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1. GENERAL

1.1 Definitions

A. “AC” or “ac” shall mean alternating current.

B. “AC Rated Plant Capacity at the POI” shall equal the total net export capability at the Point of Interconnection as defined by the Interconnection Agreement.

C. “AC System Losses” shall mean the resistance losses (I^2R) through the AC cabling and magnetization and winding losses associated with the inverter step-up transformers and is exclusive of Auxiliary Loads.

D. “Agreement” shall mean the Term Sheet between Owner and Contractor to which this Attachment F is attached.

E. “Array” shall mean a collection of solar modules connected in series, all tying into one Inverter Skid Assembly (ISA).

F. “Auxiliary Loads” shall mean power consumption from activities not directly associated with power generation or transmission losses. These include, but are not limited to, inverter power and SCADA system power.

G. “Circuit” shall have the definition set forth in Exhibit 6.

H. “DC” or “dc” shall mean direct current.

I. “DC/AC ratio” shall mean the ratio of the installed DC power to the Inverter power rating operated at maximum expected inverter-level power factor to meet power factor requirements at the POI. For example, a 2.75MVA inverter operated at a power factor of 0.92, with a total installed DC power of $3.5MW_{DC}$, would have a MW_{AC} rating of 2.53MW and a DC/AC of 1.38.

J. “ESP” shall mean Electric Service Provider.

K. “HZ” shall mean hertz.

L. “IA” shall mean the Inverter Assembly consisting of the static power inverter(s), inverter step-up transformer, associated controls, monitoring, cabling and grounding systems.

M. “kV” shall mean kilovolts.

N. “kW” shall mean a measure of instantaneous power as measured in kilowatts. If not specified, it shall be assumed to be in Alternating Current (AC).

O. “kWh” shall mean kilo-Watt-hours. If not specified, it shall be assumed to be in Alternating Current (AC).

P. “MET Station” shall mean the meteorological station/(s) installed within the solar field to measure critical weather data such as wind speed and direction, ambient temperature, solar irradiance, etc.

Q. “MP” Shall mean Minnesota Power

R. “POI” shall mean the Point of Interconnection which defines the location of the physical electrical interconnection to the ESP as defined in the Interconnection Agreement.

S. “PV” shall mean photovoltaic.

T. “Solar Substation” shall mean the interconnection facility which collects the feeds from the ISA and transforms the voltage (as required) for electrical interconnection to the ESP.

U. “TSM” shall mean the Technical Specifications Manual for Minnesota Power interconnection requirements.

V. “Project” shall mean the solar Project as defined in the Agreement. The Project shall include all equipment and systems producing solar energy, from the solar modules up to the POI, including

the collector system, substation and Generation Tie-line between the project substation and the POI, as applicable.

W. “SCADA” shall mean the Supervisory Control and Data Acquisition system, including all monitoring/control hardware and software, field instrumentation and communication devices.

X. “STC” shall mean standards test conditions, which is 1000 watts per square meter insolation, 25ºC module temperature, 1.5 AM (air mass).

Y. “Distribution Provider” shall mean the public utility (or its designated agent) that owns, controls, or operates distribution facilities.

Z. “PPC” shall mean Power Plant Controller, including all necessary equipment to house and power up the device and allow it to communicate with the SCADA System

Capitalized terms not otherwise defined above shall have the meaning given such terms in the Agreement.

1.2 Contractor Scope of Work Overview

A. Contractor shall furnish a solar photovoltaic facility Project for Owner at the specified capacity and energy production. If including optional battery storage, refer to Exhibits F1, F2, and F3 of BESS Technical Specification for additional scope requirements and definition.

B. The Project shall be capable of operating in accordance with the terms and conditions of the Agreement, this “Statement of Work” and associated attachments.

C. Contractor shall design and construct the Project in accordance with the Agreement and this Specification. Scope of Work shall consist of:

1. Specify and furnish the Equipment and Materials which shall include, but not be limited to perimeter fences, structural support and/or tracking systems, module string DC wiring harnesses and CAB system (as applicable), DC combiner boxes or load break disconnects (LBDs), ISAs or inverter configuration, SCADA system, MET Stations, AC collection, and ancillary hardware required to connect and operate listed equipment.
2. Project design engineering, software models, and drawing packages for construction permitting, installation and “as-built” documentation.
3. Project construction including all site/civil work, structural, electrical, mechanical and monitoring/control systems.
4. Third party verifications shall include piles, concrete reinforcement, soils, concrete and shall also be performed where required to comply with Applicable Permits and codes.
5. Project and construction management, including quality assurance/quality control, site safety, site material control and management of all subcontractors.
6. Project commissioning and testing in accordance with Exhibits 5 and 6.
7. Project turnover including Owner training and Project operations and maintenance documentation when applicable.

D. Contractor shall provide all temporary electrical and internet services for use during construction and commissioning.

E. Contractor shall provide all temporary lighting, including at trailers and parking lot.

F. Contractor shall obtain all Permits required to construct the project.

G. Temporary Facilities

1. Contractor shall provide space for Owner’s representative within a furnished office trailer complete with electrical, internet service.

2. Contractor shall be responsible for establishing and maintaining all portable restroom, lunchroom, and other office and meeting areas for the duration of the construction and commissioning portion of the Project.

3. Contractor shall provide hand washing stations and portable restrooms for the temporary office trailer complex. For in-field work areas Contractor shall provide temporary sanitary facilities consisting of above ground Porta-John type. Contractor shall be responsible for decommissioning the temporary sanitary facilities at the termination of construction.

4. Contractor shall maintain on-site dumpsters and personnel to maintain a clean and rubbish free work site.

5. Contractor shall be responsible for designing and implementing temporary traffic control measures as required by applicable County or local agencies throughout construction duration.

6. Contractor shall be responsible for permitting, installation, and removal of a temporary water storage facility to satisfy water requirements for dust control purposes.

7. Contractor shall be responsible for establishing and maintaining temporary parking areas for construction and office personnel. Temporary parking areas shall be returned to design grades and surfacing at the termination of construction.

G. Contractor shall be responsible for design, permitting and implementation of dust suppression and erosion control measures.

H. Contractor shall be responsible for permitting, and installation of a temporary water storage facility to satisfy water requirements for dust control purposes and other uses during construction as required by local authorities. Sizing of temporary water storage facility shall be of adequate volume for dust suppression. Temporary water storage facilities shall be removed and the area returned to design grades and surfacing. All costs for water during construction shall be paid for by Contractor.

H. Contractor shall be responsible for site security throughout construction duration until turn over, if applicable.

I. Contractor shall provide temporary barriers (snow fence or agreed upon barrier) to physically separate Circuits turned over to Owner prior to Substantial Completion, if applicable.

J. Contractor shall provide traffic management as necessary to ensure safe site access from nearby public roads for all vehicles and equipment.

K. Contractor is responsible for meeting all construction and post-construction storm water requirements as dictated by Applicable Law.

L. Contractor shall provide all relevant electrical engineering studies for a comprehensive and complete design. This will include, but not be limited to, grounding study, arc flash study, short circuit study, ampacity study, temporary over voltage study, load flow (reactive power) study, harmonics analysis, and relay settings and coordination study,

M. Contractor shall provide a Geotechnical Study suitable for the project level design work including bearing capacities, soil characteristics (including electrical and mechanical) and infiltration requirements.

1.3 Site and Environmental Criteria

A. Project design shall be based upon the design conditions listed below in Table 1-1 (to be completed by Developer). If including optional storage, refer to Attachment E – Economic and Technical Data Input Form.

Table 1-1
Site Design Conditions

Project Location	Approximately XX miles XXX of XXXX, XX.
Minimum/Maximum Dry Bulb Temperature (for inverter design)	X°F/X°F (ASHRAE extreme annual)
Extreme low temperature (for module string design)	X°F (ASHRAE extreme low annual) (OR Contractor may use SAM simulation but to be reviewed and approved by Owner)
Design Wet Bulb Temperature or relative humidity (HVAC design)	X°F (ASHRAE 0.4% design)
Maximum Elevation	X feet above mean sea level
Site Road Access	TBD
Seismic Criteria	SDS = XX, SD1 = XX, Seismic Design Category (SDC) = XXX, Site Class = D (assumed), Importance Factor = 1.0 unless otherwise approved by the local authority having jurisdiction (AHJ)
Wind Design	For Risk Category I structures (trackers), V = X MPH (X sec gust), Exposure = C (assumed), in accordance with the most recent edition of ASCE 7, unless otherwise approved by the local authority having jurisdiction For Risk Category II structures (ISAs and MET stations), V = X MPH (X sec gust), Exposure = C (assumed), in accordance with the most recent edition of ASCE 7, unless otherwise approved by the local authority having jurisdiction Wind on Ice shall be considered
Snow Load	XXXX psf For Risk Category I, Importance Factor = 0.8, in accordance with the most recent edition of ASCE 7, unless otherwise approved by the local authority having jurisdiction For Risk Category II, Importance Factor = 1.0, in accordance with the most recent edition of ASCE 7, unless otherwise approved by the local authority having jurisdiction
Risk Category	Unless indicated otherwise by the AHJ: For racking structures and racking foundations, Risk Category I For all other structures, Risk Category II
Maximum storm water velocity and depth	To be determined as part of design
Average Annual Rainfall	X inches
100 yr /Maximum 24 hr Rainfall	X – X inches
Design Maximum Rainfall Rate	100yr – Shall comply with applicable county requirements
Environmental	xxxx (based on environmental studies)
Floodplains	Projects cannot be built in a mapped floodplain. (Based on FEMA defined floodplains)
Subsurface Soil Conditions	Per final Geotechnical Report

1.4 Design Criteria

A. Project and individual components shall have a minimum design life of 30 years.

B. Project shall be designed for automatic operation.

C. Project electrical design will be in compliance with applicable codes and standards listed under Section 1.7 unless otherwise noted.

D. Dissimilar metals in contact anywhere in system shall be avoided where possible to eliminate the possibility of galvanic corrosion. Lugs shall be rated for dissimilar metals where applicable.

E. During engineering design, Contractor shall work with the Owner when determining all signage, labeling and nomenclature.

1.5 Systems and Equipment

A. Provisions shall be included in the design of all systems to allow the performance of all routine maintenance without requiring a plant shutdown. Maintenance completed on each inverter should allow for the rest of the plant to remain in service.

B. Contractor shall:

1. Receive, inspect, store, unload, maintain, erect, clean, align, and prepare all equipment in strict accordance with equipment manufacturer's instructions prior to Substantial Completion.

2. Provide lifting lugs on all equipment components or system components requiring removal for maintenance and weighing over 25 lbs.

1. Design the facility for a life of 30 years consistent with good engineering practice for solar generation facilities. However, it is understood that some of the equipment will require routine maintenance and possible replacement during the life of the facility.

1.6 Operating Criteria

A. DC grid voltage: equal to or less than 1500 volts DC, negatively grounded.

B. AC Medium voltage: below 100 kV, 60 Hz

C. DC & AC electrical systems under 1000V shall be radially configured. Medium voltage AC transformers shall be configured with loop feed features. No redundancy is required.

D. Convenience Power: 120VAC

E. Instrumentation voltage: 24VDC or 125VDC

F. Communications network: Ethernet via fiber optic within the arrays to the Communications Interface. Fiber optic to all field equipment shall be designed in a 'collapsed loop' configuration, at a minimum, to provide redundant path back to SCADA system. The network shall be 1 Gigabit and shall include adequate spare capacity to run parallel networks. Interface to Minnesota Power will be a DNP3 connection.

G. The DC/AC ratio of each inverter array shall be within 5% of the overall project DC/AC ratio.

1.7 Codes, Regulations and Standards

A. In the event that any Applicable Law or Industry Standard does not govern specific features of any item of Equipment and Materials, Temporary Work or system, Contractor or Original Equipment Manufacturer (OEM) standards shall be applied, with Owner's approval. Where local codes or ordinances will have an impact on the design, Owner and Contractor shall jointly address these with the local authorities having jurisdiction.

B. Listed herein are the principal codes and standards applicable in the design, fabrication and installation of the Project; these are not intended to be all inclusive. Where local codes or ordinances will have an impact on the design, Contractor shall be responsible for meeting the codes or obtaining variances from local authorities having jurisdiction.

C. Contractor shall design and construct the Project in accordance with the most recent versions of the following standards, as applicable:

D. ACI - American Concrete Institute

E. AISC - American Institute of Steel Construction

F. ANSI - American National Standards Institute

G. AISI – American Iron and Steel Institute

H. ASCE – American Society of Civil Engineers

I. ASME – American Society of Mechanical Engineers

J. ASTM - American Society for Testing and Materials

K. AWS – American Welding Society

L. IBC - International Building Code

M. ICEA - Insulated Cable Engineers Association

N. IEC - International Electrotechnical Commission

O. IEEE - Institute of Electrical and Electronics Engineers

P. ISA – Instrumentation Society of America

Q. NEC - National Electrical Code

R. NEMA - National Electrical Manufacturers Association

S. NESC - National Electrical Safety Code

T. NETA - National Electrical Testing Association

U. NFPA – National Fire Protection Association

V. OSHA - Occupational Safety and Health Act

W. TUV SUD America

X. UL – Underwriters' Laboratories

In the case where standards have conflicting requirements, Owner and Contractor will develop a mutual agreement of the prevailing standards.

If including optional storage, refer to Exhibit F-1 - Scope of Work (BESS) for additional codes and standards references.

2. SPECIAL CONDITIONS

2.1 Construction Water

A. Contractor shall size and provide all construction-water related infrastructure necessary to support Contractor's construction and schedule.

2.2 Flood Protection

A. Associated flood hazard requirements shall be incorporated into the design and construction of the Project. Contractor shall elevate and/or provide flood protection for structures subject to the approval of the AHJ.

3. EQUIPMENT AND MATERIALS

3.1 Overview

A. Contractor shall furnish all Equipment and Materials as required to construct a fully functioning Project. Minimum requirements for major equipment are described herein. Projects including battery storage shall include Equipment and Materials as defined in Exhibits F-1, F-2, and F-3 of BESS Technical Specification including the integration and functional suitability for the PV and BESS.

3.2 PV Modules

A. Contractor to provide standard wattage, tier 1 modules from one of the approved suppliers specified in Exhibit 9. Preference will be given to domestically produced panels, if available.

3.3 Support Structure

A. The module support structures shall be designed and constructed to provide a stable support system for the PV modules that will remain effective throughout the design life of the Project.

B. Foundation shall be driven galvanized or equivalent corrosion-resistant steel members, mini-cast augured piles or equivalent. Corrosion resistance shall be as required by the findings of the Geotechnical Study and Corrosion Study. Corrosion Study shall be performed by an Owner-approved Corrosion Engineer.

C. Module support sub-structure frame may be corrosion-resistant steel or extruded aluminum.

D. Mounting hardware shall include corrosion resistant clips and fasteners.

E. Corrosion protection to be evaluated by Contractor to verify soil conditions are compatible with the module support structures.

F. The maximum support structure deflections shall prevent PV module and electrical system damage and shall not exceed allowable limits provided by the manufacturer and the most recent edition of IBC and ASCE 7 codes.

G. The module support system shall be designed and constructed to withstand environmental conditions and applied loads for the design life of the Project.

H. Dynamic force conditions from wind shall be considered and included in design.

I. Horizontal single-axis is optional.

1. Tracker drives electric motors or hydraulic. If hydraulic, oil must be bio-degradable type oil, not considered an environmental hazard.
2. Galvanized steel structural components.
3. Accurate stowing required for wind events based on design tolerance. Capable of quick stow or stowing based on accurate wind predictions or measurements.
4. Designed and manufactured per applicable AISC, AISI, ASTM, ANSI & AWS codes and standards.
5. The tracking system shall be designed and constructed to withstand environmental conditions and applied loads for the design life of the Project, if applicable.
6. Bearings and gears shall have Basic Rating Life (L10) of 100,000 hours.

J. Tracker supplier must have robust proven QA/QC program installed at shops supplying torque tubes, torque arms, drive struts, and other main components of tracker. If applicable.

K. DC cable management system - open cable trays if routed under arrays to minimize snow and ice buildup or CAB systems may be used.

L. Racking system and module mounting shall meet the requirements of UL 3703 and 2703, respectively.

M. All modules shall have a minimum ground clearance of thirty-three (33) inches at all points in their operating range and a maximum height of eight (8) feet above the ground. Combiner boxes, disconnect switches, inverter/transformers, and any other electrical equipment shall be a minimum 12" above the 100-year flood level. Module height at stow position shall be above the 100-year flood level unless otherwise required by AHJ.

3.4 DC Fused Combiner Boxes (as applicable)

A. Enclosure shall be rated NEMA 3R or 4.

B. Combiner boxes shall be installed above ground.

C. Factory assembled back panel complete with finger safe fuse holders rated for maximum VDC, reinforced, plated bus bars and power distribution blocks.

D. Combiners shall have a load-break DC disconnect switch with the capability of being pad-locked in the off position.

E. Enclosure doors shall have provisions for pad locking.

F. Completed assemblies shall be listed to UL 1741.

G. Combiner shall be labeled to meet NEC code requirements and labeled with an arc flash warning.

H. All feeders and cables into combiner boxes shall have preprinted labels with unique tags/identifiers.

I. Safety covers shall be provided for live components.

J. Surge suppression devices shall be mounted internal to combiner box.

K. All terminals shall be 90°C rated.

3.5 DC Load Break Disconnects (as applicable)

A. Enclosure shall be rated NEMA 3R or 4.

B. Load Break Disconnects (LBDs) shall be installed above ground.

C. Provisions for pad locking in the off position.

D. Completed assemblies shall be UL listed.

E. LBD shall be labeled to meet NEC code requirements and arc flash warnings.

F. All feeders and cables into LBDs shall have preprinted labels with unique tags/identifiers.

G. Surge suppression devices shall be mounted internal to LBD.

H. All terminals shall be 90°C rated.

3.6 Inverter Assembly

A. Each Inverter Assembly shall consist of inverters with step up transformer, DC cabling/bus, AC cabling/bus, auxiliary equipment, and grounding system. Requirements stated in Exhibit F-1, Section 4.6 shall be followed as applicable to PV sites with optional battery storage.

B. Inverters

1. Inverter shall be on Approved Supplier List and approved by Owner.

2. Inverter shall be UL 1741-SB Certified
3. Inverter shall be rated for use in 1500 Vdc applications.
4. Inverter shall have California Energy Commission (CEC) weighted efficiency greater than or equal to 98% (without medium voltage inverter step-up transformer).
5. Environmental ratings:
    a. Inverter shall be capable of operation at full nameplate rating ambient air temperatures between -20 ºC to 50ºC. Depending on Site Design Temperature a 45 ºC upper limit may be acceptable.
    b. Inverter electronic compartments (IGBTs, communications, etc.) shall be NEMA 4 or better (or European equivalent) and the overall enclosure rating shall be NEMA 3R or better (or European equivalent).
    c. Inverter enclosure should be designed with ingress protection to limit dirt/dust/insects/rodents from entering the enclosed space over the full temperature range.
6. Nameplate: Inverter shall be sized to deliver rated power at ±0.95 power factor up to 50°C.
7. Quantity: Adequate inverters shall be provided, considering losses and reactive power, in order to deliver the required power at the POI at the design temperature.
8. Inverters shall have the capability of dynamic power factor adjustment from 0.95 lag to 0.95 lead and be set to a .98 absorbing minimum, according to the MP TSM unless more stringently defined by Interconnect Agreement.
9. Inverters shall not de-rate while operating within their rated DC voltage range for an ambient temperature of 50˚C and below. A gradual de-rate may be experienced in the case that the operating conditions are outside the rated DC voltage or ambient temperature range(s).
10. Current and voltage harmonics: <3% THD and IEEE-519-2014 requirements at the POI.
11. Inverter shall be designed to the requirements of IEEE C57.159 to be compatible with its step-up transformer in terms of harmonics and resonance.
12. Inverter cooling system shall not be susceptible to particle contamination and require minimal maintenance.
13. Inverters shall be provided with surge suppression devices on both the DC Input and AC Output.
14. Inverter shall have protective measures to prevent single IGBT failures from causing cascading failures.
15. Inverter AC breaker shall be externally operated, with visual open indication such as an indication light, and capable of remote operation to minimize arc flash hazards.
16. Inverter shall be provided with ground isolation detection devices where used with systems having ungrounded PV arrays.
17. Inverter shall be operated in accordance with manufacturer’s recommendations. Any deviation shall be authorized in writing from the manufacturer and not before notification and acceptance by Owner.
18. Inverter shall have built-in protection against undervoltage, overcurrent, overvoltage, and transients.
19. Inverter-based DER shall be able to meet the requirements of IEEE 1547-2018 Abnormal Performance Category III for response to abnormal conditions. Tables 13 and 16 and Figure H.9 of IEEE 1547-2018 are applicable for abnormal voltages and Tables 18 and 19

and Figure H.10 of IEEE 1547-2018 are applicable for abnormal frequencies. These systems are directly connected to distribution systems, Contractor shall provide equipment and functionality to meet voltage and frequency ride-through requirements per the current or future TSM requirements as is practicable.

20. Inverter shall integrate Inverter Step-up Transformer signals (low oil, high pressure, high-temp warning, and high-temp trip) into SCADA system and trip/warn/de-rate signals appropriately where applicable.

21. Inverters shall have adequate and easily accessible grounding points to add ground clusters during maintenance activities.

3.7 Inverter Step-up Transformers

A. Transformers shall be of the compartmental pad-mount design with dead front and loop feed features.

B. Ratings: Transformer kVA rating shall match ISA combined inverter rating. Impedance shall match inverter manufacturer requirements. Cooling class = KNAN

C. Primary voltage: Below 100 kV Delta with elbow surge arrestors located on transformers that do not contain a loop feed out. If the distribution-side of the GSU is delta, the inverter-side of the GSU can be either delta or wye. If the distribution-side of the GSU is grounded-wye, the inverter-side should not be delta.

D. Secondary Voltage: Matched to selected inverter.

E. High efficiency: 99.2% or greater at nameplate output.

F. No-Load losses shall be limited to 0.15% of full KVA rating.

G. BIL ratings: To be stated in data sheet for Owner review.

H. Winding insulation: 65ºC rise over 45ºC ambient.

I. Number of windings: Maximum of three.

J. De-energized tap changer with high voltage taps: (2) 2.5% above and below nominal position – fully rated.

K. Hook stick disconnect switch with visual open shall be located such that Arc Flash protection is not required for operation.

L. Over-current protection via bayonet fuse (with holder) in series with partial range current limiting fuse, or internal expulsion fuse in series with oil immersed with current limiting fuse shall be provided.

M. Top powder coat of ANSI 70 light grey or other color as approved by Owner.

N. Oil level, pressure/vacuum and oil temperature gauges: All instrumentation shall be read into SCADA. Oil temperature gauge to be furnished with two alarm contacts (warning and trip). Oil temperature and pressure transmitters shall provide binary outputs. Oil level gauge to be furnished with alarm contacts. Instrument gauges shall be located such that gauges can be read without requiring Arc Flash protection. Access to the equipment shall be provided in accordance with NEC and OSHA standards.

O. Drain valve with oil and dissolved gas analysis (DGA) sampling provisions, readily accessible in normal operation.

P. Transformer mounting pad design may be required to incorporate features for secondary containment of oil. Contractor shall conform to requirements of local authorities having jurisdiction and design shall be reviewed and accepted by Owner.

Q. In addition to all routine factory testing per most recent standard of ANSI/IEEE standard C57.12.90 and C57.12.00, the following tests shall be conducted:

1. Full ANSI impulse test on one (1) unit, preselected during production by Owner.
2. Heat run test on one (1) unit, preselected during production by Owner.

I. Shall comply with the following latest ANSI/IEEE standards:

1. C57.12.00 - IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. C57.12.10 - IEEE Standard Requirements for Liquid-Immersed Power Transformers
3. C57.12.28 – Switchgear and Transformers, Pad-Mounted Equipment – Enclosure Integrity.
4. C57.12.34 - IEEE Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers
5. C57.12.90 - IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
6. C57.91 – Oil-immersed transformer temperature monitoring

R. Baseline DGA, conducted at factory or on Site, shall be provided with each transformer.

3.8 PROJECT SCADA

A. SCADA system (Inside the fence) shall be composed of hardware and software, field instrumentation, meteorological stations, and communications devices designed for remote monitoring, control, and historical trending of the Project. If including optional battery storage, SCADA system shall be capable of interfacing with both PV and BESS to ensure charging of the BESS is only capable from coupled PV generation sources. Refer to Exhibit F-1 - Scope of Work (BESS) for supplemental details and requirements.

B. Shall be NERC CIP compliant and meet cyber security requirements (password protected with permission levels).

C. Site SCADA and telecom shall be fully protected and behind a firewall.

D. Shall be able to communicate with external parties in their protocols (DNP3). All power plant controller setpoints, etc. must be logged (set point, user, etc.).

E. The SCADA system shall meet all data frequency and duration requirements specified in Exhibit 6.

F. Contractor shall supply, install, and commission the SCADA System hardware at the Site in connection with the performance of its services pursuant to the terms of the Agreements.

G. SCADA system shall display data in real time and record and log performance data at regular intervals from the Project.

H. All SCADA data shall be made available for an OSI PI interface and other third parties as required for remote access, monitoring and data collection.

I. Fiber Optic Installation Specification: All fiber optic cable is to be installed per the specifications below.

1. Placed within HDPE innerduct, 1.25” minimum diameter
2. Placing depth 42-48” or as specified by permits
3. Cable marking ribbon 12-18” above fiber in any plowed sections
4. Underground cable marker posts placed at every hand hole, on either side of every road crossing, at directional changes, on each side of any water crossings, within 50’ of driveways and every 500’ along route

5. Locate wire direct buried with fiber duct and terminated to fiber marker test stations at every hand hole
6. Hand holes, minimum size 24” W x 36” L x 24” D, placed at every location as marked on map and a minimum of every 5000’
7. 100’ Fiber cable slack loops in every hand hole
8. Pea rock placed in bottom of every hand hole

J. SCADA System

1. Contractor shall program the control software for the Project on an industry-standard SCADA open platform for easy integration into Owner’s operation. The unlocked control code and documentation will be provided to the owner at the end of the Project. Software shall employ both remote monitoring and control and an Antivirus server.
2. Contractor shall provide a historian capable of capturing all data points for all sites 250 kW or higher or where there are communications readily available, at one second intervals (or fastest available or permitted by each device) and log data for at least 1 year or minimum required to meet local ISO, NERC, or other requirements.
3. IP addressing to be coordinated with Owner.
4. All SCADA and network equipment must be of utility grade substation quality equipment by standard industry grade suppliers.
5. All fiber shall be terminated on bulkheads/enclosures.
6. All fiber networks shall support 1 Gigabit network architecture.
3. Contractor shall install minimum one operator station (HMI) for access to the SCADA system and historian server and provide all SCADA/historian licensing for the Project. Such hardware/software shall be located at the Site, and title to such hardware/software shall be transferred to Owner.
7. SCADA shall employ Remote I/O to be deployed at major data collections points in the Project. Typical locations for the Remote I/O include the ISAs.
8. The Remote I/O shall function as the input/output point for the command-and-control signals.
4. The SCADA system shall be either connected to its own UPS 8hr run-time required.
5. The SCADA System should display interconnect status for breaker Trip/Close or any transformer or system related alarms in the solar array.
6. The SCADA System should display the internal building or control system enclosure temperature and access/entry door open/close.

