) GE
iv) Virginia Transformer

c) Solar
i) ABB
ii) Cooper Power Systems
iii) GE
iv) Virginia Transformer

4) GSU Pad-mount Transformers

a) Energy Storage
i) ABB
ii) General Electric
iii) Cooper Power Systems
iv) Siemens
v) WEG

b) Wind
i) ABB
ii) General Electric
iii) Cooper Power Systems
iv) Siemens
v) WEG

c) Solar

5) Instrument Transformers

a) All Technologies
i) Hitachi
ii) ABB (Except for MV Potential Transformers)
iii) Trench Ltd
iv) GE/Alstom
v) Arteche

6) Load Center Unit Substations

a) Energy Storage

i) ABB
ii) Eaton
iii) General Electric
iv) Powell Manufacturing
v) Schneider Electric / Square D
vi) Siemens Power T&D

b) Wind
i) ABB
ii) Eaton
iii) General Electric
iv) Powell Manufacturing
v) Schneider Electric / Square D
vi) Siemens Power T&D

c) Solar
i) ABB
ii) Eaton
iii) General Electric
iv) Powell Manufacturing
v) Schneider Electric / Square D
vi) Siemens Power T&D

7) LV Motor Control Centers

a) Energy Storage
i) *Eaton
ii) ABB
iii) Allen Bradley
iv) General Electric
v) Powell Manufacturing
vi) Schneider Electric / Square D
vii) Siemens Power T&D

b) Wind
i) *Eaton
ii) ABB
iii) Allen Bradley
iv) General Electric
v) Powell Manufacturing
vi) Schneider Electric / Square D
vii) Siemens Power T&D

c) Solar
i) *Eaton
ii) ABB
iii) Allen Bradley
iv) General Electric
v) Powell Manufacturing
vi) Schneider Electric / Square D
vii) Siemens Power T&D

8) Medium Voltage Switchgear, Starters and Controllers

a) Energy Storage
i) Powercon
ii) Siemens Power T&D
iii) ABB
iv) Eaton

v) General Electric
vi) Powell Manufacturing
vii) Schneider Electric / Square D

b) Wind
i) Powercon
ii) Siemens Power T&D
iii) ABB
iv) Eaton
v) General Electric
vi) Powell Manufacturing
vii) Schneider Electric / Square D

c) Solar
i) Powercon
ii) Siemens Power T&D
iii) ABB
iv) Eaton
v) General Electric
vi) Powell Manufacturing
vii) Schneider Electric / Square D

9) Protective Relays

a) All Technologies
i) Schweitzer Engineering Laboratories (SEL)
(1) Final devices (including part number and firmware) must be compatible with PGE standards and approved by PGE in advance of procurement, final design, and start of construction

10) Revenue Meters

a) Schweitzer Engineering Laboratories (SEL)
i) Final devices (including part number and firmware) must be compatible with PGE standards and approved by PGE in advance of procurement, final design, and start of construction

b) Schneider Ion 8650
i) Final devices (including part number and firmware) must be compatible with PGE standards and approved by PGE in advance of procurement, final design, and start of construction

11) Relay Panels

a) Energy Storage
i) Electrical Power Products (EP2)

b) Wind
i) Electrical Power Products (EP2)

c) Solar

12) SF6 Circuit Breakers (High Voltage and Medium Voltage)

a) Energy Storage
i) Siemens
ii) ABB
iii) Mitsubishi
iv) GE/Alstom
v) Hitachi/HVB (Georgia)

b) Wind
i) Siemens
ii) ABB
iii) Mitsubishi

iv) GE/Alstom
v) Hitachi/HVB (Georgia)

c) Solar
i) Siemens
ii) ABB
iii) Mitsubishi
iv) GE/Alstom
v) Hitachi/HVB (Georgia)

13) Single Mode Fiber Cable & Attachment Hardware

a) Energy Storage
i) AFL –ADSS and OPGW
ii) OFS –ADSS
iii) Preformed Line Products
iv) Tyco/Commscope FOSC splice cases
v) Anixter

b) Wind
i) AFLADSS and OPGW
ii) OFS-ADSS
iii) Preformed Line Products
iv) Tyco/Commscope FOSC Splice Cases
v) Anixter

c) Solar
i) AFL ADSS and OPGW
ii) OFS ADSS
iii) Preformed Line Products
iv) Tyco/Commscope FOSC Splice Cases
v) Anixter

14) Substation Capacitors

a) Energy Storage
i) Cooper Power Systems
ii) General Electric

b) Wind
i) Cooper Power Systems
ii) General Electric

c) Solar
i) Cooper Power Systems
ii) General Electric

15) Substation Control Enclosure

a) Energy Storage
i) Trachte
ii) AZZ
iii) Systems Control

b) Wind
i) Trachte
ii) AZZ
iii) Systems Control

c) Solar
i) Trachte
ii) AZZ
iii) Systems Control

16) Substation Disconnect Switches (115-230KV)

a) Energy Storage
   i) Pascor
   ii) Cleaveland Price
b) Wind
   i) Pascor
   ii) Cleaveland Price
c) Solar
   i) Pascor
   ii) Cleaveland Price

17) Substation Distribution Metering

a) Energy Storage
   i) Novatech Bitronics M871 (SCADA distribution feeder metering)
   ii) Novatech Bitronics M650 (SCADA distribution transformer metering)
b) Wind
   i) Novatech Bitronics M871 (SCADA distribution feeder metering)
   ii) Novatech Bitronics M650 (SCADA distribution transformer metering)
c) Solar
   i) Novatech Bitronics M871 (SCADA distribution feeder metering)
   ii) Novatech Bitronics M650 (SCADA distribution transformer metering)

18) Substation Human/Machine Interface

a) Energy Storage
   i) Schneider Electric
b) Wind
   i) Schneider Electric
c) Solar
   i) Schneider Electric

19) Substation Remote Terminal Unit

a) Energy Storage
   i) Eaton Cooper Power System
b) Wind
   i) Eaton Cooper Power System
c) Solar
   i) Eaton Cooper Power System

20) Substation SCADA Ethernet Switches and Port Servers

a) Energy Storage
   i) Siemens RuggedCom RSG2300 – Managed Layer 2 switch, Rack mount, 32 ports
   ii) Siemens RuggedCom RS900 – Managed Layer 2 switch, Rail mount, 9 ports
   iii) Siemens RuggedCom RX1500 – Managed Layer 2 & Layer 3 switch, Rack mount, maximum 24 ports
   iv) Siemens RuggedCom RS416 – Serial port server, Rack mount, 16 ports
b) Wind
   i) Siemens RuggedCom RSG2300 – Managed Layer 2 switch, Rack mount, 32 ports
   ii) Siemens RuggedCom RS900 – Managed Layer 2 switch, Rail mount, 9 ports
   iii) Siemens RuggedCom RX1500 – Managed Layer 2 & Layer 3 switch, Rack mount, maximum 24 ports
   iv) Siemens RuggedCom RS416 – Serial port server, Rack mount, 16 ports
c) Solar
   i) Siemens RuggedCom RSG2300 – Managed Layer 2 switch, Rack mount, 32 ports
   ii) Siemens RuggedCom RS900 – Managed Layer 2 switch, Rail mount, 9 ports
   iii) Siemens RuggedCom RX1500 – Managed Layer 2 & Layer 3 switch, Rack mount, maximum 24 ports

iv) Siemens RuggedCom RS416 – Serial port server, Rack mount, 16 ports

21) Substation SCADA Gateway

a) Energy Storage
   i) Eaton Cooper SMP SG4260
b) Wind
   i) Eaton Cooper SMP SG4260
c) Solar
   i) Eaton Cooper SMP SG4260

22) Substation SCADA Input/Output Devices

a) Energy Storage
   i) Eaton Cooper Power Systems
b) Wind
   i) Eaton Cooper Power Systems
c) Solar
   i) Eaton Cooper Power Systems

23) Transformer Bushings

a) Energy Storage
   i) PCORE
   ii) Hitachi
b) Wind
   i) PCORE
   ii) ABB
c) Solar
   i) PCORE
   ii) ABB

24) Uninterruptible Power Supply System (UPS)

a) Energy Storage
   i) Ametek Solidstate Controls
   ii) CEG
   iii) Gutor/Schneider
b) Wind
   i) Ametek Solidstate Controls
   ii) CEG
   iii) Gutor/Schneider
c) Solar
   i) Ametek Solidstate Controls
   ii) CEG
   iii) Gutor/Schneider

25) 48 VDC Battery & Charger

a) Energy Storage
   i) East Penn Manufacturing
   ii) C&D Technologies
   iii) Delta/Eltek
   iv) SENS
b) Wind
   i) East Penn Manufacturing
   ii) C&D Technologies
   iii) Delta/Eltek
   iv) SENS
c) Solar
   i) East Penn Manufacturing

ii) C&D Technologies
iii) Delta/Eltek
iv) SENS

26) 125 VDC Chargers

a) Energy Storage
i) *SENS
ii) Ametek Solid State Controls
iii) Cyberex
iv) Hindle Power
b) Wind
i) *SENS
ii) Ametek Solid State Controls
iii) Cyberex
iv) Hindle Power
c) Solar
i) *SENS
ii) Ametek Solid State Controls
iii) Cyberex
iv) Hindle Power

27) 125 VDC Batteries

a) Energy Storage
i) *GNB
ii) BAE
iii) Hoppecke
iv) C&D Technologies
b) Wind
i) *GNB
ii) BAE
iii) Hoppecke
iv) C&D Technologies
c) Solar
i) *GNB
ii) BAE
iii) Hoppecke
iv) C&D Technologies

28) Collection System Cable

a) Energy Storage, Wind, and Solar
i) Southwire
ii) Prysmian Power Cables and Systems
iii) Okonite

<u>Energy Storage Project Equipment Vendors:</u>

1) BESS Suppliers, Batteries (Cells)

a) BYD
b) CATL
c) LG Chem
d) Samsung
e) Panasonic
f) Tesla

2) BESS Suppliers, Inverters

a) Energy Storage
   i) Power Electronics
   ii) SMA
   iii) Sungrow
   iv) Tesla
   v) TMEIC
   vi) EPC

Wind Project Equipment Vendors:

1) **Climb Assist/Lift System**
   a) 3S Lift, Climb Auto System
2) **Transmission Line Type Grips**
   a) *Chicago
   b) Alcoa Pocket
   c) Kellum (for stringing operation)
3) **Transmission Tubular Steel Towers**
   a) Valmont
   b) Sabre
   c) TAPP
4) **Transmission Overhead Conductor and Cables**
   a) Southwire
   b) Prysmian
   c) Nehring
5) **Wind Turbine OEM**
   a) Siemens Gamesa
   b) Vestas
   c) General Electric
6) **Rolling Element Bearings**
   a) Schaeffler/FAG
   b) SKF
   c) NSK
   d) Timken
7) **Gearbox**
   a) Winergy
   b) ZF
8) **Pitch Bearings**
   a) IMO
   b) Thyssenkrupp/Rothe Erde
   c) GE O-bearing
   d) Liebherr
9) **Approved Subcontractors, Met Towers**
   a) World Tower
   b) Magnum Tower
   c) CER
   d) Aerial Erectors
   e) Anetech
   f) Sabre
   g) Tower Systems
   h) Nello

i) Vikor
j) Vertical Technologies

Solar Project Equipment Vendors:

1) **SCADA System**
   a) Vertech
   b) Green Power Monitor (GPM)
   c) Norcal Controls
2) **PV Module**
   a) Canadian Solar
   b) First Solar
   c) GCL
   d) Hanwha Q-CELLS
   e) JA Solar
   f) Jinko Solar
   g) LONGi Solar
   h) Trina Solar
   i) Yingli
   j) Tracker
3) **Array Technologies (ATI)**
   a) NEXTracker
   b) DC Combiner Box and/or Load Break Disconnect
   c) Bentek
   d) Shoals
   e) Solar BOS
   f) WTEC
4) **Inverter**
   a) Power Electronics
   b) SMA
   c) Sungrow
   d) TMEIC

APPENDIX M2
ATTACHMENT 01
EXHIBIT 01

WIND PLANT SPECIFICATIONS

RENEWABLE ENERGY RESOURCES

PORTLAND GENERAL ELECTRIC

2025

REQUEST FOR PROPOSAL

NO.	DATE	REVISION	BY	CHK'D	APPROVALS	
0	14Apr23	Issued for Implementation	1898 & Co.	PGE	CPA	Craig Armstrong
1	15Dec23	Change to Rev 0	PGE	PGE	CPA	Craig Armstrong
2	19Jun25	Revision to 2023 Specs	PGE	PGE	SPF	Sean Flak

TABLE OF CONTENTS

1.0 EXHIBIT INFORMATION

1.1 PURPOSE

1.1.1 Without limiting the information summarized herein, the purpose of this document is (a) to summarize the minimum scope of work requirements for Contractor, which generally include the complete development, engineering, procurement, and construction of the Project, including Wind Turbine supply and installation, all balance-of-plant infrastructure, and all tasks necessary to achieve Wind Turbine Commissioning Completion of all Wind Turbines; and (b) to summarize the minimum performance specifications, quality standards, and other criteria required for the development, engineering, procurement, and construction of the Project.

1.2 PROJECT DESCRIPTION

1.2.1 The [Project Name] Wind Project is a nominal [capacity] megawatt wind energy project using a quantity of [quantity] [model] Wind Turbines located in [County Name] County, [State Name].

1.3 REFERENCES

1.3.1 In addition to anything summarized herein, all Work related to the Project shall conform to the Owner standards set forth in M1. In the case of any conflict between any Owner standards below and any requirement set forth herein, the more stringent requirement shall apply.

1.4 DEFINITIONS

1.4.1 Unless defined in this exhibit, terms that begin with an upper case shall have the meaning defined in the Agreement.

1.4.2 For purposes of only this exhibit, the following words shall have the respective meanings set forth below. [NTD: a definition for items noted as “TBD” will be provided within the Agreement.]

(1) “**Abnormally Severe Weather Conditions**” means any of the following: (a) cumulative precipitation in excess of [2.0”] inches in a 24-hour period or (b) cumulative precipitation in excess of [4.0”] inches in a one-week period, in each case as measured at the Project Site. [NTD: to be aligned with final contract documents.]

(2) “**Applicable Law**” means [TBD].

(3) “**Applicable Permits**” means [TBD].

(4) “**Applicable Standards**” means the minimum standards and industry codes and any other criteria required for the performance of the Work by Contractor, including those set forth in Attachment 2 (*Applicable Standards*) to this exhibit.

(5) “**As-Built Drawing**” means a complete set of drawings prepared by Contractor or a subcontractor which accurately and completely represent the Work as constructed and installed.

(6) “**BOP Contractor**” means [Contractor to add BOP Contractor name].

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

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

(9) "**Contract Price**" means an amount equal to [$TBD] to be paid to Contractor by Owner as full and complete payment for all Work to be performed by Contractor under the Agreement.

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

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

(12) "**Functional Groups**" means a rotor blade set; hub; pitch system; main shaft arrangement, including main bearing; gearbox; mechanical brake; high-speed shaft coupling; generator; internal crane; power converter; [medium-voltage transformer]; 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.

(13) "**Gen-Tie Line**" means the [VOLTAGE]-kV high-voltage transmission line connecting the Project Substation with the Point of Interconnection.

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

(15) "**Major Subcontractor**" means any subcontractor with whom Contractor will enter (or has entered) into an agreement or purchase order for performance of any part of the Work that has an aggregate value in excess of $250,000.[NTD: to be aligned with final contract documents.]

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

(17) "**Owner**" means Portland General Electric.

(18) "**Point of Interconnection**" means the point where the Gen-Tie Line connects to the [Contractor to add switchyard name] Switchyard, as more fully described in Exhibit [●] (*Interconnect Agreement*).

(19) "**Project**" means the generating facility described in the Proposal.

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

(21) "**Project Substation**" means the 34.5/[VOLTAGE]-kV substation to be located at the Project Site, with all necessary equipment to connect the Project to the interconnecting utility's grid.

(22) "**Prudent Wind Industry Practices**" means (a) those practices, methods, equipment, specifications and standards of safety, performance, dependability, efficiency and economy as are acceptable for construction and professional engineering firms

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

(23) "**Raceway**" means all 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.

(24) "**Requirements**" means the Specifications in Exhibit [●] (*Specifications Exhibit Name*), Prudent Wind Industry Practices, Applicable Law, Applicable Permits, Applicable Standards, the Project Schedule, the Interconnection Agreement in Exhibit [●] (*Interconnect Agreement Exhibit Name*), the designs in Exhibit [●] (*Preliminary Design Exhibit Name*), the landowner requirements in Exhibit [●] (*Landowner Requirements Exhibit Name*), the Utility Specifications, the Turbine Supplier Project Site Requirements, and the other requirements of the Agreement.

(25) "**Roads**" and "**roadways**" means all access roads, Wind Turbine string and spur roads, substation roads, transmission line service roads, meteorological tower roads, operations and maintenance building roads, and temporary construction roads to be constructed for the Project by Contractor.

(26) "**SCADA**" means supervisory control and data acquisition.

(27) "**Special Tools**" has the meaning set forth in Section 10.3.5.

(28) "**Submittal Schedule**" means the schedule for Contractor's delivery of submittals, as set forth in PGE Exhibit M1-01-02-01 (*Documents and Deliverables Table*).

(29) "**Substantial Completion**" means [TBD].

(30) "**Turbine Equipment**" means all of the parts, components, equipment, materials, apparatus, structures, tools, supplies, consumables, goods, and other items required or appropriate for a complete, fully-functional Wind Turbine or that otherwise form or are intended to form part of the Work or the Project, including all equipment, materials, apparatus, structures, tools, supplies, Delivery Devices, Special Tools, and other goods provided and used by Turbine Supplier for performance of the Work, but that are not incorporated into the Project.

(31) "**Turbine Foundation**" means each Wind Turbine foundation.

(32) "**Turbine SCADA System**" means the supervisory control and data acquisition system for the Wind Turbines.

(33) "**Turbine Supplier**" means [Contractor to add OEM name].

(34) "**Wind Day**" means an occurrence wherein erection of Wind Turbines is specifically scheduled to occur and the main erection crane is fully functional and unable to operate due to any of the following conditions: (a) actual 10-minute average wind speeds of [22] miles or more per hour for at least four (4) consecutive hours during a regularly scheduled shift of ten (10) hours or more as measured at the tip of the respective crane. [NTD: to be aligned with final contract documents.]

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

(36) "**Wind Turbine Equipment**" means Wind Turbines, the Turbine SCADA System, and all other materials and equipment identified in the Agreement (including this exhibit) and incorporated into the Project by Contractor and Turbine Supplier in performing the Work.

(37) "**Wind Turbine Mechanical Completion**" means [TBD].

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

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

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 Unless expressly noted otherwise, any requirement to "provide", "supply", or "furnish" goods or services herein shall be considered equivalent.

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

2.0 GENERAL SERVICES

2.1 GENERAL PROVISIONS

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

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

2.1.3 Contractor shall provide supervision, inspection, testing, and quality control of the Work to ensure it is completed safely, competently, and efficiently. Contractor shall devote attention, skills, and expertise as is necessary to perform the Work in accordance with the Requirements. All materials shall be new, unused, of the highest quality, free of defects and irregularities, and consistent for use in wind generation facilities. Equipment shall be installed, assembled, and tested in strict compliance with the manufacturer's drawings, manuals, code markings, and instructions, and any proposed materials, structures, and/or assemblies shall be maintainable in the simplest and most cost-effective manner possible.

2.1.4 Not used.

2.1.5 Contractor shall not construct any portion of the Work until the applicable issued-for-construction drawings have been approved by Owner. Turbine Foundations shall not be constructed until (a) the Turbine Foundation drawings and calculations have been approved by Owner, including its independent engineer; and (b) until pre-determined hold points have been approved by Owner, including inspection of rebar placement prior to pouring concrete.

2.1.6 Contractor shall design all aspects of the Project based on verifiable criteria that are specific to the Project and the Project Site, including elevation, terrain, ground cover / vegetation, corrosivity, precipitation (rain, snow, ice), frost depth, seismic loads, and subsurface conditions. All such design criteria shall be clearly displayed on the design drawings.

2.1.7 Notwithstanding any reference to specific codes or standards herein, all Work shall comply with the latest revision of the Applicable Standards, including those set forth in Attachment 2 (*Applicable Standards*) to this exhibit. The method for handling conflicts between Applicable Standards shall be as set forth therein.

2.1.8 Exhibit M1-05-07 (*Approved Vendors and Service Suppliers)* contains a list of approved materials, equipment suppliers, and subcontractors. Contractor shall request approval from Owner prior to executing any contract for the procurement of such material or with such equipment supplier or subcontractor (a) if Contractor is considering the selection of a material, equipment supplier, or subcontractor that is not listed below; (b) for any Major Subcontractor not listed below; or (c) for the Project's engineer(s) of record and geotechnical engineer(s). Equipment catalog cut sheets shall be submitted for Owner review and approval prior to procurement. In some categories, a supplier has been identified as "Preferred" with an (*) in order to maintain the same suppliers of equipment as Owner has utilized the supplier for its generating fleet. Contractor is expected to consider lead time of vendors, including Owner review and approval timeline of drawings and documentation, in their ordering schedule.

Exceptions will not be granted because Contractor has failed to do so. All equipment must be designed for, and officially supported in, the United States market.

2.1.9 Unless explicitly stated otherwise, including for Turbine Foundations as set forth in Section 4.1.3 herein, the minimum design working life of the Work shall be 30 years. For the avoidance of doubt, Wind Turbines shall have a minimum design life of 20 years and the Project's permanent drainage facilities shall be designed in accordance with Section 4.1.2.

2.1.10 Requirements for rigging and tooling:

(1) All rigging shall be rated; inspected daily; and load tested in accordance with the Applicable Standards or other more rigorous requirements set forth in the HSSE 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.

(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) Contractor shall utilize tooling in accordance with manufacturer recommendations, including any Turbine Supplier guidelines for use of Special Tools.

2.1.11 Contractor shall cause the Project Contracts, including without limitation the Turbine Supply Agreement and Balance of Plant Agreement, to be entered into, either by Contractor or a direct Affiliate. The Project Contracts shall provide for the planned Wind Turbines to be purchased by (or on behalf of) Contractor and delivered to the Project Site for installation by Contractor's subcontractors.

2.2 SITE CONDITIONS

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

2.2.2 Contractor shall furnish weather equipment at the Project Site capable of measuring rainfall, wind speed, and other conditions as necessary to determine the occurrence of Wind Days and Abnormally Severe Weather Conditions, respectively.

2.2.3 Any existing infrastructure, including communications towers, pipelines, telephone lines, and electrical lines, shall be maintained in their current condition throughout the construction of the Project. Existing access to the Project Site, including along public roads, shall remain open throughout construction.

