Scope of Work

And Specifications
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1.0 DEFINITIONS

**AC/ac** shall mean alternating current.

**Acceptance Test Procedures** shall mean a document, or set of documents, agreed to by the Owner and Contractor which detail the procedures to be completed during acceptance testing and requirements which must be met.

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

**Commissioning Process** methodical testing procedures used as proof of operation as designed/intended.

**Contractor** shall refer to the organization to which this Request for Proposal is addressed and who will engineer, procure, and construct the Project as specified within this document.

**DC/dc** shall mean direct current.

**Energy Management System** shall refer to a Graphical User interface developed with the intent to display metrics in a common language and display format suitable for the general public.

**Interconnection agreement** *(to be referenced once provided by coops)*

**Inverter Skid Assembly** (ISA) shall consist of the static power inverter, inverter step-up transformer (if applicable), associated cabling and grounding system.

**Owner** shall refer to the Project entity whom the Contractor will enter into an agreement to complete all Project requirements as specified in this Scope of Work, and whom will ultimately take control of the Project.

**Perimeter Fence** shall mean a physical security that is installed in such a manner as to surround the property allocated for the Project. The fence shall be contiguous without interruption (except for personnel and vehicle gates).

**Point of Interconnection** *(POI)* shall define the location of the physical electrical interconnection between Owner furnished electrical facilities and Contractor provided electrical facilities as part of this Project.

**Power Capacity Guarantee** shall mean an agreement between the Contractor and Owner in which the capacity of the Project is described. This capacity guarantee will include environmental and Project conditions at which the capacity is tested.

**Power Capacity Test** shall mean a power output capacity test to confirm that the Project has met the plant output guarantee. The test shall consist of a DC capacity test, an AC capacity test and a system losses test.

**Project** shall mean the initiative to install a solar facility for long term operations.

**SCADA** shall mean the Supervisory Control and Data Acquisition system, and shall include all monitoring/control hardware and software, field instrumentation and communication devices.

**Scope of Work** shall mean any and all activities necessary to complete the Project as specified.
Site shall mean the physical location where the solar facility will be installed. It is defined by the Owner.

2.0 INTRODUCTION

2.1 Basics of Document
A. This Scope of Work and Specifications document is designed to provide the Contractor with the details necessary to engineer, procure and construct the facilities to the requirements desired by Owner.

2.2 Bidder Submittals
A. The Proposal Data Submittal Form document (separate section) shall be populated by the Contractor and submitted to the Owner for review. The Contractor is to populate the tables in the Proposal a Submittal Form with information upon which the design is based. This Scope of Work and Specifications document should be used as a guide for populating the Proposal a Submittal Form.

2.3 Limits to Scope
A. The list of approved suppliers and specifications provided herein are intended to provide a collection of suitable vendors and specifications important to primary equipment only. It is recognized here that there are more components to a functional installation than those listed below.
3.0 CONTRACTOR SCOPE OF WORK

3.1 General

A. The Contractor shall furnish Project for Owner at the output level of energy production as proposed by the Contractor in the Proposal Form.

B. The Project shall be capable of operating in accordance with the guidelines of this Request for Proposal as well as subsequent contractual documents entered into between Contractor and Owner.

C. The Contractor shall design and construct the Project in accordance with any contractual documents and this Scope of Work and Specifications Document.

D. The Contractor shall specify and furnish the equipment and materials which shall include, but not be limited to perimeter fences, PV modules, structural support systems, module string DC wiring harnesses, DC combiner boxes, inverters, inverter step-up transformers, ISAs, SCADA system, and ancillary hardware required to connect and operate listed equipment.

E. The Contractor shall provide Project design engineering and drawing packages for construction permitting, installation and “as-built” documentation. Engineering firm and Engineer of Record must be licensed in the Commonwealth of Virginia.

F. The Contractor shall provide Project construction including all site/civil work, structural, electrical, mechanical and monitoring/control systems.

G. The Contractor shall provide Project and construction management, including quality assurance/quality control, site safety, site material control and management of all subcontractors.

H. The Contractor shall provide Project commissioning and testing in accordance with this document.

I. The Contractor shall provide the Owner training and Project sequence of operations; installation and maintenance documentation.

J. The Contractor shall be responsible for obtaining and providing to Owner, all permits necessary to support construction and Project installation.

K. The Contractor shall be responsible for connection of the Project to electrical interface provided by Owner.

L. Temporary Facilities
   1. If necessary, the Contractor shall be responsible for establishing and maintaining all restroom, lunchroom and other office and meeting areas for the duration of the construction and commissioning portion of the Project.
2. The Contractor shall provide temporary sanitary facilities with location at the discretion of Owner. Contractor shall be responsible for decommissioning these temporary sanitary facilities at the termination of construction.