K. Solar Power Plant Controller: The Solar Power Plant Controller shall be able to accept commands from the following locations and distribute these commands to all equipment on Site as necessary:

9. Local operator station
10. Owner’s centralized remote command center
11. Utility or ISO dispatch commands (such as Automated Dispatch System in CAISO) .
12. At a minimum, the following controls capabilities shall be available at the plant level:
    a. The Project shall have a Location that will act as the central point for the SCADA System. SCADA network and all associated hardware will be located here.
    b. The Control Location shall also function as the Owners communications center for the site with limited physical access to the communications equipment.

c. The Contractor will be allowed access to this data via the remote system for an agreed upon time period (if applicable). The access method must be agreed upon by the Owner.

L. Meteorological Station ("Met Station"). Met Stations are required on sites greater than 1 MW. The Met Station shall consist of instruments to measure the meteorological parameters listed in Exhibit 6. Accuracy and quantity requirements of Met Stations and associated measuring devices are specified in Exhibit 6. Met Station must have a backup power supply to allow normal data collection for a period of 48 hours without external power. Additional MET Station equipment required by the Utility shall be provided by the Contractor. Proposed locations shall be reviewed and accepted by the Owner.

M. Typical SCADA points monitored include the following:

1. Meteorological Parameters shall conform to all Participating Intermittent Resource Program (PIRP) requirements including but not limited to the following unless otherwise specified in these Contract documents (accuracy requirements specified in Exhibit 6):

a. Outside Air Temperature and Relative Humidity

b. Secondary Standard Horizontal Thermopile Pyranometer (Direct & Indirect Irradiance)

c. Secondary Standard Plane-of-Array Thermopile Pyranometer (Direct & Indirect Irradiance)

d. Rainfall Amount

e. Barometric Pressure

f. Back of module Temperature (see PV Module Points below)

g. Anemometer and Wind Vane (Wind Speed and Direction. Wind speed should be ranged for the full design spec of the site.)

2. ISA Points (per ISA)

h. Inverter Performance Points

i. To include real time AC and DC electrical characteristics, including but not limited to power, energy generated, inverter status and diagnostics, alarms, cooling system and component temperatures, and all data available from inverter system.

3. PV Module Points

i. PV Module Back Surface Temperature (minimum two (2) per MET Station). Temperature sensors shall be placed so as to accurately represent the average module temperature in the inverter array.

2. PV Sub-Array DC Current Points

a. PV Sub-Array DC Current Transmitters (one for each Inverter DC Sub-Array or inverter feeder input)

3. Inverter step-up Transformer at ISA Points

a. Transformer Oil Temperature Warning (Digital)

b. Transformer Oil Temperature Trip (Digital)

c. Transformer Pressure (Digital)

d. Transformer Low Oil Level (Digital)

4. Tracker

a. Tracker angles (setpoint and actual position)

b. Tracker status and operating state (including stow)

c. Tracker alarm states

d. All other applicable and industry standard data points

5. Soiling Station (as required for Capacity Test, see Exhibit 6)

a. Soiling Ratio

b. Voltage of clean and dirty panels

c. Current of clean and dirty panels

6. Solar Substation Points

a. SCADA system shall be open architecture using standard programming language and support bidirectional data exchange between the Owner supplied equipment and the Contractor supplied equipment. See Exhibit 1.

7. AC Revenue Meter Points

a. Shall include real time AC electrical characteristics, including but not limited to power, energy generated, meter status and diagnostics.

b. All points required by utility and ISO.

4. ELECTRICAL INSTALLATION

4.1 General

A. Cable runs shall only be made parallel and perpendicular to array mounting system.

B. Grounding lugs installed outdoors within 18” of grade shall be UL-listed for direct burial. Other grounding lugs installed outdoors shall be copper or brass with brass or stainless-steel hardware, or tin-plated aluminum with stainless steel hardware. All grounding lugs shall be UL listed.

C. Backfill and compaction of trenches shall meet geotechnical recommendations and shall be performed with compaction equipment specifically designed for such duty. Lifts shall not exceed 12”.

D. All cables and cable ties shall be UV resistant. This means their exterior materials shall be rated to withstand sunlight and extreme heat as defined per table 1-1 and NEC requirements. Materials shall contain UV inhibitors and a minimum of 2% carbon black, with a particle size no larger than 35 nm.

E. Direct-buried wiring shall meet NEC requirements for burial depth and warning ribbon. Warning ribbon width shall be 4” minimum. Cables shall be surrounded by a minimum of 4” of clean fill free of stones larger than 1-inch in diameter.

F. Electrical equipment shall be located a minimum of 12” above the 100-year floodplain elevation unless otherwise noted.

G. Conduit openings shall be sealed to protect against intrusion of pests and other wildlife.

H. Above ground bare copper ground cables shall be painted gray.

4.2 DC System Wiring

A. Contractor may combine strings in combiner boxes or with factory-supplied in-line fused connections and load break disconnects (LBD).

B. System shall be designed such that the maximum DC voltage drop for any one inverter array (from module string to inverter DC input) at full load and STC do not exceed 1.5%.

C. Series string connections between modules will be via locking multi-contact connectors and jumpers factory-supplied with modules.

D. All wiring shall be supported per NEC and manufacturer’s requirements.

E. DC cabling may run above grade, where allowed by code. Method to be reviewed and accepted by Owner.

F. Contractor shall submit cable data sheets and project cable schedule to Owner for approval for each application prior to procuring the cable.

G. DC cable for the wiring from the combiner box or trunk cable to the inverters shall be 1.5kV minimum, 90ºC (wet or dry), power cable type RHW-2 or XLPE with UL 1581, VW-1 rating, and suitable for direct burial. Conductors may be stranded copper or aluminum.

H. DC cable for the wiring from the modules to the combiner boxes or trunk cables shall be 1.5kV minimum, 90ºC (wet or dry), power cable type XHHW-2 or PV wire (as applicable), with UL 1581, VW-1 rating, and suitable for application. Conductors shall be stranded copper or aluminum.

I. Harnesses or cabling shall be rated to withstand sunlight and extreme heat as defined per table 1-1 and NEC requirements. For ultraviolet protection materials shall contain a minimum of 2% carbon black with a particle size of 35 nm or less.

J. Fuses shall be accessible and replaceable.

K. Factory cable assemblies may be pre-cut to length.

L. Locking multi-contact connectors shall mate with module terminations.

M. Wiring harnesses and cabling shall be UL listed.

N. Metal wire loom clamps or approved equivalent shall be used for cable fastening.

4.3 Low Voltage AC System Wiring

A. All conductors, lugs and cable accessories shall be UL listed.

B. No splicing shall be allowed.

C. System wiring installed in raceways shall be type THHN/THWN-2, or XHHW-2. Conductors may be stranded copper or aluminum.

D. System wiring installed in direct burial applications shall be type USE-2 with XLP insulation. Conductors may be stranded copper or aluminum.

E. When terminating aluminum conductors, coat conductor with oxide inhibitor and install per terminator manufacturer's instructions.

4.4 Medium Voltage AC System Wiring

A. Phase conductors shall be jacketed MV105 or MV90 (if temperatures are low enough), (dry or wet) single compact or compressed concentric conductor, aluminum, 100% or 133% EPR insulation, concentric neutral.

B. Equipment grounding conductor shall meet NEC requirements.

C. Conductor size to not exceed temperature rating of conductor insulation at full generation and to allow for no more than 2% voltage drop at full generation at Solar Substation connection.

D. System shall be designed such that MV conductor kW losses (from high-side of MV ISA transformer to Solar Substation) at full load do not exceed 1.25% in total across the entire facility at Project nameplate rated capacity.

E. Medium voltage terminations shall be 600 A-rated dead break elbows that meet the requirements of ANSI/IEEE 386. Allow 18" of slack to facilitate re-termination.

F. Provide fault indicators at MV terminations, except for those at the end of a circuit.

G. No splices shall be allowed unless long AC collection cabling runs required due to site geometry. In such cases, only above ground splice boxes, approved by Owner, shall be acceptable.

4.5 Overhead Medium Voltage AC Wiring

A. Overhead wiring shall be used where economically efficient in routing power to Solar Substation with minimal losses.

B. Overhead wiring and poles shall be routed so as to minimize shading on the solar arrays.

C. All overhead lines shall be designed to maintain all applicable code and regulatory clearance requirements.

4.6 Grounding

A. Grounding system shall meet the requirements of NEC, IEEE 80, and ANSI C2 at a minimum. Grounding design shall be verified in grounding study.

B. All electrical equipment shall be grounded in accordance with local, state, and federal electrical and safety codes and applicable standards.

C. ALL DER sites 100 kW or greater in size shall meet IEEE 1547-2018 7.4.1 and 7.4.2. The supplemental grounding requirements in Minnesota Power's TSM section 6.8 are applicable for all site 100 kW or greater if IEEE 1547-2018 7.4.1 and 7.4.2 are not satisfied by other means.

D. All grounding hardware shall be listed and approved for the application.

E. Where applicable, ground equipment per the manufacturer's requirements.

F. A ground test well shall be furnished at each ISA. A flush cover over the test well shall expose one ground rod and cable with mechanical cable to rod connectors to allow disconnection for testing purposes.

G. Contractor shall install supplemental fence grounding or isolation sections where deemed necessary by the grounding study.

H. Contractor shall provide the required grounding for the DER. IEEE 142-2007 is an appropriate reference for grounding.

4.7 Labeling and Identification

A. For diagnostic and troubleshooting purposes, all string harnesses and combiner boxes, or load break disconnects (LBD), shall be uniquely tagged and identified with such tagging on the record construction drawings. These cables shall have a label affixed to the outer jacket with a cable marker tape at each termination. The marker tapes shall be vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process. Marker tapes to be approved by Owner before installation.

B. As part of the Contractor Deliverables that must be delivered prior to Final Completion, Contractor shall provide to Owner a Microsoft Access database including all module serial numbers which can be sorted by array, combiner box or LBD, and harness. Contractor shall also submit an "As-Built" drawing depicting the physical location of each array, combiner box or LBD, and harness indicating the unique tag number for each combiner box or LBD and harness. Electrical equipment shall be labeled to meet applicable safety codes and requirements.

4.8 Electrical Studies

A. Contractor shall prove the design meets Contract requirements and all relevant standards by performing the following studies:

1. Short Circuit Study: fault analysis of collection system. Contractor shall show that all equipment is rated for the relevant fault current.
2. Ampacity Study: Contractor shall prove equipment will not exceed its temperature rating at full load. Ambient temperatures shall be per ASHRAE. Contractor shall use no less than a 60% load factor for cable design. Greater values for AC cables shall be used if the interconnect agreement requires VAR-at-night support or energy storage is included.
3. Load Flow and Reactive Power Compensation Study: Contractor shall prove Project performance will meet all GIA and IEEE 399 requirements.
4. Harmonics Study: Contractor shall prove Project meets all IEEE 399 harmonics requirements.
5. Grounding Study: Contractor shall prove Project meets all IEEE 80 requirements, taking into account considerations in IEEE 2778. Show that step and touch potentials on all exposed conductors, including tracker tubes and fence, do not pose a hazard to site personnel or the public. Perform the analysis using a soil model based on the Geotechnical survey, taking freezing and thawing conditions into account. Assume a 50 kg body and no PPE. Fault duration shall be per Protection Coordination Study, or 0.5s if it has not yet been performed.

6. Arc Flash Study: Contractor shall perform an arc flash hazard analysis in accordance with NFPA 70E and IEEE 1584, taking the relevant switching and generation scenarios into account. Analysis software shall be SKM and deliverables shall include .prj files and associated library files.

4.9 Electrical Equipment Enclosures

A. Control Cabinets, pull boxes and junction boxes shall be in accordance with NEMA Standards and type number and shall be suitable for the location conditions. Base design shall be:

1. Indoor: NEMA 1
2. Outdoor: NEMA 3R

B. All enclosures shall be provided with pad locking provisions.

4.10 Lightning Protection for Field Enclosures

A. Lightning protection, (where required) shall be limited to air terminals, down conductors and a connection to the ISA grounding electrode loop as well as surge arrestors at the inverter step-up transformer and inverter. Lightning protection (where required) shall comply with the requirements of NFPA 780 Standard for the Installation of Lightning Protection Systems. Master label certification is not required.

B. All components shall be un-insulated, copper, and exposed for inspection purposes.

5. FIRE PROTECTION

5.1 Fire Protection System

A. As necessary, the Contractor shall provide a complete fire protection system in accordance with the recommendations and requirements of NFPA, UL, FM, and the local Fire Marshal. The systems shall receive the approval of the Owner's insurance carrier. If including optional storage, BESS fire protection shall include provisions as defined in Exhibit F-1 - Scope of Work (BESS).

B. The engineer responsible for the fire protection system shall be a practicing fire protection engineer registered as a Professional Engineer in the applicable State. All drawings and specifications shall be signed and sealed by the Professional Engineer.

C. Portable CO_2 fire extinguishers of sufficient size shall be provided in all areas requiring handheld fire protection.

D. Fire walls for oil-filled transformers shall be provided between transformers and adjacent structures in accordance with Section 5.0 of NFPA 850.

E. Adequate access roads and spacing to PV arrays and equipment shall be provided as required by local Fire Marshal.

F. General

1. Fire protection during plant construction shall meet requirements and recommendations of NFPA 241.

2. All fire protection systems are subject to the review and approval of the local fire department authorities.

6. COMMUNICATIONS SHELTER

This section defines the requirements for the fabrication and delivery of at least one (1) prefabricated, transportable, non-inhabited, fire-resistant communications equipment shelter. The shelters shall be suitable for outdoor placement in the climate found in Northern Minnesota. The shelters will be used to house and protect control panels, metering, relay protection and fiber optic communications equipment utilized by the Owner as part of their existing control and communications network. If including optional storage, space allocation for control equipment necessary to operate the BESS shall be included.

Contractor shall submit a proposed floor plan for approval by the Owner.

6.1 Description of Shelters (required for sites greater than 1 MW).

A. Each communications shelter shall be prefabricated with an equipment compartment with cable ladder and communication and electrical line entry ports. The table below shows the shelter configuration and construction options required:

Building Size	Minimum 10'-0" X 14'-0" (8'-0" Ceiling Height) Min)	
Building Type	Precast Concrete	Metal or Wood Frame
HVAC	Electric	Electric
Electrical Panel	200A 120/240	200A 120/240

The building shall have a single door opening outward to the outside of the shelter.

6.2 Workmanship

A. The shelters shall be crafted with first-class workmanship in every respect. Walls, ceilings, floor and parts shall be aligned, plumb, level and straight. Force shall not be required to mount equipment or appurtenances on mounting studs, fasteners, bolts or screws. Holes shall be aligned so field drilling is not required. The exterior finish of the building shall be in unblemished condition when received on site. There shall be no patches, cracks, voids, or repairs indicating a less than new appearance. Wall penetrations for doors, louvers, HVAC units, conduits, cable entrance panel, doors and other equipment shall be properly caulked, sealed and made completely weather-tight and dust resistant. The communications shelter shall be fully functioning and tested such that it is ready for service upon connection to suitable electrical power sources.

6.3 Occupancy Classification

A. All buildings are intended for use as unoccupied operations facilities.

6.4 Applicable Codes

A. The proposed shelters and all associated equipment shall meet or exceed requirements of the following –

1. Uniform Building Code (UBC),
2. International Building Code (IBC),
3. Building Officials and Code Administrators (BOCA),

4. Interstate Industrialized Buildings Commission (Minnesota Certification),

The proposed shelters and associated equipment shall also meet or exceed all other relevant standards or approval authorities including but not limited to ACI, ANSI, ASTM, NFPA (NEC), and NEMA.

6.5 Exterior Finish and Color

A. Exterior finish of the shelters shall be natural stone exposed aggregate material or suitable metal siding. Color selections for painted exterior trim fixtures of shelters shall be coordinated at time of shop drawing approval. Contractor shall submit available wall color chips for Owner approval. Except for electrical fixtures, exterior finish of all metallic and other accessories and parts (doors, louvers, awnings, trim, etc.) shall be painted in a complementary tone subject to the painting specifications provided at time of shop drawing approval.

6.6 Shelter Construction

A. The shelter foundation and apron shall be reinforced concrete designed and constructed based on the recommendations of a final Geotechnical investigation and report performed by a licensed professional Engineer in applicable state. Additionally, foundation shall meet requirements of all applicable building codes.

B. The shelter shall be precast preassembled steel reinforced solid concrete, or metal, or wood frame. The shelter shall be designed and fabricated so that the interior floor is smooth and perfectly level, the walls are plumb, and the roof is symmetrical with an appropriate exterior sloped roof design to shed water and melting snow away from the building and extend past any wall mounted equipment.

C. The structure shall be fabricated upon a steel, rust resistant skid assembly of either beam and/or pipe-beam construction. The skid assembly shall be designed and sized for the loads presented by each building type. The structure shall be uniform in appearance and finish and shall be weather tight and free of holes or other irregularities which would allow the penetration of water, insects, vermin, or dust.

D. Each shelter shall have a floor system comprised of a reinforced construction suitable for supporting the floor loads stipulated within this specification. All surfaces shall be smooth. The interior surface shall be covered with 1/8 inch light colored commercial grade vinyl floor covering, bonded with a waterproof contact adhesive.

E. The roof panel shall be minimum 4” thick gable design with minimum 1/8” per foot drainage slope. The roof shall provide at least a 1” overhang on all sides. It shall cap and fit over the walls, leaving no exposed roof to wall joint. Plastic joint or corner trim shall be installed at all panel joints.

F. The wall panel shall be minimum 4” thick with an exterior exposed aggregate finish. Interior walls shall be finished with a smooth surface and light in color to permit maximum utilization of available light, and shall be designed to support loads as specified. Plastic joint or corner trim shall be installed at all panel joints. Floor to wall intersection shall be finished with 4” vinyl baseboard. There shall be no exposed wall to floor joint.

G. Insulation (or other thermal composition of the building fabrication design) shall be provided in roof, walls, and floor to achieve the following minimum performance objectives:

1. Floor: R-19
2. Roof: R-30
3. Walls: R-19

H. Door frames shall be 16 gauge galvanized steel, primed, painted and fastened to the wall panel. Doors shall be 18 gauge galvanized steel, insulated, rust resistant, and painted and shall have the following minimum dimensions:

1. 3’- 0” wide for equipment compartment;

2. 7’- 0” tall
3. 1¾” thick

Door position and hinge swing side shall be as defined on project shop drawings. The door threshold shall be not less than 3.5" or more than 6" above the concrete pad (or platform) upon which the shelter shall rest. The door jams shall sit perfectly flush with the interior of the shelter wall. The door threshold shall be of full width aluminum construction. The door shall be sealed and have weather strips on all sides.

I. The entry door and any exterior wall-mounted equipment shall have a drip cap/rain hood installed on the outside of the shelter. Doors shall be hung on 4" x 4" stainless steel hinges with non-removable pins. The hinges shall be bolted through the door jam with stainless steel fasteners. For tamper resistance, the hinges shall be oriented in the full-mortised position with no fasteners exposed when the door is closed. Each door shall include a heavy duty stainless steel door holder/closer. The device shall allow the door to be set in the open position. Once set in the open position, the holder/closer shall resist moderate wind and allow for shock absorption. The door stop mechanism shall prevent the door from contacting the outside wall of the shelter or any exterior fixtures. Doors shall be trimmed with weather-tight neoprene gaskets on all sides. The standard door hardware latching device shall be a single sided deadbolt lock with interior turn/release knob. An exterior anti-pick plate shall cover the bolt assembly. The Owner shall provide the successful bidder with the designated door lockset and manufacturer for Contractor to procure and install.

6.7 Drawings

A. Sufficient drawings shall be furnished to uniquely identify the proposed shelters including proposed foundation, unique site preparation needs, and overall shelter weights. Within five (5) calendar days after notice of intent to award a contract, the successful Contractor shall furnish preliminary shelter shop drawings in AutoCAD format to the Owner. The shop drawings shall show layout, proposed construction details, and bill of material. Not later than ten (10) calendar days after return of annotated shop drawings, Contractor shall furnish one (1) AutoCAD file and one (1) PDF copy of fabrication/approval drawings to the Owner for each new shelter showing details suitable for the intended purpose. The PDF copy shall be certified by a Minnesota registered professional engineer or architect who is competent and experienced in building design. Written evidence of all necessary building code approvals shall be furnished to the Owner by the Contractor, before construction of the shelters begins.

6.8 Environmental Performance

A. Temperature performance of the completed building shall provide for floor, roof, and wall systems that allow for thermal movements resulting from an ambient outdoor air temperature ranging from -40 F to +110 F. The design shall prevent separating or buckling, opening of joints, over-stressing of components, failure of joint sealants, failure of connections, and other detrimental effects which will shorten the life of the structure or the contents. Shelters shall be completely weather-tight and every seam or joint shall be sealed with an industrial grade polyurethane caulk during and after assembly. All exterior corner joints shall be capped with a one-piece aggregate corner cover as required to complete the exterior finish detail. The supplier shall be responsible for making field corrections, at the delivery site, of any joint separation or construction anomaly which may develop during the course of shipping, offloading, or setting of the shelter as part of the contracted work.

6.9 Fire Suppression

A. Built-in shelter fire suppression systems shall be as required per relevant codes. Shipped shelters shall include one (1), exposed, wall mounted fire extinguisher mounted inside each entry door as depicted below:

B. Communications Room: 10 lb. 'Halotron' Portable (1A,10B;C Rating)

6.10 Delivery & Installation

A. All shelters shall be delivered, offloaded, and set upon the foundation constructed and prepared by Contractor. All delivery costs shall be listed separate from actual shelter fabrication cost. Contractor shall list any special resources (lifting equipment, crew size, etc.) required to offload and set various shelter options.

B. Special handling equipment, local permits or other requirements not related to shelter transportation costs shall not be included in delivery cost. Such additional costs shall be separately identified as a narrative attachment to the proposal. Owner shall have the option of coming to manufacturer's facility to complete pre-shipment inspections with travel and accommodations being paid by Owner. If Owner is unable to complete a pre-shipment inspection onsite, the manufacturer shall be required to provide detailed photographic evidence of the construction and final product to Owner prior to shipment.

6.11 Permits & Inspections

A. Not less than ten (10) working days before the completed shelter(s) are scheduled for shipment; Contractor shall notify the Owner that the shelter(s) are being scheduled for release from the factory. At the option of the Owner, the shelter(s) may be inspected by the Owner at the manufacturing facility for assurance that construction and fabrication practices reflect the requirements of the shop drawings and will meet the needs of the project.

Any defects or corrections identified during the pre-shipment inspection or through the photographs sent to the Owner shall be corrected at no cost prior to release of the shelter(s) from the factory. Any modifications which vary from approved shop drawings as requested by the Owner during the pre-shipment inspection or photographs shall be subject to approval via the change order process.

6.12 Structural Loading

A. The shelter shall meet the following loading requirements.

1. Roof Live: The design shall allow for live loads of 125 pounds per square foot as defined in ANSI A58.1. The roof shall resist impact of a falling object weighing 220 lbs without damage or deflection to either the interior or exterior of the shelter.
2. Roof Snow: The design shall allow for roof snow load of 115 pounds per square foot as defined in ANSI A58.1.
3. Walls: Minimum wall depth shall be 4". In locations shown by applicable notes on the shop drawings, interior walls shall provide adequate strength to support hanging of equipment with minimum dead weight loads of 175 lbs.
4. Floor: Uniformly placed floor loads of 350 pounds per square foot are contemplated in the communications equipment areas.
5. Wind: The design shall allow for a maximum wind speed of 150 miles per hour per ANSI A58.1.

6.13 Rodent Resistance

A. Unless an applicable substitute is approved, the underside of the floor assembly, and any exposed wood surfaces, shall be covered with a 16-mesh (.011 wire) rodent shield before the floor assembly is attached to the skid assembly.

6.14 Handling & Offloading

A. All components provided inside buildings shall be installed at manufacturing location to verify fit, finish and alignment. All shelters shall be provided with lifting rings so that the shelter can be hoisted up using overhead equipment such as cranes or boom trucks. Shelter handling instructions shall be provided with each delivery to help the receiving party properly determine how to handle the shelter once it is set in place at the site.

6.15 Shelter Warranty

A. The shelter shall carry a ten (10) year limited warranty, which covers the materials and workmanship of the enclosure. The shelter manufacturer's liability on an item purchased from others, by manufacturer, and installed in a shelter shall be stipulated with the bid for each respective item

6.16 Factory Installed and Packaged Shelter Subsystems

A. Alarm System

1. Alarm Control Point (ACP)

a. The ACP (Marshalling Point) shall be located within the communications equipment room. All door intrusion sensors, smoke/fire detection sensors and high/low temperature sensors shall be wired to the ACP for inclusion in the customer owned equipment. Owner will specify the exact location of the ACP on the shop drawings. The general location shall be near the electrical panels. The ACP shall receive inputs via normally open (NO) sensor or detector. Each connection on the ACP shall present on a set of isolated contacts on a Type '66' communications block that is to be furnished with the shelter and interfaced to other external annunciation equipment by others. Upon alarm, these external contacts remain active for the duration of the alarm condition.

b. Door Intrusion Sensors

i. Each shelter entry door shall be outfitted with one (1) set of NO magnetic switch contacts. Each set of contacts shall separately deliver NO circuit continuity to the ACP. Upon opening the shelter entry door, the associated contact for that door shall change to a closed contact status and remain in that state until the door is re-secured. Wiring from door intrusion sensors shall be via conduit or armored flexible cable to the ACP.

c. Smoke/Fire Detection Sensors

i. Each shelter shall have at least one (1) independently functioning smoke/fire detector with NO contacts. The detectors shall be mounted to the ceiling and spaced appropriately to provide uniform room coverage. The detectors shall be combination devices incorporating both rate-of-rise (temperature) and ionizing detection technology. Wiring from fire detection sensors shall be via conduit or armored flexible cable to the ACP.

d. Independent High/Low Temperature Sensors

i. Each shelter compartment shall contain one (1) each, Normally Open high and low temperature alarm sensors wired to the ACP. The high/low temperature alarm sensors shall be independent of alarm sensors furnished as part of the HVAC package. Set points for the high and low temperature limits shall be field adjustable with the selected set point clearly visible on a dial or indicator as part of the assembly.

6.17 Electrical Package

A. All furnished electrical packages are to be installed and wired in conformity to the latest edition of the National Electric Code. A suitable penetration will be provided to allow for a 2/0 ground wire to be routed from the ground bar in the building to the grounding grid inside the fence of the solar site. This penetration will be located and sized on the approval drawings.

B. All shelters shall include an electrical package which shall consist of:

1. Load Center and Transient Voltage Surge Suppression (TVSS)
2. 2” through wall electrical entrance penetration into the Load Center and rated service disconnect on the outside of the building
3. Feeder and Branch circuit conduit, boxes, wire, fixtures, outlets, and interior grounding and bonding materials

C. Basic Shelter Electrical Requirements

1. All wiring shall be carried through the structure via UL listed thin wall conduit. Where interior grounding conductors penetrate walls, floor or ceiling, the ground should pass through the partition via PVC conduit sleeve. Use of “seal tight” or other flexible conduit shall be allowed as permitted on shop drawings and applicable codes; use of “SO” cord connections shall be as permitted on shop drawings and applicable codes. Conduit fill capacity shall strictly observe the limits imposed by the NEC; any conduit which has reached its fill limit at time of production shall be upsized to the next largest conduit dimension. All wiring, conduit, and equipment mounted inside and outside the building shall be aligned, plumb, level, straight and square to the building and equipment. Flexible conduits shall be cut to length without excessive slack or bends.