2.3 CONSTRUCTION MANAGEMENT

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

2.3.2 Contractor shall furnish and maintain throughout construction of the Project a construction radio system for use by Owner and Owner's representative(s), including access to Contractor's primary safety channel. At least five (5) fully-functional radios shall be furnished for this purpose. This radio system shall be fully functional within 30 days of Contractor mobilization and be capable of reaching any and all locations at the project site where work

would occur.

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

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

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

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

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

2.3.8 Contractor shall ensure compliance with all landowner agreements as further prescribed in Exhibit [●] (*Landowner Requirements*), including repair of all crop damage. Recognizing the importance of strong positive landowner or occupant and community relations, Contractor shall support and participate in landowner or occupant informational/planning meetings (e.g., Wind Turbine/road/collection line location confirmation) and governmental meetings (e.g., planning commission, board, or informational meetings). Contractor shall document any landowner issues during the development and construction of the Project and share such list with Owner. [NTD: an exhibit outlining Project-related landowner requirements will be provided at a later date and attached to the Agreement]

2.3.9 Contractor shall contact local authorities, pipeline companies, and utility companies to locate conflicting underground facilities *prior* to starting any excavation or trenching Work. Contractor shall be responsible for all damages resulting from contact with identified underground facilities in the vicinity of each excavation, including, but not limited to, those identified through the local "One-Call" service, the Owner-provided ALTA survey, or other similar information made available to Contractor or available to Contractor through the exercise of reasonable diligence. In the event of any conflict with an underground facility, Contractor shall immediately notify Owner and shall document the nature of the conflict, relocation of the conflicting facility or structure, any damages which occurred, and final resolution. This documentation shall be provided to Owner within 48 hours of such conflict.

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

2.4 PROJECT DOCUMENTATION

2.4.1 Contractor shall prepare and submit all deliverables and submittals necessary for the

successful completion of the Work, including, but not limited to, Job Books, As-Built Drawings, completion certificates, design documents, and all other manuals, drawings, plans, studies, calculations, safety- related documentation, reports, checklists, completion procedures, and other similar items (collectively, the "Contractor Deliverables"). All Contractor Deliverables shall be coordinated and discussed with all pertinent parties prior to and during the construction phase of the Project; shall be subject to review and/or approval by Owner, as applicable; shall be submitted by the applicable dates in the Submittal Schedule; and shall comply with the minimum requirements set forth in PGE Exhibit M1-01-02 (*Engineering Documents, Drawings, and Other Deliverables*). The following list provides an indicative sample of Owner requirements for specific Contractor Deliverables for the sole purpose of ensuring clarity of expectations for the referenced submittals; *this list is not intended to be an exhaustive listing of all Contractor Deliverables or the requirements thereof*.

(1) Contractor shall prepare, implement, and manage a detailed Project schedule that reflects the Project management plan and anticipated sequence of site operations (the "**Project Schedule**"), and shall cause the reports summarized in Attachment 1 (*Schedule Requirements*) to this exhibit to be submitted with each weekly Project Schedule update; the Project Schedule shall comply with the minimum requirements set forth in Attachment 1 (*Schedule Requirements*) to this exhibit. Contractor shall also provide an individual (the "**Scheduler**") who shall (a) be dedicated to the Project; (b) develop and maintain the Project Schedule; (c) be an experienced specialist that is skilled in critical path method scheduling; (d) be capable of producing CPM reports within 24 hours of Owner's request; and (e) attend (either remotely or in person) and actively participate as needed in all Project meetings related to construction progress, alleged delays, or time impact.

(2) Contractor shall prepare, implement, manage, and observe the health and safety plan, the security plan, and the environmental plan (collectively, the "**HSSE Plan**"). These plans shall conform to the minimum requirements set forth in Exhibit [●] (*HSSE Plan Requirements*) and PGE Exhibit M1-01-07 (*Security and Compliance*), collectively. [NTD: an exhibit outlining minimum requirements for the HSSE Plan will be provided at a later date and attached to the Agreement]

(3) Contractor shall prepare, implement, and manage a detailed quality assurance plan that is specific to the Project and Project Site. This plan shall conform to the minimum requirements set forth in Exhibit [●] (*Quality Plan Requirements*). [NTD: an exhibit outlining minimum requirements for the Quality Plan will be provided at a later date and attached to the Agreement]

(4) Contractor shall submit the design drawings and calculations for the Project to Owner for review and comment at points roughly equivalent to being 30 percent complete, 60 percent complete, 90 percent complete, and issued-for construction ("**IFC**") in accordance with the Agreement unless mutually agreed to between Contractor and Owner.

(5) Contractor shall provide one (1) complete copy of Job Books in hard copy format *and* one (1) complete copy of Job Books in electronic format on flash drive. Job Books shall conform to the minimum requirements set forth in Exhibit [●] (*Job Book Requirements*).

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

on flash drive. As-Built Drawings shall comply with PGE Exhibit M1-01-09 (*PGE CAD and Numbering Standards*).

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

(8) Not used.

(9) Contractor shall prepare, implement, and manage critical lift plans that are specific to the Project and Project Site. The critical lift plan shall clearly identify precautions for all critical lifts; coordination plans, including pre-lift meetings, with all participating personnel; and sample documentation/checklists for all critical lifts. Prior to performing any critical lift, Contractor shall perform a practice lift with a similar crane configuration and load configuration; practice lifts shall always be performed with the same crew and using the same lifting equipment as those used for the critical lift; to the extent that Contractor has successfully performed a practice lift, any subsequent, identical lifts shall not require another practice lift. Any lift exceeding ninety-five percent (95%) of a crane's load chart is prohibited. For purposes of this exhibit, a "critical lift" shall include, at a minimum, any lift that exceeds seventy-five percent (75%) of the rated capacity of the crane, per the respective crane's load chart; any lift that exceeds 50,000 pounds; any lift that requires the use of more than one crane; any lift requiring blind picks; any man-basket lifting operation; any load that is lifted/transported over or near energized electrical equipment, such as power lines, transformers, or switchgear; any lift in a confined space or restricted area (including an operating facility) where the load, or any part of the crane or equipment structure, could come within three (3) feet of any existing structure; or any lift where the equipment is set up near manholes, catch basins, sewers, sinkholes or other known surface or sub-surface interferences.

(10) Contractor shall prepare two (2) spill prevention, control, and countermeasure ("**SPCC**") plans in accordance with EPA requirements. For the avoidance of doubt, Contractor shall be responsible for development of both a construction-phase SPCC plan and an operational-phase SPCC plan, respectively.

(11) Contractor shall prepare, implement, and manage a detailed tower rescue plan that is specific to the Project and Project Site.

2.4.2 Contractor shall upload electronic copies of all Contractor Deliverables (including drafts and final) to Owner's web-based document management site. Further, Contractor shall designate a document control lead to work with Owner's document control lead towards the timely, efficient, and organized submittal of documents.

2.4.3 Contractor shall prepare and maintain a documentation list for the Project. This list shall include, at a minimum, a listing of all Contractor Deliverables and the status (including

responsible party) and revision number of each. The naming and labeling conventions for all Contractor Deliverables shall be coordinated with and approved by Owner. The documentation list shall be updated by Contractor each time a new or revised drawing or document is issued, at a minimum, including identifying any open and/or pending submittals for review.

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

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

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

2.5 SIGNAGE

2.5.1 Contractor shall furnish, install, and maintain throughout the performance of the Work all signage required by the Applicable Permits, the Applicable Standards, and other applicable Requirements. All signage and equipment marking (including numbering and labeling) shall be approved by Owner prior to installation.

2.5.2 Contractor shall furnish and install (a) a permanent sign at each Wind Turbine string road listing the name(s) of all Wind Turbine(s) along that road and (b) identification numbers and permanent, weatherproof labels on the base of all Wind Turbine towers, indicating Owner tower number and Collection System Circuit number, respectively.

2.5.3 Contractor shall furnish and install identification numbers and permanent, weatherproof labels on all Gen-Tie Line structures.

2.5.4 Contractor shall furnish, install, and maintain above-ground "buried cable" marker signs (a) at all locations where an underground Collection System Circuit crosses a road, fence, or underground utility respectively; (b) at a minimum of every 2,000 feet of trench length; and (c) at all sharp turns in the Collection System Circuits.

2.5.5 Contractor shall furnish and install a permanent, free-standing, non-masonry sign at the O&M Building location indicating Project name, Owner name, and entry requirements. The location, contents, and format of this sign are subject to Owner approval.

2.5.6 Contractor shall furnish and install a permanent sign on the fence at the Project Substation entrance. This sign shall indicate Project name, Project Substation name (if applicable), Owner name, and contact information. The location, contents, and format of this sign are subject to Owner approval.

2.5.7 Contractor shall furnish and install "no trespassing" signs at access road entry points and

permanent speed limit signs at intervals of no greater than two (2) miles along all Project access roads.

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

2.5.9 Contractor shall furnish, install, and maintain signage as needed for blind corners, dips, trucks entering roadways, restricted areas, and other potential hazards. Contractor shall also furnish, install, and maintain danger signs, signals, lights, guard rails, reflectors on curves, and notices as may be necessary to adequately protect the Work and personnel of any company at the Project Site, including visitors, against injury or property damage. All such signage shall be installed prior to commencing construction activities.

2.5.10 Contractor shall furnish, install, and maintain signage as needed to provide reasonable information and direction to Project Site personnel and to facilitate orderly entrance and egress from the Project Site. Contractor shall also furnish, install, and maintain signage identifying personnel assembly locations for use during emergencies or Project Site evacuations.

2.5.11 Contractor shall furnish and install emergency response (E-911) address signs in accordance with local authorities.

2.5.12 Contractor shall uninstall, remove, and discard of all temporary signage at the completion of the Work, or as otherwise prescribed in the Applicable Permits. Temporary signage shall be legible and of sufficient durability to last the duration of construction activities.

2.6 PERMITS

2.6.1 Contractor shall obtain, pay for, and maintain all permits required for its performance of the Work including, but not limited to, the Contractor Permits. Contractor shall provide copies to Owner of all permit applications for Contractor Permits promptly after such applications are submitted to the applicable authority.

2.6.2 Contractor shall maintain copies of all permits at the Project Site during construction of the Project and shall at all times comply with all requirements of Contractor Permits, including closeout of such permits, and shall transfer to Owner such permits required for the operation and maintenance of the Project.

2.6.3 Contractor shall provide reasonable assistance, including engineering support, to Owner in applying for, obtaining, and maintaining the Owner Permits.

2.6.4 Contractor shall comply in all material respects with the requirements of all Contractor Permits and all inspection and documentation requirements of all Contractor Permits and shall provide copies of inspection reports and documentation related thereto to Owner.

2.7 TRAINING

2.7.1 Contractor shall prepare and conduct comprehensive training of Owner and its operations and maintenance personnel in the safe operation and maintenance of the Project and its equipment, as further described in Exhibit [●] *(Contractor-Provided Training*). Such training shall cover, at a minimum, the Project Substation, the Collection System Circuits, the Communications System, the Gen-Tie Line, the O&M Building, and the meteorological towers. [NTD: an exhibit outlining training requirements will be provided at a later date and attached

to the Agreement]

2.7.2 Turbine Supplier shall prepare and conduct comprehensive training of Owner and its operations and maintenance personnel in the safe operation and maintenance of the Wind Turbines and Turbine SCADA System. Such training shall be made available to up to six (6) persons designated by Owner at a time reasonably convenient to Owner.

2.7.3 Contractor shall provide regular and ongoing lockout-tagout training to on-Site personnel throughout the performance of the Work.

2.8 TEMPORARY FACILITIES

2.8.1 Contractor shall furnish and install one (1) 24-foot by 60-foot double-wide office trailer for Owner's exclusive use. Each trailer shall be located at the laydown yard and shall be installed and ready-to-use no later than 10 days after the Contractor mobilization date or on the same date when Contractor's trailers are installed, whichever occurs first. Owner's trailer(s) shall be removed from the Project Site at Project Substantial Completion or when Contractor's trailers are removed from the Project Site, whichever occurs last.

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

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

(3) Each trailer shall include at least one (1) unisex restroom, each complete with running water, one (1) flushable toilet, one (1) flushable urinal, and one (1) sink. Toilets shall be of a type to ensure that all discharges are contained and removed from Site. Toilets shall be outfitted for weather conditions (i.e., space heater in winter).

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

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

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

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

(8) Each trailer shall be furnished with a wifi-enabled printer that includes scanning capabilities, and with 8.5-inch by 11-inch and 11-inch by 17-inch print sizes.

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

(10) Contractor shall furnish bottled water and ice in each Owner trailer and for Owner's

exclusive use throughout the duration of the construction activities.

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

2.8.2 Not used.

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

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

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

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

2.8.7 As required to perform the Work, Contractor shall procure, permit, install, construct, and maintain batch plant(s) at the Project Site, including all necessary labor and materials related to the operation of the batch plant, and removal of the batch plant at the conclusion of the Work. The batch plant shall be removed from the Project Site by Contractor within 30 days of the final Project concrete pour utilizing the batch plant, not to occur after substantial completion of the Project. Power to operate the batch plant shall be the sole responsibility of Contractor.

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

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

(1) The laydown yard shall be sufficient in size to allow for simultaneous (a) storage of equipment that will not be stored at the Wind Turbine Pads; (b) storage of office trailers and other temporary facilities; (c) portable restrooms; (d) parking for approximately 10 Owner vehicles; and (e) regular construction traffic; Contractor shall incorporate this into the design and construction of the laydown yard.

(2) The laydown yard shall be covered throughout with at least six (6) inches of aggregate over a compacted subgrade. The maximum aggregate size shall not exceed three (3) inches.

(3) The laydown yard shall be graded to drain and 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.

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

2.9 DEBRIS

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

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

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

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

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

2.10 LOGISTICS

2.10.1 Contractor shall furnish and deliver all equipment to the Project Site.

2.10.2 Contractor shall perform all off-Project Site clearing necessary for the transportation of equipment to the Project Site, including, but not limited to, tree trimming / removal and clearing of overhead obstructions. Contractor shall also upgrade and maintain public roads, bridges, and culverts as required for the transportation of equipment to the Project Site and including obtaining any necessary permits.

2.10.3 Contractor shall perform all clearing at the Project Site necessary for the transportation of Wind Turbines at the Project Site, including, but not limited to, tree trimming / removal, clearing of overhead obstructions, and utility line drops along county roads and access roads.

2.11 COORDINATION

2.11.1 Contractor shall actively coordinate the sequence of Work with Owner, Turbine Supplier, BOP Contractor, and other subcontractors to support the Project Schedule.

2.11.2 Contractor shall coordinate with all transportation contractors to mitigate congestion within the

Project Site.

2.11.3 Contractor shall (a) comply with all crossing requirements for the Project, including any crossing agreements, and (b) coordinate with local utilities and pipeline companies to facilitate crossings and interconnections necessary to perform the Work. For the avoidance of doubt, this shall include contacting local authorities, pipeline companies, and utility companies to locate conflicting underground facilities *prior* to starting any excavation or trenching Work, as further described in Section 2.3.9 herein.

2.12 PROJECT SITE CLOSEOUT AND RESTITUTION

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

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

2.12.3 Contractor shall perform restitution, restoration, and/or reclamation of Work areas to include, but not limited to, the following. Notwithstanding anything that follows, all Work areas at the Project Site shall be restored, at a minimum, in accordance with the requirements set forth in the Applicable Permits, the SWPPP, and the other Requirements, as appropriate, and shall be fully restored to their pre-construction condition, at a minimum.

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

(2) Preserve and/or restore to their pre-construction condition all land and water resources adjacent to construction areas. Such work shall include restoration of all terraces to their pre-construction condition.

(3) Notwithstanding the following paragraph (a), Wind Turbine Pads, laydown areas (including the laydown yard), roadway shoulders, and roadway turning radii shall be decompacted and reclaimed, including proper grading, aggregate touchup, and seeding with an approved mixture. For the avoidance of doubt, such areas shall not be reclaimed until applicable Wind Turbine erection activities have been completed.

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

(4) Re-dress all road surfaces within the Project Site such that the final cross section meets the Contract specifications, including those presented herein, and such that all roadway surfaces are graded for draining and low spots are removed.

(5) Seed all cut / fill slopes utilizing an approved seed mixture. Seeding shall occur during a time / season when the probability of successful seed germination is maximized;

hydro- seeding is acceptable for slopes.

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

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

(8) Spread recovered aggregate from laydown yard within approved disturbance limits at Owner-approved locations including but not limited to on access roads, beauty rings, and/or the O&M Building yard.

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

(10) Contractor shall be responsible for reinstatement of all fences, walls, watercourses, roads and embankments crossed by MV cable to the satisfaction of Owner and in accordance with all Applicable Permits.

3.0 GEOTECHNICAL SERVICES

3.1 GENERAL PROVISIONS

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

3.1.2 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.

3.2 SUBMITTALS

3.2.1 Contractor shall submit to Owner, *prior* to initiating subsurface investigations, the name, office location, and qualification statement for proposed geotechnical engineer.

3.2.2 Contractor shall submit to Owner, *prior* to initiating subsurface investigations, the proposed scope of subsurface investigation, including number, location, and depths of borings; anticipated plan for laboratory testing; and detailed descriptions of additional site investigation techniques, including thermal and electrical resistivity or other necessary testing.

3.2.3 Contractor shall submit a complete geotechnical engineering report (the “Geotechnical Report”) containing the required information summarized below, at a minimum. The Geotechnical Report shall be utilized for the design and construction of all Project structures, including Turbine Foundations.

(1) Subsurface and groundwater conditions encountered, including groundwater hydrology data and maps of the area.

(2) Description of the geology, including maps for areas of landslides, slope instability, potential landslides, potential geologic hazards, karst, mine subsidence, past (historical) earth movements, flooding, difficult soil conditions, and transitions between geologic units; special consideration shall be given to identify active and potential landslide zones.

(3) Description of the drilling and sampling program.

(4) Field photographs.

(5) Boring coordinates, boring location drawings, and final boring logs.

(6) Summary of results of field and laboratory tests performed. Testing shall include soil index tests, consolidation tests, proctor compaction tests, direct shear and triaxial compression tests, and soil chemical tests.

(7) Specific design criteria for the Project, including (a) impacts of new construction on existing facilities; (b) factors of safety used in determining allowable foundation loads; (c) recommended foundation types for all structures; (d) discussion of the dynamic soil properties at the Project Site, including dynamic shear modulus, Poisson's ratio, Young’s Modulus, and shear wave velocity; (e) recommendations for designing for seismic issues, including liquefaction potential and the identified building code site coefficient/site classification for seismic design; (f) recommendations for site dewatering and construction practices, including design water level; and (g)

recommendations for permanent slope and rock stability measures.

(8) 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; and (f) dynamic spring constants for foundations supporting vibrating machines, if applicable.

(9) 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, anticipated settlements and lateral deflections; (e) static and dynamic spring constants; and (f) non-destructive testing requirements.

(10) Recommendations for slopes, including (a) temporary excavation slopes and OSHA soil types; (b) permanent slopes; and (c) temporary and permanent excavation support requirements.

(11) Corrosion potential and chemical attack to construction materials.

(12) 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.

(13) An evaluation of the expansive, dispersive, and collapsing nature of the on-Site soil materials and discussion of design features to resist these tendencies, including recommendations for mitigation measures for difficult soils (expansive, dispersive, and collapsible).

(14) Recommendations for earthwork including acceptable fill materials, moisture contents, compactive effort, trenching, lift thickness, soil stabilization amendments, proofrolling, equipment, and compaction testing, and recommended aggregate gradations for general fill, load bearing fill, granular road base, and granular surfacing.

(15) Recommendations for frost heave loading, if applicable.

(16) Recommendations for shear modulus degradation factor.

(17) If needed, recommendations for design and installation of earth retaining structures and ground improvements.

3.3 FIELD INVESTIGATIONS

3.3.1 Contractor shall drill geotechnical borings and conduct material sampling at the locations and minimum frequencies set forth below:

(1) Wind Turbines: one (1) per Wind Turbine location, or more as necessary to characterize soil and bedrock conditions within the Turbine Foundation influence zone.

(2) Project Substation: minimum of five (5) locations at the Project Substation.

(3) Gen-Tie 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 two (2) locations at the O&M Building.

(5) Meteorological towers: each free-standing meteorological tower location.

3.3.2 Contractor shall perform electrical resistivity measurements at the minimum frequencies set forth below, in each case using the Wenner Four-Electrode method (ASTM G57) in accordance with ANSI/IEEE Std 81: 1983 - IEEE Guide to Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of Ground Systems. Unless otherwise approved, the probe spacing shall be equally spaced with spacings of 2, 5, 10, 15, 20, 30, 40, 50, 80 and 100 feet, and in each case with final locations approved by Owner prior to testing:

(1) Wind Turbines: ten percent (10%) of all Wind Turbine locations.

(2) Project Substation: one location near the center of the proposed substation footprint.

(3) Gen-Tie Line: minimum of one (1) location per mile.

(4) Collection System Circuits: minimum of one (1) location per circuit.

3.3.3 Contractor shall perform thermal resistivity testing in accordance with ASTM D5334. Laboratory testing shall include a measurement of the soil's moisture content, maximum dry density, and thermal dryout characteristics in accordance with backfill compaction requirements. Thermal resistivity in-situ and reconstituted results shall be included at applicable compaction values as they are jointly determined by Contractor and Owner. Thermal resistivity testing shall be conducted at the same frequency as electrical resistivity measurements in Section 3.3.2 above.

3.3.4 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. Monitoring of groundwater levels shall be taken over a minimum one (1) year period to capture seasonal fluctuation in groundwater levels. The geotechnical engineer shall determine the design groundwater level at each of the boring locations noted above, which shall take into account seasonal fluctuation as well as long term groundwater levels and shall account for any buoyancy effects resulting from the design groundwater level.

3.3.5 Contractor shall perform any additional geophysical or other site investigations, including, but not limited to, standard penetration tests, Shelby tube samples, deepened borings, additional borings, test pits, seismic refractions, cone penetrometer soundings, *in situ* testing, and other similar or related methods, as necessary to supplement the required geotechnical investigations summarized herein or to otherwise provide the data and recommendations required in the Geotechnical Report.

3.3.6 Other boring and material sampling requirements:

(1) 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, and the Project Site premises shall remain free from accumulations of waste materials or rubbish resulting from the geotechnical field investigations.

(2) Existing utilities near borings or other subsurface test locations shall be identified and protected.

(3) Each Wind Turbine boring shall be to a minimum depth of the greater of (a) 50 feet; (b) at least one (1) foundation diameter for spread footer foundations; or (c) at least 10 feet beyond the anticipated depth of the foundation at such location (including anchors, if applicable) for rock anchor foundations. All other borings shall be to a depth of at least 35 feet below the base of the applicable foundation / structure.