3. The Contractor shall maintain on-site dumpsters and personnel to maintain a clean and rubbish free work site. Location of dumpsters at the discretion of Owner.

4. The Contractor shall be responsible for permitting, installation and removal of all equipment necessary to satisfy water requirements for dust control purposes. Temporary water storage facilities, if used, shall be removed and the area returned to existing grades and surfacing.

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

6. Contractor may access and park at each construction site as necessary for construction; the temporary parking areas shall be returned to design grades and surfacing at the termination of construction. Contractor parking shall not interfere with normal member-owner business nor Owner activities.

M. The Contractor shall be responsible for site security throughout construction duration.

N. The Contractor shall provide traffic management as necessary to ensure the safe entry to and exit from public roads for all vehicles and equipment.

O. The Contractor shall, if applicable, conduct a Geotechnical Study suitable for the Project level design work including bearing capacities, soil characteristics and infiltration requirements. Owner shall provide access, if requested by Contractor, to site to perform structural testing.

3.2 Owner Provided Facilities and Services

A. The Owner will provide electrical panels as designated to accommodate Point of Interconnection (POI).

B. The Owner will provide, if applicable, the Protective Device Coordination Study, Load Flow Study, Short Circuit Analysis and Grounding System study at the POI. Owner will furnish completed study to Contractor.

C. The Owner will provide access to building as required.

D. The Owner will provide access to temporary electrical power where possible; Contractor shall be responsible for providing power to any construction location where Owner is unable. In situations where there is conflict, Contractor will provide their own power generation consistent with Section 3.6 C.
3.3 Design Criteria
A. Project and individual components shall have a minimum design life of 25 years.
B. Project shall be designed for fully autonomous operation.
C. Project electrical design will be in compliance with applicable codes and standards listed under Section 3.6 unless otherwise noted.
D. Project shall be so designed as to maximize kWh production or kW demand production and stated as such in Proposal Data Submittal Form.
E. Dissimilar metals in contact anywhere in the Project shall be avoided to eliminate the possibility of galvanic action. If unavoidable, proper transitional materials shall be used.
F. During engineering design, Contractor shall work with the Owner when determining all signage, labeling and nomenclature.

3.4 Projects and Equipment
A. Provisions shall be included in the design of all systems to allow the performance of all routine maintenance without requiring a shutdown of the entire Project.
B. Contractor shall:
   1. Receive, inspect, store, unload, maintain, erect, clean, align and prepare all equipment in accordance with equipment manufacturer’s instructions before initial operation.
   2. Provide lifting lugs on all equipment components or Project components requiring removal for maintenance and weighing over 25 lbs.
   3. Select materials of construction and design equipment and systems to provide a minimum of a 25-year operating life at all operating conditions specified.
   5. Provide grounding lugs and ground all equipment.

3.5 Operating Criteria
A. DC grid voltage: 600 volts DC or greater (with Owner approval), shall be grounded.
B. AC grid voltage: (determined by site POI requirements as defined by the Owner). Panel NHW: 480/277V, 150 A maximum. Panel NLW: 208/120V, 100 A maximum.
C. DC & AC electrical systems under 1000V shall be radially configured. No redundancy is required.
D. Convenience Power: 120VAC
E. Communications network: Ethernet via fiber optic within the arrays.
3.6 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 encompassing. Where local codes or ordinances will have an impact on the construction, 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 following standards, as applicable:
1. ACI - American Concrete Institute
2. AISC - American Institute of Steel Construction
3. ANSI - American National Standards Institute
4. AISI – American Iron and Steel Institute
5. ASCE – American Society of Civil Engineers
6. ASME – American Society of Mechanical Engineers
7. ASTM - American Society for Testing and Materials
8. IBC - International Building Code
9. ICEA - Insulated Cable Engineers Association
10. IEC - International Electrotechnical Commission
11. IEEE - Institute of Electrical and Electronics Engineers
12. ISA – Instrumentation Society of America
13. NEC - National Electrical Code
14. NEMA - National Electrical Manufacturers Association
15. NESC - National Electrical Safety Code
16. NETA - National Electrical Testing Association
17. NFPA – National Fire Protection Association
18. OSHA - Occupational Safety and Health Act
19. UL – Underwriters’ Laboratories

D. In the case where standards have conflicting requirements, Owner and Contractor will develop a mutual agreement of the prevailing standards.
4.0 EXISTING SITE DESIGN CONDITIONS

4.1 Site Physical Location

Table 4-1. Project Location

| Project Location | 180 Oakwood Drive, Harrisonburg, VA 22801 |

Figure 4-1. Vicinity Map of Site
5.0 INDEPENDENT PROJECT DETAILS

5.1 Parking Canopy Array
A. The intent of this Project is to create a covered parking area for members and guests by utilizing installed PV panels as cover. If possible, canopy should extend over adjoining sidewalk.