2. General Material Summary

ITEM	DESCRIPTION	MFR	UNITS
1	Lighting Panel w/ 200A Main Disconnect	Square – D, C-H	1
2	2 Ton Wall Mounted HVAC Unit, 7.5 kW heat strip, Tan, RH, Econ		1
3	Thermostat Controller		1
4	Master Ground Bars		2
5	12" Cable Ladder Tray		lot
6	Smoke Detector		1
7	4’, 2 Bulb LED Light Fixture		4
8	19” Rack Mount enclosures		A/R
9	Convenience outlets, duplex		4
10	Security light, dusk to dawn		1

3. Additional Notes:

   a. All furnished electrical packages are to be installed and wired in conformity to the latest edition of the National Electric Code. Shop drawings shall include a conduit fill table.

   b. Ground door frame, cable tray, service boxes to the grounding system. Do not ground baseboard heaters, disconnects, wireway or distribution panel enclosures to the grounding system.

   c. Interior green 2/0 ground to connect to each end of the interior master ground bar and flow through the cable ladder on the bottom of double J-hooks. This 2/0 open ring is two separate runs and is spaced 1' apart where they would meet. Interior grounding system is to be kept away from any metal conduit a minimum of 1 ½".

   d. Penetrations located in the floor will be identified on the Approval Drawings and allow for a conduit raceway. There will be a rectangular floor penetration for the Metering equipment, Solar Field low voltage, Solar Field Communications, Re-closer low voltage and fiber optic cable. The penetration will provide a barrier against insects and vermin and have a suitable interior cover to seal the hole.

   e. Every electrical circuit device (outlet, switch, HVAC device, etc.) shall be properly labeled with a permanent, securely affixed, non-fading label which identifies the panel board number and circuit ID.

   f. Furnish and install Qty. one (1) exterior, high efficiency, security down light with dusk to dawn sensor; single circuit, switched

   g. Furnish and install wall outlets as specified on shop drawings and per relevant codes.

   h. Furnish and install Qty. one (1) 120 VAC, 20 AMP GFCI, weather proof, exterior receptacle

   i. Unless otherwise specified herein, install interior grounding system as per Motorola 'R56' and Owner specifications.

   j. Furnish and install Qty. one (1) 3/4" flexible conduit drop with two (2) 30A, 240 VAC circuits for battery charging equipment as specified on shop drawings and per relevant codes

   k. Install a single 20A, 120 VAC drop to be inserted into cable management on its own circuit. Exact location to be determined by the owner.

   l. Install awnings over exterior doors. Awnings shall extend two feet from the building with a total width to be a minimum of the door frame exterior dimension plus one foot on either side. Awnings shall direct rain and snow away from the side above the door handle.

6.18 Shelter mechanical & HVAC systems

A. The building shall be equipped with an HVAC system as described below. Pre-approved manufacturer of HVAC equipment shall be Bard, but bidder may propose a suitable substitute. The HVAC units shall be designed for wall mounting and shall consume no interior space within the shelter. HVAC units shall be equipped with dual blowers having multi-speed capability. Internal, make-up heat strips shall be provided. The HVAC systems shall be outfitted to automatically operate in an "Economizer" mode permitting reduction of energy costs when environmental conditions permit its use. HVAC unit shall be configured for single sided service access. The HVAC unit shall be adequately sized to meet the requirements of the shelter and maintain an interior ambient temperature between 68 and 70 Degrees F.

B. The following minimum mechanical/HVAC systems are required:

1. Qty. One (1)
2. Input voltage 240 VAC, Single Phase
3. Compressor Type: Scroll
4. SEER efficiency: Minimum 10
5. 2 Ton Cooling Capacity (Based on building size and design)
6. 7.5 kW Heat Strip (Based on building size and design)
7. Filter: 2" Pleated 35% dust spot efficiency
8. Alarm relay kit
9. Painted Housing
10. Awnings
11. Solid State Lead/Lag Controller, Thermostat Equipment Room Ventilation

7. SITE WORK

7.1 General Requirements

A. This section covers the minimum scope and quality for the plant civil design and construction.

B. Contractor shall develop a Worker Environmental Training Program. All site personnel shall undergo the Worker Environmental Training Program prior to being allowed to work on the site.

C. Contractor is responsible to inspect the Site, obtain all necessary Site data, obtain all required geotechnical and drainage investigations, and determine all Site data for the design and construction of the PV power plant. This shall include determination of local code requirements for seismic and wind design loads. It is Contractor's sole responsibility to ensure that the Site work complies with all federal, state, and local code requirements and all applicable industry codes and standards, including standards of applicable authority having jurisdiction.

D. The scope shall include, but not be limited to the following:

1. Design and prepare the construction plans, final design reports, and project specifications for the civil site work, including the storm water drainage, grading, roads, temporary construction facilities, etc. All must meet the approvals of the Owner and jurisdictional government agencies.
2. Coordinate design with other engineering firms and utilities responsible for scope outside of its own scope.
3. Obtain all necessary permitting associated with civil site work construction such as wetland permits, grading permits, haul permits, dust permits, storm water pollution prevention plans, etc., in compliance with City or County requirements and other jurisdictional government agencies as may pertain.
4. Construction of all civil site work, including the storm water drainage infrastructure, earth grading, roads, security fencing, etc. Construction of any temporary civil site work such as temporary security fencing, temporary construction roads, etc.
5. Perform flood damage management and storm water pollution management during construction in compliance with state and local sediment and erosion control rules, regulations, ordinances and approved Storm Water Pollution Prevention Plan (SWPPP).
6. Perform dust control measures during construction in compliance with state and local rules, plans, regulations, permits and ordinances for fugitive dust emissions.
7. Perform the geotechnical evaluations as necessary for the civil site work.
8. Prepare the drainage report(s) to meet applicable agency's permit requirements.
9. Perform all construction surveys (construction staking).
10. Prepare record drawings that depict any deviation from original design drawings.
11. Contractor shall prepare a Vegetation Management Plan to address establishment or site vegetation upon the completion of construction and continue to maintain the vegetation for 3 years after COD.

E. The Project design shall take into account existing site conditions with respect to soil characteristics, site clearing, grading, and drainage. The Contractor shall be responsible for all site preparation including any demolition, soil stabilization, grading, drainage, roadways, and temporary parking areas.

7.2 Units

A. All design dimensions and design calculations shall be in British (United States Customary) units (Feet/Inches).

7.3 Geotechnical

A. The Contractor's final design shall be based on the recommendations of a final Geotechnical investigation and report performed by a licensed professional Engineer in the applicable state.

7.4 Construction Surveys

A. Contractor is responsible for the construction surveying and staking. All construction surveying and staking shall be performed under the supervision of a surveyor licensed in the applicable state. Environmentally sensitive areas shall be flagged in a different color than other flagging.

B. Contractor is responsible for all surveys required for environmental and cultural permitting; and shall meet all such permit requirements during the execution of the Project.

7.5 Site Preparation and Maintenance

A. Site Clearing and Grubbing

1. Immediately prior to Substantial Completion, Contractor shall remove all weeds and trim all native vegetation from areas surrounding PV Modules, other electrical equipment and site infrastructure, in compliance with the Revegetation Plan. The Contractor shall be responsible for all applicable permitting with jurisdictional agencies for use of herbicides should the decision be made to use them during construction.
2. Owner will provide specific clearing and grubbing restrictions, if any.

B. Debris

1. All construction-related debris and unsuitable material including material from site clearing and grubbing shall become the immediate property of Contractor and shall be removed from the premises and lawfully disposed of off-Site by Contractor at Contractor's cost.

C. Stormwater Management and Erosion Control

1. Contractor shall prepare a Storm Water Pollution Prevention Plan (SWPPP) for its construction activities. The Contractor shall be responsible for installing and maintaining the storm water controls and best management practices in compliance with the SWPPP. The Contractor shall provide for sediment and erosion control during and after construction in accordance with project permits and local and state laws and regulations. Best management practices such as check dams and sedimentation basins shall be used during construction to minimize erosion. Long-term operational best management practices shall be installed prior to substantial completion and be designed to minimize erosion on site and sedimentation of waterways.
2. Drainage facilities shall be designed and constructed in a manner to minimize erosion and prevent excessive erosion within the Array areas. Excessive erosion shall be considered as anticipated erosion exposing the pile such that the design embedment depth is no longer met. Drainage facilities should also be designed to limit off-site sedimentation of waterways per applicable regulations or permits and may include retention basins as appropriate to achieve these objectives.
3. Drainage design shall be approved by AHJ, as applicable.
4. Contractor shall design and construct site grading/drainage to minimize potential for site flooding and ponding. The working area of the site shall be well drained during and after

construction. The civil drainage infrastructure design shall conform with the standard of the jurisdictional government agencies.

5. Contractor shall prepare drainage report(s) to support obtaining construction permits for the project, as applicable. The report(s) shall meet the standards and requirements of the applicable agency and shall describe the final design of the storm water drainage infrastructure and provide the hydrologic and hydraulic calculations applied.
6. The Contractor shall prepare a design meeting the acceptance of Owner, such acceptance shall not be unreasonably withheld, which incorporates permanent, long-term measures which mitigate the flood potential associated with on-site generated storm water runoff.
7. Waters of the United States shall not be impacted, filled, or used in connection with the site drainage plan unless proper permits are obtained.

D. Road Maintenance

1. All temporary access roadways used by Contractor, as well as the new site permanent roads shall be maintained in serviceable condition. Contractor shall keep the surfaces of those roadways free from spills, mounds, depressions, and obstructions, which might present a safety hazard or annoyance to traffic.
2. Contractor shall be responsible for securing authorization and permits to transport oversized/overweight loads on local, County and State roads for the supply of materials under Contractor's scope.
3. Contractor shall supply and install any temporary or permanent facilities required to facilitate delivery of Contractor and Owner equipment/materials. Contractor shall also be responsible for removing all such temporary facilities.

E. Signs and Barricades

1. Signs and barricades shall be provided and maintained by Contractor and shall be in accordance with jurisdictional regulations for accident prevention and Contractor's safety plan. Signs shall further comply with any County-specific design standards.

F. Dust Control

1. Dust Control for Construction Activities
    a. Contractor shall be responsible for obtaining dust control permits, if required, and complying with requirements of said permit. Contractor shall be responsible for compliance with State and local requirements for fugitive dust emissions and shall obtain local authority approvals and conform to the dust control regulations and reporting requirements.
    b. Contractor is responsible for locating source of construction water to support dust control and construction activities.

G. Open Burning

1. Onsite open burning is not permitted.

H. Earth Grading

1. Contractor shall balance the earth grading and leave no stockpiles or pits remaining at the completion of the full build-out of the project. (Stock piling in accordance with applicable regulations may be permitted in support of phased construction.) The grading design shall balance the earth work such that no major volumes of soils will be imported or exported from the Site for grading purposes. Any permitting, or costs for import or disposal will be the responsibility of the Contractor.
2. The Contractor is responsible to meet the grades and slopes as necessary to support the solar installation. The Contractor is responsible for any re-grading or repair costs

associated with not providing ground surfaces which adequately support the solar installation.

3. Contractor shall identify site specific grading restrictions, if any.

I. Excavation, Filling, and Backfilling

1. Excavated native material may be used on the site for embankment and backfill, if suitable. All unsuitable materials such as; rock, concrete, wood, metal, and other materials from the excavation shall be considered debris and disposed of as described herein.
2. Structural fill, bedding material, topsoil, and other materials not readily available on site shall be procured, tested, and delivered to the site by the Contractor.
3. Contractor shall be solely responsible for maintaining the stability of all excavated faces and shall provide adequate sheeting, shoring, and bracing to support any lateral earth pressure.
4. Contractor shall be solely responsible for protecting personnel and adjacent structures against any damage from cave-ins, heaving or other earth movements. Sheeting, shoring and bracing shall be removed as backfilling proceeds or it may, with the approval of Owner, be left fully or partially in place.
5. Fill characteristics and compaction requirements shall be determined by Contractor's geotechnical investigation and report recommendations.
6. All equipment used to meet compaction requirements shall be specifically designed for such duty.

7.6 Roads

A. Site Access:

1. Site Access road improvement shall be the responsibility of the Contractor.
2. Access to the Site will be constructed in accordance with applicable agency requirements, including, but not limited to the local fire department.
3. Contractor shall be responsible to obtain and comply with all encroachment permits required to construct driveway aprons or otherwise connect access roads to county-maintained roads, as applicable.

B. Roads on-site shall consist of the following:

1. The perimeter roads shall be routed around the exterior of the solar arrays, connecting the Solar Substation, O&M Building (if applicable), inverter access driveways, and any areas designated for flood management. Roads shall be stabilized in accordance with the recommendations of the geotechnical evaluations.
2. Array access driveways shall be constructed to provide access to the interior array inverters. Array access driveways shall consist of a compacted aggregate roadway. Widths will vary depending on design, but design should consider access requirements for operations and maintenance.

C. Access Design Characteristics

1. The following plant design characteristics shall be adhered to:
   a. At a minimum, roads for accessing inverters, MET, Communications Shelter, and substation shall be designed to accommodate Owner specified design vehicles. A design vehicle is to be defined for this project to be a typical crane used in placement and servicing of site equipment, such as inverters. Contractor shall model vehicle swept paths with AutoTURN software or equivalent to verify design

vehicle accommodations in road designs. Modeling reports shall be provided to Owner for review.

b. Inverter access road width shall be at minimum 12-feet wide within a 20-foot corridor to allow access by design vehicles.

c. Substation/Communications Shelter access road width shall be at minimum 20-feet wide to allow access by design vehicles.

d. Site design shall include a 20-foot width from module edge to fence line to allow for operations and maintenance access after plant is in operation.

e. The perimeter road width shall be at minimum 16 feet with an additional 6 feet of cleared ground on either side to allow sufficient space to get a tractor trailer and or crane down a row to replace transformers or inverters in the event one fails.

f. All roads shall have sufficient turning radii (30' minimum) for expected use of design vehicles.

g. All roads shall meet minimum requirements of local fire department or AHJ, if required.

h. The minimum distance between an inverter and the nearest module shall allow for maintenance and repair of any and all components of the ISA with locally available equipment.

i. Design to provide for adequate snow storage and clearing locations to allow access to the Communications Shelter and inverters.

j. All roads to be designed for HS-20 loading.

7.7 Security

A. A game fence shall be installed around the perimeter of the site.

1. Alternative fencing is not allowed unless authorized by Owner.

B. Permanent perimeter fence shall consist of 6'-3" minimum of Stay-Tuff Deer Fence Wire 1775-6 Class 3 or approved equal with a single barbed wire 9 inches above top of game fence fabric. See Exhibit 14 for additional fence details. End, corner, and gate posts shall be set in concrete. Fence fabric shall be no more than 2 inches above finish grade. Contractor shall provide a temporary physical barrier between completed Circuits in the custody of the Owner and Circuits under construction by the Contractor. The physical barrier shall allow for controlled access to the completed Circuits in the custody of the Owner. Contractor shall move all such fencing, as necessary, as Circuits are turned over to Owner, and shall remove all temporary fencing prior to Project Substantial Completion. Materials for site game fencing shall meet the requirements of Game Fence Details in Exhibit 14. Security site specific design requirement as set forth in this Attachment F.

C. Gates:

1. Main Entrance Contractor shall install a minimum 20-foot wide swing gate.

2. Maintenance Gates: Contractor shall install swing gates as required to allow access to all areas of the site.

a. Gates shall be swing type, hinged to swing 180 degrees from closed to open, complete with frames, latches, stops, keepers, hinges, fabric, and braces.

b. Latches shall be plunger-bar type with locking device and padlock eyes integral to the latch. Keeper to automatically engage gate leaf and secure free end of gate in open position.

D. Contractor shall repair and/or replace fencing damaged by construction activities.

E. Cameras and Lighting: At a minimum, one camera and lighting shall be installed at the main gate of the site and of the Communications Shelter with a view of the entire site. See Exhibit 1 for additional requirements.

7.8 Vegetation Management Plan

A. Contractor shall prepare a Vegetation Management Plan developed by Contractor that meets Owner and permitting requirements. Ground cover and vegetation management shall be included in the proposal. At a minimum the plan shall include provisions for:

1. Site specific native species pollinator habitat seed mix
    a. Seeding plan and methodology
2. 3-year establishment management plan
3. Warranty terms for vegetation establishment
4. Long term O&M options for contracting or training as needed for best practice long term maintenance. Sheep grazing will be considered as a viable strategy in the long-term vegetation management plan.

7.9 As-Built Drawings

A. Contractor shall prepare as-built drawings as may be necessary to meet the standards of the jurisdictional government agencies. At minimum, Contractor shall prepare as-built drawings for the Owner's record which contain as-built elevations, dimensions, etc. and any variation from the design drawings, sealed by an engineer or surveyor licensed in the applicable state.

8. STRUCTURAL

8.1 Materials

A. Steel

1. Design of hot-rolled structural and miscellaneous steel shall be in accordance with the American Institute of Steel Construction (AISC) “Manual of Steel Construction”. Design of structural and miscellaneous steel shall also be in accordance with National Electrical Manufacturers Association (NEMA) “SG6” and “TT1”, American Society of Civil Engineers (ACSE) “Guide for the Design of Steel Transmission Towers, Manual No. 52” and the International Code Council “International Building Code”. Design of cold-formed steel shall be in accordance with the American Iron and Steel Institute (ANSI) “North American Specifications for the Design of Cold-Formed Steel Structural Members”.
2. Materials for structural steel and miscellaneous steel shall conform to the following requirements of the American Society for Testing and Materials:
    a. Wide Flange (WF) Shapes and Tees cut from WF: ASTM A992, Grade 50 or multi-certification A36/A572, Grade 50.
    b. M shapes, S shapes, HP (Bearing Piles), Channels, and Angles: ASTM A36
    c. Structural Plates and Bars: ASTM A36
    d. Square/Rectangular Hollow Structural Sections (HHS): ASTM A500 Grade B
    e. Pipe: A53, Grade B
3. High strength bolts, nuts, and washers shall conform to ASTM A325, ASTM A563, and ASTM F436 respectively and shall be galvanized in accordance with ASTM A2329.
4. Bolts, nuts and washers under one-half inch in diameter shall conform to ASTM A307, Grade B, ASTM 563 and ASTM F844 respectively and shall be galvanized in accordance with ASTM F2329.
5. Anchor bolts, anchor bolt assemblies and concrete embedments shall be galvanized.
6. Anchor bolts shall conform to ASTM A449, ASTM F1554, Grade 36, or A307. Anchor bolt sleeves shall conform to ASTM A501.
7. All structural welding shall conform to the requirements of AWS D1.1.
8. Galvanizing, as specified herein, shall conform to the requirements of ASTM A123, ASTM A153 or ASTM A2329, as applicable.
9. Stainless steel shall conform to ASTM A167.

B. Aluminum

1. Design of structural and miscellaneous aluminum shall be in accordance with the latest version of the Aluminum Association – “Aluminum Design Manual” and “Aluminum Standards and Data”.
2. Materials for structural and miscellaneous aluminum, including structural shapes and plate, shall conform to ASTM B209 and ASTM B308 and shall be aluminum alloy 6061-T6.
3. Bolts and nuts shall conform to ASTM F468 and ASTM 467, respectively and shall be aluminum alloy 6061-T6. Washers shall be aluminum-clad steel Alclad 2024-T4 or approved equal.

C. Concrete

1. Design of structural concrete shall be in accordance with the latest version of the American Concrete Institute (ACI) - "Building Code Requirements for Structural Concrete," ACI 318. All concrete formwork shall conform to ACI 347.
2. Hot and cold weather concreting shall be in accordance with the latest version of ACI 305 and 306.
3. Concrete intended for use on native soil shall be specified consistent with the properties of the soil. Concrete mix proportions, including documentation of materials, admixture product information, and compressive strength of mix, shall be submitted and approved by the Owner prior to placing concrete.
4. Minimum concrete strength classes for various structures shall be as follows:

Item	Minimum Ultimate Compressive Strength (psi) (at 28 Days)
Electrical Duct banks	3,000
Major equipment/structures where required and all other construction	4,500

5. Reinforcing bars shall be deformed bars conforming to ASTM A615, Grade 60. Welded wire fabric shall conform to ASTM A185. Plain wire shall conform to ASTM A82. Placement shall be in accordance with Chapters 7 and 12 of ACI 318 and the Manual of Standard Practice of The Concrete Reinforcing Steel Institute.
6. Cement shall be Portland cement conforming to ASTM C150, Type I or Type II or as suggested by the Contractor's Geotechnical report.
7. Aggregates for normal weight concrete shall conform to ASTM C33.
8. All foundations shall extend a minimum of 6 inches above the adjacent finish grade.
9. All concrete trucks may be rinsed out at one designated location on-site in accordance with applicable permits. Rinse material shall be properly disposed of off-site.

8.2 Concrete Testing

A. Field testing and sampling shall be performed by an independent testing laboratory at Contractor's expense. The testing technician shall be an ACI Concrete Field Testing Technician Grade 1.

B. Compressive strength determinations shall be made from 6-inch diameter by twelve-inch long concrete cylinders or 4-inch diameter by eight-inch long concrete cylinders tested in accordance with ASTM C39. Cylinders shall be prepared for compressive strength tests on concrete with a designed compressive strength of 2,500 psi or higher for the following conditions:
   1. Each one hundred (100) cubic yards or fraction thereof of concrete poured;
   2. At least once per day
   3. For each 5,000 square feet of surface area for slabs or walls.
   4. A minimum of four concrete cylinders shall be prepared from each composite sample.

C. Field slump tests shall be performed in accordance with ASTM C143 and shall be performed for the following conditions:
   1. The first batch produced each day,
   2. For every 50 cubic yards or fraction thereafter, and
   3. With every set of test cylinders.

D. 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 the American Society of Testing Materials (ASTM). Test results shall be provided to Owner for records within 30 days of test completion. In the event of failure of any aforementioned test, the Owner shall be notified.

8.3 Structural Loading

A. Contractor shall determine all Site data for the design and construction of the plant. This shall include determination of local code requirements for seismic and wind design loads. It is the Contractor's sole responsibility to ensure that the plant structural and architectural facilities comply with all federal, state, and local code requirements and all industry codes and standards.

B. Structural loads shall be applied with post embedment depth accounting for maximum scour associated with 100-year storm event.

C. Dead Loads

1. Dead loads shall include all vertical loads due to weight of permanent structural and nonstructural components, including permanent hung loads.

D. Live Loads

1. Live loads shall be in accordance with the IBC and ASCE 7 as modified by the applicable agency Local Additions and Addenda.

E. Snow Loads

1. Snow loads shall be in accordance with the IBC and ASCE 7 as modified by the applicable agency Local Additions and Addenda

F. Wind Loads

1. Wind loads shall be in accordance with the adopted versions of the IBC and ASCE 7, as modified by the applicable agency Local Additions and Addenda. Wind tunnel testing method is permitted upon explicit Owner consent. Irrespective of any wind tunnel testing results, the minimum design wind pressure shall be no less than 10 pounds per square foot (psf) applied normal to the face of each PV module. The PV module rack shall be designed in such a way that deflections due to wind will not damage the PV modules. Contractor shall ensure that the PV modules support foundations can withstand the uplift due to wind loading.

G. Seismic Loads

1. Seismic loads shall be in accordance with the adopted versions of the IBC and ASCE 7, as modified by the applicable agency Local Additions and Addenda. The soil profile type shall be determined by the Contractor based on the results of a subsurface investigation, which shall be obtained by the Contractor.

H. Thermal Loads

1. Buildings and structures shall be designed for forces and/or movements resulting from changes in temperature. Induced thermal loads (i.e., thermal loads induced by equipment operating temperatures) shall be considered in design of applicable structural elements.

I. Adfreeze Loads

1. Adfreeze (frost heave) shall be designed in accordance with recommendations of Contractor's Geotechnical Engineer. Provisions for mitigating adfreeze shall be included in the design.

J. Vehicle Loads

1. Design loading, for areas accessible to trucks, shall be (AASHTO) HS20.

K. Soil and Hydrostatic Pressure Loads

1. Earth pressure and hydrostatic pressure loads shall be based on the geotechnical conditions and groundwater levels at the project site.

L. Transmission Line Loads

1. In addition to the aforementioned loading criteria, overhead transmission loads shall also conform to ASCE Manuals and Reports on Engineering Practice No. 74 “Guidelines for Electrical Transmission Line Structural Loading” and to NESC requirements.

M. Load Combinations

1. Load combinations shall be in accordance with the IBC and ASCE 7. If the state or county that the project is located in has any Additions or Addenda to this code, it is the Contractor’s responsibility to determine this and adhere to it.

8.4 Structural Foundations

A. Type of foundations required and allowable bearing values for soil and rock shall be as recommended by Contractor's Geotechnical Engineer based on the subsurface conditions found in the Contractor’s Geotechnical report. All loose materials shall be removed from excavation bottoms. Unsatisfactory foundation subgrade material shall be removed and replaced with compacted structural fill material or with 2000 psi (minimum) concrete. Total foundation settlements will be limited to 1 inch or as required by applicable building or industry codes, and equipment supplier’s recommendations.

B. A minimum of 18 inches of the native soil to be removed and compacted to 95% of relative compaction as a subgrade for various concrete housekeeping pads.

1. All equipment used to meet compaction requirements shall be specifically designed for such duty.

C. Building and Equipment Foundations

1. Building and equipment foundations shall be of reinforced concrete and shall include all formwork, rebar, waterstop, etc.

D. Transformer Foundation and Containment

1. Transformers shall be provided with secondary oil containment equal to 110% of the volume of oil present in the transformer.

8.5 Corrosion Protection

A. In general, all exposed carbon steel surfaces shall be treated for corrosion protection. Contractor shall design and specify corrosion protection systems, which shall include surface preparation measures, for the following conditions:

1. Carbon steel exposed to ambient environmental conditions (i.e., PV module support structure, if applicable)

2. Carbon steel exposed to soil conditions below grade (i.e., driven or augured piles, if applicable). This coating shall be designed such that it is not damaged during installation. The Contractor shall consult a corrosion engineer to recommend corrosion protection measures based on the soil conditions. Submit the corrosion engineer’s recommendations to the Owner for information and acceptance of the recommendations. In no case, however, shall a galvanized coating be assumed to last the life of the project.

B. Stainless steel and galvanized steel shall not be painted.

8.6 Buildings/Structures (if applicable)

A. The Contractor shall obtain Owner's approval of building arrangements prior to detailed design.

9. COMMISSIONING AND PROJECT ACCEPTANCE TESTING

9.1 Commissioning, Functional Testing & Capacity Testing

See Exhibits 5 and 6 for requirements of Commissioning, Functional Testing, and Capacity Testing. If including optional storage, Contractor shall provide a Functional Testing plan to Owner for approval demonstrating the integration of BESS and PV generation, including the charging of the BESS from local PV generation. BESS capacity testing requirements shall be considered as detailed in Exhibit F-2 - Performance Testing Procedures (BESS).

10. PROJECT AND CONSTRUCTION MANAGEMENT

10.1 Staffing

A. Contractor shall provide the appropriate personnel to manage all aspects of the Work.

B. Contractor shall ensure an OSHA “competent” person be present during all work hours.

C. Contractor may work on Site at any time subject to Applicable Laws. In project areas with residents within ½ mile from the site, pile driving activities shall be limited to 8:00 AM – 5:00 PM or as otherwise agreed upon.

10.2 Reporting/Meetings

A. Contractor shall provide progress and schedule reporting on a weekly basis. A two-week look ahead of activities shall be provided at weekly reoccurring meetings with the Owner, Contractor and Contractor’s subcontractors.