(4) 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.

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

3.3.7 In-situ testing, including cone penetration testing ("**CPT**"), dilatometer, pressure meter, vane shear, and other in-situ test methods shall be supplemented with a minimum of 10 percent borings with sampling to correlate soil material properties to the in-situ tests.

3.3.8 Seismic testing, including downhole seismic, seismic CPT, and surface methods, shall be conducted at minimum of 10 percent of proposed sites in order to determine shear and compression wave velocity of the subsurface materials. The shear and compression wave velocities shall then be used to determine dynamic shear modulus and be input into dynamic analyses of Turbine Foundation stiffness.

3.4 LAB TESTING

3.4.1 Contractor shall perform all laboratory testing necessary to classify the materials and to obtain physical characteristics of the subsurface materials. At a minimum, laboratory testing shall include (a) moisture content per ASTM D2216; (b) grain size analysis per ASTM D422; (c) dry unit weight tests per ASTM D7263; (d) Atterberg limits per ASTM D4318; (e) unconfined compressive strength per ASTM D2166; (f) compaction characteristics / standard proctor density of the soil per ASTM D698; (g) soil corrosiveness (chloride, sulfate, and pH) per ASTM D4972 and USEPA methods; (h) unconsolidated-undrained triaxial compression per ASTM D2850; (i) direct shear per ASTM D3080; (j) one-dimensional consolidation / settlement characteristics per ASTM D2435; (k) one-dimensional swell or collapse of soils per ASTM D4546; (l) thermal resistivity testing including dry-out curves including 0% moisture per ASTM D5334; and (m) unconfined compressive strength per ASTM D2166.

3.4.2 All testing described herein shall be performed by an independent, experienced third party.

4.0 CIVIL / STRUCTURAL WORKS

4.1 GENERAL PROVISIONS

4.1.1 All civil / structural works, including, but not limited to, access roads, Turbine Foundations, Wind Turbine Pads, and the laydown yard, shall conform to Turbine Supplier's requirements for roads, crane pads, and hardstands, as set forth in Exhibit [●] (*Turbine Supplier Project Site Requirements*) (the "Turbine Supplier Project Site Requirements"). [NTD: an exhibit outlining OEM-specific civil and structural requirements for civil is assumed to be provided at a later date by Contractor and will be attached to the Agreement]

4.1.2 All low-water crossings shall be designed and constructed to withstand a 50-year, 24-hour storm event. All other permanent drainage facilities, including culverts ditches, and swales, shall be designed and constructed to withstand a 20-year, 24-hour storm event.

4.1.3 The design working life of the Turbine Foundations shall be a minimum of 30 years.

4.1.4 Requirements for access road crossings:

(1) All access road crossings, including public roads, railroad, pipeline, utilities, and property lines, shall be as close to ninety degrees (90°) as reasonably practicable. All access road crossings of buried facilities (e.g., pipeline, utility line) shall maintain at least 36 inches of cover, or deeper if required by the applicable crossing agreements.

(2) All access road crossings of buried facilities (e.g., pipeline, utility line) shall be marked on each side with an above-ground cable marker, each meeting the requirements in Section 5.1.11 below.

(3) Contractor shall coordinate with local utilities and pipeline companies as set forth in Section 2.11.3 herein.

4.1.5 Requirements for site roads:

(1) Roads shall be designed, constructed, and maintained adequately to support all anticipated construction loads, equipment delivery (including Wind Turbines), crane crawling, construction traffic usage (including concrete trucks), and weather conditions to be expected. Maintenance shall include the requirements set forth in Section 4.3.3 herein.

(2) Roads shall comply with the Geotechnical Report (for subgrade and cross-section requirements), the Turbine Supplier Project Site Requirements, and the drainage and erosion control requirements in Section 4 herein.

(3) Road entries, intersections, and turns 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. Cantilevered loads (e.g., Wind Turbine blade ends) shall be considered to ensure obstructions adjacent to the roadway are cleared and will not endanger the equipment delivery. Wind Turbine spur roads shall have a minimum turning radius of 25 feet from other roads at final construction.

(4) Roads shall be a minimum of 16 feet wide, except for meteorological tower roads which shall only be 12 feet wide. Where crane walks are to be utilized, roads shall have a minimum 10-foot temporary compacted earthen shoulder on each side. Roads shall be widened through turns and curves, as necessary.

(5) Roads shall be covered with at least six (6) inches of DOT-compliant aggregate over a

compacted subgrade, including geotextile fabric (or equivalent) as required. The maximum aggregate size shall not exceed two (2) inches, shall include appropriate fines, and shall conform to local department of transportation requirements. The subgrade shall be cleared and compacted to at least ninety-five percent (95%) of the maximum density within the moisture content of three percent (3%) below optimum to three percent (3%) above optimum, as determined by ASTM Standard D698.

(6) Roads shall be designed and constructed with a maximum grade of eight percent (8%). Approaches to Wind Turbine Pads from access / spur roads shall be designed and constructed sufficiently level to allow transport vehicles, including Wind Turbine transport vehicles, to park on a flat surface during offloading.

(7) Maximum vertical crest and dip on roads is six (6) inches vertical to 50 feet horizontal, or as otherwise listed in the Turbine Supplier Project Site Requirements.

(8) The longitudinal radii (convex or concave) of roads shall not be less than (a) 750 feet or (b) a “K” value of 16.5, or as otherwise listed in the Turbine Supplier Project Site Requirements.

(9) Roads shall be designed with turnarounds to assist in truck and trailer flow throughout the Project Site, as well as lay-bys as required by the Turbine Supplier Project Site Requirements. Backup motions for tractor trailers shall be kept to a minimum and are subject to Owner approval; if backup motions for tractor trailers are necessary, the backup path shall be as straight and short as possible. Dead-end roads shall be designed with adequate turnaround space for a tractor/trailer to turn around; cleared Wind Turbine Pads are suitable for this purpose provided any non-graveled areas present a suitable driving surface.

(10) Roads shall be cleared of overhead obstructions (e.g., power lines) as necessary to complete the Work, including to support Wind Turbine deliveries.

(11) Proof rolling shall be performed in the presence of a qualified, competent, practicing geotechnical engineer or their qualified representative. Proof rolling shall be performed using a fully-loaded tandem-axle truck or fully-loaded water truck, in either case with a minimum gross weight of 25 tons. An acceptable proof roll shall produce rutting of no greater than 1.5 inches and no “pumping” of soil beneath and/or behind the wheels of the loaded truck.

(12) Roads shall meet all required design elements at Substantial Completion (as defined in the Agreement). For the avoidance of doubt, this shall include replenishing road aggregate, repairing road damage, repairing subgrade damage, and other loss of strength or stability that may have occurred during the course of construction.

4.1.6 Requirements for drainage and erosion control:

(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.

(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. Roads shall have no more than two percent (2%) crown / side slope, unless such roads will be utilized as crane paths, in which case the maximum crown / side slope shall be one percent (1%). All roadways, including shoulders, shall be graded to self-drain and must not allow water to puddle and all roadways shall have a minimum crown / side slope of one percent (1%) to promote drainage.

(3) Storm water shall not channel flow across constructed roads and a self-draining ditch shall be construed on the high (cut) side of roadways. Sheet flows shall be collected and conveyed to culverts or channels to safely pass storm water flows.

(4) Erosion and sediment control, both during and after construction, shall be provided as required by the Requirements and the Contractor-provided SWPPP to retain sediment onsite and to control the erosion of embankments, temporary and final exposed slopes, and temporary stockpiles, as well to protect water quality as applicable. 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) All storm water flows shall be returned to their original drainage patterns and the Project shall not increase flow rates from their historic levels. The natural drainage patterns of the Project Site shall be maintained and ponding shall be prevented, other than explicitly where small scale ponding is specifically designed to minimize erosion during drainage. Any pre- existing drains which are damaged in the Work shall be restored.

(6) Culverts or low-water crossings shall be installed / constructed where required to pass existing storm water concentrated flows. Culvert pipe ends, swales, and ditches shall be designed and constructed to control concentrated flow velocities and minimize erosion and siltation. Only culverts shall be used at entrances; low-water crossings are not allowed at entrances.

(7) Wetlands impacts shall be avoided to the maximum extent practicable and are subject to regulatory approval or other applicable Requirements.

(8) 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.

4.1.7 Requirements for excavation, fill, and backfill:

(1) Materials suitable for use as fill at the Project Site shall include only materials that are free of debris, roots, stumps, organic matter, frozen matter, coal, ashes, cinders, stones larger than three (3) inches in diameter, slag, other deleterious materials, and as recommended by the Geotechnical Report. 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.

(2) 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 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.

(3) Structural fill lifts shall not exceed a thickness of 8 inches. Other fill lifts shall not exceed a thickness of 12 inches.

(4) Turbine Foundation embedment depth shall consider final height requirements for the applicable Turbine's FAA DNH letter.

(5) Excavations shall be fully drained prior to any construction work within them.

4.1.8 Requirements for fencing and gates:

(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. All permanent fencing shall be appropriately grounded.

(2) Unless stated otherwise, permanent fencing shall be 8-foot-high (7-foot fence plus 1-foot barbed wire), anti-climb, chain link, perimeter fencing with 2-inch diamond mesh. Fencing fabric / slats are not required.

(3) Barbed wire 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 four (4) lines of barbed wire shall be provided when used.

(4) Gate widths shall be consistent with road widths, wherein all gate posts shall be set outside of the road width area. Sufficient space and graded area shall be provided near each gate to allow truck turning.

(5) All gates shall adequately contain livestock without being pushed open, bending, or otherwise failing, and all gates shall adequately prevent opening due to wind conditions expected at the Project Site.

(6) All corner posts and gate posts shall be steel and shall be set (embedded) in concrete. Other fence posts shall be direct-embed galvanized t-posts.

(7) Cattle guards shall (a) cover the full road width; (b) be installed level; and (c) be provided with a stable base capable of sustaining heavy loads without shifting or settling.

(8) Each temporary gate shall match the existing fence materials, and the existing fencing shall be reestablished at the end of construction activities.

4.1.9 Requirements for structures:

(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. Notwithstanding the foregoing, all such structures shall comply with the foundation preparation recommendations set forth in the Geotechnical Report.

(2) 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. All foundations shall be designed with consultation of a licensed geotechnical engineer.

(3) All foundations and slabs-on-grade shall have a minimum projection (reveal) 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.

4.1.10 Requirements for concrete:

(1) Concrete for Turbine Foundations shall have a minimum specified compressive strength of 5,500 psi and any other structural concrete (including all Project Substation concrete) shall have a minimum specified compressive strength of 5,000 psi. Wind Turbine mud mats shall have a minimum specified compressive strength of 2,000 psi while all other non-structural concrete shall have a minimum specified compressive

strength of 3,000 psi.

(2) Concrete mix designs and concrete placement procedures shall be approved by Owner prior to use; see Section 4.2.4 herein for mix design requirements. Concrete shall be placed only in the presence of a duly-authorized representative of Contractor. A successful break test showing the minimum specified compressive strength(s) shall be provided from the concrete source(s), including an on-site batch plant if applicable, at least five (5) days prior to placing concrete from such source(s).

(3) If allowed by the applicable engineer of record, fly ash may be used to replace up to a maximum of 20 percent (20%) of cementitious material content by weight. If used, fly ash shall be in accordance with ASTM C618 and shall be Class F; Class C fly ash shall not be used without Owner approval.

(4) 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.

(5) 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) Concrete placement shall not be permitted when weather conditions or other pertinent factors prevent proper placement and consolidation. Hot weather concreting shall be in accordance with ACI 305R. Cold weather concreting shall be in accordance with ACI 306R.

(7) The maximum aggregate size for concrete shall not exceed 1.5 inches. Smaller maximum aggregate size, such as 0.75 inches, may be necessary for pumped or tremie concrete. Rounded aggregates may be necessary to produce desired workability.

(8) All exposed foundation edges shall include a 0.75-inch chamfer.

(9) 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.

(10) Maximum water/cement ratio: 0.45.

(11) Turbine Foundations shall not have joints, unless approved by Owner and detailed by the engineer of record, and only for the base and pedestal interface in a spread footer foundation. Where allowed, the 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.

(12) All fins and other surface projections shall be removed from all formed surfaces.

(13) 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 (or equivalent). Care shall be taken to see that all excess water is removed before making any finish.

(14) Concrete shall be protected from loss of moisture by membrane curing compound and the curing medium shall be maintained to prevent detrimental loss of water from the concrete for the duration of the entire curing period. An Owner-approved curing membrane shall be applied in accordance with manufacturer's recommendations as soon as the water sheen has disappeared from the concrete surface and following finishing operations, with an application rate of not less than 1 gallon per 200 square feet. If hot weather concreting is performed and an evaporation retardant is used, this retardant shall be applied prior to application of the curing agent, immediately following finishing of the concrete surface.

(15) Unhardened concrete shall be protected from heavy rains, flowing water, excessive heat, excessive cold, or mechanical damage. Finished surfaces shall be protected from stains, abrasions, or physical damage.

(16) All concrete which is porous, honeycombed, or otherwise defective (including conditions which adversely affect durability, strength, and/or appearance) shall be repaired. 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. 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.

(17) Concrete testing:

(a) 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 100 cubic yards or fraction thereof and not less than one set for each foundation or structure.

(b) Field slump tests in accordance with ASTM C143 shall be performed, at a minimum, prior to the first batch of concrete placed each day and with each set of test cylinders. Adjustment or fixing of concrete *in situ* shall not be allowed.

(c) Air content, concrete temperature, and air temperature tests shall be performed for the first batch of each day and with each set of test cylinders. All testing shall be done in accordance with the requirements of ASTM C231 (air) and ASTM C1064 (temperature).

(d) 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.

(18) If the Geotechnical Report indicates the presence of high sulfate content throughout different areas of the Project Site, then all concrete design, including for Turbine Foundations, shall employ sulfate-resistant concrete, including Type V cement as appropriate.

4.1.11 Requirements for grout:

(1) Grout shall be (a) cementitious grout conforming to ASTM C1107 or (b) epoxy grout with a coefficient of expansion (as determined by ASTM C531) as determined by the Turbine Foundation engineer of record. All grout shall be non-ferrous, non-shrink, prepackaged/factory-packaged grout.

(2) Grout specifications and grouting plans/procedures shall be approved by Owner prior to use.

(3) 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.

(4) Grout test reports shall be provided to Owner within 72 hours of testing, and for Turbine Foundations, 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. Sampling and testing of grout material shall be in accordance with ASTM C579.

(5) Any person who mixes and/or places grout below the Wind Turbine flange shall have received in-person, hands-on training from a representative of the grout manufacturer. Such training shall be received by each individual (a) with the Project-approved grout mix; (b) within the 12-month period preceding grout placement; and (c) *prior* to installation of grout.

4.1.12 Requirements for forms:

(1) Forms shall be substantial and sufficiently tight to prevent leakage and shall be properly supported and braced to maintain position and shape. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings, and forms for all exposed surfaces shall produce smooth, dense, and true finishes free of fins, imperfections, or other defects.

(2) 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.

(3) 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. 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.

(4) Forms may be of wood, plywood, concrete-form-grade hardboard, metal or other acceptable material, which will produce smooth, true surfaces. Metal forms shall have smooth surfaces free from any pattern, irregularities, dents, or sags.

(5) 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) inch in diameter in concrete surfaces.

(6) Remove forms in a manner to avoid damage to the structure, with particular care for corners and edges.

4.1.13 Requirements for reinforcing bar:

(1) All weldable bars shall confirm to ASTM A706 while all other reinforcing bars shall conform to ASTM A615; all reinforcing steel shall have a minimum yield strength of 60 ksi. All reinforcing steel, including welded wire mesh, shall be accurately located and held in position using proper reinforcing steel supports, spacers, and accessories in accordance with ACI SP-66 "*Detailing Manual*" and CRSI's "*Manual of Standard Practice*".

(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.

(3) Where not otherwise specified, the minimum coverage of concrete over steel shall be as follows:

(a) Concrete cast against and permanently exposed to earth: 3 inches.

(b) Formed concrete exposed to earth or weather: 2 inches.

(c) Concrete in beams and columns not exposed to ground or weather: 1.5 inches.

(d) Concrete slabs and walls not exposed to weather: 1.5 inches.

(4) Concrete shall be placed at a consistent coverage thickness / depth over all rebar (e.g., all areas with a required minimum of 3 inches of cover shall have a consistent thickness of 3 inches, without significant increases).

(5) Concrete supports (dobies) shall have the same or higher compressive strength as specified for the concrete in which they are located.

(6) No reinforcement in the Turbine Foundation shall be welded. Exothermic (e.g., Cadweld) welding of grounding elements to reinforcing steel is also prohibited.

4.1.14 Requirements for anchor bolts:

(1) Anchor bolts shall be properly located, accurately positioned, and maintained securely in place before placing of concrete. The threads on the upper end of each anchor bolt shall protrude sufficiently to satisfy the Requirements and adequately complete tensioning activities.

(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. When installed, anchor bolts shall be cleaned and the portions to be embedded in concrete shall free of oil or other deleterious substances which would adversely affect the bond between the bolt and concrete, unless otherwise specified by Turbine Supplier.

(3) 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.

(4) Following installation, anchor bolts shall be given an application of corrosion inhibitor and finished with bolt caps.

(5) Unless otherwise required by Turbine Supplier, anchor bolts, nuts, and washers shall

comply with the following:

(a) Anchor bolts: ASTM A615 Grade 75 or A722 Grade 150, cold rolled threads, hot dip galvanize to ASTM A153.

(b) Nuts: ASTM A29 or ASTM A576, hot dip galvanize to ASTM A153.

(c) Washers: ASTM F436, hot dip galvanize to ASTM A153.

(6) Embedment rings shall be (a) minimum 1.5-inches thick; (b) ASTM A36, ASTM A529, or ASTM A572; (c) grade 50, minimum; (d) plain finish; and (e) new material (not reused).

(7) Template rings shall be a minimum 1-inch thick, ASTM A36 or ASTM A572 Grade 50, plain finish.

(8) Load spreading plates, if used, shall be (a) minimum 1.5-inches thick; (b) ASTM A36, ASTM A529, or ASTM A572; (c) grade 50, minimum; (d) galvanized; (e) new material (not reused); and (f) compliant with Turbine Supplier specifications. For galvanization, the plate shall be hot dip galvanized provided it does not adversely affect the flatness of the plate; otherwise, the protective finish shall be subject to Owner approval.

4.1.15 Requirements for structural steel fabrication and connections:

(1) Specific structural steel materials shall comply with the following, at a minimum:

(a) W-shapes: ASTM A992/A992M (50 ksi yield strength).

(b) Channels, angles-shapes: ASTM A36/A36M.

(c) Plate and bar: ASTM A36/A36M.

(d) Cold-formed hollow structural sections: ASTM A500, Grade B structural tubing.

(e) Steel pipe: ASTM A53/A53M, Type E or S, Grade B.

(f) Weight class: standard.

(g) Finish: galvanized.

(h) Welding electrodes: comply with AWS requirements.

(2) Structural steel shall be fabricated and assembled in shop to greatest extent possible.

(3) Design and fabrication shall be according to AISC's "*Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design*".

(4) High-strength structural steel shall be identified according to ASTM A6/A6M and maintain markings until structural steel has been erected. Materials shall be marked and match- marked for field assembly.

(5) Structural-steel assemblies shall be completed, including welding of units, before starting galvanizing operations.

(6) 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.

(7) 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.

(8) 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.

(9) Weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel shall be verified that they will limit distortions to allowable tolerances. Butt welds shall be ground flush. Exposed fillet welds shall be ground or filled to smooth profile. Exposed welds shall be dressed.

(10) Zinc coating shall be applied by the hot-dip process to structural steel according to ASTM A123/A123M.

(11) Vent holes shall be filled and ground smooth after galvanizing.

(12) 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.

4.2 SUBMITTALS

4.2.1 Contractor shall prepare the civil works design documents per the Submittal Schedule and containing the following information, at a minimum: (a) design basis; (b) plan views of Project Site, including all access / site roads, crane paths, Wind Turbine locations, staging / laydown areas, Project Substation location, Gen-Tie Line route, Collection System Circuit routes, landowner names, parcel identification number, parcel statuses (participating, non-participating), easements, and public right-of-way; (c) Wind Turbine delivery flow plan; (d) profile views for all vertical curves; (e) grading and drainage plans; (f) details for erosion control, fencing, gates, compaction, road cross sections, road curves (horizontal and vertical), and Wind Turbine Pad cross sections; (g) properties for backfill / fill and road materials; (h) public road improvements; (i) drawing index; (j) inspection, testing, and quality control requirements; and (k) geospatial file (.SHP and/or .KMZ format) showing all Wind Turbines, meteorological towers, access roads, crane paths, and intersection improvements, at a minimum.

4.2.2 Contractor shall provide a hydrology study for the Project. Such study shall include a two-dimensional analysis of the Project area to determine specific flooding hazards (depth, velocity) at all locations within the Project Site boundary; such information shall be presented in a maximum 50-foot grid size and native (*.SHP) files shall be included. The hydrology study shall include an analysis of the following storm events: (a) 20-year, 24-hour; (b) 50-year, 24-hour; and (c) 100-year, 24-hour.

4.2.3 Contractor shall prepare the Turbine Foundation design documents per the Submittal Schedule and containing the following information, at a minimum: (a) design basis to outline all references, design procedures, and software tools to be utilized for the design and analysis of Turbine Foundations; (b) plan and profile view of Turbine Foundation design, including cross sections; (c) details for reinforcing steel, conduit, and grouting; (d) civil works requirements (e.g., backfill, compaction, grading, drainage, etc.); (e) tensioning sequencing and parameters, including post- installation re-tensioning; (f) structural calculations, to be provided with each set of Turbine Foundation design drawings; (g) rebar and embedment ring shop drawings; (h) drawing index; (i) bill of materials; and (j) inspection, testing, and quality control requirements.

(1) For the avoidance of doubt, the approval of the Turbine Foundation design documents

by Owner's independent engineer shall be received *prior* to constructing any portion of the Turbine Foundation. Contractor shall allocate adequate review time to the independent engineer for this purpose and shall coordinate with the independent engineer as reasonably required to address and incorporate any comments required to receive approval.

4.2.4 Contractor shall provide a foundation inspection report for each Turbine Foundation excavation (each, a "**Foundation Inspection Report**"). A Foundation Inspection Report, including all accompanying documentation, shall be completed prior to placement of the mud mat and provided to Owner as a condition of each Turbine Foundation completion. Each report shall include information on the foundation excavation, including, but not limited to, (a) date of excavation; (b) date of inspection; (c) ambient air temperature and weather conditions at time of inspection; (d) structure name / number and location; (e) structure type and foundation type; (f) soil conditions; (g) verification of subgrade against expected condition, including test results; (h) actual depth to rock and depth to water; (i) estimated depth to rock and depth to water with corresponding borehole reference; and (j) independent verification of lift sizes.