B. The structure may be of any style deemed structurally suitable; however, the canopy should cover the entire span of parking spaces without reduction or material change to any parking space or adjoining sidewalk.

C. The structure shall have no impact to ingress and egress around parking lot.

D. Consideration will be given for aesthetic value and level of architectural fit to existing facilities.

E. The array shall be connected to a common energy management system.

F. If branding credit is part of a proposal, Contractor shall include its branding requirements within its proposal. Please note that SVEC intends to provide to third parties, including its consumer members, comparative reports of the installation output, operations and maintenance cost as well as other performance and economic information about each installation. If an installation is branded to identify the Contractor, such report will include the name of the Contractor in order that third parties may better compare one installation against another. For any installation that is not branded, SVEC expects to provide information about the manufacturers of components used, but not the name of the Contractor. Inclusion of branding credit as part of an installation shall constitute the agreement of the Contractor to the foregoing provision concerning the provision of such information. Use of comparative report, creation of derivative works based upon, distribution or display thereof, without the prior written consent of Owner, is prohibited.

5.2 Tracking Array
A. The intent of this Project is to demonstrate a residential or small commercial scale array that maximizes energy output by tracking the movement of the sun and adjusting panel orientation accordingly.

B. The array shall be constructed using infrastructure components that would typically be found on residential or small commercial installations unless otherwise identified in this specification document.

C. The array may be any shape or configuration as long as it is representative of a product reasonably available to a residential member or small business owner.

D. The array shall be connected to a common energy management system.
E. If branding credit is part of a proposal, Contractor shall include its branding requirements within its proposal. Please note that SVEC intends to provide to third parties, including its consumer members, comparative reports of the installation output, operations and maintenance cost as well as other performance and economic information about each installation. If an installation is branded to identify the Contractor, such report will include the name of the Contractor in order that third parties may better compare one installation against another. For any installation that is not branded, SVEC expects to provide information about the manufacturers of components used, but not the name of the Contractor. Inclusion of branding credit as part of an installation shall constitute the agreement of the Contractor to the foregoing provision concerning the provision of such information. Use of comparative report, creation of derivative works based upon, distribution or display thereof, without the prior written consent of Owner, is prohibited.

5.3 Solar Shingles

A. The intent of this Project is to demonstrate residential and small commercial solar shingle installations. Project shall be built and installed in a manner closely resembling that of a residential or small commercial technique and style.

B. The array shall be constructed using infrastructure components that would typically be found on residential or small commercial installations unless otherwise identified in this specification document.

C. Please note that the roof for mounting is on a Facility that does not yet exist but will be designed and built by SVEC to best meet the design submitted in the successful Contractor’s proposal.

D. The array shall be connected to a common energy management system.

E. If branding credit is part of a proposal, Contractor shall include its branding requirements within its proposal. Please note that SVEC intends to provide to third parties, including its consumer members, comparative reports of the installation output, operations and maintenance cost as well as other performance and economic information about each installation. If an installation is branded to identify the Contractor, such report will include the name of the Contractor in order that third parties may better compare one installation against another. For any installation that is not branded, SVEC expects to provide information about the manufacturers of components used, but not the name of the Contractor. Inclusion of branding credit as part of an installation shall constitute the agreement of the Contractor to the foregoing provision concerning the provision of such information. Use of comparative report, creation of derivative works based upon, distribution or display thereof, without the prior written consent of Owner, is prohibited.
5.4 **Roof Array**

A. The intent of this Project is to replicate a standard PV array found on residential or small commercial buildings. Project shall be built and installed in a manner closely resembling that of residential or small commercial technique and style.

B. The array shall be constructed using infrastructure components that would typically be found on residential or small commercial installations unless otherwise identified in this specification document.

C. Please note that the roof for mounting is on a Facility that does not yet exist but will be designed and built by SVEC to best meet the design submitted in the successful Contractor’s proposal.