B. Progress meetings shall be held at the Site on a weekly basis on dates mutually agreeable to Owner and Contractor.

10.3 Safety Plan

A. Contractor shall maintain a safety plan and observe all safety practices required for performing construction work of this type including OSHA standards.

B. Contractor shall submit final Safety Plan, per the requirements of Exhibit 4, a minimum of 30 days before the start of construction for review and approval.

10.4 Work Schedule

A. Contractor shall submit a detailed schedule in native file using Primavera P6 or similar mutually agreed upon project management software which also meets the requirements of Exhibit 7.

B. The Project Schedule shall be updated monthly against the baseline schedule and submitted to the Owner.

11. DESIGN ENGINEERING

11.1 Engineering Design Package

A. Contractor shall develop a comprehensive design package consisting of drawings generated in a format in accordance with Exhibit 2. Design packages and submittals shall be provided for Owner review in native or PDF format.

EXHIBIT 1 – METERING, TRANSFORMERS, RELAY AND COMMUNICATIONS

1. METERING REQUIREMENTS

A. 277/480 volt metering allowed up to 2 MW.

1. Voltages above 277/480 require primary metering for all installations.

B. Above 5 MW on a 15 kV or less system requires more specialized equipment and H frame pole structures to be engineered.

C. All other Minnesota Power TSM requirements apply.

2. TRANSFORMER REQUIREMENTS

A. Contractor to procure transformer for the site. MP to review and approve transformer specifications.

B. Grounding Requirements:

3-phase DER step-up transformer winding configuration:

Inverter-Based DER

Primary Winding	Secondary Winding	Zero Seq Continuity Maintained	Allowed for DER interconnection when feeder load is >= 50% Line-to-Ground Connected	Allowed for DER interconnection when feeder load is < 50% Line-to-Ground Connected
Wye-grounded	Wye-grounded	Yes (w/ 4-wire LV)	Yes*	Yes (1)
Wye-grounded	Wye	No	Yes	Yes (1)
Wye-grounded	Delta	No	No	Requires Review (2)
Delta	Any	No	Yes	Yes (1)

3. RELAY AND GROUNDING REQUIREMENTS

3.1 Direct Transfer Trip

In special circumstances Minnesota Power may require direct transfer trip of DER. This involved the utility sending a signal to a customer owned recloser or breaker to disconnect from the Local EPS. DTT may need to be used based on the size of the DER and relative system loading or other unique system conditions that are identified during the study process.

3.2 Reclose Blocking

Provisions for hot bus/dead line supervision of reclosing on the distribution feeder's substation breaker is required when aggregate DER generation exceeds 80% of minimum annual distribution feeder load. The need for reclose blocking will be reviewed with the interconnection study of each DER facility.

3.3 Overvoltage Protection

If DER generation is >= 80% of minimum feeder load, overvoltage protection may be required at the primary side of the feeder's substation transformer to prevent line-to-neutral overvoltage conditions on the primary circuit caused by persistent ground faults and the loss of the primary circuit's utility source.

3.4 Recloser and Communication Requirements

<250kW	250kW-1MW	>1MW
Recloser not required	Recloser may be required	Recloser Required
No communications required	Communications required	Communications required

3.5 Communications

A. When required, installer will utilize DNP and the following SCADA points/values for communications from the DER or relay:

Status Points

o Status of any lockout relay

o Status (open/close) of the interconnection breaker(s) or if transfer switch is used, status of each transfer switch. Hard wired from monitoring RTU directly to the breaker, not supervised by the breaker relay.

o High voltage alarm (settings defined by DEA)

o Low voltage alarm (setting defined by DEA)

o DC supply / charger trouble alarm

o Trouble alarm (relay failure alarm) from each protective relay providing the utility required protection elements.o General Trouble Alarm, can be a common alarm or individual alarms, need to include generation control trouble, issues with DC voltage.

Control Points

o Remote control of interconnection breaker (open / close) hard wired from Minnesota Power RTU directly to the breaker, not supervised by the breaker relay.

o Ability to start and stop DER and transfer load off the system. (if required for interruptible rate)

o Ability to remotely turn on/off modes of operation, and/or monitor which modes of operation are active (if applicable)

• Analog Values (Values updated at least every 10 seconds)

o Individual phase voltage values representative of the Area EPS's service to the facility.

o Individual Phase amps (DER output)

o DC voltage from protective DC battery

o 3 Phase Real (kW) and reactive (kVAR) power flow for each DER unit.

o Total Current harmonic distortion (Current THD)

o Total Voltage harmonic distortion (Voltage THD)

EXHIBIT 2 – CONTRACTOR DELIVERABLES

1. SCOPE

This specification outlines the review and approval requirements for the Contractor deliverables. Contractor scope includes all documents in this specification.

2. PURPOSE

This Attachment defines the Contractor and Contractor Supplier deliverables to be submitted with the following information:

- Schedule for the deliverables to be submitted to Owner.
- Review/Approval requirements.
- Format that the deliverables are to be submitted to Owner as addressed in Section 7 of this Attachment.
- Number of copies to be submitted to Owner as addressed in Section 7 of this Attachment.

3. RESPONSIBILITIES

- The Contractor is responsible for submitting documentation in accordance with this Matrix.
- Owner is responsible for defining date of the award of the contract from which the document submittal dates are timed.
- Upon receipt of the transmittal, Contractor shall allow ten (10) Business Days for Owner review and comment cycle for all documents and drawings unless otherwise indicated.
- Owner reserves the right to review all engineering documents and records produced by Contractor during each design phase and until Project Substantial Completion. Contractor shall respond in writing to all of Owner's comments.
- Contractor is responsible for the following regarding design of the Project:
    - 30%, 60%, 90%, and 100% (or Issued For Construction, IFC) packages. 30% is considered the design issued at bid with refinements and additions to completely define the project to potential financing partners. 90% is a package complete enough to issue for permitting. 60% is the intermediary package between 30% and 90%. Many of the Engineering Studies and calculations are due at 60%. 100%, or IFC, is a complete package with all details necessary to be able to construct the Project.
    - Contractor shall host a meeting to review the 30% design with Owner within 5 business days after its issue. The meeting shall be hosted either at an agreed upon location or virtually on-line with adequate time to cover major elements of the design.
    - Upon issue of the 60%, 90%, and IFC design packages, Contractor shall, upon Owner request, host design review meetings.
- Contractor shall provide as-built drawings for all Drawings used and issued for construction. As-built drawings shall be provided as CAD files at the end of the project.

4. INSTRUCTIONS

The review/approval matrices shall be used as the basis for submitting documents to Owner. Following is a definition of the codes associated with each document:

Issued for Owner Review (IFR): Contractor shall submit documents to Owner for review and approval and shall incorporate comments from Owner.

Issued for Information (IFI): Contractor shall submit documents to Owner for information only. (Owner reserves the right to comment).

Owner will, by a notice to Contractor, review the submittal to issue comments or indicate the acceptance or rejection of the documents per the agreed upon Deliverables Matrix. Owner review of and/or comments, or lack of comments to Contractor documents does not relieve Contractor of any Contract requirements.

5. DOCUMENT REQUIREMENTS

Contractor shall provide copies of Submittals as indicated in Section 7 of this Attachment in incompliance with the guidelines established within the document to ensure proper document control capabilities and seamless transfer of information to Owner.

6. GENERAL REQUIREMENTS

This Section covers the scope of the engineering services to be provided by the Contractor. Contractor shall perform all design engineering work including but not limited to the following items:

- **Design Documents:** Prepare design documents, models, size equipment, generate drawings and specifications, and other supporting activities to the degree of detail required to fully and clearly define construction work requirements.
- **Calculations:** Prepare calculations and models as required for design decisions, equipment and material selection, construction drawings preparation, and regulatory review and approval.
- **System Descriptions:** Prepare system descriptions indicating equipment data, operating characteristics, design basis, functions, and other process information for:
  1. PV Modules and DC wiring systems
  2. Trackers
  3. ISAs
  4. AC Collection System
  5. SCADA System
- **Equipment Lists:** Prepare electrical, instrument, and mechanical equipment lists with summary descriptions, vendors, and pertinent data.
- **Design Package:** Provide a comprehensive design package consisting of drawings including all civil, electrical, Instrumentation and Control, mechanical, and structural construction drawings for the plant and supporting systems. This will include, but not limited to, the following:

  1. Cover Sheet
  2. Site plan
  3. Symbols, abbreviations and notes

  <u>Electrical</u>
  1. Symbols, abbreviations and notes
  2. Layout plans for all equipment
  3. Cable routing plans
  4. One-line electrical diagrams for AC and DC systems
  5. Three-line diagram (Substation)
  6. Module string and combiner wiring diagrams (typical)
  7. Inverter skid assembly wiring diagrams
  8. Grounding and lightning protection plans and details
  9. Lighting plans and details (where applicable)
  10. Equipment specifications for all equipment, including inverters, transformers, switchgear, cables, metering and grounding
  11. Engineering Studies (refer to Electrical Matrix)

  <u>Instrumentation and Control</u>
  1. Instrumentation Layout and Location Plan
  2. Instrumentation Installation Details
  3. Control Block Diagram
  4. Control Logic Specifications
  5. Instrument Data Sheets
  6. Instrument Index
  7. Control Room Layouts
  8. SCADA Field Panel Drawings with Wiring Details
  9. SCADA Network Architecture Drawing
  10. Telecom Design

  <u>Civil/Structural</u>
  1. Grading plan

2. Offsite Drainage Plan
3. Onsite Drainage Plan
4. Soil erosion and sediment control plan
5. Vegetation Management Plan
6. Hydrology report (as required for permitting and drainage design)
7. Geotech Report
8. Site fencing and roadway plans
9. Structural plans, details and elevations
10. Foundations and Equipment Pads
11. Structural Steel details
12. Array and Inverter Layout Plans

Operations Building (If Applicable)
1. HVAC plans
2. Plumbing plans
3. Electrical Plans
4. Architectural Plans, Elevations, and Details
5. Fire Protection Systems

- **Technical Specifications:** Prepare technical specifications and other documentation to support all equipment procurement, materials, and construction requirements.

- **Operation and Maintenance Manuals**: Prepare O&M manual of Photovoltaic power system and Solar Substation, to include system description, equipment list, equipment data sheets, calibration certificates, warranties, and as-built drawings.

- **Plan approvals and Building permits**: Obtain necessary plan approvals and building permits from appropriate state, county and local building authorities. Architectural, Civil, Structural, Mechanical, Electrical, and Instrument and Control design documents that are issued for construction or procurement shall be prepared by or under the direct supervision of a professional engineer or architect registered in the applicable state. Documents shall be prepared and sealed where required by the jurisdiction having authority.

- **System Startup & Commissioning Test Procedures and Reports:** Startup and commissioning test procedures and reports, and test protocol shall be prepared for all systems in accordance with Exhibit 5. Copies of the test procedures and of the test results shall be provided to Owner per requirements established in Section 7 of this Attachment.

- **Project Execution Plan:** Prepare and submit for review a Project Execution Plan indicating a responsibility matrix; key Project contacts; document distributions; Project scope; Project organization; execution plan; administrative procedures; quality control procedures; Project schedule; equipment, piping, and instrument tagging procedures; design criteria; and other key Project execution functions.

- **Outage Plan:** Contractor shall prepare an outage plan for all scheduled interruptions of electrical power or other utilities-interference that would affect the Owner or third parties. This plan shall be submitted by Contractor to Owner and the affected parties at least thirty (30) days prior to outage.

- **Contractor Acquired Permits:** Contractor shall provide Owner copies of all Contractor Acquired Permit applications as they are being submitted to the responsible agency, per the requirements established in Section 7 of this Attachment. Contractor shall provide Owner copies of all issued Contractor Acquired Permits upon approval from the responsible agency, per the requirements established in Section 7 of this Attachment.

- **Module Fabrication Quality Assurance and Quality Control (If by Contractor):** Contractor shall provide a separate quality control & quality assurance plan specifically to manage these elements at the factory or factories where the photovoltaic modules are to be manufactured for the Work and at the Site.

- **Quality Assurance and Quality Control:** Contractor and its Subcontractors shall establish and maintain a documented QA Program conforming to applicable sections of this Specification.

- **Quality Assurance (QA) Plans** Contractor shall prepare one or more QA Plans for Equipment or Services in Contractor's scope. These QA Plans shall be submitted to Owner for review as specified in this Attachment and shall be revised, if necessary, to reflect Owner's comments. Each QA Plan shall describe how Contractor's QA Program will be applied to Equipment or Services to be furnished and shall address requirements defined by the Contract Documents. QA plans shall also contain the Scope of Work and Schedule of Key Activities.
  The Design Quality Assurance Plans shall address the following key elements:

  Contract review
  Control of customer supplied product
  Control of non-conforming product
  Corrective and preventative action
  Design control
  Document and data control
  Handling storage packaging and delivery
  Internal quality audits
  Management responsibilities
  Process control
  Product identification and traceability
  Quality records
  Quality system definition
  Services
  Training

  The Construction Quality Assurance Plans shall address the following key elements:

  Audit/surveillance
  Backfill and compaction procedure
  Calibration
  Care and maintenance instruction procedure
  Change control
  Concrete placement procedure
  Control of measurement and test equipment
  Control of Nonconformance
  Corrective Action
  Document control
  Drawing format and document identification
  Electrical fabrication and installation
  Equipment installation
  Examination
  Examination status
  Handling storage and preservation
  Identification and control of items
  Inspection and test status
  Inspection and testing
  Personnel indoctrination training records
  Personnel Qualification
  Procedure development and approval

Procurement controls
Quality assurance records
Receiving Examinations
Structural Steel installation
Survey control
Vendor qualification and source surveillance
Warehouse and material control

- Contractor shall furnish all factory acceptance test procedures and reports (on equipment with FAT's) to Owner for information.
- At Owner's request, Contractor shall provide available manufacturers quality control documentation.
- Owner shall pay Owner's costs associated with any Witness Test.

- **Manuals and Instruction Books:** Contractor is responsible for providing Manuals that will cover all the details required in order to operate and maintain the PROJECT; including but not limited to Equipment Manufacturer Documentation, and Contractor generated Documents. Manufacturer's instruction books shall be properly referenced out of the plant manual with multiple volumes and provided per the requirements set forth in Section 7 of this Attachment. A preliminary plant manual shall be provided no later than the start of training. 3 hard copies and 1 electronic version of final manuals will be provided.
  The plant manuals shall contain site specific information on the plant operation, the latest as-built information for the facility. Contractor shall obtain as-built information for vendor's equipment. Manuals shall be updated with any modifications to equipment or systems made to the facility during the warranty period resulting from defects corrected under the warranty. Contractor shall provide markups to vendor as-fabricated drawings to reflect changes made in the field. The Manuals shall address the following table of contents:

  - **Installation, start-up and initial test** instructions.
  - **Operating instructions**, including safety precautions. Normal operating modes, parameters and sequences (including startup and shutdown) shall be described together with normal running inspections for all supplied equipment and systems Special notes and cautionary statements shall be included and highlighted throughout the manual to enable easy recognition of special procedures and techniques that must be followed to ensure correctness and safety for equipment and personnel.
  - **Maintenance** Procedures and routine adjustments. Troubleshooting and diagnostic recommendations shall also be included. Maintenance and replacement instructions, which shall include detailed assembly drawings with parts numbers, parts lists, instructions for ordering spare parts, and complete preventative maintenance instructions required to ensure satisfactory performance and longevity of the equipment involved.
  - **Parts** illustrations, including parts lists adequate for the purpose of identifying and ordering replacement parts and lists of recommended spare parts for three (3) years of operation of any given component.
  - **Wiring schematics** for electrical equipment.
  - **Detailed descriptions of the functions** of each principal component of a system.
  - **Performance and nameplate data**.
  - **Safety precautions**.
  - **Parts lists** shall be submitted in vendor's standard format.

- **Turn-Over Documents:** Contractor shall submit all Turn-Over documents for review and approval by Owner to fulfill requirements for Substantial Completion. These documents shall include all pre-commissioning and commissioning testing results and all of the above-mentioned documents and those mentioned in the Matrix at their respective milestone dates.

7. DELIVERABLES MATRIX

For sake of clarity, "days" in these tables refers to business days.

1) CERTIFICATES AND KEY NOTICES		
Submittal Description	**CODE**	**Timing/Frequency**
Mechanical Completion	IFR	10 days prior to planned Mechanical Completion issue
Functionality	IFR	5 days after Functional Test
Performance Guarantee (Capacity Test)	IFR	5 days after completion of Capacity Test
Substantial Completion	IFR	10 days prior to planned Substantial Completion
Final Completion	IFR	At Completion

2) SCHEDULES		
Submittal Description	**CODE**	**Timing/Frequency**
Notice of Long Lead Time Equipment	IFR	5 days after LNTP
Project Schedule (including Critical Path Schedule and proposed completed Key Date Schedule)	IFR	30 days after FNTP
Updates to Critical Path Schedule	IFR	Monthly after FNTP
Current Week Progress and Rolling look ahead Schedule – 2 Weeks	IFR	Weekly after FNTP
Material Delivery Schedule	IFR	Weekly after FNTP

3) PROCEDURES		
Submittal Description	**CODE**	**Timing/Frequency**
Vendor Factory Witness Test Plan	IFR	20 weeks after FNTP or 8 weeks prior to test, whichever comes first
Lifting Plan	IFR	1 week prior to lift

4) PROJECT PLANS		
Submittal Description	**CODE**	**Timing/Frequency**
Site-Specific Environmental, Health & Safety and Plan	IFR	30 days after FNTP
Vendor Shop Test Inspection Plan	IFR	2 weeks prior to the start of procurement
Project Quality Assurance/ Quality Control Plan (Including Management of Change)	IFR	45 days after FNTP
Alternate Supplier Plan	IFR	45 days after FNTP
Commissioning Plan	IFR	90 days after FNTP
Document Control Plan	IFR	30 Days after FNTP
Project Execution Plan	IFR	45 days after FNTP

5) PURCHASE ORDERS/INVOICES		
Submittal Description	**CODE**	**Timing/Frequency**
Invoices Including Support documentation as required	IFR	As Issued
Materials and Equipment Procurement Specifications	IFI	Prior to ordering

6) SUBCONTRACTS		
Submittal Description	**CODE**	**Timing/Frequency**
Subcontracts (un-priced)	IFI	As Requested
Subcontractor List if added outside of list	IFR	5 days prior to add

7) INSTRUMENTATION AND CONTROL		
Submittal Description	**CODE**	**Timing/Frequency**
SCADA Narratives (Including Supplier Equipment)	IFR	With 90% Design
Instrumentation and Control Block Diagram	IFR	With 90% Design
Wiring Specification Drawings	IFR	With 90% Design
Wiring Drawings	IFR	With 90% Design
Control Panel Layout and Construction Drawing	IFR	With 90% Design
Instrument Specifications and Data Sheets	IFR	With 90% Design
Cable Routing Diagrams, including Junction Box Drawings	IFR	With 90% Design
Instrument Installation Details including MET Station and field POAs and temperature sensors, as applicable	IFR	With 90% Design
SCADA Architecture Diagram	IFR	With 60% Design
Point Configuration and System Configuration Details	IFI	With 90% Design
SCADA Vendor Drawings and Data	IFI	With 90% Design
Instrument List (Including Set-points, Engineering Units, Ranges, Type, signal type, etc.	IFR	With 90% Design

8) ELECTRICAL		
Submittal Description	**CODE**	**Timing/Frequency**
Title Sheet, Legend, and Notes	IFR	With 30% Design
Array and Substation Layout w/Major Equipment Locations	IFR	With 60% Design
AC Single Line(s)	IFR	With 30% Design
DC Single Line(s)	IFR	With 30% Design
Inverter Skid Layout	IFR	With 60% Design
Monitored Points List	IFR	With 60% Design
Site Logistics Plan	IFR	With 60% Design
Specification List	IFR	With 60% Design
Conduit, cable block diagrams, and raceway drawings	IFR	With 90% Design
Cable Routing Layouts	IFR	With 60% Design
Grounding and Lightning Protection layouts	IFR	With 60% Design
Panel Layout	IFR	With 90% Design
Underground electrical	IFR	With 60% Design
Lighting Drawings (as applicable)	IFR	With 100% Design
Supplier Internal Power and Control Wiring Diagrams (as applicable)	IFR	With 100% Design
Electrical Schematics and Connection Diagrams	IFR	With 60% Design
IEEE 80 Study	IFR	5 days prior to 100% issue
Short Circuit Study	IFR	With 60% Design
Grounding Study	IFR	With 90% Design
Ampacity and Loss Study	IFR	With 60% Design
Relay Coordination Study	IFR	With 100% Design
Load Flow and Voltage Compensation Study	IFR	With 60% Design
Arc Flash Study	IFR	With 100% Design
Transient Over Voltage Study	IFR	With 100% Design
Harmonics Study	IFR	With 100% Design
Vendor Drawings (one-line and outline drawings as well as vendor manuals for review all other for information)	IFR	With 100% Design
Electrical Load List	IFI	With 90% Design

Cable Schedule	IFR	With 90% Design
Lighting and Small Power Distribution Board	IFR	With 90% Design
Cable trench details	IFR	With 60% Design
Construction details	IFR	With 90% Design
Protection & metering diagrams	IFR	With 100% Design
Equipment performance data sheets and Nameplate Data	IFI	With 100% Design
Equipment performance data sheets (vendor as applicable)	IFI	With 100% Design
Main Power Transformer (MPT, Substation) Specification (If by Contractor)	IFR	5 days after FNTP
MPT Loss Table (if by Contractor)	IFR	At 60% Design

9) CIVIL		
Submittal Description	**CODE**	**Timing/Frequency**
Title Sheet, Legend, Notes	IFR	At 60% Design
Overall Site Plan	IFR	At 60% issue
Plant General Arrangement	IFR	At 60% issue
Access roads, and fencing	IFR	At 60% issue
Grading and Drainage Plans and Topography	IFR	At 60% issue
Stormwater Pollution Prevention Plan	IFR	At 100% issue
Site construction utilities	IFI	At 60% issue
All Site surveys	IFI	At 60% issue
Lay down and temporary facility Plans	IFR	At 60% issue
All construction specifications	IFR	At 60% issue
Paving Plan and Pavement Design	IFR	At 60% issue
All Geotechnical Reports	IFI	At start of design
Hydrology Report (If required by AHJ)	IFR	At start of design
Final Soil Stabilization Plan	IFR	At 60% issue

10) STRUCTURAL		
Submittal Description	**CODE**	**Timing/Frequency**
Title Sheet, Legend, Notes	IFR	At 60% Design
All Structural Steel Design Drawings	IFR	At 100% issue
Foundation Location Plans	IFR	At 60% issue
All Foundation Drawings	IFR	At 100% issue
All Structural Steel Fabrication Drawings	IFI	At 100% issue
All Rebar Engineering Drawings	IFI	At 100% issue
All Construction Specifications	IFR	At 100% issue
Structural and Foundation Design Calculations	IFI	At 60% issue
All Structural Material Specifications	IFI	At 100% issue
Pile Load Test Results	IFI	10 days after test

11) ELECTRICAL EQUIPMENT ENCLOSURE		
EEE outline dimensions, physical requirements, floor plan, interior and exterior dimensions, elevations, suggested foundation elevations and dimensions, and the location of all primary accessories included with the EEE.	IFR	At 60% issue
Equipment and electrical performance data, including cut sheets and technical specifications adequate to determine quality of equipment being provided concerning the EEE and all components included as part of the EEE (i.e. HVAC equipment, lights, batteries, battery charger, AC & DC panels, etc.).	IFR	At 60% issue
Proof of being in the EEE design and manufacturing business for a minimum of 5 years, and be able to supply proof of supplying at least 25 EEE's of a similar type in that timeframe.	IFR	With proposal
Mechanical and mechanical performance data	IFR	At 60% issue
Shipped and installed weights.	IFI	At 60% issue
Mounting provisions and structural loading	IFR	At 60% issue
Exceptions to these specifications or any required standards	IFI	With proposal
Outline of all tests which will be performed	IFR	At 60% issue
Schedule of all submittals	IFR	10 business days after order
Complete Bill of Materials	IFR	At 60% issue
Contractor to provide one (1) electronic copy (PDF or AutoCAD) of design loads for foundation design, all static and dynamic loading calculations, foundation reactions, and all critical mounting features for the EEE	IFR	2 weeks ARO
Contractor to provide one (1) electronic copy (PDF or AutoCAD) of design loads for foundation design, all static and dynamic loading calculations, foundation reactions, and all critical mounting features for the EEE. One (1) electronic copy (PDF or AutoCAD) of all other approval documents. Approval documents shall include: A. Bill of Material B. Outline C. Mounting and Moving Provisions D. Schematics E. Nameplate F. Other rating data furnished with this specification. G. A standard color chart shall be provided to Owner for interior and exterior color selection prior to manufacturing. H. Door and door frame details. I. Roof and wall sections with proposed framing J. Design loads for Foundation Design . K. HVAC Calculations L. Secondary Heating Calculations M. Structural Submittals: The structure manufacturer shall submit a structural design criteria document stating the basis of structural design in the form of a drawing, letter or	IFR	2 weeks ARO

calculation package, certified by an Engineer licensed in the state of the project. Fabrication of the structure shall not commence until this document has been reviewed and approved by the Owner. This document shall include, as a minimum, the following items: 1. Live Loads: Floor and roof live loads. 2. Snow Loads: Ground snow load, flat-roof snow load, exposure factor, importance factor and thermal factor. 3. Wind Loads: Ultimate and nominal design wind speeds (mph), risk category, exposure category, internal pressure coefficient and components and cladding wall and roof wind pressures (psf). 4. Seismic Loads (if applicable): Risk category, importance factor, mapped spectral response acceleration parameters, site class (assume D unless other information is provided), seismic design category, basic force resisting system(s), design base shears, seismic response coefficients, response modification coefficients and analysis procedure use. 5. Base support frame layout including dimensions, maximum foundation support spacing (assuming support by multiple drilled pier foundations). 6. Foundation reactions for both drilled pier and slab foundation options. Identify whether foundation reactions are service load or factored reactions, and provide breakdown of forces by load type. Include maximum vertical compressive and uplift forces, shear and moment (if applicable), including units. Include recommended or maximum support spacing for drilled pier foundation option. 7. Structural framing and floor plate deflection calculations or written statement outlining maximum live and total load deflections as a ratio of element length. 8. Anchor bolt and clip drawings		

13) PERFORMANCE AND TESTING		
Submittal Description	**CODE**	**Timing/Frequency**
PV Simulation Model (PVSyst)	IFR	At Contract Execution
Functional Test Plan/Procedure	IFR	90 days after FNTP
Capacity Test Plan/Procedure	IFR	90 days after FNTP
Functional Test Report	IFR	5 days after Functional Testing
Capacity Test Results	IFR	10 Business Days after the completion of the test
PSS/E Steady State Model	IFR	At Contract Execution
PSS/E Dynamic Model	IFR	At Contract Execution