4.2.5 Contractor shall prepare concrete mix designs; grout specifications; and concrete and grout placement procedures. All such submittals shall be approved by Owner prior to use. Each mix design submitted by Contractor shall be stamped by a professional engineer with an active license in the state where the Project is located and shall include, at a minimum, (a) documentation of achieving Project-specific compressive strength requirements per ACI procedures; (b) gradation, source, and type of aggregates; (c) mill reports for cement and fly ash; (d) product data for admixtures, including vendor certification of compliance with applicable ASTM standard; (e) ASR test results, including expansion results per ASTM C1567; (f) specified slump value; (g) specified water/cement ratio; (h) specified air entrainment per ASTM C260; (i) water quality test per Table 2 of ASTM C1602 if non-potable; and (j) an approval stamp by the applicable engineer of record.

4.2.6 Contractor shall submit three (3) laboratory tension test reports for anchor bolts for each heat number furnished, complete with threads, and to be prepared by an independent third-party tester. This task shall be in accordance with ASTM A370 and the report shall include yield stress and tensile stress.

4.2.7 Contractor shall provide copies of mill certificates for all steel reinforcement (rebar) and anchor bolts.

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

4.2.9 If blasting is required, Contractor shall prepare blasting plans and procedures for all blasting work to be performed at the Project Site. All such submittals shall be approved by Owner prior to use.

4.2.10 Contractor shall prepare an aggregate mix formula based on recommendations from the final Geotechnical Report and complying with the requirements in Section 4.1.5 herein. Each formula shall be approved by Owner prior to use and shall be accompanied by testing data for each aggregate source, including sieve analysis, moisture data, liquid limit, and plastic limit.

4.2.11 Contractor shall submit manufacturer's approval drawings or product sheets (material cut sheets) for all permanently-installed equipment and materials. This shall include, but is not limited to, geotextile fabric, permanent gates, permanent culverts, block mesh / flexamat (or

similar) if used for low-water crossings, anchor bolts, rebar, curing compounds, joint compounds, crack repair compounds, sealants, corrosion inhibitors, and grout.

4.3 PROJECT SITE PREPARATION

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

(1) 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 three (3) inches in diameter. Topsoil shall not be used as structural fill. Appropriate erosion control measures shall be utilized on stockpiled topsoil.

(2) 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.

(3) Removal of or damage to trees outside of the designated disturbance areas is prohibited without written approval of Owner. Trees shall be adequately protected, including protecting tops, trunks, and roots of existing trees at the Project Site which are to remain.

(4) Any waste generated from such activities, including tree trimmings or grubbed vegetation material, shall be Contractor's responsibility to dispose of.

4.3.2 Contractor shall provide and maintain throughout the duration of construction activities all necessary construction surveying and marking necessary to construct the Project and complete the Work, to include, but not limited to, (a) grading limits; (b) limits of disturbance; (c) laydown and storage areas; (d) culturally-, archeologically-, and/or environmentally-sensitive areas; (e) utilities, pipelines, and other buried facilities; (f) Wind Turbine locations; (g) access roads and crane paths; (h) Project Substation pads; (i) Collection System Circuit routing; (j) Gen-Tie Line routing, including centerline and structure locations; (k) O&M Building, including pads, parking area, and property limits; and (l) easements.

(1) Contractor shall be solely responsible for locating any survey monuments at or near the Project Site and shall replace such monuments if they are disturbed during performance of the Work.

(2) All structure foundations shall be surveyed and staked prior to excavation. The methods of staking and final alignment shall be designed such that the finished condition of the Work meets the requirements for alignment, position, elevation, and rotation.

(3) All permanent Project facilities, including roads, Collection System Circuits (including feeder routing, junction boxes, and splices), and the Gen-Tie Line (including structures and line routing), shall be surveyed following their construction and included in the applicable As-Built Drawings. Surveyed locations shall be included in the drawings and a Contractor- provided geospatial file (.SHP and/or .KMZ format) for each. Contractor shall also furnish an as-built version of the PLS-CADD (.BAK) file for the Gen-Tie Line.

4.3.3 Contractor shall maintain all access roads and construction areas throughout the duration of the Work. Maintenance of such areas shall include washboard removal, pothole removal,

snow removal, cleaning of silt and debris from cattleguards, cleaning of silt and debris from culverts as necessary to facilitate drainage, dust control along access roads, and other similar items, in a condition suitable for daily construction traffic. Maintenance by Contractor of graveled roads at the Project Site is included in these maintenance requirements.

4.3.4 Contractor shall furnish, install, and maintain temporary orange snow fencing or other Owner-approved delineation / marking method around all archeologically-, culturally-, and environmentally-sensitive areas at the Project Site, including those identified in the Applicable Permits. All temporary fencing shall be (a) promptly replaced if it becomes deteriorated / unfit for purpose and (b) removed prior to Contractor demobilization but not before Work in the applicable area(s) is completed.

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

(1) 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. All permits and licenses required for blasting shall be obtained, paid for, and maintained by Contractor.

(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. Blasting shall be performed only by persons who are qualified, competent, and thoroughly experienced in the use of explosives for rock excavation. Blasting near utilities, pipelines, or facilities (buried or above-ground) shall be subject to approval of owning agency and Owner.

(3) 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.

(4) 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. Under no circumstance shall caps or other exploders or fuses be stored, transported, or kept together with powder.

(5) 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 consult with the geotechnical engineer prior to using blasted material as general fill at the Project Site. Contractor shall be responsible for verifying that the quantity, quality, and size of such rock is suitable for use as aggregate at the Project Site in accordance with geotechnical engineer’s recommendations.

(6) Excessive overbreak or damage to adjacent structures, exposed cut slopes, equipment, utilities, or buried pipeline and conduit shall be avoided. Charge holes shall be located properly and drilled to correct depths for charges used, and charges shall be limited in size to the minimum required for reasonable removal of material by excavating equipment. 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.

4.4 SITE ROADS

4.4.1 Contractor shall design, furnish, construct, and install all roads, including access roads and spur roads, temporary turnarounds, intersection/radius improvements, crane paths, and transitions to/from existing roads in conformance with the minimum requirements set forth herein. Access roads shall include a road to each Wind Turbine, permanent meteorological tower, Project Substation, and O&M Building, at a minimum.

(1) All roads shall be constructed at the locations shown in the [preliminary] design documents in Exhibit [●] (*Design Documents*). [NTD: a site plan or civil design will be referenced here and attached to the Agreement; this information is expected to be added at a later date, prior to contract execution.]

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

4.4.2 Contractor shall furnish and install a gate or cattleguard at every location where a roadway penetrates an existing fence line at the Project Site.

(1) Each permanent gate shall be a double-hung, prefabricated, finished metal gate; each such gate shall be a minimum 20-feet-wide (for 16-foot roads) manual swing gate with a pipe frame and manufacturer's standard coating finish, complete with hinges and latching hardware, and lockable via lag bolt.

(2) Unless explicitly noted otherwise above, all fencing, gates, and cattleguards shall comply with the applicable requirements in Section 4.1.8 herein.

4.4.3 Contractor shall furnish and install any new, permanent wire fencing shown in the Project design documents. Unless explicitly noted otherwise, all fencing, gates, and cattleguards shall comply with the applicable requirements in Section 4.1.8 herein.

4.4.4 Contractor shall furnish and install any necessary matting, blisters, or other similar items required to facilitate crossings of pipelines or other underground facilities during construction, including for Wind Turbine deliveries at the Project Site.

4.5 PUBLIC ROADS

4.5.1 Contractor shall design, furnish, construct, and install all public road improvements in accordance with the road use agreements in Exhibit [●] (*Road Use Agreement*), including upgrading and maintaining any public roads, bridges, and culverts as specified therein, and as necessary to permit full access for the Project and permit delivery of all plant and equipment required for the Project. [NTD: the Project(s) road use agreement(s) will be referenced here and attached to the Agreement; this information is expected to be added at a later date, prior to contract execution.]

4.5.2 Contractor shall maintain graveled public roads within the Project Site boundary throughout construction of the Project, including dust control, snow removal, washboard removal, and pothole removal.

4.5.3 Contractor shall, prior to mobilization to the Project Site, digitally video and document the condition of existing public roads to quantify the extent of any Contractor-caused wear and tear.

4.6 DRAINAGE AND EROSION CONTROL

4.6.1 Contractor shall furnish, construct, install, and maintain all temporary and permanent drainage or erosion and sediment control, as necessary to control the erosion of embankments,

temporary and final exposed slopes, and temporary stockpiles, and including the use of Best Management Practices (as defined above) all in conformance with the minimum requirements set forth herein, including Section 4.1.5(12) and the [preliminary] design documents in Exhibit [●] (*Design Documents*). [NTD: the Project's civil design will be referenced here and attached to the Agreement; this information is expected to be added at a later date, prior to contract execution.]

4.6.2 Contractor shall continuously monitor construction operations to avoid creating conditions that could lead to excessive erosion of soil with surface runoff from Work areas. Contractor shall furnish, construct, and install any necessary controls to protect water quality.

4.7 DUST CONTROL

4.7.1 Contractor shall provide construction dust control at the Project Site throughout the duration of the Work, including furnishing of all labor, equipment, and materials, including water and/or palliatives, necessary for dust control and as necessary to reduce the risk of dust becoming a nuisance. Water used for dust control shall be treated to ensure no negative impacts to human health and ecology, including downstream environments; for the avoidance of doubt, potable water is not required for dust control, and treatment of the water source utilized by Contractor for dust control is only required to the extent necessary to comply with the Requirements.

4.7.2 Not used.

4.8 TURBINE FOUNDATIONS

4.8.1 Contractor shall design, furnish, construct, and install one (1) Turbine Foundation per Wind Turbine location, including grounding, in conformance with the minimum requirements set forth herein and the [preliminary] design documents in Exhibit [●] (*Design Documents*). [NTD: the Turbine Foundation design will be referenced here and attached to the Agreement; this information is expected to be added at a later date, prior to contract execution.]

(1) Turbine Foundations shall be constructed at the locations shown in the [preliminary] design documents in Exhibit [●] (*Design Documents*).

(2) Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe Turbine Foundation configuration.

(3) Turbine Foundations should be conventional spread footing / gravity-type foundations. No alternate Turbine Foundation type, including P&H or rock anchor, shall be utilized without Owner approval.

(4) Turbine Foundations shall be reinforced concrete designed in accordance with Turbine Supplier Project Site Requirements, the Applicable Standards, and the Requirements.

(5) Turbine Foundations shall, at a minimum, be designed using the final Geotechnical Report, including net allowable soil bearing capacity values determined by geotechnical investigation from soil borings at each specific Wind Turbine site and equipment loads provided by Turbine Supplier. No portion of Turbine Foundations shall be constructed on non-structural fill material or within ten (10) feet of a fill slope without Owner approval.

(6) 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: (a) Turbine Supplier Project Site Requirements; (b) incorporate the recommendations, values, and minimum requirements set forth in the

Geotechnical Report; (c) installation of adequate ground for personnel safety, including touch and step potentials (to be demonstrated by Contractor via calculations in the grounding study); (d) incorporate local resistivity measurements; and (e) a ground resistance <= 10 ohms.

(7) Turbine Foundation anchor bolts shall have a minimum projection of two (2) anchor bolt diameters beyond the tightened anchor nuts.

(8) Turbine Foundation materials, including rebar, anchor bolts, forms, concrete, and grout, shall comply with the applicable structural requirements in Section 4.1 herein.

(9) The area surrounding the Turbine Foundation shall be constructed with a grade of two percent (2%) sloping away from the Turbine Foundation for the greater of (a) 25 feet from the edge of the pedestal or (b) the distance calculated as 1 foot from the bottom outer edge of the base plus the distance to the surface at a slope of 1H:2V from the bottom of the excavation.

(10) Contractor shall provide all necessary dewatering of the Turbine Foundation excavation.

(11) Each Turbine Foundation shall include at least two (2) thermocouples for concrete temperature monitoring, including one at the center and one near the outer surface.

(12) Turbine Foundation gapping is prohibited without Owner and Turbine Supplier approval.

4.8.2 Contractor shall furnish and install the subgrade improvements set forth in the Geotechnical Report, including overexcavations, geopiers, and subgrade densification as described therein.

4.9 WIND TURBINE PADS

4.9.1 Contractor shall design, furnish, construct, and install one (1) Wind Turbine Pad per Wind Turbine location in conformance with the minimum requirements set forth herein and the [preliminary] design documents in Exhibit [●] (*Design Documents*). Contractor shall maintain the Wind Turbine Pads throughout the duration of the Work. [NTD: the Wind Turbine Pad design will be referenced here and attached to the Agreement; this information is expected to be added at a later date, prior to contract execution.]

(1) 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.

(2) Wind Turbine Pads shall comply with the Turbine Supplier Project Site Requirements.

(3) Wind Turbine Pads shall be cleared of crops, 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.

(4) 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) Wind Turbine Pads shall have a competent, compacted soil working surface with subgrade 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 Report or the Turbine Supplier Project Site Requirements.

(6) 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 removal and / or installation).

4.9.2 Contractor shall design, furnish, construct, and install a gravel ring (i.e., “beauty ring”) at each Wind Turbine location in conformance with the minimum requirements set forth herein.

(1) Each beauty ring shall be installed after the applicable Wind Turbine is installed and after the removal (including decompaction) of the Wind Turbine Pad at such location.

(2) Each beauty ring shall be installed around the perimeter of each Wind Turbine location at a minimum distance of twelve (12) feet beyond the Turbine Foundation pedestal wall and transformer pad / Wind Turbine tower stairs (as applicable) in all directions.

(3) Each beauty ring (a) shall have an identical cross section as the Wind Turbine access roads (i.e., same thickness, same surfacing material); (b) shall be shaped to move water away from the Turbine and pad-mount transformer (if any); and (c) shall be constructed to prevent water ponding.

4.10 TESTING AND QUALITY CONTROL

4.10.1 Contractor shall inspect and test each roadway, except for public roads, in accordance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

(1) All roadways and compacted areas shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

(2) Testing standards: (a) maximum dry density and optimum moisture content per ASTM D698 or ASTM D1557; (b) in-place density by nuclear methods (shallow) per ASTM D2922; (c) aggregate sampling per ASTM D75; (d) sieve analysis of fine and coarse aggregates per ASTM C136; (e) sand equivalent value per ASTM D2419; and (f) liquid limit, plasticity limit, and plasticity index per ASTM D4318.

(3) Fill material / embankments: (a) proof roll over entire length; (b) grain size analysis, moisture content, Atterberg limits on fines contents, and standard proctor test on each material type; (c) if proof roll fails, moisture density test at 4 per lift or every 1,000 feet of road, whichever is greater; and (d) DCP test at any location where moisture density testing fails. The civil engineer of record shall specify passing criteria for the DCP test (e.g., minimum blows per 6 inches).

(4) Compacted subgrade: (a) proof roll over entire length prior to placement of aggregate base; (b) moisture density test every 1,000 feet or 3 per road, whichever is greater; and (c) DCP test (recorded to a minimum depth of 2 feet) at any location where moisture density testing fails. The civil engineer of record shall specify passing criteria for the DCP test (e.g., minimum blows per 6 inches).

(5) Aggregate base: (a) proof roll over entire length; (b) DCP test (recorded to a minimum depth of 2 feet) every 1,000 feet or minimum 3 per road, whichever is greater; (c) sieve analysis, liquid limit, and plasticity index every 2,500 cubic yards; and (d) wet ball mill or Los Angeles abrasion test every 5,000 cubic yards. The civil engineer of record shall specify passing criteria for the DCP test (e.g., minimum blows per 6 inches).

(6) Crane paths (including shoulders): proof roll over entire length.

(7) Other testing set forth in the Project design documents.

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

4.10.2 Contractor shall inspect and test each Turbine Foundation in conformance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

(1) All Turbine Foundations shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

(2) Certification of integrity of Turbine Foundation sub-base, including verification that conditions within excavation align with expected / design conditions and all information required in Foundation Inspection Report (as defined herein); *the Foundation Inspection Report, including all accompanying documentation, shall be completed prior to placement of the mud mat*.

(3) Compacted subgrade (all performed prior to placement of mud mat): (a) proof roll over entire length; (b) soil probe or shallow hand auger probes to determine presence of unsuitable soils below the surface, to aid in classifying soils, and to make comparisons of exposed soils to those available in the Geotechnical Report; and (c) static cone penetrometer ("**SCP**") tests on cohesive soils and dynamic cone penetrometer ("**DCP**") tests on cohesionless soils to verify against requirements in the Geotechnical Report, including one test at the center at the Turbine Foundation and one test in each quadrant (five total). The foundation engineer of record shall specify passing criteria for the SCP/DCP test (e.g., minimum blows per 6 inches). The mud mat shall be installed within 24 hours of an approved test and inspection.

(4) Concrete / grout strength and properties, including break tests, grout cubes, slump, air, and temperature, each at the minimum frequencies specified in Section 4.1.10 and Section 4.1.11 herein.

(5) Random tension test of at least 10 percent (10%) of anchor bolts on each Turbine Foundation. If any bolts do not meet the required tension value, all bolts on such Wind Turbine shall be re-tensioned and the 10-percent check repeated until all tests pass.

(6) Other testing set forth in the Project design documents and the recommendations set forth in the Geotechnical Report.

4.10.3 Contractor shall inspect and test each Wind Turbine Pad (including Turbine Foundation backfill as applicable) in conformance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

(1) All Wind Turbine Pads shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

(2) Structural fill below Turbine Foundation: (a) two (2) unit weight tests per lift and (b) two (2) moisture density compaction tests per lift.

(3) Common fill around Wind Turbines / Wind Turbine Pads (including backfill for Turbine Foundations): (a) for every 2,500 cubic yards of fill placed and at least one set per Wind Turbine location, provide (i) grain size analysis per ASTM D422; (ii) moisture

content per ASTM D2216; and (iii) standard proctor maximum dry density per ASTM D698; and (b) for each fill lift at each Turbine Foundation backfill location, provide density test per ASTM D6938, including test location, dry density, and moisture content for each test.

(4) All Wind Turbine Pads shall be proof-rolled over the entire length.

(5) Turbine Foundation concrete temperature monitoring results (to be furnished to Owner within 72 hours of concrete placement).

(6) Other testing set forth in the Project design documents and the recommendations set forth in the Geotechnical Report.

4.10.4 Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Owner within 10 days of completing such test. 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.

5.0 COLLECTION SYSTEM CIRCUITS

5.1 GENERAL PROVISIONS

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

5.1.2 Contractor shall design and construct the Project such that the total annual energy losses under Project Site-specific wind distribution data, measured between the generator leads of each Wind Turbine and the Point of Interconnection shall not exceed [2.25 percent (2.25%)] (the "Electrical Loss Limit"). For the avoidance of doubt, this shall include all medium-voltage transformers, Wind Turbine cabling, Collection System Circuit cabling, main step-up transformer, and the Gen-Tie Line up to the Point of Interconnection. [NTD: confirm value per project]

5.1.3 Contractor shall design and construct the Collection System Circuits in accordance with the Collection System Electrical Studies, as defined herein.

5.1.4 All Collection System Circuits shall be installed underground.

5.1.5 No more than 10 Wind Turbines or 35 megawatts of combined capacity shall be installed on any single Collection System Circuit.

5.1.6 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.

5.1.7 All Collection System Circuit backfill, including splice pits (if used), shall be compacted to a minimum of 85 percent (85%) of standard proctor density, unless otherwise noted on the design drawings. For the avoidance of doubt, collection backfill at Turbine Foundations and access road crossings shall be compacted to ninety-five percent (95%) as noted elsewhere herein.

5.1.8 Requirements for power cabling:

(1) All Collection System Circuit power cabling shall be 34.5-kV, three (3)-phase, 60 Hertz.

(2) Jacketed, single-conductor, appropriately-sized concentric neutral, insulated medium-voltage underground distribution power cable 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. All Collection System Circuit cables shall be UL listed.

(3) Collection System Circuits 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.

(4) 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. Allowable conductor sizes are 1/0 AWG through 1250 kcmil. Other cable sizes shall not be used

without Owner approval.

(5) Cable ampacity shall not exceed 95 percent (95%) of the rated value, based on Project Site- specific thermal resistivity and in consideration of all external heat sources. Ampacity shall be calculated assuming the soil around the cable within the trench is dried out to zero percent (0%) moisture content and that soil above the cable within the trench is at two percent (2%) moisture content.

(6) Notwithstanding the requirements for cable crossings in Section 5.1.10 herein, all underground Collection System Circuit cabling shall be direct buried at a depth of at least 42 inches below grade. [NTD: Update based on county decommissioning requirements.]

(7) 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. Establishing slack via coil under the pad-mount transformer (if applicable) or junction box, in a plenum or vault, is required.

(8) 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. At least 25 feet (or more if required to allow for at least two (2) future terminations) of excess cable shall be provided at each Wind Turbine such that the cables may be re-terminated if needed following installation.

(9) 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.

(10) No splices shall be permitted to underground cabling unless explicitly approved in writing by Owner. Underground splices, if approved by Owner, shall be identified using GPS-located marker balls. Splices shall only be performed by a skilled, qualified craft worker who shall receive training at the Project Site from the splice kit manufacturer prior to performing splices; the coordinates of each splice shall be recorded and noted within the As-Built Drawings. Splicing of different cable types, splices between Wind Turbines (except at directional boring locations), and “dutchman” cable splices are each strictly prohibited. Training certificates shall be included in the Job Books.

(11) Excessive bending of cabling shall be avoided. The manufacturer recommended bending radius or NEC standard (whichever is greater) shall not be exceeded. Contractor shall ensure vault size and depth allows for bending radius.

(12) BIL voltage rating: 200 kV.

(13) Maximum short-circuit conductor temperature: 250°C.

(14) Only Turbines from the same manufacturer shall be installed on a circuit (e.g., all Vestas Turbines shall be on the same circuit(s) and all GE Turbines shall be on the same circuit(s); no GE Turbines shall be on a Vestas circuit or vice versa).

(15) Cable trefoil configuration shall be maintained by use of zip ties or suitable tape in accordance with manufacturer recommendations and Owner approval.

5.1.9 Requirements for trenches:

(1) All Collection System Circuits shall be installed via trenching; plowing is not permitted and excavation by blasting for the Collection System Circuits is strictly prohibited. Trench widths shall be kept to a minimum to allow sufficient space for equipment installation. The trench bottom shall be firm for the entire length and width. Trenches shall be kept free from water. Conduit and cable shall not be placed on frozen ground.

(2) Bedding and/or backfill 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, with any backfill within 12 inches of cable being free of sharp objects, rocks, and other debris larger than 0.5 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. Backfill above the first lift shall be placed in maximum 12 inch lifts and tamped or compacted between lifts.

(3) Ditch dams, consisting of sand bags or soil cement berms placed over the conductors at a 30 degree angle, shall be placed at intervals in all cable runs which traverse slopes greater than 3 percent (3%). Spacing shall vary, depending on the steepness of the grade, from 100 feet to 300 feet.

(4) All collector trenches shall be laid out and pre-graded to ensure correct burial during final grading. Changes of grade between trenching and final profiles shall be accounted for in confirming burial depth.

(5) Prior to trenching, the topsoil layer shall be removed. The topsoil layer is defined as either the darkest color soil or highest content of organic material; the removal depth shall be based on field observation at regular intervals. Trenching shall be open cut and be firm for entire length and width. Dispose of excavated material not used or suitable for use as backfill.

5.1.10 Requirements for cable crossings:

(1) Unless crossing agreements require a greater depth, all Collection System Circuit (a) railroad crossings shall be buried at a depth of at least 120 inches below the railroad; (b) public road crossings shall be buried at a depth of at least 60 inches below the road, including the ditch(es) on either side; (c) wetland and stream crossings shall be buried at a depth of at least 60 inches below the steam bottom; and (d) utility and pipeline crossings shall be buried at a depth of at least 48 inches below the existing utility or pipeline. All other Collection System Circuit crossings shall be buried at a depth of at least 48 inches below the applicable infrastructure. Possible surface reduction from future road maintenance shall be considered when selecting the cable burial depth at public road crossings.

(2) All Collection System Circuit crossings (including those set forth in Section 5.1.10(1) above) shall be installed in conduit as more particularly described in Section 5.1.18 below.

(3) All crossings, including public road, railroad, pipeline, utility crossings, property lines, wetlands, and streams, shall be marked on each side with buried marker balls and above- ground cable markers, each meeting the requirements in Section 5.1.11 below.

(4) Contractor shall coordinate with local utilities and pipeline companies as set forth in

Section 2.11.3 herein.

5.1.11 Requirements for markers:

(1) Cable marking tape shall be furnished and installed in all trenches along the length of all buried cable. Such tape shall be red, metallic, and detectable. Marking tape shall be placed at least 30 inches below grade and 12 to 18 inches above cable.

(2) GPS-located marker balls shall be placed within all cable trench at the following: (a) each side of crossings / directional bore locations; (b) each above-ground cable marker location; (c) every splice location; (d) all turns in a Collection System Circuit; and (e) minimum of every 300 feet of trench length. The markers shall be programmed with the feeder number as per the Project Substation breaker identification number.

(3) An appropriate cable locating device shall be provided to enable the location of underground cables and electronic markers.

(4) Above-ground cable markers shall be a Curv-Flex marker or equivalent and shall include a decal warning of buried cable and other Owner-approved details, including cable voltage details and telephone numbers of both the Owner and dig-safe agency. Landowners shall also be provided with these phone numbers and the as-built cable route details and drawings.

(5) In addition to crossings (noted above), all changes in Collection System Circuit direction shall be marked with buried marker balls and above-ground cable markers.

5.1.12 Requirements for fiber optic cabling:

(1) Fiber optic cable shall be installed in the same trench as the Collection System Circuit power cabling.

(2) When fiber cables are installed in a trench, the fiber cable shall be placed in min minimum four inch conduit Armored Pest Duct (required for all non-armored cable), or continuous three inch innerduct; the fiber cable shall be rated for underground use; and there shall be a suitable locating cable installed in the innerduct/conduit. If installed in conduit , innerduct shall have a minimum diameter of 1.25 inches. Fiber optic shall be separated from any power cables by a minimum of 1 foot when co-located in a trench.

(3) Armored Pest duct to be bonded to ground at each vault splice, and entrance locations.

(4) All fiber cables shall consist of a minimum of 12-strand multi/single mode fiber, except that the fiber run between the Project Substation and O&M Building shall be a minimum of 144-strand single mode. 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.

(5) All fiber cables shall be designed with a minimum of fifty percent (50%) spare fiber.

(6) Excess slack shall be provided to allow re-termination in the event of failure. At least 100 feet of excess cable shall be provided at each pull box such that the cables may be re- terminated if needed following installation. Terminations shall be completed with an approved fiber optic pigtail kit and an approved fanout kit.

(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) The fiber system shall be designed for a minimum of five (5) dB system margin.

(9) The fiber system design shall be a fiber ring topology. or a “daisy-chained loop” system.

(10) Conduits for fiber entry into the Wind Turbine areas shall include a pull string for pulling the cable.

(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.

(12) All splices shall be fusion splices. Other types of splices are subject to Owner approval.

(13) All underground splices will be placed inside vaults of not less than 4’ x 4 ’x 4’ in size. Cable end tails of not less than 100’100’100 feet from each direction to be coiled in vault for splicing operations. Owner to supply vault numbers and tags.

(14) Maximum attenuation: (a) 0.35 dB/km at 1310 nm and (b) 0.25 dB/km at 1550 nm.

(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.

(16) Pull boxes shoujld be installed at 500’-600’ intervals.

(17) No more that 270deg of bends on fiber cable runs without a pull box or vault.

(18) As-buildbuildbuilt drawings of the Fiber routes shall be supplied to Owner separately from collectorcollectoras-built drawings of the Collection System Circuit network.

5.1.13 Requirements for junction boxes:

(1) Junction boxes shall meet the requirements of ANSI C57.12.28, including water resistance.

(2) Junction boxes shall be stainless steel or fiberglass.

(3) Junction boxes shall be lockable with a padlock.

(4) 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.

(5) Junction boxes shall be clearly marked with an appropriate high-voltage sign identifying the junction box number and Collection System Circuit number.

(6) The coordinates of each junction box shall be recorded and noted within the As-Built Drawings. Junction box locations shall be installed reasonably close to a roadway, property line, or Wind Turbine location to facilitate access. All junction box locations are subject to Owner approval.

(7) No medium-voltage cable run shall exceed 10,000 feet without a sectionalizing junction box.

(8) A flag shall be installed at each junction box location to make them visible in the event of high snow or crops.

(9) Infrared windows shall be installed in the junction box lid such that the Owner can monitor all the bushing and elbow temperatures using an infrared camera without opening the junction box.

(10) Concentric neutral tails are to be connected to the ground bus supplied with the cabinet, with sufficient slack to allow free movement of the terminations for maintenance or replacement. The cable jacket shall be carefully sealed against moisture ingress at all jacket openings.

(11) Sufficient slack cable shall be installed such that the cables can be re-terminated after the project is commissioned per applicable section. If the cable size permits this to be achieved by coiling in the ground sleeve/basement, such cable shall be trained neatly in the ground sleeve area, with a minimum amount of crossovers and buried in sand to prevent damage to the cable from failures in the cable riser section.

(12) If a junction box is installed in area used for livestock, an appropriate Owner-approved system shall be installed to prevent the livestock from rubbing on the junction box.

5.1.14 Requirements for pad-mount transformers (if applicable):

(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. Pad-mount transformers (including spares) shall be in accordance with the requirements set forth in Table 1 *(Summary of General Requirements for Pad-Mount Transformers)* herein, at a minimum.

Table 1: Summary of General Requirements for Pad-Mount Transformers

Description	Value
Quantity	1 per Wind Turbine plus spares noted herein (see Section 5.3.2)
Type	Oil filled, hermetically sealed, outdoor installation
Voltage ratio	34,500 / 690 Volts (or as applicable to Wind Turbine model)
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 (see Electrical Loss Limit)
Temperature gauge	Required
Pressure level indicator	Required
Pressure relief device	Required
Oil sampling valve	Required (located on end of drain valve outside LV compartment)
Filling orifice	Required
Tank ground tag	Required
Oil level indicator	Required
Grounding	Solid (MV source, LV winding), un-grounded delta (MV winding)
Nitrogen bleed valve	Required
Exterior fill valve	Required

(2) 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 (a) compliance with the requirements of IEC 60787 or ANSI/IEEE equivalent; (b) short circuit protection of the MV transformer winding; (c) that degradation of the fuses does not occur as a result of the flow of repeated transformer magnetizing in-rush currents; and (d) ease of replacement following an in- service operation.

(3) Transformers shall have an appropriate K-rating to mitigate harmonic signals emitted by inverter-based wind turbines.

(4) Pad-mount transformers shall be fitted with a low-side load break disconnect from outside any arc-flash hazard with means to take a Wind Turbine offline without taking an entire Collection System Circuit offline or de-energizing other Wind Turbines.

(5) Each pad-mount transformer will have at least one three (3)-inch diameter or larger infrared viewing port installed on both primary and secondary sides, such that the viewing angle of an IR camera does not exceed 30 degrees from perpendicular.

(6) In addition to any requirements set forth herein, pad-mount transformers shall comply with the minimum requirements set forth in PGE Exhibit M1-04-02 (*General Transformer Specification*).

(7) For each Wind Turbine type and size, each transformer in the Project shall be of the same type and shall be directly interchangeable with any other.

(8) Pad-mount transformers shall be supplied with ice shields.

(9) Enclosure:

(a) 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.

(b) The cabinet shall extend to floor level, fully shrouding all cable tails, having the facility for being directly bolted to the supporting pad. The cabinet depth shall be at least 24 inches.

(c) The MV and LV compartments shall be partitioned such that access to each compartment is via a separate door. HV and LV cabinet doors shall operate independently, each with own locking handle. 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.

(d) Each pad-mount transformer shall be equipped with an exterior fill valve, drain valve, external oil sample port, oil level gauge, temperature gauge, and nitrogen bleed valve, under lockable covers separate from the HV or LV cabinets. 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.

(e) 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.

(10) Foundations / vaults:

(a) Pad-mount transformers shall be installed on vaults or concrete box pads; fiberglass box pads will not be used.

(b) 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.

(c) Each pad-mount transformer shall have ball studs installed for capability to hang grounds on the low-voltage side. Short, vertical ball studs (facing up) are preferred.

(d) If required due to proximity to waterway, oil-filled pad-mount transformers will be supplied with a bund adequate for the purpose of containing oil. A vault, in which the transformer is mounted upon, may be configured to serve this purpose. A minimum bund capacity of 110% of the transformer's maximum oil

volume is required and the bund shall be shielded to prevent the accumulation of rainwater.

(e) Transformer mounting flanges shall be flush with the vault surface to prevent rodent ingress.

(11) Contractor shall provide aluminum or copper options for LV cable for Owner's final approval. LV cable from turbine to pad-mount transformer (if any) shall be installed in conduit. Conduits shall be filled with stainless steel brillo and sealant to prevent rodent entry into tower and smoke from being drafted up tower from the pad-mount transformer. At least two spare power conduits are required between the pad-mount transformer and Wind Turbine tower.

(12) Each pad-mount transformer shall be equipped with an oil switch. The operating handle shall be accessible from the side of the transformer, outside the MV cabinet under a lockable cover under a lockable cover.

(13) For each Wind Turbine type and rating, each transformer in the Wind Farm shall be of the same type, configuration, and size, and shall be directly interchangeable with any other.

(14) It shall be possible to completely replace any pad-mount transformer without removing any Wind Turbine or Wind Turbine tower.

(15) Pad-mount transformer LV bushings shall be provided in a staggered arrangement, in accordance with Figure 8 in IEEE Std C57.12.34-2015

(16) X0 bonding jumper shall be external to the tank (inside the LV cabinet) and separable.

5.1.15 Requirements for surge arresters:

(1) Surge arresters shall be provided at the end of each string of Wind Turbines. Surge arresters shall be fully shielded, submersible, dead-front devices rated at 35-kV class, 600A, 30kV/24.4kV MCOV (or greater if required by the Contractor-provided TOV study) equipment meeting the requirements of ANSI C62.11 for Station Class installation in a 60- Hertz outdoor installation, unless a greater rating is required by the Contractor-provided transient overvoltage study.

(2) Surge arresters shall provide overvoltage system protection in an insulated, fully shielded, submersible, dead-front device. Surge arresters shall be provided in pre-molded rubber elbows.

5.1.16 Requirements for grounding:

(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. Driven ground rods shall be installed for each Wind Turbine transformer, and bonded to the Turbine Foundation ground grid and rebar cage via Eufer ground, at a minimum of two places. All connections shall meet or exceed requirement identified in the grounding study report.

(2) Ground rods shall be incorporated into the grounding system (a) if determined to be necessary by the results of the Contractor-provided grounding study and/or (b) if required by Turbine Supplier. Ground rods shall be copper-clad, 5/8-inch diameter, 10-foot-long rods at a minimum.

(3) Turbine Foundations shall include a grounding grid, as further described herein.

(4) Meteorological towers shall be independently grounded; meteorological tower grounding shall not be interconnected to the Wind Turbine grounding system.

(5) All below-grade grounding connections shall be exothermic weld (e.g., Cadweld); mechanical / compression connections are not permitted.

(6) All Collection System Circuits shall include a bare copper ground cable. The size shall be determined by included studies but be no smaller than 1/0 bare soft-drawn cable. Copper weld trench ground cable may be proposed provided it is compliant with all requirements and modeled in applicable studies.

5.1.17 Requirements for bollards:

(1) Bollards shall (a) be a minimum three (3)-inch diameter steel pipe or a minimum four (4)- inch diameter schedule 40 PVC; (b) be concrete filled for equipment protection (minimum 2,000 psi); (c) be painted red; (d) extend four (4) feet above grade with at least six (6) inches below the bollard for concrete; and (e) tie into the Wind Turbine ground grid.

(2) Bollards shall be placed in such a fashion as to be visible and provide physical protection but not infringe upon facilities that, when opened, require extended electrical working clearances.

5.1.18 Requirements for conduit:

(1) All above-ground power and communications cabling shall be installed in conduit, specifically including Project Substation risers. All below grade crossings, including public road and utility crossings, shall be installed in conduit. Conduit shall be installed from each Wind Turbine to each pad-mount transformer.

(2) Conduit size / fill ratio shall be in accordance with ANSI / NFPA 70, at a minimum.

(3) The location of all conduit shall be recorded within the As-Built Drawings.

(4) Non-metallic conduit shall be protected from sunlight. All exposed conduits shall be PV Schedule 80 UV resistant.

(5) 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 and bell housing shall be installed on all conduit ends.

(6) 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) Use suitable temporary plugs or caps to protect installed conduit against entrance of dirt, moisture, and debris.

(8) All conduit materials required shall be furnished new and undamaged in accordance with the following requirements, at a minimum:

(a) Duct: polyvinyl chloride, Schedule 40 PVC in accordance with NEMA TC-2 with smooth interior surface and suitable pulling lubricant used to prevent cable damage while pulling cable into duct.

(b) Couplings: plastic, for use with duct previously specified and “Duct-to-steel” adapters as required, including joint cement.

(c) Spacers: plastic high impact, interlocking, base and intermediate type

(d) 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).

(e) End bells: plastic.

(f) Plugs: plastic, high impact, tapered to fit end bell provided.

(g) Duct binder: hemp or sisal twine coupling.

5.1.19 Requirements for miscellaneous material:

(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.

(2) Dead front, load break, and/or dead break elbows shall be supplied with test ports.

(3) Cable fault indicators shall be installed. The remote head shall be mounted in the cabinet wall to allow viewing from outside the cabinet. Directional fault indicators shall be installed at every junction box and at a frequency of no more than every third Wind Turbine location (i.e., such that any single fault indicator monitors no more than three (3) cable segments). Each fault indicator shall include a fiber optic indicator-extension, with lenses mounted through the enclosure; all fiber optic indicator extensions shall be of such length as to allow normal unimpeded opening of the enclosure, and normal operation of its contents. All fault indicators shall be installed and phase orientations displayed uniformly, and be representative of the phase orientation within the enclosure.

(4) All cable and communication terminations or above-ground junctions shall be along the road-side.

5.2 SUBMITTALS

5.2.1 Contractor shall prepare the Collection System Circuit design documents per the Submittal Schedule and containing the following information, at a minimum: (a) design basis; (b) plan view of the overall system, including power and fiber; (c) one-line electrical diagram; (d) fiber optic loop diagram, including communication loop and connection / termination details for all Wind Turbines, permanent meteorological towers, and the O&M Building; (e) cable installation details, including cable specifications, trench details, splice details, and cable marker details; (f) cable crossing details and schedule, including road crossings, utility crossings, pipeline crossings, and directional boring; (g) grounding details, including trench grounds and Wind Turbine grounding; (h) termination details, including junction boxes and Wind Turbine switchgear; (i) junction box details; (j) meteorological tower power details; (k) conduit and cable schedules; (l) civil works requirements (e.g., backfill, compaction, grading, drainage, etc.); (m) drawing index; (n) bill of materials; (o) inspection, testing, and quality control requirements; and (p) geospatial file (.SHP and/or .KMZ format) showing all Wind Turbines, cable routing, and junction box locations, at a minimum.

5.2.2 Contractor shall prepare equipment specifications to define the requirements and properties for the procurement of all permanently installed Collection System Circuit equipment and materials. The specifications shall be submitted to Owner for review *prior* to the procurement of the applicable equipment. The following specifications shall be provided, each as applicable to the design: (a) construction specification; (b) pad-mounted transformers, including vaults; (c) junction boxes; (d) power cable; (e) fiber optic cable; (f) handholes /

enclosures; and (g) surge arresters.

5.2.3 Contractor shall submit manufacturer's approval drawings or product sheets (material cut sheets) for all permanently installed Collection System Circuit equipment and materials, including all items identified in Section 5.2.2 above as well as splice kits, marker balls, fault detectors, surge arresters, patch panels, and elbows.

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

(1) Cable Ampacity Study: load flow study with power flow analysis for the Collection System Circuits, including all medium-voltage cable and low-voltage cable (from the Wind Turbine to the pad-mounted transformer) (if applicable). Final report shall include table showing cable ampacity and percent loading per cable section corresponding to the Project one-line diagram. Cable ampacity shall not exceed the limit set forth in Section 5.1.8(5). All external heat sources shall be considered, including parallel circuits. Thermal design shall account for actual field soil samples and backfill requirements (native or engineered).

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

(3) Annual Energy Loss Report: electrical losses evaluation, including estimate of annual energy losses for Project design. Such analysis shall be sufficient to demonstrate that the Electrical Loss Limit, as defined herein, is not being exceeded, and shall be based upon Project-specific cabling and transformer specifications, Project Site-specific soil conditions, Project Site-specific wind data, and other similar considerations. A pre-construction annual energy loss report and an as-built energy loss report, respectively, shall be submitted. The energy loss calculation shall include supporting assumptions and breakdown of subsystem loss contribution The energy loss calculation shall be based on site specific wind speed distribution and turbine specific power curve.

(4) Reactive Compensation Study: reactive power flow report, including power factor study at Point of Interconnection. The study shall identify reactive compensation required to meet the Requirements, including the Generator Interconnection Agreement requirements for power factor and voltage regulation, and including any capacitor bank and/or reactor requirements. The study shall include combinations of (a) active power (no load to full load at ten percent (10%) increments); (b) power factor (0.95 leading to 0.95 lagging); and (c) voltage (0.95 to 1.05 pu) at the Point of Interconnection, or more stringent as necessary to meet the Requirements, including the Generator Interconnection Agreement and compliance with FERC Order 827. A pre-construction reactive compensation study and an as-built reactive compensation study, respectively, shall be submitted.

(5) Harmonic Analysis Report: power quality analysis at the Point of Interconnection to determine the harmonic resonance and flicker conditions within the Project, and demonstration that the Project design meets the harmonics distortion requirements in

the Requirements (including IEEE 519), including any necessary filtering or mitigation to be provided by Contractor. A pre-construction harmonic analysis report (performed at 90 percent design) and an as-built harmonic analysis report, respectively, shall be submitted.

(6) Harmonics Metering Plan: process to measure the harmonic voltage distortion and harmonic current distortion at the Project to compare with the limits of IEEE 519-2014. The plan shall include recommendations for harmonic metering equipment, equipment locations, and measured quantities where the resulting harmonic meter dataset collected will be used to determine whether there are any harmonics at the Project Site which might damage equipment or be cause for concern.

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

(8) Insulation Coordination Report: study to ensure the insulation coordination requirements of IEEE C62.22-2009 have been satisfied within the Project electrical design, including proper application of surge arresters to safeguard electric power equipment within the Collection System Circuits, Project Substation, and Gen-Tie Line against hazards of abnormally-high voltage surges of various origins. This study shall also confirm any system modifications required to adequately limit transient overvoltage on the collection system circuits, including determination of the transient overvoltage levels on the collection system circuits after feeders have been isolated from the project substation due to a line-to-ground fault or lightning strike, and determination of the maximum energy required to be absorbed by each surge arrester on the collection system circuit feeders Contractor shall provide calculations which verify that each equipment's basic insulation level, basic switching impulse level, and chopped wave withstand rating are acceptable. Contractor shall also provide protective ratio calculations and verify that insulation coordination has been met as defined in the most recent revision of IEEE standard C62.22 or superseding equivalent.

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

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

(a) For both the Wind Turbine Ground Grid Report and Substation Grounding Report, Contractor shall follow (a) most conservative body weight shall be assumed (50 kg); (b) a minimum of 3,000 Ohm-meter surface rock to be

installed, surface rock to be four inches in depth with an appropriately compacted base layer of ¾-inch minus and no felt separating the layers; and (c) as-built crushed rock depth shall be recorded and updated in the calculation.

(b) The grounding calculations shall be performed in CDEGS software and provided to Owner for review. CDEGS software shall conform to the following: (i) software version: Contractor shall verify acceptable version with Owner.; (ii) multi-layer soil model in RESAP; (iii) grounding plan in SESCAD; (iv) step and touch potentials in MALZ; and (v) Wind Turbines shall be modeled as they are actually constructed (i.e., if not solidly bonded (e.g., using wire ties), they should be modeled accordingly). This study shall consider clearing time in the event of a breaker failure for the purpose of determining if the grounding design (e.g., ground potential rise) is acceptable.

(11) Arc Flash Study: Refer to PGE Exhibit M1-05-02 (*Substation Design Specification*).

(12) Transformer Sizing Calculations: medium-voltage and main power transformers calculations shall be provided prior to procurement of any power transformer.

(13) Subsynchronous Resonance Study (if required): study shall confirm no subsynchronous resonance issues or mitigation is required. EMTP software shall be used (Owner to approve software version).

(14) The Collection System Electrical Studies shall be performed utilizing EasyPower software (Contractor shall confirm acceptable software version with Owner). Systems or components considered as part of the Bulk Electric System ("**BES**") shall be modeled using Aspen OneLiner. Contractor shall follow Owner's modeling and naming conventions. Each report shall include executive summary, assumptions, methodology, analysis, and conclusion sections. Each report shall be submitted with the native software files and any referenced files for the Owners use in reviewing.