PSCAD Model	IFR	At Contract Execution

14) REFERENCE DOCUMENTS/LISTS/INDICES		
Submittal Description	**CODE**	**Timing/Frequency**
Master Document List (transmittal log)	IFR	30 days after FNTP
Vendor Document List (manuals, cutsheets, dwgs)	IFR	30 Days After FNTP
Equipment List	IFI	30 days after FNTP
Drafting Standards/Symbols	IFI	30 days after FNTP
Non-proprietary Calculations, Including: -Electrical -Mechanical -Civil/Structural -Instrumentation	IFR	At 100% issue
Construction Specifications, Including: -Electrical -Civil/Structural -Instrumentation -Mechanical	IFR	30 days after FNTP
Monthly Reports	IFI	No later than the 10th of each month
Engineering Drawing List	IFI	10 days after FNTP
Supplier Drawing List	IFI	60 Days after FNTP
Equipment Data Books	IFI	At Final Completion
System Turn-over Record Books	IFR	At Final Completion
Commissioning and Start-up Spare Parts List (Including Equipment Criticality Rating)	IFI	60 days prior to Mechanical Completion of first Circuit or 20 weeks after FNTP whichever comes first
Operating spare Parts List (1, 3, and 5 years)	IFR	60 days prior to Mechanical Completion of first Circuit or 20 weeks after FNTP whichever comes first

FAT Documentation	IFR	60 days prior to Mechanical Completion of first Circuit or 20 weeks after FNTP whichever comes first
Systems List (Per Turn-over definition)	IFR	60 days prior to Mechanical Completion of first Circuit or 20 weeks after FNTP whichever comes first
Project Design Data	IFR	30 days after FNTP
Project Punchlist (As generated from Construction to Commissioning Turn-over and Commissioning/Client Walkdown)	IFR	As Issued after Mechanical Completion of each Circuit, and at least 10 days prior to scheduled Substantial Completion

15) TRAINING		
Submittal Description	**CODE**	**Timing/Frequency**
Training Syllabus	IFR	20 days prior to training or 30 weeks after FNTP whichever comes first
System Training Manuals (including major equipment training)	IFR	20 days prior to training or 30 weeks after FNTP whichever comes first
Training Schedule	IFR	20 days prior to training or 30 weeks after FNTP whichever comes first

16) MANUALS AND INSTRUCTION BOOK		
Submittal Description	**CODE**	**Timing/Frequency**
Operation and Maintenance Manuals List	IFI	30 days Prior to Circuit Substantial Completion of the first Circuit
Contractor Operation and Maintenance Manuals	IFR	At Circuit Substantial Completion of the first Circuit
Vendor Operation and Maintenance Manuals	IFI	At Circuit Substantial Completion of the first Circuit

17) QA DOCUMENTATION		
Submittal Description	**CODE**	**Timing/Frequency**
Quality Plans (Including Design, Construction and Commissioning)	IFR	45 days after FNTP
Reports of Supplier Inspections	IFI	10 days after inspection
Quality Audit Plan	IFR	45 days after FNTP
Quality Dossiers	IFR	At Final Completion
Health, Safety and Environmental Review Reports	IFR	As Required By Permit Conditions
Personnel Qualifications and Certifications Requirements	IFI	45 days after FNTP
Personnel Qualifications and Certifications	IFI	45 days after FNTP
Field Inspection and Test Reports	IFR	As Issued
Non-Conformity Reports and Solutions	IFR	As Issued
Instrument Assurance Certificates	IFI	As Issued
Electrical Assurance Certificates	IFI	As Issued
Equipment Assurance Certificates (Including Vendor Equipment)	IFI	As Issued
Material Identification and Traceability Procedure/Records	IFI	As Issued
PV Modules Flash Test Data	IFI	At submittal of Turn-over documents
Soiling Station and all instrumentation Calibration Certificates	IFI	5 days prior to Capacity Test
Equipment Factory and Field Test Reports	IFI	10 days after test

EXHIBIT 3 – PERMIT REQUIREMENTS

8. CONTRACTOR ACQUIRED PERMITS

Bidder to list all:

- Contractor is responsible for all siting, zoning, wetland and building/construction-related permits required for the construction of the Project.
- Contractor is responsible for all labor or health standard permits, and approvals reasonably related to construction of the Project.
- Contractor is responsible for all business permits reasonably related to the conduct of the operations of Contractor and all Subcontractors in the State of [Project Specific] and local government units where such permits may be required (including all contractors' licenses and related documents).
- Contractor is responsible for all permits, approvals, consents or agreements from or with any Person necessary for the performance by Contractor of the Work or its warranty obligations hereunder, for the transportation or importation of equipment, tools, machinery and other items used by Contractor in performance of the Work.
- Contractor is responsible for all permits, visas, approvals and certifications necessary for Contractor's employees to legally perform the Work in the State of [Project Specific] (including documentation of citizenship or legal residency in the United States). Without limiting the foregoing, Contractor Acquired Permits include permits for temporary construction utilities and temporary sanitary facilities, dump permits, road use permits, permits related to the use, storage and disposal of Hazardous Materials, and permits issued pursuant to any building, mechanical, electrical, plumbing or similar codes.

Permit/Approval	**Agency**
Dust Permit	[Project Specific]
Grading Permit	[Project Specific]
Building Permit	[Project Specific]
Trailer Permit	[Project Specific]
Fence Permit	[Project Specific]
Storm Water Notice of Intent	[Project Specific]

EXHIBIT 4 – SAFETY AND SITE SECURITY REQUIREMENTS

1. GENERAL SAFETY & SITE SECURITY

1.1 Overview

A. 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. 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.

B. 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.

C. 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.

D. Contractor shall immediately notify Owner of any governmental agency (OSHA, Fire Dept., Health Dept., etc.) complaint and/or inspection of the Site.

E. 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.

F. Contractor shall be responsible for any and 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.

EXHIBIT 5 – COMMISSIONING

1. OVERVIEW

The Commissioning process provides a quality-oriented methodology for verifying and documenting the design, construction, functionality, and performance of the Project. The commissioning process shall ensure that all system components perform interactively to meet the defined system objectives and criteria of the Owner, as established in the Agreement and its Exhibits.

The Commissioning representative to be used by the Contractor must be proposed to Owner as part of Commissioning Plan and agreed upon by Owner before start of work.

2. SCOPE

All commissioning activities shall be executed under a phased approach, as identified below. Activities of each phase shall be documented and submitted to the Owner for review, acceptance, and documentation:

2.1 Design Phase

2.1.1 Design Review: Design review is part of the Commissioning process. The Contractor shall provide regular design reviews with the Owner to ensure the Owner's project requirements are being met. There is to be a Conceptual Design Review at the launch of the project (LNTP) and at each of the design package milestones of the Construction Drawings (refer to Agreement). The Commissioning team will participate in later phases of the reviews.

2.1.2 Commissioning Plan: A project-specific Commissioning Plan shall be developed and issued by the Contractor. The Plan shall outline the proposed personnel and/or company, tasks, processes, procedures, and deliverables required to prove the function and performance of the Project and all of its systems. It will include a section on Deficiencies and Resolution Procedures for each phase and the Commissioning Schedule. The Plan shall also reference safety requirements for start-up and commissioning, including electrical safety and lock-out/tag-out procedures. The Plan shall be submitted to the Owner for review and approval. The plan shall include example forms for each commissioning activity that clearly state the pass/fail criteria, the individual(s) performing the test, the date and time of the test and the result of the test.

2.1.3 Commissioning Specifications: Commissioning specifications shall be provided by the Contractor to outline the requirements for the installing contractors.

2.1.3 Commissioning Review: A commissioning review of the design drawings shall be performed by the Contractor and shall address design fundamentals for reliability, maintainability, and commissionability (e.g., design, location, and quantity of primary and secondary measurement devices)

2.1.4 Commissioning Log: A detailed commissioning log will be developed and issued by the Contractor for the tracking of all commissioning issues, observations, and deficiencies. The commissioning log will enable current status and resolution tracking of any open items. The log will be circulated to the project team on a regular basis for review.

2.2 Construction Phase

2.2.1 Meetings: Commissioning meetings will be held on-site on a periodic basis. A commissioning kick-off meeting will be held with the project team at the commencement of project construction, or at least 30 days before commissioning. The Commissioning Team

consists of, at a minimum, the Contractor's Commissioning Agent, project manager, design team representative, construction team representative, the Owner's project manager and project engineer.

2.2.2 Submittal Reviews: Approved equipment submittals shall be reviewed by the Contractor for compliance with the project design, intent and specifications.

2.2.3 Factory Acceptance Tests:

The following PV equipment shall be tested for functionality, operability, and performance:

1. Solar Modules (IEC 61215 tests and Flash Tests)
    a. Contractor to provide Owner approved means for large file transfer in order to effectively share documentation.
2. Combiner Boxes (or Load Break Disconnects as applicable)
3. Inverter Skid Assemblies
4. Solar Substation GSU
5. SCADA
6. Trackers
7. MET Station

OWNER and ENGINEER shall be given opportunity to witness each test and shall be given 15-day advance notice prior to any planned test. The related expense will be paid by the Contractor. Owner and/or Engineer's travel expense for attending factory acceptance testing will be paid by the Owner

Refer to Exhibit 5-01 for the required factory tests on the inverter. Since inverter efficiency and other testing are impractical in the field, the Project requires more stringent testing in the factory. All testing results shall be fully documented and reported to Owner.

If including optional battery storage refer to Exhibit F-2 - Performance Testing Procedures (BESS).

2.2.4 Prefunctional Checklists: Project and equipment-specific prefunctional checklists shall be developed and issued by Contractor to the installing contractors. The prefunctional checklists shall address proper installation methods, vendors' requirements, applicable codes and standards, and good engineering practice requirements. A master checklist, with acceptance criteria, shall be included in the Commissioning Plan which is issued to the Owner. Prefunctional check out of all systems shall be required as part of Mechanical Completion [refer to Agreement section for more definition]

2.2.5 Inspections: Equipment delivery inspections shall be carried out by Contractor during the course of construction. Reports shall be issued for inspections of inverter skids. This will include signatures of the responsible personnel and verification of proper installation of all equipment, devices, and wiring per manufacturer's recommendations. This will also include observations and punch-lists from Quality Control personnel verifying installation has occurred per their design drawings and specifications.

2.2.6 Functional Testing: There are two types of functional testing required:
1) Equipment-specific functional testing and 2) PV Plant Functional Testing – these protocols will be developed and executed by Contractor to address functionality and safe operation of components and systems. The functional testing protocols shall be detailed so as to address operation, failure modes, and recovery modes.

Equipment-specific functional testing: The Project will consist of PV generation equipment and sub-systems: PV modules, DC wiring, combiner boxes or Load Break

Disconnects (LBD), Inverter Skid Assemblies, trackers, and all associated structural elements and interconnecting cables that will allow the PV Plant to generate and deliver the AC power to the Project Point of Interconnection. Prior to energization, all NETA-ATS tests shall be completed including the following checks and testing, at a minimum:

1. Proper mechanical and electrical installation of the PV modules.
2. Completion of the pre-functional tests of the PV Modules and DC collection system, including but not limited to string level Open Circuit Voltage Testing, Operating Current Testing, IV Curve Tracing (to be performed on 1% of the strings, and to re-test strings that are outside acceptable tolerances), cable Megger Tests, and Grounding Tests.
3. AC cabling Very Low Frequency (VLF) testing or Partial Discharge (PD) testing.
4. Proper installation and operation of the Inverter Skid Assemblies.
5. Completion of Inverter pre-functional checks and functional tests per Contractor's commissioning protocols (Including phase rotation and synch checks, emergency and safety features). Inverters shall be checked for proper firmware, installation and connection of all components and systems such as fuses, capacitors, CTs, IGBTs, grounding, and cooling. All pre-functional checks shall be followed strictly per manufacturer's instructions (Cold commissioning plans).
6. Inverters shall have no manual deratings and shall be set to default manufacturer nameplate ratings. Inverters shall have all settings at factory default settings unless approved in writing in advance.
7. Grounding tests shall be completed for each system. Grounding path from inverter skid to tracker piles shall also be checked in each inverter array and not exceed [TBD] ohms. Completion of the pre-functional checks and functional tests of the inverter medium voltage transformers, including but not limited to Megger Tests, HI-POT Tests, Oil sampling tests (Dissolved Gas Analysis required to be performed either in factory or field in order to establish a baseline), Grounding Tests, operation of alarm and indication sensors. Insulation resistance of windings and turns ratio test at all tap settings shall be performed in both the factory and the field.
    a. Liquid filled transformers shall have the following field testing requirements:
        i. Verify nameplate data.
        ii. Coordinate and perform instrument transformer tests on CTs with transformer assembly.
        iii. Winding Tests:
            1. TTR at all no-load taps.
            2. Megger winding to ground.
            3. Megger winding to winding.
        iv. Set high-side voltage taps at positions determined by Engineer.
        v. Check and measure equipment ground; neutral to grounding grid resistance shall not be more than one ohm.
        vi. DGA:
            1. Check insulating fluid for clear or pale amber color and report any variance to Owner. Other colors may indicate contamination from decomposition of insulation, foreign material, carbon, or other substances.
            2. Test oil samples from each transformer with standards in accordance with ASTM D1816.
        vii. Check liquid level in tanks.
        viii. If equipped with cooling fan, check operation of cooling equipment and cooling controls before energizing transformer.
        ix. Check calibration of pressure relief device, top oil temperature gauge.
        x. Test all gauges including level, temperature, and pressure gauges.
    b. Dry type transformers shall have the following field testing requirements:
        i. Verify nameplate data.
        ii. Winding tests:
            1. TTR at all taps.

2. Megger winding to winding.
3. Megger winding to ground.

iii. Check equipment ground to assure continuity of connections. Notify Owner if ground is more than one ohm.
iv. Check for proper operation of the winding temperature gauge and cooling fans.
v. Set high-side voltage taps at positions determined by Engineer.
vi. Check connections for tightness; clean out dust and other foreign material.

8. Trackers: Verify trackers are fully functional. Ensure they operate in unison and adjust angle accurately remaining normal to sun even with clouds and reset to proper angles after stow or night; back-tracking function works properly with no sustained interior shading. Proper tracker stow shall be checked and wind and hail stow shall be verified.
9. Completion of the functional test of cable terminations in all electrical cabinets including switchgear (if applicable) per Contractor's commissioning protocols, including but not limited to PID or VLF testing, and Disconnect devices integrity and operability, insulation test on each phase conductor with respect to phase to phase and phase to ground, verification of ratios of all VTs, and CTs, insulation resistance test of all VTs, CPTs, and CTs, polarity check of all CTs, verification of protective relay settings, secondary injection test.
10. Test plant controls to verify all control features are fully functional, including reactive power control (PF/VAR/voltage) and power curtailment.
11. All auxiliary systems and devices are installed and functionally tested.
12. Proper operation of the SCADA monitoring and control system. This includes all associated instrumentation, communications, and controls between SCADA and other System Devices (e.g., Inverters), alarms, data acquisition, and historian.
13. Fiber loop feed shall be tested to verify fully functioning fiber ring, including OTDR testing.

PV Plant Functional Testing: Plant Functional Testing is required on the entire electrical generation system prior to Substantial Completion [refer to Agreement section].

The Functional Test will ensure that a fully functioning PV Plant is commissioned and placed into automatic operation, including confirmation of the following systems: Inverters, trackers, auxiliary systems, transformers, SCADA, Power Plant Controller (PPC), MET stations, and other equipment.

The Contractor shall develop a detailed plan to test the functionality of the PV Plant and submit to Owner for Owner's review and acceptance. Functional Testing shall be conducted by Contractor in accordance with the agreed upon Functional Test Plan.

The Functional Test Plan shall define and record the pre-test start condition of each Circuit, automatic start-up and shut-down of the inverters, trackers, auxiliary systems or devices, or any other automatic operation. Basic parameters that define such automatic operation shall be recorded as part of the test (e.g., Inverter Wake-up Voltage, shutdown, etc.)

Energization shall have been fully completed. There shall be no power curtailment or non-standard facility set points or settings, unless approved by Owner in writing in advance.

During the Test, as a minimum, the following operating parameters shall be captured of the Circuit of Project under test:

a. Irradiance
b. Ambient Temperature
c. Wind speed
d. Inverter Voltage, Amperage (both DC and AC)

e. Inverter IGBT (measured at heat sink) Temperature
f. Power, Voltage, Amperage
g. Module Temperatures
h. Transformer temperatures and pressures and alarm status
i. Tracker angle
j. All faults, alarms, errors, and warnings of all equipment

The Test shall be carried out for 120 hours without interruption or operator intervention under Normal Operating Conditions and emergency conditions shall be excluded. The Test shall maintain a 100% time-based availability of all equipment under test for the entire duration of the Test. An allowance of one inverter's downtime for one hour will be allowed during the Test (for the avoidance of doubt, no downtime is allowed for a 2nd inverter). The Test shall provide 100% data availability for all equipment under test for the entire duration of the Test. Owner will consider allowing some secondary data reporting to be temporarily non-functioning such as angle of one tracker.

2.3 Acceptance Phase

2.3.1 Capacity Testing: The performance of the PV Project and its components and systems shall be measured and documented pursuant to the procedures set forth in Exhibit 6.

2.3.2 Aerial Thermographic Survey: An aerial survey of the plant shall be completed prior to Final Completion. The survey shall use infrared imagery with adequate resolution to identify hot spots in the individual modules, strings, and ISAs. A report summarizing the findings shall be submitted to Owner for review.

2.3.3 Training: Contractor shall provide a training program to the Owner, including classroom and field training. The training program will cover operational aspects of the Project.

2.3.4 O&M Manuals: Contractor shall provide detailed and specific Operations and Maintenance (O&M) Manuals in mutually-agreed format. The O&M Manuals shall include, but not be limited to: System descriptions, method of plant operation, sequences of operation, troubleshooting procedures, maintenance procedures, as-built drawings, and all equipment vendor and subcontractor supplied manuals, warranties, and specification sheets.

2.3.5 Warranty Review: Contractor shall review all equipment warranties for compliance with contract documents. Extended warranty requirements and warranty activation dates shall be documented.

2.3.6 Commissioning Manual: Contractor shall create a Commissioning Manual, addressing the disposition of all system installation, functionality, and operation tests identified in the Commissioning Plan. The Commissioning Manual shall include all relevant start-up and commissioning documentation, test data, site reports, equipment start-up data, and checklists in a logical and sequential format. Upon completion of the project, the Commissioning Manual shall be submitted to Owner electronically.

3. INSTRUMENTATION

Contractor shall be responsible for all standard testing instrumentation. Testing instrumentation shall include, but is not limited to:

- Power meters
- Voltmeters
- Clamp-on meters (Amp meters)
- Irradiance meters
- Power quality test equipment
- Temperature sensors
- Met stations: Wind speed sensors, rain gauge, ambient temperature sensors, and all other sensors.

All instrumentation is to be NIST, or approved equivalent, calibrated; calibration certificates shall be current for all instrumentation used by Contractor during testing.

All irradiance meters shall be cleaned no less than once per week during testing.

4. SAFETY

During commissioning, Contractor shall be responsible for any requirements for specific safety procedures and equipment that are in addition to the standard site safety requirements. This shall include such items as:

- Fall protection
- Electrical Safety
- Lockout/Tagout

EXHIBIT 5-01 – INVERTER TESTING REQUIREMENTS

1. OVERVIEW

The Inverter factory testing shall ensure that all inverter components perform interactively to meet the inverter requirements and criteria of the Owner, as related to the site-specific requirements of the Project. This includes all safety, control, performance, and environmental aspects.

The Owner's objective is to verify that the inverter is fully functional and performing to meet all Project requirements. Test instrumentation accuracy shall be according to Table 1 of this Exhibit.

Owner shall have the opportunity to witness factory testing. Contractor shall give Owner fifteen business days.

If including optional storage, Contractor shall provide a Functional Testing Plan to Owner for approval demonstrating the integration of BESS and PV generation, including the charging of the BESS from local PV generation. BESS capacity testing requirements shall be considered as detailed in Exhibit F-2 - Performance Testing Procedures (BESS). Any ancillary services as defined in Attachment E – Economic and Technical Data Input Form shall have a Functional Testing Plan submitted to Owner for approval. ys advanced notice along with factory testing plan for review and response prior to testing.

2. SCOPE

The inverter manufacturer shall provide the following documentation from a certified NRTL:

1. UL 1741 Test Report
2. UL 1741 Certification
3. UL 1741 SA Test Report (if applicable)
4. UL 1741 SA Certification (if applicable)
5. IEEE 1547/519 Harmonics Test Report (including raw test data)
    a. Current THD < 3%
6. NERC PRC-024-2 Voltage and Frequency Ride-Through Test Report
7. CEC Efficiency Test Results

The inverter manufacturer shall provide the following documentation from type testing (or from a certified NRTL) to show the inverter meets the specifications outlined in the data sheet. The documentation shall include, at a minimum: active power, reactive power, frequency, DC voltage/current, AC voltage/current, and critical component temperatures (for ambient temperature testing).

1. Active Power
    a. Inverter manufacturer shall provide test documentation showing the inverter can operate up to the nameplate power rating (including any "overdrive" or 110% functionality).
2. Reactive Power
    a. Inverter manufacturer shall provide test documentation showing the inverter can operate up to the maximum reactive power capabilities.
    b. Minimum Requirement: 0.8 lead/lag in 0.01 intervals
3. Plant Controller Response
    a. Inverter manufacturer shall provide test documentation showing the inverter can receive active and reactive commands from a simulated plant controller interface.
    b. Inverter manufacturer shall provide test documentation showing the inverter can operate at the maximum and minimum ramp rates for both active and reactive power variation.
4. Edge-of-Cloud Effects
    a. Inverter manufacturer shall provide test documentation showing the inverter can track the PV array maximum power point (MPP) during high DC voltage and current transients.
5. DC Voltage

   a. Inverter manufacturer shall provide test documentation showing the inverter can operate over the rated DC voltage operating range.
   b. Inverter manufacturer shall provide active power vs. DC voltage de-rating curves.
6. AC Voltage
   a. Inverter manufacturer shall provide test documentation showing the inverter can operate over the rated AC voltage operating range.
   b. Inverter manufacturer shall provide active power vs. AC voltage de-rating curves from 0.9 to 1.1 p.u. terminal voltage and 0.9 lead/lag.
7. Ambient Temperature
   a. Inverter manufacturer shall provide test documentation showing the inverter can operate over the entire ambient temperature range (minimum 4 hours at each test condition).
   b. At a minimum, the test documentation must include the following operating conditions:
      i. 25°C
      ii. 45°C
      iii. Maximum Operating Temperature
      iv. Minimum Operating Temperature
      v. Any “corner points” on ambient temperature de-rating curves
   c. Inverter manufacturer shall provide active power vs. ambient temperature de-rating curves.
8. DC/AC Ratio
   a. Inverter manufacturer shall provide design calculations and/or test data showing the inverter performance and reliability information at multiple DC/AC ratios including, but not limited to, the maximum and minimum DC/AC ratios specified for the project.
9. Reliability
   a. Inverter manufacturer shall provide test documentation summarizing the accelerated life testing (ALT) and highly accelerated life testing (HALT) testing that has been completed.
   b. Inverter manufacturer shall provide mean time between failures (MTBF) and mean time to failure (MTTF) rates for critical components such as:
      i. IGBTs
      ii. DC switches/contactors
      iii. AC contactors/breakers
      iv. DC link and AC filter capacitors
      v. Communications boards
      vi. Cooling system components (fans, pumps, etc.)

At a minimum, the following tests shall be performed on each inverter during production testing:

1. Calibration of all DC and AC voltage, current, and power circuitry/sensors.
2. UL 1741 production testing such as hi-pot and PE/ground testing
3. GFDI
4. Emergency stop (fast stop)
5. Remote start/stop
6. Burn-in (minimum 4 hours per inverter)
   a. Burn-in testing should be completed under elevated ambient temperature and high DC current conditions at maximum rated power.
7. Harmonic content verification (during burn-in tests)
8. Efficiency verification
   a. Verify inverter efficiency at multiple DC voltages and power levels which shall be consistent with the levels tested during CEC testing.
      i. The official CEC test procedure is not required.
9. Reactive power control (0.95 lead/lag) at rated apparent power
10. Voltage and frequency ride-through verification per IEEE 1547 and/or PRC-024-2

Table 1 Basic Measurement Requirements

Parameter True RMS (V, I, P)	**Allowable Maximum Uncertainty**
DC Voltage	± 1% of reading
AC Voltage	± 1% of reading
DC Current	± 1% of reading
AC Current	± 1% of reading
DC Power	± 1% of reading
AC Power	± 1% of reading
Temperature	± 1˚C
DC Current Ripple	± 5% of reading

Table 2 Power Conversion Efficiency Test Points

Test	**Vdc**	**Vac**	**Inverter DC Input Power Level**						
			100%	**75%**	**50%**	**30%**	**20%**	**10%**	**5%**
A	Vnom	Vnom							
B	Vmax	Vnom							
C	Vmin	Vnom							
D	Vmin	102% Vmin							
E	Vmax	98% Vmax							

EXHIBIT 6 – PV CAPACITY TEST

1. OVERVIEW

Capitalized terms not otherwise defined in this Attachment shall have the meaning given such terms in the Agreement. The following is an overview of the procedures to be utilized in connection with the execution of performance tests of the PV Power Plant. The objective of the Capacity Test is to verify contract requirements and guarantees have been met. A PV Power Plant Capacity Test will be performed once the entire PV Power Plant is fully functional. The Contractor has the option of performing capacity tests on circuits prior to the contractual Capacity Test.

The tests are to be executed once Contractor has successfully completed all Functional Tests set forth in Exhibit 5, Commissioning, however, the Capacity Test may be run concurrently with the Functional Test if approved by Owner. Contractor shall remediate the shortcomings and re-test until the guarantees are achieved.

On or before Substantial Completion of the PV Power Plant, Contractor shall commence the Capacity Test which may be witnessed by Owner or Owner's representative. In such case that Contractor fails to satisfy all requirements of the PV Power Plant Capacity Test on or before the Substantial Completion of the PV Power Plant, Contractor shall remediate the shortcomings during the Cure Period before commencing re-tests.

This Capacity Test is based on ASTM E2848 but incorporates considerations for bifacial modules. PRC is the actual power measured at the Reporting Conditions (RC). PMIN is the guaranteed power at RC. Pass/fail: PRC/PMIN *100 greater than or equal to 97% (accounts for 3% test measurement error). PRC is determined from filtered on-site data (5 min or 1 min), running multiple regression and calculating from resulting equation with its coefficients, at RC. PMIN is determined by running Pvsyst with site weather data (1 hr, averaged from site data) or if not available from other source such as Solar Anywhere, filtering, running regression, calculating at RC. RC is determined from site data (can also use modeled but prefer site data), finding Irradiation Irro mean +/- 20%, 40%/60% distr., above 400 W/m2, and averaging T_0 and W_0.

If including optional battery storage, refer to Exhibit F-2 - Performance Testing Procedures (BESS)

2. DEFINITIONS

Agreement
The Term Sheet between Owner and Contractor to which Attachment F and this Exhibit 6 is attached.

Circuit
Group of ISAs that make up a portion of the full capacity of the PV Power Plant. This is the total AC power associated with one circuit breaker of the Solar Substation. If there are two feeders connected to one circuit breaker this will still be considered one Circuit.

Guaranteed Capacity
This is the guarantee by the Contractor for the total Power Rating of the PV Power Plant. It shall be verified by the Capacity Test (see section 5 below) in which the guaranteed Minimum Power Rating, $\mathbf{P_{MIN}}$, as calculated and predicted with the PV Simulation Model at the Reporting Conditions, is compared to the Power Rating, $\mathbf{P_{RC}}$, as measured by the Main Facility Meter at the Point of Interconnection. Guaranteed Capacity shall be calculated as 97% of the Facility Performance (allows for a percentage less than 100% accounting for some test measurement uncertainty). It shall be expressed as a percentage.