(a) One-Line Diagram: The EasyPower/Aspen model shall include a complete system one-line electrical diagram with the following minimum requirements: (i) utility source information including calculated maximum and N-1 three-phase and single line-to-ground short-circuit current values and X/R ratios; (ii) bus nodes with ampacity and voltage ratings, and available short circuit current; (iii) transformer ratings with all MVA ratings, voltage ratings on all windings, positive and zero sequence impedance ratings of each winding connection (primary-secondary, secondary-tertiary, primary-tertiary), load tap changer ratings, de-energized tap changer ratings, and inrush currents; (iv) cable and iso-phase bus size, type, impedance, and cable lengths within 10 feet of actual (through the 480 V level); (v) circuit breaker or protective device make and model, frame ampacity, trip plug rating, and protective settings; (vi) motor circuit protectors make and model, ampacity, and protective settings; (vii) motor loads including horsepower, voltage, full load amps, and locked rotor amps; (viii) variable speed drives and protective settings; (ix) generators, including all nameplate information; (x) neutral grounding resistor/transformer size and ratings; (xi) 480 V panelboards including all branch circuit information; (xii) protective relay make, model, and protective settings; (xiii) DC/UPS chargers, inverter, batteries, disconnects, and panelboards; (xiv) 120/208 V panelboards including all branch circuit information; (xv) as agreed upon by Owner, below a certain KVA, any loads fed from a single distribution panel, including

aggregated power sources, can be lumped together as an individual element within the model.

(b) Contractor shall provide Owner with native data files for their use. Native data files for generation facilities shall include (i) Detailed Load Flow and Dynamic (RMS) Model: PSLF or PSS/e model of the entire facility; (ii) Electromagnetic Transient Model: PSCAD model of the entire facility; and (iii) Aggregate Load Flow / Dynamic (RMS) Model: PSLF model from NERC testing would satisfy this requirement.

(c) Modeling of inverter-based generation or Type IV wind turbines as a synchronous generator is not permitted.

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

5.2.6 Contractor shall provide a complete recommended spare parts list for the Project's electrical works, including the Collection System Circuits. Such list shall include recommended quantities, part / model numbers, and nominal pricing.

5.3 COLLECTION CIRCUITS

5.3.1 Contractor shall design, furnish, construct, and install the Collection System Circuits in conformance with the minimum requirements set forth herein and the [preliminary] design documents in Exhibit [●] (*Design Documents*). [NTD: the collection system design will be referenced here and attached to the Agreement; this information is expected to be added at a later date, prior to contract execution.]

(1) The Collection System Circuits shall be installed at the locations shown in the [preliminary] design documents in Exhibit [●] (*Design Documents*).

(2) The Collection System Circuits shall not cross through (under / over) the O&M Building yard.

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

5.3.2 Contractor shall furnish a quantity of [QUANTITY] medium-voltage, pad-mounted transformers, including one (1) per Wind Turbine location plus spares at a ratio of 1:40 (one spare per 40 (or fraction thereof) installed) by Contractor, including at least one (1) spare per Wind Turbine model / type. All spare units shall be specifically marked and packed for storage. [NTD: Update to 'Reserved' for projects with medium-voltage transformers supplied internally to Wind Turbine.]

5.3.3 Contractor shall complete all electrical connections of the Wind Turbines to the Collection System Circuits, as more particularly described in Section 10.5.5 herein.

5.3.4 Notwithstanding the following sentence and as more particularly described in Section 10.5.5 herein, Contractor shall complete all fiber optic terminations, including, but not limited to, those at the Wind Turbines, O&M Building, Project Substation, and permanent meteorological towers.

5.3.5 Contractor shall perform directional boring at all Collection System Circuit crossings with a stream, wetland, public road, railroad, pipeline, or other buried facility; refer to Section 5.1.10

herein for crossing requirements.

5.3.6 Contractor shall install four (4) bollards around every junction box and pad-mount transformer, respectively.

5.4 TESTING AND QUALITY CONTROL

5.4.1 Contractor shall test, commission, start-up, and place into successful operation each Collection System Circuit, including the electrical infrastructure and communications infrastructure. At a minimum, testing shall be in conformance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

(1) All Collection System Circuits shall be tested to demonstrate they meet stated design criteria and are fit for purpose.

(2) All testing specified in the Applicable Standards, including NETA.

(3) All testing reasonably recommended or required by the applicable equipment suppliers.

(4) All exposed cable sections (including Turbine cabling) 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 Wind Turbine location and junction box.

(6) Megger test of all 34.5-kV Wind Turbine cables.

(7) Very low frequency ("**VLF**") test of all 34.5-kV power cabling *prior* to energizing. Testing shall be performed at 0.1 Hertz for at least 60 minutes and in accordance with IEEE 400.2. Testing shall include all terminations and splices.

(8) Insulation resistance testing of all low-voltage cabling, including Wind Turbine down-tower cabling and 600-Volt class meteorological tower cabling.

(9) Final continuity tests (including phase continuity of each phase) after completion of all system connections.

(10) Compaction testing shall be verified at a minimum of every 1,000 feet and at every splice pit location. Compaction testing shall be performed at depths of approximately 12 inches and 24 inches, respectively, below grade.

(11) Communications system testing per Section 8.4 herein.

(12) If any pad-mount transformers, minimum factory testing on all units unless expressly noted otherwise: (a) all tests identified as "Routine" in IEEE C57.12.00 Table 18 and performed in accordance with IEEE C57.12.90.00; (b) resistance measurements of all windings; (c) polarity and phase relation; (d) ratio at rated voltage on all taps; (e) no-load losses and excitation current; (f) load losses and impedance voltage; (g) lightning impulse test on first unit produced; (h) audible sound emissions on first unit produced; (i) dissolved gas analysis on all units *prior* to temperature rise test; (j) temperature rise test on first unit produced; (k) dissolved gas analysis on tested unit *after* temperature rise test; (l) dielectric tests; (m) oil testing on all units *prior* to energization; and (n) oil testing on all units within 30 days of energization.

(13) Other testing set forth in the Project design documents.

5.4.2 Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and

acceptance criteria) shall be submitted to Owner within 10 days of completing such test.

6.0 PROJECT SUBSTATION

6.1 GENERAL PROVISIONS

6.1.1 Requirements for Project Substation: refer to PGE Exhibit M1-05-02 (*Substation Design Specification*). Contractor shall receive explicit approval from Owner or Owner's representative(s) of the design of the Project Substation prior to construction. Owner shall have unlimited access to such designs throughout the design process, and construction of all such facilities shall be completed by one of Owner's approved subcontractors, as more particularly detailed in Exhibit TBD (*Approved Subcontractors*).

6.1.2 Requirements for main power transformer: refer to PGE Exhibit M1-04-03 (*General Transformer Specification*).

6.1.3 Contractor shall comply with Turbine SCADA System technical specifications, including but not limited to ratings (thermal, fault, etc.) of all electrical equipment and the following control building requirements:

(1) Revenue meters and downstream plant to account for gross and net generation, as well as station service and auxiliary loads. sourced from , revenue grade current and voltage transformers, Actual revenue meter locations and instrument transformer specifications shall be determined by PGE metering personnel. SCADA .The control building shall be grounded and include HVAC. Redundant HVAC systems shall be installed.

(2) The control building shall include adequate space and clearance for all Turbine Supplier-furnished Turbine SCADA System equipment as well as Owner IT, Physical Security, and SCADA equipment.

(3) Revenue meter accuracy testing.

7.0 GEN-TIE LINE

7.1 GENERAL PROVISIONS

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

7.1.2 The Gen-Tie 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. Contractor shall utilize Grade B construction.

7.1.3 Contractor shall design and construct the Gen-Tie Line in accordance with the Project Substation Electrical Studies and the Electrical Loss Limit, each as defined herein.

7.1.4 PLS-CADD software shall be utilized to spot and perform detailed analysis and design of the Gen- Tie 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.

7.1.5 The Gen-Tie 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.

7.1.6 If it is determined by the meteorological report that an area is prone to icing, galloping should be considered. The ellipse amplitude safety factor in PLS-CADD shall not be less than 1.0.

7.1.7 Weather cases and loading criteria shall be developed by Contractor based on requirements set forth in the Applicable Standards, including extreme wind and extreme ice. All 230 kV and higher voltage transmission lines to withstand NESC heavy loading conditions, including appropriate wind and ice loading criteria defined in NESC 250C and NESC 250D.

7.1.8 The Gen-Tie Line shall be designed and constructed to meet guidelines set forth by the Avian Power Line Interaction Committee.

7.1.9 Contractor shall receive explicit approval from Owner or Owner's representative(s) of the design of the Interconnection Line prior to construction. Owner shall have unlimited access to such designs throughout the design process, and construction of all such facilities shall be completed by one of Owner's approved subcontractors, as more particularly detailed in Exhibit TBD (*Approved Subcontractors*).

7.1.10 Requirements for Gen-Tie Line civil and structural works:

(1) All civil works for the Gen-Tie Line shall comply with the applicable specifications in Section 4.0 *(*Civil / Structural Works).

(2) All Gen-Tie Line structures, foundations, assemblies, and components shall be designed and constructed in accordance with the applicable structural works specifications in Section 4.1 herein, in addition to the following.

(a) All wood poles shall be directly embedded at least 10% of the structure height plus 2 feet. All light-duty steel poles shall be directly embedded at least 10% of the structure height plus 5 feet as a minimum. Each foundation embedment shall be analyzed for the given load cases and soil parameters. Adjustments

may be made if rock is encountered at a shallower depth, on steep slopes, or when poor soils are encountered.

(b) A preliminary report summarizing existing soil explorations in the area will serve as a basis for 30% foundation design. This report will verify soil assumptions used for setting depths and be used to develop preliminary engineered steel pole foundation design. A final geotechnical report will be received prior to the 60% submittal.

(c) For drilled pier design, resultant horizontal deflection will be kept below 0.25” for switch supporting structures and 0.5” for other structures.

(d) Foundations shall be designed using L-Pile or MFAD software, and soil conditions shall be based on geotech study. Foundations will be designed with anchor cages and rebar (not full length anchor cages). The reinforcement steel shall be Grade 60 conforming to ASTM A-615. The concrete strength shall have a compressive strength of 3500 PSI in accordance with ASTM C150. Foundation serviceability requirements are as follows: (i) Deflection: 1.5” at top of pile head with un- factored loads (OLF = 1.0); (ii) Rotation: 1° Rotation under factored loads (From PLS-CADD/PLS-POLE); (iii) Soil Capacity: Deflection less than 10" with un- factored loads multiplied by an OLF of 2.0

(3) All Gen-Tie Line structures shall be wood, light duty steel, tubular steel, or lattice steel as necessary for the voltage class. Steel structures shall be either galvanized or self- weathering.

(4) All tangent and dead-end structures shall be analyzed using intact loading cases in addition to camber and deflection loading cases. Pole tip deflection shall be limited to 1/20 of pole height under any loading condition for dead-end. Pole shall be pre-cambered if deflection under cambered load case exceeds six (6) inches under camber load case.

7.1.11 Requirements for conductors, shield wire, and optical ground wire (“**OPGW**”):

(1) All conductor cables, shield wire, and OPGW shall be installed by controlled tension methods.

(2) Pre-stressing of any type of wire shall not be permitted without the prior written approval of Owner.

(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. As used here, the “same day” shall be understood to be the same 24-hour period to avoid cables in the same bundle having substantively different creep characteristics.

(4) Prior to sagging, each sag span and control span shall be measured with surveyor’s transits to verify exact span lengths and all conductor cables, shield wire, and OPGW sag spans and control spans shall be measured. This step may be omitted if (a) staked coordinate differences between structures align with the predetermined span lengths and (b) staked locations are provided to the engineer of record and Owner for confirmation.

(5) 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.

(6) 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.

(7) No single conductor cable within a bundle shall be more than one (1) inch from its sag position relative to the other conductor cables.

(8) 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 cable hardware.

(9) Wire tension limits shall be in accordance with the Applicable Standards, including, but not limited to, NESC C2 2017.

(10) The exact location where each reel of conductor was installed shall be recorded.

(11) 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.

(12) OPGW shall be installed the entire length of the overhead route and coordinated with the SCADA System/communication/protection specification.

(13) OPGW shall include a minimum fiber count of 48, single mode.

(14) OPGW design tension limits shall be specified in the Project-specific sections.

(15) Stringing tensions for the OPGW shall not exceed twenty percent (20%) of the ultimate cable strength.

(16) Splice locations shall be selected and provided with weatherproof splice boxes suitable for the selected OPGW.

(17) At each splice location, a 50-foot coil of spare wire shall be maintained.

(18) Spare wire may be coiled on the pole, placed in an underground vault, or coiled in an aerial slack storage device.

(19) The OPGW shall be solidly bonded to the structure with a braided soft drawn copper jumper and steel structures shall incorporate a welded grounding nut for that purpose.

(20) Shield wire shall be minimum 3/8-inch, 7-strand EHS steel wire. OPGW / OHGW shall be sized to meet the required short circuit rating.

(21) Shield wires and OPGW shall be bonded to the pole grounding system using a suitable ground wire.

(22) Conductors shall be limited to those listed in PGE LD23000, 795 ACSS Drake, or 1272 ACSS Pheasant. Conductors shall not exceed the following maximum operating temperatures: (i) AAC: 200°F; (ii) ACSR: 212°F; (iii) ACSS: 355°F; (iv) Copper: 212°F; (v) Neutral: 120°F; (vi) Communications Wires: 120°F

7.1.12 Requirements for crossings:

(1) All Gen-Tie Line conductor cables, shield wire, and OPGW crossings, including roads, utilities, and railroads, shall comply with NESC minimum requirements plus any additional clearance that may be required for signage, fencing, guards, or other similar items.

(2) Contractor shall coordinate with local utilities and pipeline companies as set forth in Section 2.11.3 herein.

7.1.13 Requirements for insulators and hardware:

(1) All surfaces of metal parts shall be relatively smooth with no projecting points or irregularities, which may cause corona.

(2) Nuts shall be hexagonal and of corona-free design.

(3) All ferrous material except stainless steel shall be hot dip galvanized to conform to ASTM A153.

(4) Cotter keys shall be austenitic stainless steel and each piece shall be marked for identification with the manufacturer's part or catalog number.

(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.

(6) Insulator length, strength, and required number shall be determined based on loading requirements, switching surge and lightning requirements, and by contamination levels.

(7) The standard porcelain / glass insulator unit to be used is a 5.75-inch by 10-inch bell with a ball and socket coupling.

(8) Insulators shall be wet-process porcelain.

(9) Materials shall be packaged in weather-resistant cartons or crates suitable for outdoor storage.

(10) The insulators shall be protected with suitable material to prevent damage to the sheds, bell, connections, and/or end fittings during shipping.

(11) Line guards and armor rods shall be installed in conjunction with suspension clamp assemblies.

(12) The center of the armor rods shall be within one (1) inch of the suspension clamp.

(13) The termination of the armor rods shall be within one-half (0.5) inch of each other.

(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.

(15) Transmission suspension insulators shall use built in corona rings on polymer insulators on 230 kV and higher voltages.

(16) A vertical construction load (weight of workers and equipment) of 650 pounds shall be applied at conductor wire attachment and an unbalanced longitudinal stringing load shall be applied at each attachment under the Camber / Rake weather case.

7.1.14 Requirements for grounding:

(1) All overhead poles shall be grounded locally at each pole. The ground should consist of a copper ground wire connected to a 0.5-inch, coated, carbon steel ground rod.

(2) Maximum resistance shall be no greater than 10 ohms. If ground resistance is greater than 10 ohms, special grounding designs shall be prepared. A ground resistance test shall be done at every structure.

7.1.15 Requirements for lightning protection:

(1) The Gen-Tie Line shall be protected against lightning by the use of shield wire(s). The shield wires shall be located so as to intercept lightning strikes and prevent direct strikes to the conductors. 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.

(2) 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.

(3) The method of grounding and the required ground resistance to minimize the outage rate shall be calculated.

7.1.16 Requirements for marking and lighting:

(1) All Gen-Tie Line structures shall be marked in accordance with the Requirements.

(2) The Gen-Tie Line lighting system shall comply with the requirements as defined in US DOT-FAA Advisory Circular No. AC 70/7460-1M: *Obstruction Marking and Lighting*.

7.2 SUBMITTALS

7.2.1 Contractor shall prepare the Gen-Tie Line design documents per the Submittal Schedule and containing the following information, at a minimum: (a) design basis; (b) plan and profile drawings, including electrical phasing matching the phasing at the Project Substation terminations with minimal rolls and phase swapping; (c) structure details and drawings, including elevations, spacing, and hardware; (d) civil works drawings, including subgrade preparation, grading, drainage, and erosion control; (e) foundation design and embedment drawings; (f) anchoring and guying details; (g) structural calculations; (h) PLS-CADD design files, including .BAK and .KMZ files; (i) grounding details; (j) drawing index; (k) bill of materials; and (l) inspection testing, and quality control requirements.

7.2.2 Contractor shall prepare equipment specifications to define the requirements and properties for the procurement of all permanently installed Gen-Tie Line equipment and materials. The specifications shall be submitted to Owner for review *prior* to the procurement of the applicable equipment. The following specifications shall be provided, each as applicable to the design: (a) construction specification; (b) structures; (c) conductor; and (d) OPGW.

7.2.3 Contractor shall submit manufacturer's approval drawings or product sheets (material cut sheets) for all permanently installed Gen-Tie Line equipment and materials, including all items identified in Section 7.2.2 above.

7.2.4 Contractor shall prepare energization plans and procedures for the Gen-Tie Line. Energization plans shall be submitted to Owner for approval *prior* to use. Energization plans shall include both electrical and communications infrastructure as well as backfeed plans,

soaking plans, testing plans, and lock out tag out procedures, at a minimum.

7.2.5 Contractor shall provide a complete recommended spare parts list for the Project's electrical works, including the Gen-Tie Line. Such list shall include recommended quantities, part / model numbers, and nominal pricing.

7.2.6 Contractor shall provide a Field Effect Study for the Gen-Tie Line. Calculations shall be made for measurement heights of one (1) meter above ground surface in areas accessible to the public, within the ROW. Electric Field Strength shall be calculated for the line voltage as well as any under build. Magnetic Field Strength shall be calculated at full rated ampacity, with balanced phase currents.

7.3 TRANSMISSION LINE

7.3.1 Contractor shall design, furnish, construct, and install the [/###]-kV Gen-Tie Line in conformance with the minimum requirements set forth herein and the [preliminary] design documents in Exhibit [●] (*Design Documents*). [NTD: the transmission line design will be referenced here and attached to the Agreement; this information is expected to be added at a later date, prior to contract execution.]

(1) The Gen-Tie Line shall be installed at the location shown in the [preliminary] design documents in Exhibit [●] (*Design Documents*).

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

(3) The Gen-Tie Line shall not cross through (under / over) the O&M Building yard. Placement of structures within the yard is prohibited.

7.4 TESTING AND QUALITY CONTROL

7.4.1 Contractor shall test, commission, start-up, and place into successful operation the Gen-Tie Line, including the electrical infrastructure and communications infrastructure. At a minimum, testing shall be in conformance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

(1) All Gen-Tie Line equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

(2) All testing specified in the Applicable Standards, including NETA.

(3) All testing reasonably recommended or required by the applicable equipment suppliers.

(4) 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.

(5) After installation and completion of all required splicing and terminations, all OPGW shall be verified 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 each fiber in both directions at 1310 nm and 1550 nm. A successful test result shall be (a) less than 0.35 dB per connection and (b) ~~(i) less than -50 dB if UPC and (ii) less than -65 dB if APC~~. Contractor shall compare results with reel tests performed by the manufacturer.

(6) Following OTDR testing, an optical attenuation test shall be performed on all fibers.

This test shall be performed at 1300 and 1550 nanometers, using a calibrated light source and optical power meter

(7) Resistance testing on grounding grid at each structure location following structure erection but prior to bonding the shield wire or optical ground to the structure.

(8) All Gen-Tie Line foundations shall be tested for concrete and grout properties (strength, slump, air content, temperature).

(9) Compaction.

(10) Other testing set forth in the Project design documents.

7.4.2 Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Owner within 10 days of completing such test.

8.0 COMMUNICATIONS SYSTEM

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 designed 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 Turbine Supplier's requirements.

8.1.5 All Contractor-furnished communications facilities shall comply with PGE Exhibit M1-05-04 (*Communication, SCADA, and Metering Facilities*) and PGE Exhibit M1-01-07 (*Security and Compliance*), respectively.

8.1.6 Requirements for system functionality:

(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 (via Turbine SCADA System), and other critical sensors.

(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.

(3) The Communications System shall include the necessary equipment (hardware and software) for the exchange of signals with and integration of (a) Project Substation equipment to support grid monitoring; (b) any required reactive compensation devices (e.g., capacitor banks, reactors); (c) the permanent meteorological towers to support data monitoring; and (d) Wind Turbine and meteorological tower FAA lights.

(4) 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.

8.1.7 Requirements for fiber network:

(1) See Section 5.1.12 for fiber optic cabling requirements.

8.1.8 Requirements for monitoring and control:

(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.

(2) The Communications System shall be provided with the following supervisory screens, at a minimum.

(a) 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).

(b) Project Substation alarms and notifications: (1) status of all relays and (2) status of all alarms and notifications.

(c) Main power transformer status, including the following for each main power transformer: (1) operation and fault status, including alarms; (2) relay statuses; (3) temperatures (winding, oil); and (4) tap changer position.

(d) Breaker status, including the following for each medium- and high-voltage breaker: (1) operation and fault status, including alarms; (2) relay statuses; and (3) breaker readings (current, power, voltage), including per Collection System Circuit.

(e) Control building status, including the following: (1) operation and fault status, including alarms; (2) enclosure alarms (fire/smoke alarm status, enclosure temperature, intrusion, etc.); (3) battery charger voltage and status; (4) intrusion detection; and (5) HVAC status.

(f) Wind Turbine status (via Turbine SCADA System), including the following: (1) Wind Turbine status (e.g., online, offline for maintenance, curtailed) for each unit; (2) Wind Turbine generation level for each unit; (3) total Project power; and (4) atmospheric conditions.

(3) 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).

(4) The Communications System shall include control functionality for the following, at a minimum (via Turbine SCADA System): (a) active power; (b) reactive power; (c) frequency; (d) voltage; (e) power factor; and (f) noise-related operations.

(5) 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.

8.1.9 Requirements for reporting and storage:

(1) All reporting shall be in Generation Availability Data System ("**GADS**"), wind format.

(2) SCADA system reporting shall include, at a minimum, the following for the Project Substation, permanent meteorological towers, and Wind Turbines: (a) performance parameters, availability, operation counters, faults, and alarms; (b) browsing and

filtering of historical data; and (c) creation of pre-defined and custom reports.

(3) 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. It shall be possible to store at least one (1) year of data from the Project without archiving it from the system. It shall be possible to remotely download raw SCADA data (in native resolution, up to 1 Hz) by means of an online database facility for further analysis. All raw data shall be available to Owner via an on-site data link.

(4) 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 by Owner.

(5) All stored data and generated reports shall be exportable as ASCII and Microsoft Excel formats.

(6) The system shall not permit unwarranted tampering with or changing of raw data or functionality.

8.1.10 Requirements for data integration:

(1) Refer to PGE Exhibit M1-05-04 (*Communication, SCADA, and Metering Facilities*).

8.2 SUBMITTALS

8.2.1 Contractor shall prepare configuration files and a comprehensive data points list and protocol specification for communications, as more particularly described in Section 8.1.6 herein. The points list shall include all required points for the Turbine Supplier, interconnection utility, and offtaker(s) as required.

8.2.2 Refer to Section 5.2.1 and Section 6.2.1 for additional Communications System submittals.

8.2.3 Contractor shall submit manufacturer's approval drawings or product sheets (material cut sheets) for all permanently-installed equipment and materials.

8.3 COMMUNICATIONS SYSTEM

8.3.1 Contractor shall design, furnish, construct, and install the Communications System in conformance with the minimum requirements set forth herein and the [preliminary] design documents in Exhibit [●] (*Design Documents*). [NTD: the comms design will be referenced here and attached to the Agreement; this information is expected to be added at a later date, prior to contract execution.]

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

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

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

(4) Contractor shall furnish and install / ~~terminate~~ all fiber optic cabling between the Wind Turbines (subject to the responsibility for fiber terminations in the base of each Wind Turbine as described in Section 5.3.4 herein), Project Substation, permanent

meteorological towers, and O&M Building, including patch cables between fiber patch panels and devices.

(5) Contractor shall develop and furnish HMI supervisory screens for the Project Substation RTAC as described in Section 8.1 herein.

(6) Contractor shall furnish and configure the RTAC, including incorporation of the Turbine SCADA System (i.e., Vestas VOB, WindSCADA) and dissemination of points to the interconnection utility and offtaker, as requested.

8.3.2 Contractor shall furnish and install the Turbine SCADA System, including all power and fiber optic terminations.

8.4 TESTING AND QUALITY CONTROL

8.4.1 Contractor shall test, commission, start-up, and place into successful operation the Communications System, including the electrical infrastructure and communications infrastructure. At a minimum, testing shall be in conformance with the following minimum requirements. All testing shall be performed by an independent, experienced third party.

(1) All Communications System equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

(2) All testing specified in the Applicable Standards, including NETA.

(3) All testing reasonably recommended or required by the applicable equipment suppliers.

(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) Verify all alarms, indications and analog quantities are communicated and received properly by the RTU and displayed correctly on the HMI.

(6) Verify all communication channels (intra- and inter-Project Substation), including Project Substation LAN, operate as expected.

(7) Verify fiber optic system performance (power losses, splice or connector losses, etc.) using 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. A successful test result shall be (a) less than 0.35 dB per connection and (b) (i) less than -50 dB if UPC and (ii) less than -65 dB if APC.

(8) All fiber optic cable shall be visually inspected and OTDR-tested prior to installation / termination.

(9) Provide system functionality and compatibility at the control room / O&M Building.

(10) Test each cable and strand on every fiber run from termination to termination.

(11) 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.

(12) Test and demonstrate integration with Owner's data collection system.

(13) Validate that security applications are configured per PGE Exhibit M1-01-07 (*Security and Compliance*).

(14) Other testing set forth in the Project design documents.

8.4.2 Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Owner within 10 days of completing such test.

9.0 INTERCONNECTION SWITCHYARD

Contractor shall cause the interconnection switchyard and all other network upgrades set forth in the Interconnection Agreement to be completed. All such work is expected to be performed in accordance with the applicable Utility Specifications and other requirements set forth in the Interconnection Agreement.

10.0 WIND TURBINE SUPPLY, INSTALLATION, AND COMMISSIONING SERVICES

10.1 GENERAL PROVISIONS

10.1.1 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.

10.1.2 All exterior surfaces of the Wind Turbine shall be white or light gray in color. RAL 9010 (pure white) is an acceptable color. A non-glare finish shall be used.

10.1.3 The Wind Turbine (including the tower and nacelle) shall have no external markings unless explicitly listed herein.

10.1.4 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).

10.1.5 Contractor 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.

10.1.6 Requirements for Turbine Supplier:

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

(2) Turbine Supplier shall validate the equipment incorporated into the Work is new, unused, of good quality, consistent for use in wind generation facilities, and complies with the Requirements. The design working life of the equipment incorporated into the Work shall be a minimum of 20 years.

(3) Turbine Supplier shall represent that 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.

10.1.7 Requirements for Wind Turbine installation:

(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 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.

(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.

(3) Wind Turbines shall be erected such that the tower door orientation is downwind of the prevailing wind direction.

(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.

(5) Transportation, offloading, storage, and erection of Wind Turbines shall be performed in accordance with the applicable instructions provided by Turbine Supplier and the specifications provided herein, including critical lift plans.

(6) 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 Turbine Supplier.

(7) All rigging utilized for the transportation, offloading, or erection of Wind Turbines shall be rated; inspected daily; and load tested in accordance with Applicable Standards or other more rigorous requirements set forth in the HSSE Plan. Inspection reports shall be maintained at the Project Site and available for review by Owner.

(8) Copies of testing certificates and calibration records for all tooling shall be maintained at the Project Site and available for review by Owner.

10.1.8 Requirements for Wind Turbine components:

(1) The rotor shall be of three-bladed cantilevered construction, mounted upwind of the tower, and shall have a horizontal-axis orientation.

(2) Rotor blades shall be supplied with leading edge protection. Each leading edge will be treated with erosion protection prior to rotor assembly, preferably at blade factory, or prior to affixing to main bearing assembly.

(3) Blade, generator, and main bearings shall be fitted with automatic lubrication and grease catchers to prevent egress of excess grease.

(4) A climb assist or service lift system shall be included. The climb assist shall be compatible with the standard tower ladder, provide a reduced carrying weight of at least 75 pounds, and meet all OSHA standard requirements for safety and construction.

(5) Critical Wind Turbine components, including the main bearing, gearbox, generator, tower, and blades, shall be monitored by a condition monitoring system for the purpose of targeting predictive maintenance and proactively monitoring failures.

(6) Each 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. The switchgear shall consist of a main circuit breaker, along with associated equipment. To the extent possible and applicable, wind plant relaying shall follow the same standards and requirements as the Project Substation relaying.

(7) Each Wind Turbine shall be furnished with lightning protection designed in compliance with, at a minimum, the requirements of IEC 61400-24 and IEC 62305.

(8) 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.

(9) The Wind Turbine shall be compliant with all current power quality and grid interconnection standards, including, at a minimum, FERC 661a, FERC 827, and IEEE 519.

(10) 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, or more stringent if required by the Interconnect Agreement.

(11) Total harmonic distortion shall be no greater than five percent (5%).

(12) Each Wind Turbine shall be equipped with an Owner-approved cold-weather package.

(13) Contractor shall design features, such as door alarm in SCADA, to prevent theft and vandalism.

10.2 SUBMITTALS

10.2.1 Contractor shall cause Turbine Supplier to prepare and submit all deliverables and submittals necessary for the successful completion of the Work, including, but not limited to, all manuals, drawings, plans, studies, calculations, checklists, completion procedures, and other similar items (collectively, the "Turbine Supplier Deliverables"). All such materials shall be subject to review and/or approval by Owner, as applicable; shall be coordinated and discussed with all pertinent parties prior to and during the construction phase of the Project; shall be submitted by the applicable dates in the Submittal Schedule; and shall comply with the minimum requirements set forth in PGE Exhibit M1-01-02 (*Engineering, Documents, Drawings, and Other Deliverables*). The following list provides an indicative sample of Owner requirements for specific Turbine Supplier Deliverables for the sole purpose of ensuring clarity of expectations for the referenced submittals; *this list is not intended to be an exhaustive listing of all Turbine Supplier Deliverables or the requirements thereof*.

(1) Turbine Supplier shall prepare a manufacturing and testing schedule for each Wind Turbine (the "**Manufacturing Schedule**"). The Manufacturing Schedule shall be provided to Owner at least 60 days prior to the start of manufacturing of the first Wind Turbine major component and shall be updated on a weekly basis thereafter. The Manufacturing Schedule shall include the anticipated production / manufacturing dates locations for each major component.

(2) Turbine Supplier shall provide a Wind Turbine installation manual, including in hard copy format and electronic format.

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

(4) Turbine Supplier shall provide information for the design of the Wind Turbine Foundations, including, but not limited to, loading information, Markov matrices, and tower alignment information.

(5) Turbine Supplier shall prepare an assessment of suitability of the Wind Turbines at the Project Site. This assessment shall include a representation from Turbine Supplier confirming the suitability of the Wind Turbine for the Project Site and its ability to withstand the Project Site conditions for a period of at least 20 years. Turbine Supplier's requirements for wake sector management (if any) shall be included in the suitability assessment. For cold-weather packages, the site-specific loads analysis and energy production estimate must state that it explicitly considers the planned operating temperature range. Any additional features of Wind Turbines shall be including in energy production estimates, including leading edge protection.

(6) Turbine Supplier shall provide a current certification of compliance with IEC WT 01 / IEC 61400-1 / IECRE OD-501, either in the form of a Type Certificate or an A-Design statement of compliance, for the Wind Turbine. The Certificate shall be from an approved certifying entity, including Det Norske Veritas, TÜV NORD Group, or an Owner-approved equal.

(7) Turbine Supplier shall provide the quality- and factory-testing-related documentation as set forth in Exhibit [●] (*Wind Turbine Testing Requirements*).

(8) A Wind Turbine model in PSS/E format shall be furnished and the model parameters shall be validated for both Wind Turbine and generator and automatic voltage regulator and frequency control.

(9) Turbine Supplier shall furnish a complete bill of materials for all Wind Turbine Equipment, including equipment name, serial numbers, and model numbers.

(10) Turbine Supplier shall furnish a complete Spare Parts List. Such a list shall include recommended quantities, part / model numbers, and nominal pricing.

10.3 WIND TURBINE SUPPLY

10.3.1 Contractor shall furnish [QUANTITY] complete, fully-functional [MODEL] wind turbine generators.

(1) Each Wind Turbine shall conform to the specifications set forth herein, including Section 10.1 above.

(2) Each Wind Turbine shall include all of the parts, components, equipment, materials, apparatus, structures, tools, supplies, consumables, goods, and other items required or appropriate for a complete, fully-functional Wind Turbine, including, but not limited to, a rotor blade set; hub; pitch system; main shaft arrangement, including main bearing; gearbox; mechanical brake; high-speed shaft coupling; generator; internal crane; power converter; medium-voltage transformer (if applicable); internal tower wiring and cabling; controller; auxiliary system; wind vane; anemometer; yaw system; cooling system; hydraulic system; tower section, including internal access ladder, platforms, and lights; switchgear; ground controller; uninterruptible power supply; condition monitoring system; and heavy duty door with lock, key, and concealed hinges (all Wind Turbine exterior entry points shall have electronic lock sets (e-locks) by Assa-Abloy).

(3) Each Wind Turbine shall include one (1) climb assist or service lift.

(4) Each Wind Turbine shall include a minimum two-year defect warranty consistent with the terms set forth in the Turbine Supply Agreement.

(5) Each Wind Turbine shall be furnished with the power curve, sound level, defects, and serial defects warranties consistent with the terms set forth in the Turbine Supply Agreement. Contractor shall cause the power curve test and sound level test, respectively, to be performed and successfully passed.

(6) The Wind Turbine Equipment shall be factory tested in accordance with the minimum requirements set forth in Exhibit [●] (*Wind Turbine Testing Requirements*) and Owner shall have the right to witness such testing as set forth therein.

(7) Contractor shall furnish and install one (1) fire extinguisher (sized per the Applicable Standards and other Requirements); one (1) fire extinguisher bracket and fire extinguisher in the base of each Wind Turbine tower; and (1) fire extinguisher bracket and fire extinguisher in each Wind Turbine nacelle, respectively.

10.3.2 Contractor shall furnish the Turbine SCADA System and conforming to the specifications set forth herein and as provided by the Turbine Supplier, collectively, including PGE Exhibit M1-05-04 (*Communication, SCADA, and Metering Facilities*).

10.3.3 Contractor shall furnish all required obstruction light brackets and obstruction lights, including wiring.

10.3.4 Contractor shall furnish medium-voltage transformers as set forth in Section 5.3.2.

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

(1) All rigging shall be rated; inspected daily; and load tested in accordance with the Applicable Standards or other more rigorous requirements set forth in the HSSE 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.

(2) Copies of testing certificates and calibration records for all tooling shall be maintained at the Project Site and available for review by Owner or Owner's representatives.

10.3.6 Contractor shall furnish all consumables, consumable parts, and installation spare parts necessary or appropriate to perform the Work.

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

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

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

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

10.3.8 Contractor shall provide an arc flash hazard analysis of the Wind Turbine Equipment and ANSI- approved warning labels warning of the dangers of arc flash to be affixed to any Wind

Turbine Equipment that may require service or maintenance while energized.

10.3.9 Contractor shall furnish all spare parts necessary for Wind Turbine installation and commissioning, including the Spare Parts Inventory.

10.4 WIND TURBINE DELIVERIES

10.4.1 Contractor shall transport all Wind Turbine Equipment to the Project Site on or before the applicable milestone dates in the Agreement.

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

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

10.4.4 Contractor shall coordinate with Turbine Supplier on a test run for Wind Turbine deliveries at the Project Site by use of non-loaded trucks to demonstrate that road dimensions will be appropriate for successfully delivering components to the Wind Turbine Pads. Such trial run will be performed by Turbine Supplier prior to commencing deliveries of Wind Turbine Equipment to the Project Site. Any non-compliant areas shall be immediately corrected by Contractor.

10.4.5 Contractor shall furnish and operate assist vehicles as necessary for delivery and movement of Wind Turbine Equipment, including at and within the Project Site.

10.4.6 Contractor shall receive, visually inspect, and inventory all deliveries of Wind Turbine Equipment (including Wind Turbines, transformers, down-tower converters, switchgear, climb assists / service lifts, Turbine SCADA System, Special Tools, and shipping containers) to the Project Site. Contractor shall submit reports to Owner within 24 hours of delivery regarding receipt, inspection, and inventorying of all such deliveries, including any damage identified.

(1) For any previously-manufactured equipment (e.g., safe harbor components), Owner shall have the right (but not the obligation) to inspect such equipment prior to shipment from storage or delivery to the Project Site.

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

(1) Wind Turbine SCADA System, service lifts (if any), the Spare Parts Inventory, parts shipped loose, and other equipment shall be delivered to the Project Site laydown yard or other location(s) at the Project Site as specified by Owner.

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

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

10.5 WIND TURBINE INSTALLATION

10.5.1 Contractor, Owner, and Turbine Supplier shall meet (a) on a weekly basis before Wind Turbine deliveries begin and (b) daily after Wind Turbine deliveries begin; the purpose of

such meetings shall be to coordinate schedule for delivery and commissioning of the Wind Turbines. On a weekly basis, a meeting shall be held to reconcile all demurrage and delays for all parties regarding deliveries and offloading of components. Contractor shall meet with Owner and Turbine Supplier prior to installation of the first Wind Turbine to participate in an in-person page turn of the Wind Turbine installation manual.

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

10.5.3 Contractor shall clean and wash all external Wind Turbine surfaces prior to erection to remove dirt generated by delivery and on-site storage. 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. All washing, including runoff, shall be in accordance with the Applicable Permits and other Requirements.

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

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

(2) Contractor shall fabricate and furnish all anchor bolt template rings as required to support Wind Turbine installation.

(3) Contractor shall design, furnish, construct, and install concrete pads for the stair support columns and concrete stair landing (approximately 3-feet by 3-feet) for each Wind Turbine.

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

(5) Contractor shall provide all crane breakdowns, both partial and full, necessary to complete the Work.

(6) Not used.

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

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

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

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

(4) Contractor shall furnish and install (a) all temporary Turbine obstruction lights, including wiring and mounting brackets and (b) all permanent Turbine obstruction

lights, including wiring and mounting brackets. Obstruction lights shall be (i) FAA Type L-810 (red, steady burning), L-864 (red, flashing), or L-865 (white, flashing, medium intensity) as determined in Owner's *Determination of No Hazard to Air Navigation* letter from the FAA; (ii) in compliance with the Requirements, including US DOT-FAA Advisory Circular No. AC 70/7460-1M: *Obstruction Marking and Lighting*; (iii) provided with an uninterruptible power supply capable of supplying back-up power for at least one (1) hour; (iv) programmed to blink in unison, including with those aviation obstruction lights that are installed on meteorological towers; and (v) night vision goggle compliant. Contractor shall remove all temporary FAA lights when no longer needed.

10.5.6 Contractor shall provide any required Wind Turbine maintenance, including any necessary generators and fuel, prior to successfully achieving Wind Turbine Mechanical Completion.

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

10.5.8 Contractor shall provide a final broom cleaning of each Wind Turbine prior to handoff following Wind Turbine Mechanical Completion. Further, each Wind Turbine should be reasonably clean and free from grease, oil, and other grime prior to Wind Turbine Mechanical Completion.

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

10.5.10 Contractor shall provide qualified personnel to perform lock-out / tag-out, switching, and other similar activities during the commissioning of the Wind Turbines by Turbine Supplier up until Contractor's Substantial Completion.

10.5.11 Turbine Supplier shall provide technical advisors at the Project Site for consultation during the offloading, assembly, erection, installation, and mechanical completion, and commissioning of the Wind Turbine. The technical advisors shall provide advice, consultation (including answering questions), and clarification to regarding the Turbine Supplier manuals, specifications, and other Wind Turbine-related technical documents.

10.6 WIND TURBINE COMMISSIONING

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

10.6.2 Contractor shall start-up, test, commission, and successfully achieve commissioning completion and substantial completion of all Wind Turbines and other Wind Turbine

Equipment, including the Turbine SCADA System and service lifts (if any), and including achievement of SCADA completion and all reliability tests being successfully run, including all testing set forth in Section 10.8 herein.

10.6.3 Following commissioning of the first Wind Turbine and until final closing, except during the performance of a Run Test, each Wind Turbine shall be maintained in normal operational mode.

10.7 COORDINATION

10.7.1 Contractor shall actively coordinate the sequence of Work with Turbine Supplier and other stakeholders to support the Project Schedule.

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

10.7.3 Contractor shall attend and actively participate in all Wind Turbine Mechanical Completion walk-downs with Turbine Supplier.

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

10.7.5 Contractor shall coordinate with Turbine Supplier on any termination of power or fiber optic cabling in Wind Turbines following Mechanical Completion.

10.7.6 Contractor shall coordinate with meteorological tower subcontractor regarding Turbine Supplier requirements for power curve testing and any recommendations for Project operation.

10.8 TESTING AND QUALITY CONTROL

10.8.1 Contractor shall test the Wind Turbine tower electrical wiring and cabling. At a minimum, testing shall include the minimum requirements set forth below. All testing shall be performed by an independent, experienced third party.

(1) All Wind Turbine electrical wiring shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

(2) All testing specified in the Applicable Standards, including NETA.

(3) All testing reasonably recommended or required by the applicable equipment suppliers.

(4) Structural works testing for grout properties, in accordance with Section 4.1.11 herein.

(5) Visual inspection, insulation resistance testing, and continuity testing of the Turbine cabling as described in Section 5.4.1 herein.

(6) Other testing set forth in the Project design documents.

10.8.2 Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and

acceptance criteria) shall be submitted to Owner within 10 days of completing such test. Contractor shall notify Owner of all onsite testing schedules as least 5 days in advance of testing activities and copies of onsite testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Owner within 5 days of Contractor receiving report from subcontractor not to exceed 30 days of completing such test. Contractor shall immediately notify Owner upon becoming aware of any deviations between specified properties and tested properties.

10.8.3 Contractor shall cause the following (each a "**Run Test**") to be performed and successfully passed for each Wind Turbine. Each Run Test shall include (i) 168 continuous hours error free operation with operational data recorded by the SCADA; (ii) a minimum Wind Turbine availability of 92% with no Wind Turbine Faults, as measured in accordance with the availability guaranty; and (iii) at least 10 MWh of energy production from such Wind Turbine during the test. For the avoidance of doubt, the Run Test shall be conducted and successfully passed for each Wind Turbine prior to commencing the final Performance Test (defined below).

10.8.4 Contractor shall cause a 72-hour Project-side performance test (the "**Performance Test**") to be performed and successfully passed to demonstrate to Owner that the Work operates satisfactorily and safely, complies with the requirements of the Agreement, and is suitable for operational handover and for the purpose of achieving Project substantial completion. A successful Performance Test shall be defined as achieving the same criteria as the individual Wind Turbine Run Tests defined in Section 10.8.3 above.

(1) If any 72-hour Performance Test is interrupted due to a fault of Contractor-supplied equipment, the test shall be restarted. If any significant defect occurs during the course of any Performance Test, it shall be remedied immediately by Contractor and the Performance Test shall be restarted.

(2) Contractor shall be responsible for liaising with third parties, including the network service provider, to ensure the efficient and timely acceptance testing of the Work.

(3) All performance data, faults, errors, trips etc. that occur during the Performance Tests(s) shall be recorded by the SCADA until such time that the test has been successfully completed. Contractor shall provide Owner with the appropriate documentation for the test period in order to verify the tests have taken place and were successfully completed.

(4) Contractor shall provide to Owner a written report stating, at a minimum, (a) start date, (b) start time, (c) start Project kW reading, (d) stop date, (e) stop time, (f) turbine faults, (g) end Project kW reading, (h) Project Availability, and (i) total Project kW reading for the duration of the Performance Test or Partial Performance Test, as the case may be (the "Performance Test Completion Report". The Performance Test Completion Report shall attach relevant data in a report from the SCADA system as proof of successful completion of the Performance Test.

(5) The achievement of Performance Test Completion or Partial Performance Test Completion, as the case may be, shall be certified by the Independent Engineer in the Independent Engineer's Completion Certificate.

11.0 METEOROLOGICAL TOWERS

11.1 GENERAL PROVISIONS

11.1.1 References to “meteorological towers” herein shall be understood to include both permanent and temporary meteorological towers, unless explicitly stated otherwise.

11.1.2 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.

11.1.3 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.

11.1.4 Meteorological tower designs, including foundation design, shall be approved by Owner prior to procurement of such equipment or materials.

11.1.5 All meteorological towers shall incorporate a safety climb cable that is capable of supporting support two persons at any one time. Each mast shall include a suitable wire or rail free fall-arrest system in accordance with ANSI A14.3 Safety Requirements for Fixed Ladders and identical to the fall-arrest system used in the Wind Turbines.