Minimum Facility Capacity
Shall be 95% with no correction for measurement uncertainty.

Minimum Power Rating (P_{MIN})
This shall mean the expected power output of the PV Power Plant at the Reporting Conditions, as computed by the procedure outlined in section 5 below.

Facility Performance
Shall mean the Power Rating divided by the Minimum Power Rating for the PV Power Plant at the time the Capacity Test is performed, expressed as a percentage.

PV Power Plant
The PV Power Plant (also referred to as the "Facility") will consist of XX MW_{AC} of PV generation equipment, including the PV Arrays, cable harnesses, combiner boxes, DC fuse boxes, inverters, transformers and switchgear (if required), as well as all associated structural elements and interconnecting cables that will allow the PV Power Plant to generate and output AC power to the Owner-supplied interconnection point.

Point Of Interconnect (POI)
This shall have the meaning set forth in the Agreement.

Power Rating (P_{RC})
This shall mean the actual power output of the PV Power Plant at the Reporting Conditions, per ASTM E2848-13. It shall be computed by the procedure outlined in section 5 below. Power measurements will be conducted within the range of power factor as required by the Project.

PV Simulation Model (Energy Model)
The PV Simulation Model shall be based on the most recent version of PVsyst at the time of limited notice to proceed. All of the program inputs shall be put forth by Contractor and Exhibit 8 and reviewed and approved by Owner and Contractor at the time of contract execution with a corresponding Guaranteed Capacity. In the event the PV Power Plant is modified by mutual agreement between the Contractor and Owner, the program inputs may be modified to match the constructed PV Power Plant if agreed upon by Owner and Contractor.

Primary Measurement Device
An instrument which provides a measurement or reading that is used in calculating the PV Power Plant Power Rating.

Reporting Conditions
This shall be as defined as the reference irradiance (Irr_0), the reference temperature (T_0), and the reference wind speed (WS_0) as determined by the procedures outlined below and referred to in ASTM E2848-13.

Secondary Measurement Device
An instrument which provides a measurement or reading that is not used in calculating the output power but

is used as check on primary measurements or for further analysis.

Supervisory Control and Data Acquisition (SCADA)
The hardware and software installed at the Project Site, which is used to monitor and collect the weather and performance data from the PV Power Plant. This typically consists of programmable logic controllers, data loggers, software, and other network devices.

Test Measurement Uncertainty
Shall be calculated as described by ASTM E2848-13 (referred to as expanded uncertainty in ASTM E2848-13).

Test Period
Shall mean the “data collection period” referred to in ASTM Standard E2848 and Test Period contained in this document below.

3. TEST MEASUREMENTS

All test measurement devices shall be fully defined for their make/model, accuracy, calibration and location. The following tables summarize these measurements that will be required for all of the tests:

Test Measurements (Minimum)

Measurement	Quantity	Type	Instrument Type	Range	Minimum Accuracy
Global Horizontal Irradiance	1 per Met Station	Secondary	Secondary Standard Thermopile Pyranometer mounted in the horizontal plane	0-1600 W/m2, 285 to 2800 nM	ISO 9060 Spectrally Flat Class A
Plane of Array Irradiance	1 per Met Station	Primary	Secondary Standard Thermopile Pyranometer mounted within Array	0-1600 W/m2, 285 to 2800 nM	ISO 9060 Spectrally Flat Class A
Rear Plane of Array Irradiance – for estimating bifacial gain	1 per Met Station	Primary	Secondary Standard Thermopile Pyranometer mounted within Array	0-1600 W/m2, 285 to 2800 nM	ISO 9060 Spectrally Flat Class A
Net Power Output (kW)	1	Primary	Owner's power meter(s) installed at the POI with calibrated CTs and PTs		+/- 0.2%
Net Power Output (kW)	1 per Inverter	Secondary	Inverter internal power meter		+/- 2%
Ambient Temperature	At each Met Station	Primary	Part of weather station	-50 – 60°C	+/- 0.3°C
Module Temperature	2 per Met Station	Secondary	Platinum RTD (resistance temperature detector) (.00385 TCR DIN B), on back surface of module	-10 - 140°C	+/-0.3°C
AC/DC Power, Volts and Amperage	1 per Inverter	Secondary	From inverter CTs and PTs connected to plant SCADA		+/- 2%
Meteorological Stations: Ambient Temp, Wind Speed and Direction, GHI, Rainfall, and others as required	1 per 50 MW, minimum 2	Primary	On-Site weather station		Per manufacturer

Module Soiling	1 per 50 MW, minimum 2	Primary	On-Site soiling stations		Per manufacturer

3.1 Instrument Calibration

All instruments used for primary measurements shall have current NIST-based or equivalent calibration certificates. All calibrations certificates shall be submitted for Owner Review prior to commencement of the applicable test.

3.2 Data Collection

Data shall be recorded by the SCADA system. The use of alternative means for data acquisition shall be used only with the prior written consent of Owner, which consent shall not be unreasonably withheld or delayed. Contractor shall provide sufficient means for Owner to access the test data during the Test Period. Should remote access to the SCADA system not be available Contractor shall provide daily test reports containing the 1-min interval data for the duration of the Test Period.

4. GENERAL TEST REQUIREMENTS

4.1 Scheduling

Contractor, in coordination with Owner's Engineer, shall notify Owner in writing of proposed PV Capacity Test date not less than ten (10) Business Days prior to the proposed date for the Performance Test.

4.2 Pre-Test Conditions

The Performance Tests may be performed only when the following conditions are met:

- Weather conditions as required to complete the Performance Tests, as addressed in this Attachment and in the approved Performance Test Procedure.
- There is grid connectivity at each inverter such that the Performance Tests can be accomplished under load.
- Contractor has achieved Mechanical Completion.
- Contractor has completed energization, hot commissioning, and Functional Test.

4.3 Pre-Test Meeting

Prior to each test, a pre-test meeting shall be conducted and recorded. The meeting shall review the applicable approved test procedure, instrumentation locations, calibration sheets and other relevant topics including safety requirements. Minutes of this meeting shall be recorded by Contractor and approved by all parties.

4.4 Test Duration and Data Frequency for Capacity Test

Testing duration and frequency shall be as follows:

CAPACITY TEST DATA COLLECTION	
Test Period	The Test Period shall be a minimum of five (5) Days. The Test Period will continue until sufficient filtered measurement data has been obtained
Data Sampling Interval	1 minute
Data Averaging Interval	5 minute

4.5 Adjustments

Any adjustments made during the tests to any portion of the PV Power Plant or test measurement devices shall be documented by Contractor and reviewed and approved by Owner prior to execution. Owner, and Owner's Engineer, shall be available during test in order to grant such approval, which will not be unreasonably withheld.

4.6 Test Reporting

Contractor shall submit a detailed test report, within five (5) Business Days of completion of successful test, to Owner consisting of the following:

1) Test procedures (as executed)
2) Instrument calibration sheets/certificates
3) Test data (manual and data acquisition) including table of averaged and filtered data
4) Test measurement and results uncertainty
5) Field notes
6) Calculations and results

4.7 Test Validation

Contractor shall validate the performance of the overall PV Power Plant through the following Capacity Test, which will be conducted by Contractor, in order to determine if the guarantees have been met.

5. CAPACITY TEST

5.1 General

The Capacity Test is used to determine the Facility Performance, by evaluating the Power Rating of the PV Power Plant compared to the expected Minimum Power Rating at the Reporting Conditions. The results of the Capacity Test are used to determine if Contractor has met the Guaranteed Capacity.

5.2 Data Collection - General

a) The pyranometers used to collect irradiance measurements shall be cleaned immediately prior to testing. Soiling will be accounted for by Contractor utilizing the average of the measurements from the on-site soiling stations, with data collected in accordance with the manufacturer's recommendations.
b) Owner shall be responsible for:
    i) Routinely reviewing collected weather and operating data for the PV Power Plant following Substantial Completion.
    ii) Agreeing to the Test Period proposed by Contractor for which there are sufficient valid data to meet or exceed the data requirements necessary to perform the procedures as described below.
c) Contractor shall collect, filter, and average data until 120 valid data points are obtained.
d) For PV plants comprising bifacial modules, rear pyranometers shall be used to collect irradiance measurements from the underside of the module. Rear pyranometers shall follow the same above criteria for testing and shall be mounted in the middle of any given PV string on the underside of the torque tube for optimal and representative irradiance collection. Care shall be taken to assure that the ground conditions in the vicinity of the rear-facing pyranometers is as typical of the ground conditions under the solar arrays to the extent practicable.

5.3 Data Collection and Selection of Reporting Conditions (RC)

a) Data collected on site per the above shall be used to determine the Reporting Conditions, per the following procedure. If site measured data is not available for determining Reporting Conditions, the contractual historical weather data file for the period of the test may be used.
b) For the Plane-of-Array (POA) and Rear Plane-of-Array (RPOA for bifacial modules) irradiance measurements, the data recorded from multiple pyranometers will be averaged for each time interval.
    i) In the event that data from one of the pyranometers is excluded due to malfunction or sensor discrepancy, the data from the un-excluded pyranometers shall be averaged (in the case of malfunctions), or the data from all the pyranometers may be excluded (in the case of sensor discrepancy out of range of sensor accuracy).
    ii) In the event multiple ground coverage ratios (GCRs) exist on site, a meteorological station shall be provided in each differing GCR area.
c) The collected data set shall be filtered according to the following operations:
    i) The guidelines and calculations described in ASTM E2848-13 will be followed.
    ii) Any test data points in which the inverter is "clipping" shall also be excluded.
    iii) POA irradiance below 400 W/m^2 will be excluded.
d) After filtering, the resultant data set shall be used to determine the Reference Irradiance (Irr_0) for the Reporting Conditions.
    i) In order to determine the Irr_0, the test data (or data from PV Simulation Model using the contractual historical weather data file) shall be sorted according to POA irradiance from highest to lowest and examined to determine the highest POA irradiance value for which there is a nearly equal distribution of valid data points in the range of the selected POA irradiance +/- 20%. This irradiance shall be considered Irr_0.
    ii) There shall be no more than a 40%/60% spread in the irradiance distribution, i.e., no more than 40% of irradiance data above Irr_0 and 60% of irradiance data below Irr_0, or vice versa.

iii) All test data where the irradiance is outside of the range of Irr_0 plus or minus the irradiance band (Irr_0 ± 20%) shall be excluded. At the agreement of Contractor and Owner, the irradiance band may be increased (not to exceed Irr_0 ± 50%), in order to obtain a necessary and reasonable number of data points.

iv) For bifacial modules, the same above criteria shall be used where POA irradiance shall be replaced with the variable Total Plane-of-Array (TPOA) Irradiance to represent the sum of the filtered POA and RPOA of the system outlined by the following Equation (Eq.1):

$$TPOA = POA + (RPOA^* \phi) \quad \textbf{(Eq. 1)}$$

Where ϕ is the bifaciality factor of the module as provided in the module specification sheet. If the ϕ is available as tested by an independent nationally recognized testing laboratory then this value shall be used.

e) The Filtered Measurement Data shall be defined as the resulting data set of section d above, and it shall have a minimum of one hundred twenty (120) data points.
   i) The one hundred twenty (120) or more data points are under the assumption of a five (5) minute averaged data interval.
   ii) If the filtered data set does not contain enough data, then additional days (maximum 4 weeks) shall be added to the Test Period to collect enough valid data.
   iii) A wider filter can be applied to irradiance band as mentioned above in section d (iii), if agreed upon by Owner and Contractor.

f) The average ambient temperature of the Filtered Measurement Data shall be calculated. This average ambient temperature shall be the reference (RC) temperature T_0.

g) The average wind speed of the Filtered Measurement Data shall be calculated. This average wind speed shall be the reference wind speed WS_0.

5.4 Minimum Power Rating (Pmin)

a) The PV Simulation Model, as derived from PVsyst simulations, shall be used to establish the Facility's expected output to be compared to the power output at the revenue meter as adjusted at the relevant conditions.
   i) Owner and Contractor, upon execution of the Agreement, shall review and agree on all inputs to PVsyst for the creation of the PV Simulation Model, including (but not limited to): losses, weather data file, and component model files.

b) Each of the PV Simulation Model outputs shall include, as a minimum, the following columns in the respective output .csv files (or 8760 files) :
   i) Date & Time (formatted with Month; Day; Hour in separate columns)
   ii) POA Irradiance (GlobInc, W/m^2)
   iii) RPOA Irradiance (GlobBak, W/m^2)
   iv) Horizontal Irradiance (GlobHor, W/m^2)
   v) Ambient Temperature (T Amb, °C)
   vi) Wind Speed (WindVel, m/s)
   vii) Near Shadings Beam Loss (ShdBLss, W/m^2)
   viii) Inverter Loss Due to Low Voltage Maximum Power Point (MPP) Window (IL Vmin, kW)
   ix) Inverter Loss Due to Power Limitation (i.e., "clipping" loss) (IL Pmax, kW)
   x) Available Energy at Inverter Output (EOutInv, kW)
   xi) Energy Injected into Grid (E Grid, kW)

c) For the purposes of this procedure, the Target Period shall be derived from historical or site-measured weather data. Using the contractual historical weather data is an option to simplify the procedure. The Target Period shall consist of a minimum of fourteen (14) days: the seven (7)-Day period prior to and after the Test start. The Target Period may be extended further than fourteen (14) Days upon agreement of Contractor and Owner.

d) The **Minimum Power Rating (PMIN)** expected from the Plant at the Reporting Conditions shall be determined from the PV Simulation Model for the site in accordance with the following:

i) Run PV Simulation Model with the contractual historical weather file, or the measured site weather data from the collected Target Period. (PVsyst will receive 1- minute or 5-minute data but will convert it to one-hour data)
ii) Apply the following filters to the resulting Target Period data file:
   a) Exclude any data points with beam shading values ShdBLss > 0.
   b) Exclude any data points where the inverter is not in 'Peak Power Point Tracking' mode, as such term is defined in section 9.1.8 of ASTM E2848-13.
   c) Exclude any data with irradiance values outside of the range established section (3)(d)(iii) above.
iii) After filtering, the resulting dataset shall have 50 one-hour data points, or more.
   a) If less than 50 data points remain in the set, then the Test Period shall be shifted and a new Target Period shall be identified per to section (3)(e)(ii) above.
   b) At Owner's discretion, the irradiance threshold may be expanded to a larger range as described in (3)(e)(iii) above.
iv) For the filtered Target Period dataset, a regression analysis shall be performed on the POA irradiance, ambient temperature, wind speed, and energy at the POI meter. The regression analysis shall be used to determine the modeled regression coefficients A, B, C and D in the following Equation 2 (Eq. 2):

   $E\ Grid = Irr_T * (A + B * Irr_T + C * TAmb + D * WindVel)$ **(Eq. 2)**
   For bifacial modules use Irr_T in the regression where Irr_T = GlobInc + (GlobBak * ϕ) for bifacial modules. Otherwise, Irr_T = GlobInc.
   Where ϕ is the bifaciality factor of the module as provided in the module specification sheet. (above adjustment assumes bifacial modules in single portrait configuration)

v) The Minimum Power Rating (P_{MIN}) shall be calculated for the site by substituting in coefficients A, B, C and D and the appropriate Reporting Conditions (Irr_0, T_0 and WS_0) as shown in the following Equation 3 (Eq. 3):

   $PMIN = Irr_0 * (A + B * Irr_0 + C * T_0 + D * WS_0)$ **(Eq. 3)**

   For projects utilizing bifacial modules, use the Reference Irradiation, Irr0, from both sides of the module, i.e., the sum of the irradiation in the plane of array on the front side and back side as illustrated in Equation 1.

5.5 Power Rating (Prc)

a) The Filtered Measurement Data for the site identified in section (3)(e) above shall be used to calculate P_{RC} for the site.
b) Filtering of the test data and calculation of the P_{RC} shall be conducted according to section 9 'Calculation of Results' of ASTM E2848-13. The equation used for the final calculation (equation 2 in ASTM E2848-13, modified for the terminology used in this test report) is:
   $P_{RC} = Irr_0 * (a_1 + a_2 * Irr_0 + a_3 * T_0 + a_4 * WS_0)$
   Where Irr_0, T_0, and WS_0, are the Reporting Conditions and the coefficients a_1, a_2, a_3, and a_4 are calculated from the measured, filtered data as described in ASMT E2848-13. The regression shall be based on the below for determining the actual coefficients from the equation using the measured site data,
      Revenue meter power (for each time stamp) = TPOA * (a1 + a2 * TPOA + a3 * TAmb + a4 * WindVel)
      Where TPOA (=POA+RPOA*ϕ for bifacial modules), TAmb, and WindVel are the measured values
c) The results of this section (P_{RC}) shall be reported in accordance with section 10 'Report' of ASTM E2848-13.

5.6 Facility Performance

a) The Facility Performance shall be calculated as below and expressed as a percentage:

Facility Performance = (P_{RC} / P_{min}) * 100

b) If the Facility Performance is greater than or equal to the Guaranteed Capacity (97%), then Contractor has met the Guaranteed Capacity. If the PV Power Plant has so achieved the Guaranteed Capacity, then no further analysis is required.
c) If, however, the PV Power Plant did not so satisfy the Guaranteed Capacity, then Contractor shall follow the process outlined in the Agreement.

EXHIBIT 7 – PROJECT SCHEDULE

1. PROJECT SCHEDULE

Contractor is to provide a detailed work schedule (hard and native electronic copies) thirty days after the issuance of Full Notice to Proceed (FNTP). This work schedule, as subsequently accepted by Owner, shall become Attachment 1 to this Exhibit 7 of the Agreement.

2. KEY DATES SCHEDULE

Key Date Schedule shall include major project milestones, including substantial completion of each circuit. Milestones indicated in the Key Date Schedule will be used as a basis for milestone payments.

3. CRITICAL PATH SCHEDULE

The Critical Path Schedule shall identify Contractor's plan of execution for the installation, commissioning and performance testing for the work. The Critical Path Schedule shall be a time-scaled critical path method logic diagram schedule (resource loaded) of all design and equipment procurement for the project and all material work activities so that substantial completion occurs on the substantial completion guaranteed date. The Critical Path Schedule shall include allowance for normal delays and difficulties that may be encountered in work of this nature including weather and holidays, etc. The Critical Path Schedule, as a minimum, must show an orderly array of activities in support of all the dates established in the Key Date Schedule), and shall be sufficiently detailed so that each of the following are included and will be readily apparent:

(A) the engineering and detailed design activities necessary to complete design, procurement and construction;

(B) materials and equipment purchases and deliveries;

(C) subcontractor interfaces and requirements;

(D) construction, by circuit and system;

(E) dates for the completion of key date items;

(F) contractor and subcontractor data cycles, and owner's review cycles;

(G) functional tests, commissioning and capacity testing;

(H) a schedule for completion of post-substantial completion date items including as built drawings and specific non-critical deficiencies listed on the punchlist costing more than $100,000 to complete.

4. SUBMITTAL

The Critical Path Schedule shall be delivered both in native electronic form and in hard copy. The Functional and Capacity Test Schedules must be coded in such a way as to provide individual test progress and schedules in accordance with an agreed upon Commissioning Plan.

EXHIBIT 8 – ENERGY MODEL

1. OVERVIEW

Energy Model Overview

Using the Project Weather File, the PVSyst Parameters, and additional loss parameters, simulations will be run to model the expected energy output from the PV system at the revenue meter producing the expected energy production. This energy model will be used by Owner for its own financial monitoring and asset management, and by Contractor as the PVSyst model for use in the Capacity Test calculations.

The general procedure is as follows:

1) Project Weather File shall be defined and agreed upon by both Owner and Contractor for preliminary models, see section 4.0. Upon project completion, weather file and system operational data shall be gathered and recorded by SCADA to update the model with site data.
2) The Project Weather File will be compiled and used to generate a file that will be loaded into PVSyst.
3) PVSyst will produce an output for the Project Weather File, which will then be loaded into the Energy Model File.
4) Calculate any losses not modeled in PVSyst.
5) Add up the contributions from all the Circuits.
6) Result is the expected net output of the PV power plant which will serve as the Energy Model.

Wherever [ ] appears in this document, it is a value to be proposed by Contractor.

2. ACCOMPANYING RESOURCES

Associated Software, Files, and References:

- **Software:**
    a. Most recent version of PVSyst.
    b. Microsoft Excel
- **Files:**
    a. Energy Model File
        i. [ ].xls
    b. Module Equipment Files for PVSyst
        i. [ ].PAN
    c. Inverter Equipment File for PVSyst
        i. [ ].OND
    d. Shading Profile File for PVSyst
        i. [ ].SHD
    e. Project File, Variant Files by Array Type
        i. [ ].PRJ
        ii. [ ].VC2
        iii. [ ].VC3

    f. PVSYST Output Reports by Array Type or Circuit or Plant
        i. [ ].pdf
        ii. [ ].pdf
        iii. [ ].xlsx

    g. Energy Prediction Report by Circuit (if Circuits differ) with AC losses excluded
        i. [ ].xlsx
        ii. Contractor to include with Bid.
- **References**
    a. System design specifying module types, strings per inverter, inverters per Circuit.

3. DATA PREPARATION

Data Collection – Calibrated to actual Site data
Preliminary models to use Solar Anywhere TMY files as specified in section 4.0. Upon project completion, data points to be used in the Energy Model will be measured and recorded by the SCADA in one-minute increments. SCADA recorded weather file to be submitted to Owner with updated energy model as specified in Exhibit 2. Measurement data recorded by the SCADA and used in running the Energy Model will include:

Measured Meteorological Data (inputs to PVSyst):

- GHI Pyranometer irradiance (W/m^2)
- Ambient temperature, T_{amb} (˚C)
- Wind speed (m/s)
- DHI (W/ m^2)
- Albedo (W/ m^2) (If bifacial modules used)

Discussion:

- GHI will be used to calculate POA in the model and ambient temperature and wind speed will be used to calculate module temperature. Though POA and T_{bom} are measured and could be input directly, the Energy Model is based on the POA/GHI transposition and T_{amb}/T_{bom} calculation.

Data Preparation

- The necessary meteorological measurements will be averaged into time intervals consistent with the minimum input parameters required for analysis in PVSyst. Currently this time interval is one hour, but if a smaller time interval becomes available, this will become the default time interval. All data fed into and read from PVSyst should be in hour beginning format.
- The raw test data shall also be analyzed and reduced to eliminate data points that clearly exhibit a high degree of random error (such as errors caused by faulty instruments).
- Missing or obviously faulty data due to equipment error shall be discarded or be replaced in accordance with the Acceptance Test Procedures.
- All methods for data filtering and manipulation shall be agreed upon between Owner and Contractor. A report of all data filtering will be provided.

Load Weather File into PVSyst

The resulting Weather File created will be converted into a TMY3 or ASCII format compatible with the input requirements for PVSyst and will replace or modify the preliminary weather file (used during bid process) used to produce the base PVSyst energy model.

4. PVSYST SIMULATIONS

Determine PVSyst Simulations to Run

Although module types and string configurations can vary within a Circuit, each Circuit must be modeled by a single average configuration and single module degradation amount (one PVSyst .VC file per Circuit) Include 8760 data as an attachment.

PVSyst Parameters

1. Project Tab
    - Latitude = [ ] deg.
    - Longitude = [ ] deg.
    - Meteo Data File: Solar Anywhere, satellite data, SUNY model - TMY
    - Altitude = [ ] meters
    - Time zone = [ ]
    - Monthly Albedo = [These values assume a one-in-portrait tracker]

Month	PVsyst Inputs
January	[ ]
February	[ ]
March	[ ]
April	[ ]
May	[ ]
June	[ ]
July	[ ]
August	[ ]
September	[ ]
October	[ ]
November	[ ]
December	[ ]

    - Lower temperature for V_{max} Abs limit = [ ] degrees C
    - Winter operating temperature for V_{mpp} Max design = [ ] degrees C
    - Usual operating temperature under 1000 W/m = [ ] degrees C
    - Summer operating temperature for V_{mpp} Min design = [ ] degrees C
2. Orientation Tab
    - Unlimited sheds
    - See attached input and assumptions for Tracker parameters
3. Horizon Tab
    - As applicable
4. Near Shadings Tab
    - As applicable
5. System Tab
    - Module .PAN file
    - Inverter .OND file
    - Nb of inverters. = [ ]
    - Modules per String = [ ]
    - Strings per Inverter = This varies by array type. See the PVSyst Assumptions Attachment - Input and Assumptions System Definition section.
    - Detailed Losses section of System Tab
        i. Uc= 25.0 W/m^2k

ii. Uv= 1.2 W/m^{2}k / m/s
iii. Ohmic Losses = [ ]
    1. 1.5% DC loss at STC
    2. See AC circuit loss table below

Circuit	AC Circuit Losses: Inverter to Injection Point (@STC)
1	[ ]
2	[ ]
3	[ ]

Table 1: AC circuit losses per Circuit for *n* Circuits
(Note: Contractor to fill out table with actual values)

    1. 0.10% iron loss, 0.90% resistive/inductive losses at STC. Add 0.10% iron loss and 0.40% resistive/inductive losses if including GSU transformer.

iv. Module Quality, LID, Mismatch
    1. 1.5% for LID
    2. [ ] Module Quality loss
    3. 1.0% Mismatch loss at MPP
v. Soiling losses:

Month	**PVsyst Inputs**
January	[ ]
February	[ ]
March	[ ]
April	[ ]
May	[ ]
June	[ ]
July	[ ]
August	[ ]
September	[ ]
October	[ ]
November	[ ]
December	[ ]

vi. Incidence angle effect: b_0= see .pan file for table.
vii. Bifacial System:
    1. Shed transparent fraction = 2%
    2. Structure shading factor
        a. 15% for one-in-portrait
        b. 5% for two-in-portrait
    3. Mismatch loss factor = 10%

6. Module Layout Tab
    - Not used
7. Hidden Parameters Menu
    - Not used

8. Preferences Menu
    - Physical Model = Perez

Additional Loss Parameters

Some losses cannot be calculated in PVSyst or not calculated to the specifications necessitated by the Contractor. These losses must be fully completed in Microsoft Excel with all the formulas, constants, and justification spelled out here.

Module Degradation Amount

To account for accumulated module degradation that has occurred for the PV Plant from the beginning of the start date of the long-term module warranty to the end of the Life of the plant, module degradation amount listed in the table below (values shown for example only. Actual values to be filled in by party responsible for module supply) shall be applied to the Energy Model for predicting the energy output for each year.