11.1.6 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.

11.1.7 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.

11.1.8 Instrumentation booms shall be oriented to minimize tower shading (e.g., perpendicular to prevailing wind direction).

11.1.9 Contractor shall include power performance testing of the Wind Turbines for compliance with the Turbine Supplier’s guaranteed power curve and the following requirements:

(1) An independently performed power curve measurement test of each Wind Turbine model shall be performed in accordance with the IEC 61400-12-1 Ed. 1.0 (Wind Turbines - Part 12-1: Power performance measurements of electricity producing wind turbines) on the number of Wind Turbines required by the Turbine Supplier per terms of the power performance guarantee, with such number being at least two (2) Wind Turbines or 5% of the Project’s Wind Turbines, whichever is greater. The report on such shall be provided within Contractor’s Specifications.

(2) As part of the power performance test, a site evaluation shall be performed in accordance with the IEC 61400-12-1 Ed. 1.0 to determine whether a site calibration is required.

(3) Any modifications or deviations on the Wind Turbine Supplier’s warranty document from IEC 61400-12-1 Ed. 3.0 must be reviewed and approved by Owner, including its independent engineer.

(4) Upon completion of the Power Curve Test, an independent engineer shall issue a report stating the result to the Owner. Contractor shall provide a digital test report compliant with IEC 61400-12-1 Ed. 3.0 and any turbine agreement requirements.

(5) The Power Curve Test shall be completed within 90 days of commissioning of the final Wind Turbine. A Power Curve Test shall be deemed to be successful if measured energy production during the test exceeds 100% of the warranted energy production, minus uncertainties. [NTD: Update as needed to align with Turbine Supplier requirements.]

(6) Contractor will maintain comprehensive records of the testing work and provide Owner with a copy of these records at the completion of the work.

11.1.10 Requirements for meteorological tower civil and structural works:

(1) All civil works for the meteorological towers shall comply with the applicable specifications in Section 4.0 *(*Civil / Structural Works).

(2) All meteorological tower structures, foundations, assemblies, and components shall be designed and constructed in accordance with the applicable structural works specifications in Section 4.1 herein.

11.1.11 Requirements for meteorological tower marking and lighting:

(1) Meteorological towers shall be painted.

(2) Meteorological towers shall be marked in accordance with the Requirements.

(3) 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. Obstruction lights shall be (a) FAA Type L-810 (red, steady burning), L-864 (red, flashing), or L-865 (white, flashing, medium intensity) as determined in Owner's *Determination of No Hazard to Air Navigation* letter from the FAA; (b) in compliance with the Requirements, including US DOT-FAA Advisory Circular No. AC 70/7460-1M: *Obstruction Marking and Lighting*; (c) provided with an uninterruptible power supply capable of supplying back-up power for at least one (1) hour; and (d) programmed to blink in unison, including with those aviation obstruction lights that are installed on the Turbines. Contractor shall remove all temporary FAA lights when no longer needed.

11.1.12 Requirements for communications:

(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. All such data shall be available to and accessible by Owner.

(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.

11.1.13 Requirements for power:

(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. If a pad-mount transformer feeds a meteorological tower, one additional meteorological tower power and one additional communication conduit or duct getaway shall be provided. The length of this duct shall be sufficient to exit the transformer vault footprint.

(2) Meteorological towers shall have local UPS or equivalent supply, capable of lasting a minimum of eight (8) hours.

11.2 SUBMITTALS

11.2.1 Contractor shall prepare the meteorological tower design documents per the Submittal Schedule and containing the following information, at a minimum: (a) design basis; (b) foundation plans and details, including all structural calculations, pier details, and footing details; (c) tower details, including boom elevations, boom directions, equipment mounting, guying details, and hardware details; (d) instrument details, including all equipment listed herein; (e) wiring schematics; (f) H- frame diagrams; (g) grounding details; (h) power supply details; (i) fiber termination diagrams; (j) drawing index; (k) bill of materials; and (l) inspection, testing, and quality control requirements.

11.2.2 Contractor shall submit manufacturer's approval drawings or product sheets (material cut sheets) for all permanently-installed equipment and materials.

11.3 POWER CURVE TEST SITE CALIBRATION REQUIREMENTS

11.3.1 Installation of the temporary 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 Turbine Foundation construction. At least three (3) months of data collection shall be assumed to be required from the time that each temporary meteorological tower is installed until the time it is removed.

11.3.2 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 11.3.1 herein). [NTD: Potential to update this to two temporary towers depending on total number of permanent towers at the Project.]

11.3.3 Upon completion of data collection for the power performance test site calibration (see Section 11.3.1 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 Turbine Foundations) *after* the temporary meteorological tower at the respective Wind Turbine location has been removed.

11.4 EXISTING METEOROLOGICAL TOWERS

11.4.1 Contractor shall decommission any existing temporary meteorological towers not utilized for the power curve test site calibration at the Project Site prior to Project construction. All equipment from these existing towers shall be stored at an Owner-designated location at the

Project Site.

11.5 PERMANENT METEOROLOGICAL TOWERS

11.5.1 Contractor shall design, furnish, construct, and install the permanent meteorological towers.

(1) The number and location of permanent meteorological towers shall be such that at all times there shall be at least one (1) mast within free-stream, non-wake-affected wind, effectively covering wind speed and direction measurement at hub height for all wind directions (360°). The permanent meteorological towers shall be at least two (2) rotor diameters from the nearest Wind Turbine.

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

(3) Permanent meteorological towers shall be installed at locations to be approved by Owner.

(4) Permanent meteorological towers shall be the same height as the Wind Turbines' hub height, self-supported (non-guyed), galvanized lattice structures, each designed and certified for maximum wind and ice loading for the Project Site conditions.

11.5.2 Contractor shall furnish and install fencing and gates at each permanent meteorological tower.

(1) Fencing shall be placed to allow a minimum of 10 feet of free space around the tower base and shall have constructed dimensions of approximately 40 feet by 40 feet. Fencing shall be grounded.

(2) At least one (1) gate shall be installed at each permanent meteorological tower. The gate shall be a lockable fifteen (15) foot swing-gate, sufficiently wide for light-duty vehicle access.

(3) All fencing and gates shall comply with the minimum specifications in Section 4.1.8 herein.

(4) The fenced area for the permanent meteorological tower shall be covered throughout with at least three (3) inches of aggregate over a compacted subgrade, with aggregate extending at least one (1) foot beyond the fence in all directions and using the same aggregate material as the access roads. Grounding shall be installed throughout (and three (3) feet beyond) the fenced area.

11.5.3 Contractor shall furnish and install a 12-foot-wide road to each permanent meteorological tower. Such roads shall be constructed of the same materials and with the same cross section as the primary access roads.

11.5.4 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) wind direction sensors near Wind Turbine hub height (below goal post). Each shall be MetOne 020C or NRG #200M.

(5) One (1) temperature / relative humidity sensor with radiation shields near Wind Turbine hub height (below goal post). Each shall be MetOne 597 or Vaisala

HMP60A.

(6) One (1) barometric pressure sensor near Wind Turbine hub height (below goal post). Each shall be MetOne 092 or Vaisala PTB 110.

(7) One (1) wind direction sensor at lower-blade height. Each shall be MetOne 020C.

(8) One (1) temperature / relative humidity sensor with radiation shields at 10 meters above ground level. Each shall be MetOne 597 or Vaisala HMP60A.

(9) One (1) precipitation sensor. Each shall be Campbell Scientific 237-L.

(10) One (1) vertical anemometer. Each shall be RM Young 27106T. [NTD: Use for sites with complex terrain.]

11.5.5 Each permanent 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) satellite or cellular (as appropriate) 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.

11.5.6 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. All cables running up the mast shall be armored, or travel within flexible conduit. The protected cables shall run into a junction box of minimum IP 66 rating for all seals and plugs.

(5) H-frame equipment rack located on the South-facing side of the mast. The H-frame shall have a minimum separation of 10 feet between support posts

(6) Fiber patch panel.

(7) Step-up transformer.

(8) Safety climb cable.

(9) Temporary power supply for data logger and aviation lights.

11.5.7 Details regarding the instrumentation and mounting hardware shall be reviewed by the manufacturer and incorporated into the design with a minimum of 3kW service for all equipment, plus auxiliary 120VAC provisions and a 20A/120VAC GFCI outlet for service work.

11.6 TEMPORARY METEOROLOGICAL TOWERS

11.6.1 Contractor shall design, furnish, construct, and install temporary meteorological towers as

required for the site calibration.

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

(2) Temporary meteorological towers shall be installed at a location at the Project Site to be approved 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.

(3) 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 Project Site conditions. Temporary meteorological towers shall be the same height as the permanent meteorological towers.

(4) Temporary meteorological towers shall not be fenced.

(5) All guy wires for temporary meteorological towers shall include avian protection, including bird diverters. The bird diverters shall be placed such that they do not interfere with the air flow at the anemometers and wind vanes.

11.6.2 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) wind direction sensor near Wind Turbine hub height (below goal post). [NTD: Required if GE is Turbine Supplier to perform power curve testing.]

(3) Any other instruments as required by Turbine Supplier for power curve testing.

11.6.3 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.

11.6.4 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.

11.6.5 Contractor shall decommission all temporary meteorological towers at the conclusion of Owner's site calibration test; such work shall include removal and disposal of any

meteorological tower foundations. All equipment from these towers shall be stored at an Owner-designated location at the Project Site. Removal of such temporary meteorological towers must occur prior to the commencement of Turbine Foundation construction and Wind Turbine erection activities for the applicable Wind Turbine.

11.7 TESTING AND QUALITY CONTROL

11.7.1 Contractor shall test, commission, start-up, and place into successful operation the meteorological towers. At a minimum, testing shall include the minimum requirements below. All testing shall be performed by an independent, experienced third party.

(1) All meteorological tower equipment shall be tested to demonstrate it meets stated design criteria and is fit for purpose.

(2) All testing specified in the Applicable Standards.

(3) All testing reasonably recommended or required by the applicable equipment suppliers.

(4) Meteorological tower foundations shall be tested for concrete strength and properties, including break tests, grout cubes, slump, air, and temperature, each at the minimum frequencies specified in Section 4.1.10 and Section 4.1.11 herein.

(5) All exposed cable sections shall be securely fastened to the tower and booms, as well as visually inspected for physical damage or manufacturing defects. Such inspections shall be performed prior to and during installation.

(6) Resistance testing on grounding grid at each tower location prior to connection to (isolated from) trench ground.

(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) Verify all alarms, indications and analog quantities are communicated and received properly by the RTU and displayed correctly on the HMI.

(9) Verify all communication channels operate as expected.

(10) Other testing set forth in the Project design documents.

11.7.2 Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Owner within 10 days of completing such test.

12.0 O&M BUILDING

Contractor shall furnish and install one (1) O&M Building at the Project Site. The O&M Building shall comply with the Project's future service provider requirements, including those of the Turbine Supplier, and shall (i) incorporate a furnished office space reserved for Owner of at least [TBD] square feet and (ii) reserve adequate space in the SCADA room for any Owner-installed communications equipment.

13.0 AIRCRAFT DETECTION LIGHTING SYSTEM

13.1 GENERAL PROVISIONS

13.1.1 Requirements for Aircraft Detection Lighting System ("ADLS") civil and structural works:

(1) All civil and structural works including, but not limited to, grading, structures, foundations, assemblies, and components for the ADLS shall be designed and constructed in accordance with the applicable specifications in Section 4.0 (*Civil / Structural Works*).

13.1.2 Radar towers shall be self-supported (non-guyed), galvanized lattice structures, each tower shall be designed and certified for the maximum wind and ice loading for the Project Site conditions.

13.1.3 All FAA obstruction lights shall be of the same make and model and consistent with the requirements in Section 10.4.3 and shall be compatible with the Wind Turbine and ADLS communication system, respectively.

13.1.4 The ADLS shall detect when an aircraft is at a defined outer perimeter around the Project Site and place the Wind Turbine aircraft obstruction lighting system in the "ON" state. When aircraft is outside of the defined perimeter of the Project Site, the ADLS system shall maintain the lights in the "OFF" state to minimize light pollution from the obstruction lighting.

(1) A failure of the ADLS radar system shall be automatically detected and place the obstruction lights in the "ON" state.

13.1.5 Contractor shall perform all required studies and analyses of the Project Site for siting of the ADLS radar tower(s). Contractor shall propose a minimum of two potential locations for the ADLS Radar tower(s) within the Project boundary on participating landowner parcels. Potential locations shall provide adequate coverage for the entire Project site.

(1) Contractor shall optimize the system considering items such as number of radar towers, radar tower height, available tower locations, distance from Collection System Circuits, etc. Contractor shall actively attempt to minimize the number of tower locations for the Project Site.

(2) Contractor shall coordinate the selection of the radar tower location(s) that are studied / analyzed and the final selected radar tower location(s) with the Owner. Selection of the radar tower location(s) shall include a site visit by the ADLS manufacturer prior to finalizing the tower location(s) to confirm the suitability of each location.

13.1.6 Requirements for power supply:

(1) Power for each radar shall be derived from the nearest Collection System Circuit or via a nearby Project source (e.g., O&M Building, Substation).

(2) Power cable shall be installed at the same depth as the Project Collection System, unless otherwise explicitly approved by Owner.

(3) The Collection System Circuit cable power to the ADLS shall include a 34.5-kV junction box extending the 34.5-kV cable from the junction box to each radar tower location. An oil-filled, distribution style pad-mounted transformer (with the requirements as in Section 5.1.14) and low-voltage Nema 4 distribution panelboard shall be utilized to step down the power to the required low voltage of the radar tower to power the

radar devices. [NTD: If pad-mounted transformers are removed from EPC scope for WTGs (or supplied internally to WTGs), may need to layer in Section 5.1.14 here or PGE's general transformer specification if removed further up.] The following exceptions are made to the requirements of the pad-mounted transformer as noted in Section 5:

(a) MV bushings: (2 or 3) 200A or (2 or 3) 600A.

(b) Phases: One (1) or Three (3)

(c) Vector Group HV/LV: HV = Ungrounded (Single phase or Delta) / LV = Grounded (single phase or Delta or Wye) as specified by Engineer of Record to provide the ADLS power requirements. Note that a three-phase transformer with a 34.5 kV Delta high voltage winding and a low voltage winding of 240V Delta with a center tap bonded to ground on one phase is allowed as a means of providing a solidly grounded low voltage system with both 240V three phase and 120/240V single phase power.

(d) Grounding: Solid (MV source, LV winding); un-grounded delta or single phase 34.5 kV (MV winding on transformer)

(e) Temperature gauge; Nitrogen pressure level indicator; Oil sampling valve; Nitrogen filling orifice: Option pricing for instrument being located in an external padlockable compartment is not required.

(f) Infrared viewing windows with metal cover: Option pricing is not required.

13.1.7 Requirements for ADLS communications:

(1) The ADLS communication system shall comply with the applicable requirements in Section 8.0 (*Communication Systems*).

(2) The ADLS communication system shall be capable of controlling and communicating between the Wind Turbine obstruction lights and Owner's SCADA system with reporting/view-only function available at the Project Substation.

(3) Communications for each tower location shall include the installation of direct buried fiber optic cable extending to the ADLS radar tower.

(4) The ADLS fiber cable shall be co-located with the power cable.

13.1.8 Requirements for ADLS grounding:

(1) The grounding system for the ADLS tower shall include a ground ring at least three (3) feet outside the perimeter fence of the ADLS tower and shall be bonded to the fence, tower, and electrical system. It shall be designed as required to meet acceptable levels of both touch and step potential and ground potential rise. See Section 6.0 for grounding system requirements.

13.1.9 Contractor shall comply with all applicable permits, the AHJ, the Federal Communications Commission ("FCC"), the Federal Aviation Administration ("FAA"), and any applicable rules established by the State of TBD and the TBD Public Service / Utility Commission.

13.2 SUBMITTALS

13.2.1 Contractor shall submit for Owner review the locations to be studied / analyzed for each

radar tower prior to proceeding with study of the location.

13.2.2 Contractor shall submit for Owner review the study / analysis for each radar location including, but not limited to the viewshed analysis for each location, required height of the radar tower structure.

13.2.3 Contractor shall prepare the ADLS design documents per the Submittal Schedule and containing the following information, at a minimum: (a) general arrangement plan and physical layout diagrams; (b) civil works drawings; (d) one-line diagrams, wiring diagrams, schematics. (e) communications block diagram, including all Communications System equipment, Owner-Supplied Equipment, and turbine manufacturer supplied equipment; (f) Communications System details, including HMI screen development, and fiber termination diagrams; (g) cable specifications and arrangements; (h) conduit and cable schedules; (i) panel schedules; (j) elevation drawings; (k) structural design documents, including foundation plans and details (with structural calculations to be provided with each set of foundation drawings); shop drawings showing fabrication of structural-steel components; details of cuts, connections, splices, camber, holes, and other pertinent data; indication of welds by standard AWS symbols, distinguishing between shop and field welds, and showing size, length, and type of each weld; indication of type, size, and length of bolts, distinguishing between shop and field bolts; mill test reports and structural steel properties, including chemical and physical; and fastener properties (mechanical/chemical), including bolts, nuts, and washers, and indicating coatings used to satisfy anchor bolt protection plan; (l) ground grid calculations; (m) ground grid plans; (n) conduit details; (o) fencing and gate details; (p) drawing index; (q) bill of materials; and (r) inspection, testing, and quality control requirements.

13.2.4 Contractor shall submit for Owner review and approval all manufacturer's product sheets (material cut sheets), warranties, and operations and maintenance manuals (as applicable) for all permanently installed equipment and materials, including but not limited to:

(1) Radar system including its control system components and power requirements.

(2) Obstruction lighting and lighting communication modules.

(3) Radar tower.

(4) Pad-mount transformer.

(5) Distribution panelboard.

13.2.5 Contractor shall submit for Owner review a description of the data that is provided by the ADLS to the SCADA system and sample reports that can be generated by the SCADA system that provide the performance data for the ADLS.

13.2.6 Contractor shall provide a complete recommended spare parts list for the ADLS system. Such list shall include recommended quantities, part / model numbers, and nominal pricing.

13.2.7 Contractor shall submit all required permits or approvals obtained for the ADLS system for Owner review

13.3 AIRCRAFT DETECTION LIGHTING SYSTEM

13.3.1 Contractor shall design, furnish, construct, and install an ADLS, radar-controlled aircraft obstruction lighting system for the Project. The ADLS-controlled lighting system shall include, but not be limited to, the power supply, grounding / surge protection, communications, radar tower structure, fencing and gates, access roads, ADLS radar, Wind Turbine obstruction

lighting, lighting control modules, ancillary equipment, and any other materials or work as necessary to provide a complete and functioning system.

13.3.2 Contractor shall furnish all labor, equipment, and materials that are necessary for a complete, fully-functional, and safe ADLS radar-controlled lighting system.

13.3.3 Contractor shall furnish and install fencing and gates around each ADLS radar.

(1) A perimeter fence with at least one gate entrance shall surround the radar tower site including the tower, pad-mounted transformer, distribution panelboard, radar control and communications equipment.

(2) Fencing shall be placed to allow a minimum of 10 feet of free space around the radar tower base including the transformer, panelboard, and radar control equipment. Fencing shall be grounded. The gate shall be a lockable swing-gate, sufficiently wide for light-duty vehicle access. See Section 4.1.8 for fencing and gate requirements.

(3) The fenced area for the radar tower shall be covered throughout with at least six (6) inches of aggregate over a compacted subgrade, with aggregate extending at least one (1) foot beyond the fence in all directions and using the same aggregate material as the Site Access Roads.

13.3.4 Contractor shall furnish and install a 12-foot-wide road to each radar tower. Such roads shall be constructed of the same materials and with the same cross section as the Site Access Roads. See Section 4.4 for site road requirements.

13.4 TESTING AND QUALITY CONTROL

13.4.1 Contractor testing plan for the ADLS system shall be submitted to Owner for review and approval. Contractor shall notify Owner of all testing schedules at least 30 days in advance of testing activities and copies of testing reports (including a summary of testing procedures and acceptance criteria) shall be submitted to Owner within 10 days of completing such test.

13.4.2 The ADLS system communication testing shall comply with Section 8.4.

13.4.3 Acceptance of the Work shall be determined by Owner only when the ADLS is fully commissioned including, but not limited to, remote access capability, ADLS report generation capability, and the ADLS is in compliance with the Requirements.

ATTACHMENT 1 TO APPENDIX M2-01-01 SCHEDULE REQUIREMENTS

Without limiting the information summarized herein, the purpose of this attachment is to summarize the minimum contents and requirements for the Contractor-prepared Project Schedule.

A. Definitions:

1. For purposes of only this attachment, the following words shall have the respective meanings set forth below.

a. "**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.

b. "**Baseline**" schedule means the initial Project Schedule, as approved by Owner.

c. "**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.

d. "**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.

e. "**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.

f. "**Predecessor activity**" means an activity that precedes another activity in the network.

g. "**Resource loading**" means the allocation of manpower, equipment, or material necessary for the completion of an activity as scheduled.

h. "**Successor activity**" means an activity that follows another activity in the network.

i. "**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.

B. General requirements:

1. Contractor's accepted Baseline schedule will be set forth in Exhibit [●] (*Project Schedule*).

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 P6.20 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. 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. Activity 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. 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.

6. 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) purchase, fabrication, and delivery of major equipment; (e) installation; (f) utility interruptions; (g) tests and inspections; (h) startup and initial operations; (i) work by Owner that may affect or be affected by Contractor's activities; and (j) training.

7. The Project Schedule shall include Milestones indicated in the Agreement. All major milestones shall be presented at the top of the Project Schedule.

8. 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.

9. 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.

10. The Project Schedule shall clearly identify all critical path activities. Scheduled start and completion dates shall be consistent with Agreement milestone dates.

11. 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.

12. Constraint dates shall be kept to a minimum, and all constraints shall be identified with descriptive text in the activity description.

13. All activities shall have a predecessor activity and successor activity except for the first and last activities in the Project Schedule.

14. The Project Schedule shall include allowances for delays that may be encountered for reasonably-expected weather conditions, non-working holidays, and other similar items.

C. Concurrent with each Project Schedule submittal, Contractor shall submit the following reports. Each such report 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.

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; and (g) activity constraints, including type.

ATTACHMENT 2 TO APPENDIX M2-01-01 APPLICABLE STANDARDS

Refer to M1-05-06 (Applicable Standards) for applicable industry codes and standards for Contractor's Work.

A. General requirements:

1. The Applicable Standards shall include (a) each of the standards and industry codes listed below and (b) each of the relevant standards and codes issued by the organizations listed below. For the avoidance of doubt, any standards or industry codes not identified herein but pertinent to the Work shall also apply.

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.

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.

4. Any general standard or organization listed below 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.

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