Year	If the module(s) has a power output less than the percentage below multiplied by the STC power nameplate rating on the back of the applicable module, then such Product shall be deemed to be in breach of the 30 Year Limited Power Output Warranty	% Degradation
1 (i.e., the first 365 days beginning on the Warranty Start Date, expiring the day before the first anniversary of the Warranty Start Date of the applicable Product)	97.50%	2.50%
2 (i.e., the second 365 days of such period until the day before the second anniversary of the Warranty Start Date of the applicable Product, etc.)	97.00%	0.50%
3	96.50%	0.50%
4	96.00%	0.50%
5	95.50%	0.50%
6	95.00%	0.50%
7	94.50%	0.50%
8	94.00%	0.50%
9	93.50%	0.50%
10	93.00%	0.50%
11	92.50%	0.50%
12	92.00%	0.50%
13	91.50%	0.50%

14	91.00%	0.50%
15	90.50%	0.50%
16	90.00%	0.50%
17	89.50%	0.50%
18	89.00%	0.50%
19	88.00%	0.50%
20	87.50%	0.50%
21	87.00%	0.50%
22	86.50%	0.50%
23	86.00%	0.50%
24	85.50%	0.50%
25	85.00%	0.50%
26	84.50%	0.50%
27	84.00%	0.50%
28	83.50%	0.50%
29	83.00%	0.50%
30	82.50%	0.50%

Table 2: Module Degradation.
(Note: Values shown are an example, not actual)

5. COMPILE AND ADJUST SIMULATION RESULTS

Once the Weather File has been compiled and input into the PVSyst model, a simulation will be run and exported in .csv format. This data can then be input into the Annual Hourly Energy Output spreadsheet to calculate the combined plant output. The procedure for running the simulation and generating the reports includes the following steps:

1. In the Simulation Screen input a unique output file name for each run/circuit. (not to exceed the number of Circuits).
2. The output parameters will include at least the following variables:
    a. Horizontal global irradiation
    b. Global incident in coll. Plane
    c. Ambient Temperature
    d. Average Module temperature
    e. Wind velocity
    f. Effective energy at the output of the array
    g. Available Energy at Inverter Output
    h. Energy injected into grid
    i. Inverter efficiency (operating)
3. Run the simulation.
4. A .csv file will be created for this simulation and will be saved with the designated file name. The .csv file can be opened in MS Excel where the data can be parsed.
5. Review the data for each case to verify the output calculated by PVSyst does not exceed the nameplate output of the inverter.

Copy and paste the output data into the appropriate column in the Energy Model File.

Energy Model File

There will be a single tab in the Excel file titled “Hourly Energy” that will include the energy production and subtract any additional losses (AC Losses, Aux Load, Availability, etc., if not already included in PVsyst). There will also be columns listing the metered energy production and the applicable project weather file (GHI, POA, wind speed and direction) for the corresponding time period.

6. FINAL ENERGY MODEL

If any changes occur to Contractor’s design (such as equipment selection) that would affect the energy model files that were used as the basis for the bid, these must be reviewed and approved by the Owner prior to modification or inclusion in Contract. If approved, updated energy model files will be created and submitted as a revision to Exhibit 8. All parameters to be submitted in PVSyst Assumptions Attachment, with explanation for any parameters differing from the those given in this Exhibit 8.

PVSyst Assumptions Attachment

Software	Version	Comment
PVsyst		
Microsoft Excel		Provide Native Post Processing File, if applicable

PVsyst File	Type	File Name
Project	.PRJ	
Variant(s)		
Meteorological	.MET	
Site	.SIT	
Module	.PAN	
	.PAN	
	.PAN	
Inverter	.OND	
Shade	.SHD	
Horizon	.HOR	
PVsyst Report	.PDF	
8760	.xlsx	

PVsyst Parameter	Value	Comment
Transposition Model		
MET File Source (e.g., SolarAnywhere)		
Latitude		
Longitude		
Altitude (m)		
Module/Tracker Orientation (e.g., 1-Portrait)		
Axis Tilt		
Axis Azimuth		
Minimum / Maximum Phi		
Backtracking (On/Off)		
Ground Coverage Ratio (GCR)		
Number of Sheds		
Pitch (m)		
Tracker/Collector Width (m)		
Inactive Band, Left (m)		
Inactive Band, Right (m)		
Axis Height Above Ground (m)		
Module Bifaciality Factor (%)		
Rear Shading Factor (%)		
Module Transparency (%)		
Rear Mismatch Loss (%)		

Monthly Albedo Profile	Jan =	
	Feb =	
	Mar =	
	Apr =	
	May =	
	June =	
	July =	
	Aug =	
	Sep =	
	Oct =	
	Nov =	
	Dec =	
Module Manufacturer		
Module Model		
Total Number of PV Modules		
Number of PV Modules (Bin Class 1)		
Bin Class 1 (W)		
Number of PV Modules (Bin Class 2)		
Bin Class 2 (W)		
Number of PV Modules (Bin Class 3)		
Bin Class 3 (W)		
Number of Modules per String		
Number of Strings in Parallel		
Inverter Manufacturer		
Inverter Model		
Number of Inverters		
Monthly Soiling Profile	Jan =	
	Feb =	
	Mar =	
	Apr =	
	May =	
	June =	
	July =	
	Aug =	
	Sep =	
	Oct =	
	Nov =	
	Dec =	
Thermal Loss Factor - Constant		
Thermal Loss Factor - Wind		
DC Wiring Loss at STC (%)		
Module Quality Loss (%)		
Module Mismatch Loss (%)		

String Mismatch Loss (%)		
LID - Light Induced Degradation (%)		
AC Circuit Loss at STC (%)		
External Transformer Iron Loss (%)		
External Transformer Resistive/Inductive Losses (%)		
Auxiliary Loss		
Grid Power Limit (MW)		
Power Factor		
Facility Availability (%)		

EXHIBIT 9 – APPROVED SUPPLIERS

1. GENERAL

This Attachment lists the acceptable suppliers/vendors that the Contractor may utilize on the Project.

2. ACCEPTABLE SUPPLIERS

Contractor shall provide equipment from the following vendors:

2.1 PV Module

A. Canadian Solar
B. First Solar
C. GCL
D. Hanwha Q-CELLS
E. JA Solar
F. Jinko Solar
G. LONGi Solar
H. Maxeon
I. Trina Solar
J. Vikram
K. VSUN
L. Heliene

2.2 Tracker

A. Array Technologies (ATI)
B. NEXTracker
C. GameChange

2.3 DC Combiner Box and/or Load Break Disconnect

A. Bentek (provisional)
B. Shoals/ConnectPV
C. Solar BOS
D. WTEC

2.4 Inverter

A. Power Electronics
B. SMA
C. Sungrow
D. TMEIC
E. Chint Power Systems (CPS)
F. SolarEdge
G. Yasakawa

2.5 Medium Voltage Transformer

A. ABB (conditionally)
    1. Contractor shall specify manufacturing location of ABB transformers and Contractor's involvement in quality assurance / quality control as respective facility.
    2. Owner reserves right to accept or reject ABB as the medium voltage transformer manufacturer for the Project.
B. Eaton Corporation (Cooper Power Systems)

C. Eaglerise (conditionally)
D. JSHP (conditionally)
E. WEG
F. Westrafo
G. Howard
H. Emco
I. Owner realizes others may be used in combination with selected inverter, but those must be reviewed and approved by Owner and may have bearing on the inverter selection.

2.6 Substation Transformer

A. SPX Transformer Solutions, Inc. - Waukesha
B. HICO
C. Hitachi
D. Siemens
E. WEG

2.7 SCADA System

A. AlsoEnergy
B. Green Power Monitor (GPM)
C. NorCal Controls
D. Trimark
E. Vertech
F. Saginaw Power and Automation

EXHIBIT 10 – MONTHLY PROGRESS REPORT

1. GENERAL

Description

Cover sheet to show the project name, the time span covered and the date of the report.

INDEX

1.1 Project Team

List personnel and functions of team comprising of:

- Contractor
- Subcontractors
- Major suppliers

1.2 Executive Summary

Provide high level summary delineating project status, milestones and issues. Limit to 1 page or less.

1.3 Health Safety and Environmental

Details may be represented using charts, graphs or narratives.

- Total man-hours worked, total recordables and total Lost Time Accidents (LTAs) and Lost Time Injuries (LTIs)
- Total man-hours since last LTA or LTI
- Total work force on site
- Reportable Incidents since last report
- Medical/incident details
- Details of any LTA
- Near-miss details
- Actions taken to mitigate any future near-miss, recordable or LTA
- Environmental compliance update (if applicable)

1.4 Project execution status

Overall

Describe for each category/bullet items:

- Major accomplishments/activities this month
- Goals and milestones for next month
- Key milestones – tabular form showing Plan, Forecast and Actual progress

Project Schedule

- Include % complete against time (Engineering Procurement, Construction, Overall)
- Progress curves for planned versus actual (Engineering Procurement, Construction, Overall)
- Overall project status

Permitting Progress

Detail any permitting progress and issues that have continued into construction phase, as applicable: site access, encroachments, building permits, etc.

Construction Report

List each area of major activity and its progress and any discussion points, key milestones, and goals for next month. This should include

- Interconnection and substation work
- PV field
- On site structures

Procurement Report

- Procurement Progress
- Manufacturing Status
- Factory Inspection and Testing
- Shipping, Expediting, and Delivery
- Procurement Status Report – Include a table of major equipment to be procured by Contractor (including its subcontractors).

EQUIPMENT DESCRIPTION	MANUFACTURER	CONTRACTED DELIVERY DATE	ACTUAL DELIVERY DATE

Start-up and Commissioning

- List major systems commissioned and turned over to owner during the reporting period
- List major systems to be commissioned and turned over to owner during the next month

Quality Assurance and Control

Report on QAQC status of project. List which areas have been inspected and the % of NCRs or some other acceptable tracking method to indicate overall quality of each installation.

1.5 Training

1.6 Key Issues and remedies (Areas of Concern)

- Late activities which impact the Project Schedule and mitigation plan
- Interface data problems
- Deviations of Work from Quality Assurance/Quality Control Plan
- Other concerns

1.7 Commercial

1.8 PHOTOS

1.9 APPENDICES

EXHIBIT 11 – QUALITY ASSURANCE

1. GENERAL REQUIREMENTS

The following sections of this Exhibit describe the minimum requirements of Contractor's Quality Plan for this Agreement. The inspections, tests and related actions specified in this section and elsewhere in the Agreement are not intended to limit Contractor's own quality assurance/control procedures that facilitate overall compliance with requirements of the Agreement. Contractor may use its own Quality Assurance/Quality Control (QA/QC) procedures provided such procedures have been reviewed and commented on by Owner prior to start of Work. Contractor's procedures must address, as a minimum, the information contained in this Exhibit and referenced documents.

2. QUALITY CONTROL PROGRAM

Basic objectives of Contractor's Quality Plan shall be as follows:

- To ensure that all work adheres strictly to all requirements of the Agreement and governing agencies where the work is being performed.
- To maintain QC procedures to ensure that tasks performed will comply with the Agreement.
- To prevent deficiencies through pre-construction quality control coordination.
- To detect and correct deficiencies in a timely manner.
- To provide an auditable record of all tests, inspections, procedures, non-compliances and corrections, and any other pertinent data as required.
- Verify compliance with Contractor's QC procedures, including those QC procedures of subcontractors and suppliers.
- To provide a basis of measuring Contractor's performance for input to Owner's Contractor resource database.

Contractor may select either outside "agency" or in-house personnel to administer Contractor's QC system. In either case, the Contractor's on-site quality control staff shall only be responsible for quality control. The QC supervisor (or person designated as the QC representative) shall report directly to Contractor's Site Manager. Contractor's QC staff shall not be involved in the management and/or control of the construction process. Contractor's QC staff members shall interface with Owner, its inspectors and consultants, as required.

3. TESTING CRITERIA

Contractor shall perform all testing and inspection of all Work (including materials) both on and off site as required by the Agreement. This shall include pre-functional and functional tests. Test passing criteria shall be clearly spelled out on work instructions and check sheets.

4. RESPONSIBILITIES OF THE CONTRACTOR'S QC SUPERVISOR

Responsibilities and duties of the Contractor's QC supervisor are:

- To communicate these minimum QC requirements to any suppliers and/or contractors.
- To have the authority to stop Work for cause, reject work, order work removed, initiate remedial work, propose solutions, and reject material not in compliance with the Agreement.
- Is present on-site and shall designate alternate individual(s) to assume responsibilities in the temporary absence of the QC supervisor. Designated alternate individual(s) must be trained and experienced in the Work and be qualified to inspect the Work.
- Be completely familiar with the Agreement Scope of Work and Drawings.
- Establish and implement QC programs for Contractor and with its various subcontractors, and monitor their conformance.
- Inspect existing conditions prior to the start of new work segments.
- Conduct a pre-construction quality control meeting with Contractor's responsible field and office representatives prior to the start of each major item of work required by the Agreement.
- Perform in-process and -follow-up- inspections on each of the work segments to ensure compliance with the Agreement. Upon request, accompany Owner on such inspections.
- Coordinate required tests, inspections, and demonstrations with Owner or any other authority having jurisdiction.
- Inspect Contractor purchased materials and equipment arriving at the Jobsite to ensure conformance to the requirements of the Agreement. Prepare and submit documentation as required by the Agreement.
- Inspect material to ensure conformance to the requirements of the Agreement.
- Identify, report and reject defective work not in conformance with the Agreement. Monitor the repair or reconstruction of rejected work and document corrective action. Confirm repaired work meets QC requirements.
- If necessary, retain specialists or sub-contractors for inspection of Work in areas where additional technical knowledge is required. Submit qualifications of subcontractors and specialists to Owner for approval.
- Work closely with Owner to ensure optimum quality control. Attend meetings as required by Owner.

5. SUBMITTALS

- A letter signed by a responsible officer of Contractor outlining the authority of the QC supervisor to include, among other things, the authority as described herein.
- Contractor shall submit its quality plan manual for review, comments, and approval prior to beginning any Work.
- Contractor shall submit an Inspection and Test Plan (ITP) for review, comments, and approval prior to beginning any Work.
- The ITP shall identify all items that are to be inspected and tested, the frequency of inspection and testing, vehicle that will be used to document the inspection, and who will witness the inspections. The ITP shall identify witness, review, and hold points.
- It shall be the responsibility of Contractor to submit all of the above documents for any and all subcontractors under their direction prior to beginning work.

- Contractor shall perform random quality audits on all disciplines and subcontractors to verify compliance of the quality program.

Contractor shall submit reports detailing the results of each test and describing each inspection. Submit separate reports for each test and inspection procedure immediately upon completion of each procedure and test.

6. GENERAL QC REQUIREMENTS

Inspection and test reports, as a minimum, shall include:

- Date issued
- Date of inspection or test
- Record of test conditions relevant to test
- Project title and number
- Testing agency name and address
- Name and signature of the inspector/tester
- Identification of the product (including serial number) and applicable specification section
- Type of inspection or test
- Pass/fail criteria
- The results as related to requirements

7. INSPECTION, MEASURING, AND TEST EQUIPMENT

Contractor shall provide and maintain all measuring and testing devices. Laboratory devices shall be calibrated as required by the Agreement specifications. The standards against which the measurement equipment is periodically calibrated shall have their accuracy verified directly by, or through a precise comparison with standards traceable to the National Institute of Standards and Technology or to a recognized national standard. Refer to traceability requirements and standards in other attachments.

8. EXECUTION

Contractor's inspection shall be adequate to cover all operations, including both on-site and off-site and will be keyed to the proposed sequence of the Work and shall include as a minimum at least four (4) phases of inspection for all definable items or segments of the Work, as follows:

- Preparatory Inspection: To be performed prior to beginning any work on any definable segment of the Work and shall include:

  - A review of Agreement requirements
  - Verification that all materials and/or equipment have been visually inspected upon receipt, tested, submitted, and accepted
  - Verification that provisions have been made to provide required control testing
  - Examination of the work area to ascertain that all preliminary work has been completed
  - A physical examination of materials and equipment to assure that they conform to accepted shop drawings or submittal data and that all necessary material and/or equipment are available

  As a part of this preparatory work, Contractor's organization will review and verify that all documents, including but not limited to, shop drawings, submittal data, method of quality control, product data sheets, test reports, affidavits, certification and manufacturer's instructions have been submitted and accepted by Owner as required herein. Each submittal to Owner shall bear the date and the signature of the Contractor's quality control manager (or authorized designee) indicating that he has reviewed the submittal and certified it to be in compliance with the Agreement Drawings or showing the required changes.

- Initial Inspection: To be performed as soon as a representative segment of the particular item of work has been accomplished and to include examination of the quality of workmanship and a review of control testing for compliance with Agreement requirements, exclusion of defective or damaged materials, omissions, and dimensional requirements. Contractor shall plan for first-in-place inspections of trenches, modules and trackers and inverters providing advance notice to Owner and vendors as applicable for inspection opportunities for all related parties.

- Follow-up Inspection: To be performed daily or as frequently as necessary to ensure continuing compliance with the Agreement requirements, including control testing, until completion.

- Final Inspection: To be conducted immediately prior to Mechanical Completion. Contractor shall inspect the work for quality, workmanship and completeness prior to notification that the item or segment of the Work has been completed.

- Specific tests and inspection procedures (including documentation) for each material or item of work are specified in the Agreement Scope of Work and the Drawings.

- Third-party inspections: Contractor shall have any third-party inspections performed as required by the authority having jurisdiction.

- Contractor's testing laboratory shall perform tests according to method(s) of testing specified in the Agreement.

- Contractor shall ensure that Owner is given sufficient time to witness tests and re-inspect work performed by Contractor.

- Contractor shall ensure that all work that does not comply with the requirements and references specified in the Agreement Scope of Work is identified and correctly dispositioned. All work installed or fabricated by the Contractor shall be inspected (i.e., punched) and resolved prior to notifying

Owner the Work is ready for Mechanical Completion. Contractor shall record all punch list items (i.e., deficiencies) on a punch list record. Material or equipment that is supplied by Owner and is found by Contractor to have deficiencies is to be immediately identified to Owner for corrective action.

- Contractor shall package and prepare all inspection and testing documentation for turnover at the completion of construction. Turnover packages are to be developed by system as determined by Owner. Each system file will contain all field inspection and testing records for the components of the system. Unless otherwise specified, Contractor shall submit two (2) clean, legible copies of all turnover packages to Owner at the completion of construction. Refer to Exhibit 2 for submittal requirements.

EXHIBIT 12 – TRAINING

1. GENERAL

Contractor shall conduct site-specific training for Owner-assigned administrative, operations, technical, and maintenance personnel. The course shall be conducted during a standard 8-hour day. Classroom training will be augmented by field reinforcement and SCADA HMI viewing of the instruction topics. All students shall be taught in a one- or two-day class session, as required. Each training session shall be conducted in an air-conditioned classroom with the appropriate visual aids. A conference call in and online web instruction capability shall be provided. The training program will cover all related aspects of knowledge required by the individual disciplines to allow them to competently operate, troubleshoot, and maintain all plant processes and utility systems.

Beyond this classroom-based training, a minimum of 12 hours of on-the-job training of operation personnel will be conducted during start-up and commissioning activities, see 2.1 below.

Owner shall advise one month in advance of the number of personnel attending training. A training sign-up sheet shall document Owner's personnel attendance and Contractor's instructor(s). Contractor shall submit the proposed Training Schedule, Training Course Outline and Training Manual for Owner's review 20 business days prior to the training, refer to Exhibit 2.

Owner shall ensure that all Operating Personnel attendees (i) are adequately pre-trained in ALL safety aspects of an industrial electrical generation facility as required by Governmental Authorities and Applicable Law and (ii) shall arrive at the classroom with all appropriate personal protective equipment required for touring the PV Power Plant. Contractor shall provide site specific safety training to these personnel.

2. SITE-SPECIFIC TRAINING

This Program will encompass on-site training.

2.1 Contractor Responsibility

Contractor shall be responsible for:

- Provide training facilities which present an environment conducive to learning (heating, lighting, low noise level and air conditioned and be furnished with an LCD projector or equivalent screen, whiteboards and markers and podium). Each student's desk (table) shall have enough working space for training manuals and the associated C size drawings.
- Preparation of all classroom and training materials.
- Scheduling and coordination of all classroom-training courses.
- Provision of instructions, lesson plans, review, and on-the-job training of the students.
- Coordination of the training schedule with Owner to allow Owner to conduct its own employee training.
- Completion of training program scheduled close enough to the hands-on operating phase so that the material will remain fresh in the minds of the operating personnel.
- On-the-job training throughout the start-up and commissioning period. During this time, Contractor's personnel, as well as representatives from the equipment representatives, shall be available to advise, support, and coach the operating staff.

2.2 Types of Training

This Program will be based on the Plant Operating and Maintenance Manuals to be prepared by Contractor and equipment manuals to be furnished by equipment providers. Training sessions will be grouped into logically organized modules. A trainer experienced in a specific subject matter will present each of the training modules. These modules will include lesson plans, system descriptions, and power point presentations for the systems. Each trainee will be provided with a copy of the classroom materials and other training documentation. Larger drawings of the solar power plant will be displayed for orientation and discussion.

All sessions shall be presented in an informal lecture style with each student having their own set of training material. Each student shall be encouraged to ask questions and to participate in group discussions. This shall be stated in the course objectives and expectations.

Two types of training shall be provided:

- PV System, Substation, and SCADA System, performed by Contractor's Training Staff.
- Vendor specific training by the appropriate equipment supplier or his duly authorized factory representative.

Training will consist of classroom instruction, discussions, site walk downs, and demonstration of ability to properly operate the facility. Contractor's training instructors will discuss the overall photovoltaic power plant, while representatives from the equipment manufacturers will address their scope of work.

2.3 Training Topics

A. PV Systems

During this section, Contractor will describe the process and discuss the principles of operation for the photovoltaic power plant.

Contractor shall provide experienced instructors to conduct its training program, which shall consist of classroom sessions bolstered by system walk downs and examinations. The course curriculum shall include the PV system design. The following outline of topics shall typically be covered but not limited to:

- Introduction
- PV Systems
- Substation
- Commissioning and Startup
- SCADA Systems
- Meteorological (MET) Stations
- Security Systems

2.4 Lesson Format

Each session shall typically include the following information:

- Lesson Objectives
- Design Basis and List of Resources
- System Overview with Drawings
- Component Description with Supporting Documentation (figures, tables, graphs, etc.)
- Demonstration of ability to properly operate the facility

2.5 Lesson Content

A. Lesson Objectives

The major information the student is expected to learn and retain from the lesson shall be presented. Referenced materials utilized in the training session shall be displayed. Listed references shall include page numbers in manuals, diagram and/or drawing numbers, and appropriate procedure of section numbers.

B. Design Basis and List of References

The design basis and reference documents shall be presented. The student is expected to learn and retain this information from the lesson.

C. System Overview with Drawings

This section shall include a brief description of the intended use of the system.

D. Component Description with Supporting Documentation

This section shall include information on the major components of the system. Tables, figures, drawings and design details shall also be provided.

E. Principles of Operation, Including Start-up and Shutdown Procedures

The various operational modes of the system and documents shall be presented, including:

- Operating Philosophy
- Start-up
- Normal Operation
- Normal and Emergency Shutdown
- Understanding and responding to alarms

- Recognizing and Handling Abnormal Operating Conditions (Troubleshooting)

Trained Owner's personnel will participate in the commissioning and start-up of Owner's facility. Therefore, Contractor's training shall emphasize safety practices and precautions throughout the entire program with the associated "dos and don'ts".

F. Walk-downs

Walk-downs shall be conducted to familiarize the students with the physical location and appearance of equipment and to clarify equipment features, controls, and displays, as well as site features such as drainage, roads, access, and security.

EXHIBIT 13 – PV MODULE WARRANTY

1. OVERVIEW

Contractor shall supply, through the PV Module Supplier, a PV Module Warranty that is applicable to utility scale solar projects. This will include the following main features:

1. A linear module Power Output Warranty that is for the life of the project 30 years, providing no less than 82% power output at STC at the final year of the Design Life (year 30 preferably), and no more than 2.5% in the first year. See Power Output Schedule below.
2. A 10-year or 12-year product warranty. OWNER prefers 12-year option.
3. Provisions for on-site testing methodology to verify defective products.
4. Provisions for sharing in-and-out costs. OWNER prefers a warranty which will provide for labor to remove and re-install product, and shipping, at no cost to OWNER.
5. Commitments (guarantees) to maximum timeframes for testing, removal, shipment, and reinstallation of defective or deficient product.
6. 60-day notice prior to shipping if module power output mix is different than agree-upon values.

2. LIMITED WARRANTY

The following main elements shall be addressed in the PV Module Warranty:

1) Warranted Products

a. Photovoltaic modules including factory assembled junction box and cables and connectors, and
b. Mounting products including factory assembled basic hardware, if any.

2) Warranty Descriptions and Durations

a. Product Warranty

b. Power Output Warranty
To include warranted degradation amount for each successive year:

Power Output Schedule at STC (values provided as an example)

Year	If the module(s) has a power output less than the percentage below multiplied by the STC power nameplate rating on the back of the applicable module, then such Product shall be deemed to be in breach of the Power Output Warranty	% Degradation
1 (i.e., the first 365 days beginning on the Warranty Start Date, expiring the day before the first anniversary of the Warranty Start Date of the applicable Product)	97.50%	2.50%
2 (i.e., the second 365 days of such period until the day before the second anniversary of the Warranty Start Date of	97.00%	0.50%

the applicable Product, etc.)		
3	96.50%	0.50%
4	96.00%	0.50%
5	95.50%	0.50%
6	95.00%	0.50%
7	94.50%	0.50%
8	94.00%	0.50%
9	93.50%	0.50%
10	93.00%	0.50%
11	92.50%	0.50%
12	92.00%	0.50%
13	91.50%	0.50%
14	91.00%	0.50%
15	90.50%	0.50%
16	90.00%	0.50%
17	89.50%	0.50%
18	89.00%	0.50%
19	88.00%	0.50%
20	87.50%	0.50%
21	87.00%	0.50%
22	86.50%	0.50%
23	86.00%	0.50%
24	85.50%	0.50%
25	85.00%	0.50%
26	84.50%	0.50%
27	84.00%	0.50%
28	83.50%	0.50%
29	83.00%	0.50%
30	82.50%	0.50%

3) Warranty Start Date

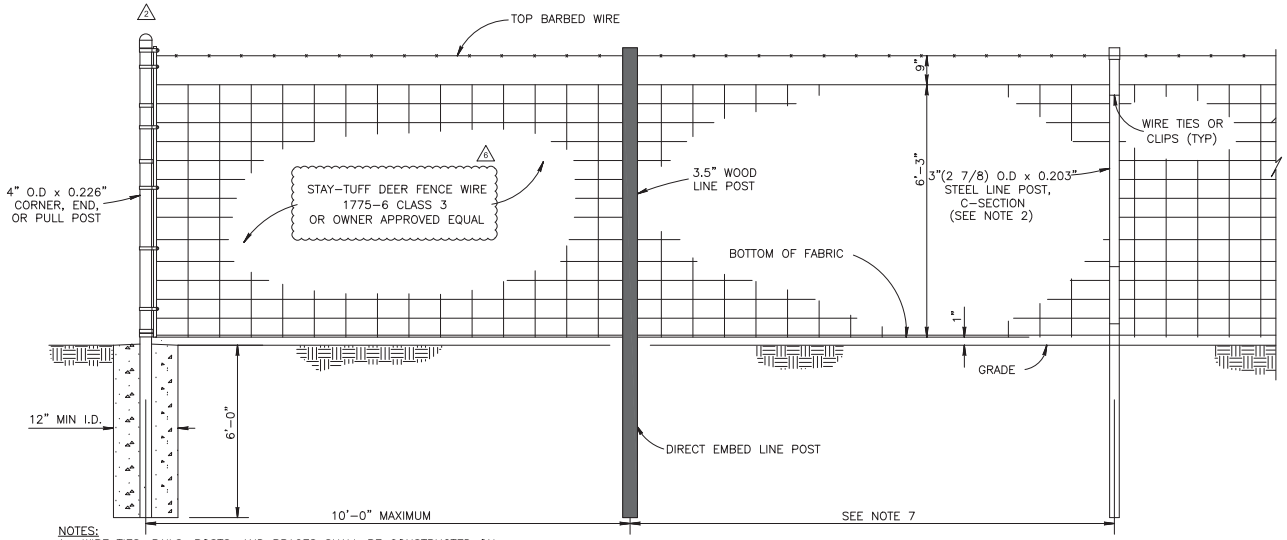
4) Exclusions and Limitations

5) Repair, Replacement or Refund Remedy

6) Rights and Remedies against Third Parties

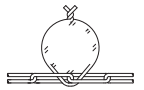
7) Claims Procedure, Notice Periods, Dispute Resolution, Testing and Verification Procedures.

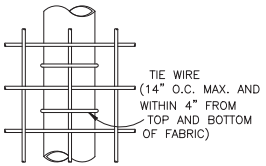
EXHIBIT 14 – MINNESOTA POWER SPECIFICATIONS



NOTES:
1. WIRE TIES, RAILS, POSTS, AND BRACES SHALL BE CONSTRUCTED ON THE SECURE SIDE OF THE FENCE ALIGNMENT. FENCE FABRIC SHALL BE PLACED ON THE OPPOSITE SIDE OF THE SECURE AREA.
2. REFER TO C004 FOR FENCE NOTES.
3. REFER TO C004 FOR CONCRETE COMPRESSIVE STRENGTH REQUIREMENT.
4. FENCE DESIGN LIFE IS APPROXIMATELY 10–15 YEARS. CORROSION ON LINE POSTS IS EXPECTED AND WILL REQUIRE FUTURE MAINTENANCE.
5. FABRIC SPLICE TO BE JOINED BY WEAVING A SINGLE STRAND TO FORM A CONTINUOUS PIECE OF FABRIC.
6. DETAILS SHOWN ARE TO CLARIFY REQUIREMENTS AND ARE NOT INTENDED TO LIMIT METHOD OF INSTALLATION TO ONE MANUFACTURER.
7. STEEL LINE POSTS SHALL BE INSTALLED AT 100–FOOT INTERVALS, AT ABRUPT CHANGES IN GRADE, AND AT CHANGES IN DIRECTION OF 15 DEGREES OR MORE.

TYPICAL PERMANENT FENCE DETAIL
NOT TO SCALE

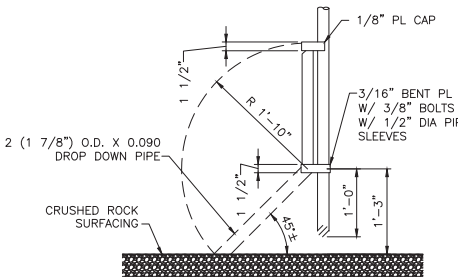




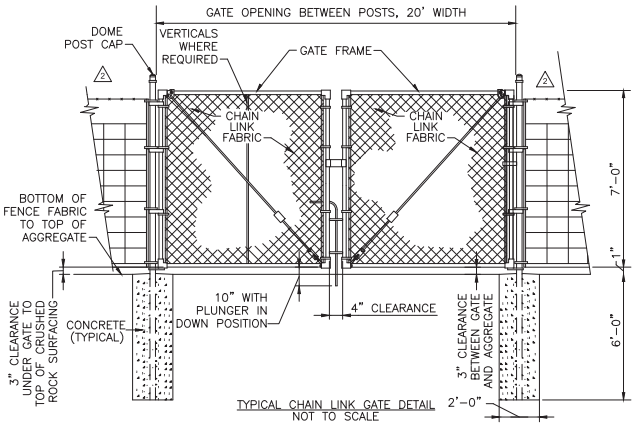
ROUND POST

LINE POST ATTACHMENT
NOT TO SCALE

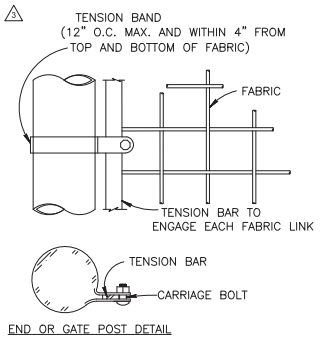
1. APPROVED ROLL-FORMED C-SECTIONS 3.25"X 2.50" (MIN) WITH A MINIMUM WALL THICKNESS OF 0.15" AND MINIMUM YIELD STRENGTH OF 50KSI MAY BE USED FOR TYPICAL LINE POSTS WHERE APPLICABLE, BUT SHALL NOT BE USED AT BRACED BAYS SUCH AS AT CORNERS, TERMINAL BAYS, OR ADJACENT TO GATES.



HOLDBACK DETAIL
NOT TO SCALE



TYPICAL CHAIN LINK GATE DETAIL
NOT TO SCALE



END OR GATE POST DETAIL

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature Kaitlyn Mores

Typed or Printed Name KAITLYN MORES

Date 05/03/22 Reg. No. 59103

CONSTRUCTION ISSUE
FIELD MARKUPS BY: _____
DEPT: _____ DATE: _____

GSOC
GOPHER STATE ONE CALL

NO.	DATE	REVISION DESCRIPTION	BY	APPROVED
6	05/03/22	IFC REVISION 2	DEY	KTM
1	08/20/21	ISSUED FOR 30% REDESIGN REVIEW	JHF	CJD
2	09/27/21	ISSUED FOR 60% REDESIGN REVIEW	JHF	CJD

NO.	DATE	REVISION DESCRIPTION	BY	APPROVED
3	11/10/21	ISSUED FOR 90% REDESIGN REVIEW	DEY	CJD
4	12/20/21	ISSUED FOR CONSTRUCTION	DEY	KTM
5	01/06/22	IFC REVISION 1	DEY	KTM

DRAWN BY H. FISCHELS
APPROVED C. DOMINGUEZ
DATE 09/27/21
SCALE N/A

ALLETE

ALLETE ENTERPRISES, INC.
SYLVAN SOLAR PROJECT
FENCE DETAILS

SHEET C700 REV. 5

MD+32387

MICROFILMED / /

CODE . . .

PERMANENT FENCES:

1. REFERENCE STANDARDS

   A. THE PUBLICATIONS LISTED BELOW FORM A PART OF THIS SPECIFICATION TO THE EXTENT REFERENCED. THE PUBLICATIONS ARE REFERRED TO WITHIN THE TEXT BY THE BASIC DESIGNATION ONLY. FEDERAL SPECIFICATIONS (FS):

   – FF–B–575 – BOLTS, HEXAGON, AND SQUARE.

   – RR–F–191J/GEN – FENCING, WIRE AND POST, METAL (AND GATES, CHAIN–LINK FENCE FABRIC, AND ACCESSORIES) (GENERAL SPECIFICATION).

   – RR–F–191/2 – FENCING WIRE AND POST, METAL (CHAIN–LINK FENCE GATES) (DETAIL SPECIFICATION).

   – RR–F–191/3 – FENCING WIRE AND POST, METAL (CHAIN–LINK FENCE POSTS, TOP RAILS AND BRACES) (DETAIL SPECIFICATION).

   B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

   – A153 – ZINC COATING (HOT–DIP) ON IRON AND STEEL HARDWARE.

   – A392 – ZINC–COATED STEEL CHAIN–LINK FENCE FABRIC.

2. GENERAL:

   A. MANUFACTURER'S STANDARD MATERIALS WHERE SUCH MATERIALS CONFORM TO THESE SPECIFICATIONS.

   B. CONFORM TO FS RR–F–191J/GEN EXCEPT AS INDICATED OR SPECIFIED OTHERWISE.

   △2 C. FENCE FABRIC HEIGHT: 6'–3". GATE WIDTH AS INDICATED ON SHEET C700.

   D. FINISH FOR FRAMEWORK AND APPURTENANCES: PIPE SHOULD CONFORM TO FS RR–F–191/3. SQUARE TUBING, H–SECTIONS, AND C–SECTIONS ARE TO BE GALVANIZED WITH A MINIMUM WEIGHT OF 2.0 OUNCES OF ZINC PER SQUARE FOOT. HARDWARE AND ACCESSORIES ARE TO BE GALVANIZED PER ASTM A153. CHAIN LINK FABRIC FOR GATES IS TO BE GALVANIZED PER ASTM A392, CLASS 2 OR COAT WITH ALUMINUM PER ASTM A491.

3. POSTS, RAILS, AND BRACES

   A. POSTS (END, CORNER OR PULL POSTS, LINE POSTS, AND GATE POSTS ARE TO CONFORM TO FS RR–F–191/3.

   △2 B. STEEL LINE POSTS SHALL BE 3–INCH (2 7/8–INCH) X 0.203–INCH POSTS. APPROVED ROLL–FORM C–SECTIONS 3.25–INCH X 2.50–INCH MINIMUM WITH A MINIMUM 0.15–INCH WALL THICKNESS AND MINIMUM YIELD STRENGTH OF 50 KSI MAY BE USED FOR TYPICAL LINE POSTS WHERE APPLICABLE, BUT SHALL NOT BE USED AT BRACED BAYS SUCH AS CORNERS, TERMINAL BAYS, OR ADJACENT TO GATES. WOOD LINE POSTS SHALL BE 3.5–INCH DIAMETER IF ROUND, OR 3.5–INCH X 3.5 INCH IF RECTANGULAR.

   C. END OR CORNER POSTS, AND GATE POSTS SHALL BE 4–INCH X 0.226–INCH STEEL POSTS.

   D. POST TOPS ARE TO BE DESIGNED AS A WEATHERTIGHT CLOSURE CAP FOR TUBULAR POSTS AND MADE OF MALLEABLE IRON OR PRESSED STEEL, BOTH GALVANIZED.

   △3 E. BARBED WIRE SHALL BE TWO–STRAND, 12–1/2–GAUGE STEELWIRE WITH 4–POINT BARBS OF NO. 14–GAUGE STEEK WIRE, 5 INCHES ON CENTER. WIRE SHALL CONFORM TO FS RR–F–221/1, TYPE 1, CLASS 3.

   △2 F. BOLTS SHALL BE ZINC COATED AND CONFORM TO FS FF–B–575.

   △5 G. FABRIC IS TO BE STAY–TUFF DEER FENCE WIRE 1775–6 CLASS 3 OR OWNER APPROVED EQUAL.

   H. GATES ARE TO BE MANUAL SWING, CONFORMING TO FS RR–F–191/2C UNLESS OTHERWISE SPECIFIED. GATE FRAMING SHALL BE 2–INCH (1 7/8–INCH) OD X 0.09 INCH STEEL PIPES CONFORMING TO FS RR–F–191/3, INCLUDE INTERMEDIATE HORIZONTAL AND VERTICAL MEMBERS FOR PROPER GATE OPERATION AND FOR ATTACHMENT OF FABRIC, HARDWARE, AND ACCESSORIES. FRAMES SHALL BE ASSEMBLED BY WELDING. ALL WELDS SHALL BE COATED WITH A ZINC–RICH PAINT. GATES SHALL INCLUDE DIAGONAL CROSS BRACING OF 3/8–INCH DIAMETER ADJUSTABLE GALVANIZED TRUSS RODS TO PROVIDE FRAME RIGIDITY AS INDICATED.

4. HARDWARE

   A. ALL HARDWARE SHALL CONFORM TO FS RR–F–191/2 AND BE GALVANIZED AS PER ASTM A153. HINGES OF HEAVY–DUTY PRESSED OR MALLEABLE IRON, NONLIFT–OFF TYPE, 1 PAIR PER LEAF. HINGES SHALL ALLOW 180 DEGREE SWING OF ALL GATE LEAVES AND SHALL NOT TWIST OR TURN UNDER THE ACTION OF THE GATE.

   B. LATCHES AND GATE STOPS SHALL BE DOUBLE LEAF. PLUNGER–BAR TYPE LATCH, FULL GATE HEIGHT, DESIGNED TO ENGAGE GATE STOP OF FLUSH–PLATE TYPE WITH ANCHORS. LOCKING DEVICE AND PADLOCK EYES TO BE AN INTEGRAL PART OF LATCH. KEEPER TO AUTOMATICALLY ENGAGE GATE LEAF AND SECURE FREE END OF GATE IN FULL OPEN POSITION.

   C. PIVOTING DROP DOWN HOLDBACK SHALL BE WEPCO BRAND OR SIMILAR.

5. CONCRETE

   A. END, CORNER OR PULL POSTS, AND GATE POSTS SHALL BE SET IN HOLES AND BACKFILLED WITH CONCRETE. THE CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS AND SHALL BE AIR ENTRAINED TO 6% ± 1 1/2%. CONCRETE SHALL HAVE 3/4" MAXIMUM AGGREGATE SIZE AND SLUMP SHALL NOT EXCEED 4". ALL CONCRETE SHALL BE MECHANICALLY VIBRATED OR RODDED FOR CONSOLIDATION.

6. EXECUTION

   A. PREPARATION:

   – PERFORM FINAL GRADING PRIOR TO INSTALLATION OF FENCE.

   △2 – FOLLOW GENERAL CONTOUR OF GROUND AND PROPERLY ALIGN FENCE. INSTALL AS INDICATED.

   B. INSTALLATION – POSTS:

   – END AND CORNER POSTS SHALL BE SET IN CONCRETE BASES AS INDICATED. TROWEL FINISH TOPS OF FOOTINGS AND DOME TO DIRECT WATER AWAY FROM POSTS. INSTALL PLUMB AND IN STRAIGHT ALIGNMENT. POST SPACING SHALL BE 10 FEET CENTER–TO–CENTER MAXIMUM.

   △2 – INSTALL STEEL LINE POSTS EVERY 100 FEET, AT ALL ABRUPT CHANGES IN GRADE, AT ALL CHANGES IN DIRECTION OF 15 DEGREES OR MORE, AND TEMPORARILY BRACE UNTIL CONCRETE IN BASES HAS SET.

   C. INSTALLATION – FABRIC:

   – FABRIC SHALL BE STRETCHED TAUT WITH EQUAL TENSION ON EACH SIDE OF LINE POSTS. FASTEN TO STEEL POSTS WITH WIRE CLIPS. SPACE WIRE TIES AT 14 INCHES ON CENTER MAXIMUM ON POSTS AND STAPLE TO WOOD POSTS. ROLLS OF FABRIC SHALL BE JOINED TOGETHER BY WEAVING A SINGLE STRAND INTO THE END OF THE ROLL TO FORM A CONTINUOUS PIECE.

   D. INSTALLATION – GATES:

   – MANUAL SWING GATES SHALL BE INSTALLED PLUMB, LEVEL, AND FREE SWINGING THROUGH FULL OPENING WITHOUT INTERFERENCE. ALL HARDWARE SHALL BE INSTALLED. INSTALL KEEPERS, GROUND SET ITEMS, AND FLUSH PLATE IN CONCRETE TO ENGAGE GATE STOP. ADJUST AND LUBRICATE AS NECESSARY FOR SMOOTH OPERATION.

7. REPAIRING DAMAGED COATINGS:

   A. REPAIR ANY DAMAGED COATINGS IN THE SHOP OR FIELD BY RECOATING WITH COMPATIBLE AND SIMILAR COATING APPLIED PER MANUFACTURER'S RECOMMENDATIONS.

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature Kaitlyn Mores

Typed or Printed Name KAITLYN MORES

Date 05/03/22 Reg. No. 59103

CONSTRUCTION ISSUE
FIELD MARKUPS BY: _____
DEPT: _____ DATE: _____

GSOC
GOPHER STATE ONE CALL

NO.	DATE	REVISION DESCRIPTION	BY	APPROVED
6	05/03/22	ISSUED FOR CONSTRUCTION REVISION 2	DEY	KTM
1	08/20/21	ISSUED FOR 30% REDESIGN REVIEW	JHF	CJD
2	09/27/21	ISSUED FOR 60% REDESIGN REVIEW	JHF	CJD

NO.	DATE	REVISION DESCRIPTION	BY	APPROVED
3	11/10/21	ISSUED FOR 90% REDESIGN REVIEW	DEY	CJD
4	12/20/21	ISSUED FOR CONSTRUCTION	DEY	KTM
5	01/06/22	IFC REVISION 1	DEY	KTM

DRAWN BY H. FISCHELS
APPROVED C. DOMINGUEZ
DATE 09/27/21
SCALE N/A

ALLETE

ALLETE ENTERPRISES, INC.
SYLVAN SOLAR PROJECT
FENCE NOTES

SHEET C004 REV. 5
MD+32387

ImageSite: .

CADD DRAWING – FOR REPRODUCTION ONLY

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CODE . . .

SECTION 32 92 00 - SEEDING

PART 1 - GENERAL

1.01 SUMMARY:

A. This Section includes seedbed preparation, seeding, mulching, and fertilizing of areas indicated and/or disturbed by Contractor's construction activities. The entire disturbed area will receive temporary seed mix and will then be supplemented by Native Pollinator Array Seed Mix in all disturbed areas not otherwise stabilized.

1.02 RELATED DOCUMENTS:

A. Appendix 32 92 00-A: MNL Solar Native Pollinator Array Mix
B. Minnesota Pollution Control Agency (MPCA) Construction Stormwater General Permit

1.03 REFERENCE STANDARDS:

A. Section 31 20 50 - Site Preparation and Earthwork.
B. American Society for Testing and Materials (ASTM):
   1. Equivalent AASHTO standards may be substituted as approved.
   2. D977 - Emulsified Asphalt
C. Minnesota DOT Standard Specifications for Construction
   1. Section 2575 – Establishing Vegetation and Controlling Erosion
   2. Section 3881 – Fertilizer
   3. Section 3882 – Mulch Material
   4. Section 3884 – Hydraulic Erosion Control Products

1.04 SUBMITTALS:

A. Certificates: Includes, but not limited to, the following:
   1. Seed shall be accompanied by certificate from vendor that seed meets requirements of these Specifications.
   2. Fertilizer shall be accompanied by certificate from vendor that fertilizer meets requirements of these Specifications.

PART 2 - PRODUCTS

2.01 FERTILIZER:

A. Fertilizer shall be approved by Owner and comply with Minnesota DOT Specification 3881 for commercial fertilizer.
   1. Uniform in composition.
   2. Free flowing and suitable for application with approved equipment.
   3. Apply fertilizer and soil improvements as recommended by the soil test report.
B. Deliver to Site in labeled bags or containers.

2.02 SEED:

A. Seed shall conform to all applicable laws of the State of Minnesota.
B. Seed shall be labeled according to the U.S. Department of Agriculture Federal Seed Act and shall be furnished in containers with tags showing seed mixture, purity, germination, weed content, name of seller, and date on which seed was tested.
C. The solar production area is comprised of areas under and between the PV panel arrays. Seeding will be starting concurrently with site preparation.

- Phase 1 – As each construction work area grading and topsoil spreading are completed, permanent seed shall be planted in areas not otherwise stabilized.
- Phase 2 - Upon completion of the pile, tracker and solar panel installation, permanent seed shall be replanted in all areas not otherwise stabilized. This period shall include any soil grading, smoothing and preparation necessary to repair and prepare the seedbed to be reseeded in any areas which have been damaged (by Contractor or others) or cannot adequately be established. Contractor shall be paid on a per acre, unit price basis for all areas that are repaired.

D. Temporary seed mixture shall be applied through a broadcast method. Contractor to supply Owner with proposed temporary seed mixture and application rates for approval.

E. Permanent Seed – Permanent seed shall be planted on all disturbed areas of the project site not otherwise stabilized. Permanent seed mix and application rates shall comply with the project SWPPP.

F. Moldy seed or seed that has been damaged in storage shall not be used.

2.03 MULCH:

A. Shall comply with Minnesota DOT Standard Specifications for Construction, Section 3882.

B. May be any of the following at Contractor's option:

1. Vegetative Mulch: Mulch shall be straw from stalks of wheat, rye, oats, or hay from fields of timothy, redtop, bromegrass, or other approved materials, and shall be partially decomposed. Mulch shall be free of noxious and undesirable seed and material.
2. Tackifiers:
   a. Asphalt Emulsion: Conform to ASTM D977, Type SS-1.
   b. Organic Glue: Hydrobond as manufactured by Erosion Control Products or approved equal.
3. Wood Cellulose Fiber:
   a. Fiber shall be produced from nonrecycled wood such as wood chips or similar wood materials and shall be of such character that the fiber will disperse into a uniform slurry when mixed with water. Fiber shall not be produced from sawdust or from paper, cardboard, or other recycled materials.
   b. Mulch shall not contain germination or growth inhibiting ingredients.
   c. Mulch shall be dyed an appropriate color to aid in visual inspection.
   d. Mulch material shall be easily and evenly dispersed when agitated in water.
   e. Supply in packages of not more than 100 pounds gross weight, and be marked by the manufacturer to show the air dry weight content of the wood cellulose fiber.
   f. Mulch shall not be water-soluble and shall comply with the following properties:
      (1) Moisture content, 15% maximum.
      (2) Organic matter - wood fiber (oven-dried basis), 90% maximum.
      (3) pH: 4.3 to 8.5.
      (4) Water holding capacity (grams of water/100 grams fiber), minimum: 1,000.
   g. Submit wood cellulose fiber material and application rates for approval by Owner.

PART 3 - EXECUTION

3.01 SEEDBED PREPARATION:

A. Dispose of any growth, rocks, or other obstructions which might interfere with tilling, seeding, or later maintenance operations.

B. Thoroughly loosen and pulverize topsoil to a depth of at least 3 inches. Minimum depth of topsoil at seeded areas shall be 4 inches.

C. Maintain tilled areas until seeded and mulched to provide a smooth area with no gullies or depressions.

3.02 APPLICATION - HERBICIDES:

A. Herbicide treatments will be peformed by individuals with a current Commercial Pesticide Applicator license issued through Minnesota Department of Agriculture.
B. There are three types of herbicides that are applicable: non-selective, broadleaf-selective and grass-selective. Methods and timing used be based on a site-specific evaluation of target species, vegetation composition, and sensitivity of adjacent areas to herbicide applications.
C. Apply herbicides at the lowest concentration recommended on product labels.
D. Herbicide should be applied to plants when plants are most physiologically prone to injury by active ingredients. Plants are most prone to herbicide injury when they are actively growing. Plant life cycles targetable for herbicide application include the flower bud-stage and the cool season photosynthesizing rosette stage. Plants that have senesced following flowering or are inactive due to high heat or drought should not be treated.

3.03 APPLICATION - FERTILIZER:

A. If required to establish vegetation, apply fertilizer at the rate specified by manufacturer.
B. Incorporate fertilizer into the soil to a depth of at least 3 inches by discing, harrowing or raking. Fertilizer may be applied hydraulically on slopes 2 horizontal to 1 vertical or steeper. If fertilizer is applied hydraulically to these slopes, incorporation into the soil will not be required.

3.04 APPLICATION - SEED:

A. Dry Seeding: Accomplish sowing by use of approved equipment, having drills no more than 4 inches apart.
    1. Drill seed to an average depth of 1/2-inch.
    2. Overlap successive seed strips to provide uniform coverage. Repeat where skipped areas appear after a show of green.
    3. Cover seed with soil to an average depth of 1/4-inch by raking or other approved methods.
B. Hydraulic Seeding: Mix seed with water and constantly agitate. Do not add seed to water more than 4 hours before application.
    1. On slopes flatter than 2 horizontal to 1 vertical, apply seed separately from fertilizer. Mechanically incorporate fertilizer into the soil prior to seeding activities. Cover seed with either hydraulic mulch or soil. If hydraulic mulching is not used, cover seed with soil to an average depth of 1/4-inch by raking or other approved methods.
    2. On slopes 2 horizontal to 1 vertical and steeper, seed and fertilizer may be applied in a single operation. Incorporation into the soil will not be required. Hydraulic mulching will be required.

3.05 APPLICATION - MULCH:

A. Apply a mulch covering to all seeded areas within 24 hours after seeding. Mulch not required on areas that are to be covered by an excelsior blanket or by an erosion-control fabric. Jute netting alone will not be considered an erosion-control fabric.
B. Apply vegetative mulch by means of a mechanical spreader or other approved methods at the application rate specified in Minnesota DOT Standard Specifications for Construction, Section 2575.
C. Apply wood cellulose fiber mulch hydraulically at a minimum rate of 1,800 pounds per acre.

1. Mulch and seed may be applied in a single operation on slopes 2 to 1 or steeper.
2. Apply mulch to achieve a uniform coverage of the soil surface.

D. Vegetative Mulch with Asphalt Emulsion:
1. Temperature of mulch at time of application shall be between 125 and 175°F.
2. Apply asphalt emulsion at the rate required in Minnesota DOT Standard Specifications for Construction, Section 2575.
3. Mulching machine shall inject emulsified asphalt at the proper rate directly into the air stream carrying the straw.
4. Hand-spray near structures.

E. Immediately following the application of the mulch, water the seeded area in one watering, at a minimum rate of 120 gallons per 1,000 square feet. Perform so as not to cause erosion or damage to the seeded surface.

3.06 MAINTENANCE:

A. Native Pollinator Array Seed Mix - Mow grass to a height of 6-10 inches during the first growing season whenever average height of grass exceeds 12 inches. During the transition phase, after more native plants are established, mow to 10-12 inches. Routinely mowing and mowing lower than 6-8 inches after establishment phase will harm native plants.
B. Remove weeds by approved chemical treatment.
C. Erect and maintain signs or barricades to exclude traffic from seeded areas.
D. Seeded Areas: Perform maintenance as required until permanent cover is achieved as defined by the MPCA Construction Stormwater General Permit.
1. Prior to acceptance, repair at Contractor's expense any portion of the seeded surface which becomes gullied or otherwise damaged, or destroyed.

END OF SECTION 32 92 00

Minnesota Native Landscapes

8740 77th Street NE Otsego, MN 55362

MNL Solar
Native Pollinator Array Mix

Date:	1/1/2020
PLS lbs/acre:	10.00

	Scientific Name	Common Name	% of Mix	PLS lbs/ac	Bloom Season
Grasses:	Bouteloua curtipendula	Side-Oats Grama	22.00	2.20	
	Bromus kalmii	Prairie Brome	8.00	0.80	
	Elymus trachycaulus	Slender Wheat-Grass	8.00	0.80	
	Elymus villosus	Silky Wild Rye	5.00	0.50	
	Elymus virginicus	Virginia Wild Rye	8.00	0.80	
	Schizachyrium scoparium	Little Bluestem	17.00	1.70	
	Sporobolus cryptandrus	Sand Dropseed	2.00	0.20	
Sedges:	Carex bicknellii	Copper Shouldered Oval Sedge	2.00	0.20	
	Carex sprengelii	Long Beaked Sedge	8.00	0.80	
Forbs:	Achillea millefolium	Yarrow	0.25	0.03	Summer
	Agastache foeniculum	Fragrant Giant Hyssop	1.00	0.10	Summer
	Aquilegia canadensis	Columbine	0.25	0.03	Spring
	Anemone canadensis	Canada Anemone	0.25	0.03	Spring
	Asclepias syriaca	Common Milkweed	1.50	0.15	Summer
	Asclepias tuberosa	Butterfly Milkweed	0.75	0.08	Summer
	Chamaecrista fasciculata	Partridge Pea	3.00	0.30	Fall
	Dalea candida	White Prairie Clover	2.50	0.25	Summer
	Dalea purpureum	Purple Prairie Clover	3.50	0.35	Summer
	Monarda fistulosa	Wild Bergamot	0.75	0.08	Summer
	Penstemon grandiflorus	Showy Penstemon	0.25	0.03	Spring
	Pycnanthemum virginianum	Mountain Mint	0.50	0.05	Summer
	Rudbeckia hirta	Black Eyed Susan	3.00	0.30	Summer
	Solidago nemoralis	Gray Goldenrod	0.25	0.03	Fall
	Symphyotrichum lateriflorum	Calico Aster	0.50	0.05	Fall
	Symphyotrichum oolentangiensis	Sky Blue Aster	0.50	0.05	Fall
	Zizia aurea	Golden Alexanders	1.25	0.13	Spring

Species subject to change based on availability.

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