D. The array shall be connected to a common energy management system.

E. If branding credit is part of a proposal, Contractor shall include its branding requirements within its proposal. Please note that SVEC intends to provide to third parties, including its consumer members, comparative reports of the installation output, operations and maintenance cost as well as other performance and economic information about each installation. If an installation is branded to identify the Contractor, such report will include the name of the Contractor in order that third parties may better compare one installation against another. For any installation that is not branded, SVEC expects to provide information about the manufacturers of components used, but not the name of the Contractor. Inclusion of branding credit as part of an installation shall constitute the agreement of the Contractor to the foregoing provision concerning the provision of such information. Use of comparative report, creation of derivative works based upon, distribution or display thereof, without the prior written consent of Owner, is prohibited.

5.5 **Energy Storage**

A. The intent of this Project is to demonstrate residential and small commercial energy storage. In this instance, because a closer inspection is possible, choices made for visibility, accessibility and componentry are very important.

B. The energy storage site shall be constructed using infrastructure components that would typically be found on residential or small commercial installations unless otherwise identified in this specification document.

C. The Project shall be constructed with public safety in mind and shall have all componentry protected from free and open access.

D. The array shall be connected to a common energy management system.
E. If branding credit is part of a proposal, Contractor shall include its branding requirements within its proposal. Please note that SVEC intends to provide to third parties, including its consumer members, comparative reports of the installation output, operations and maintenance cost as well as other performance and economic information about each installation. If an installation is branded to identify the Contractor, such report will include the name of the Contractor in order that third parties may better compare one installation against another. For any installation that is not branded, SVEC expects to provide information about the manufacturers of components used, but not the name of the Contractor. Inclusion of branding credit as part of an installation shall constitute the agreement of the Contractor to the foregoing provision concerning the provision of such information. Use of comparative report, creation of derivative works based upon, distribution or display thereof, without the prior written consent of Owner, is prohibited.
6.0 APPROVED EQUIPMENT SUPPLIERS

6.1 Approved Equipment Suppliers

<table>
<thead>
<tr>
<th>PV Modules</th>
<th>Combiner Boxes</th>
<th>Inverters</th>
<th>Racking Suppliers</th>
<th>Monitoring System</th>
<th>Solar Shingles</th>
<th>Energy Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SunPower</td>
<td>SolarBOS</td>
<td>Fronius</td>
<td>Solar Flex Rack</td>
<td>Draker</td>
<td>SolarCity</td>
<td>Tesla Powerwall</td>
</tr>
<tr>
<td>REC Solar</td>
<td>Shoals</td>
<td>Power-One</td>
<td>Unirac</td>
<td>ALSO Energy</td>
<td>CertainTeed</td>
<td>Lithium ION</td>
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<tr>
<td>Hanwha SolarOne</td>
<td>Cooper</td>
<td>SMA</td>
<td>Sunlink</td>
<td></td>
<td>RGS Energy</td>
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<td></td>
<td>Crouse-Hinds</td>
<td>TMEIC</td>
<td>Panel Claw</td>
<td></td>
<td>SunTerga</td>
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<td></td>
<td>AMtect</td>
<td>Solar Edge</td>
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<td></td>
<td>Bentek</td>
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7.0 Photovoltaic PV MODULE SPECIFICATIONS

7.1 PV Module Specifications

<table>
<thead>
<tr>
<th>PV Module Specifications</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum DC System Voltage</td>
<td>1000V</td>
</tr>
<tr>
<td>Sustainable Wind Load</td>
<td>90-MPH</td>
</tr>
<tr>
<td>Resistance to Environmental Damage (water, hail, or damage, etc.)</td>
<td>Per IEC 61215 / IEC 61646 requirements</td>
</tr>
<tr>
<td>Guaranteed Performance Degradation (25 years)</td>
<td>No more than 3% of maximum power lost at the end of year 1. No greater than 0.7% reduction in power output at the end of each following year up to 25 years.</td>
</tr>
</tbody>
</table>
| UL/IEC Certifications\(^1\)                                     | UL 1703 and IEC 61730
IEC 61215 (mono- or poly-crystalline)
IEC 61646 (thin film)                                         |

\(^1\) The listed IEC/UL certifications are applicable to all technologies, except as noted. Several Nationally Recognized Testing Laboratories (NRTLs) besides UL are authorized to test to UL standards.

7.2 PV Module Characteristics

A. Contractor must use only those panels as specified in Proposal Data Submittal Form.

B. Contractor shall provide nominal module power rating at standard test conditions for modules to be used in solar arrays, and their power rating tolerance.

C. Contractor shall make at least three panels accessible at each Project location for adjustment by owner; Owner should be able to adjust panels up to 30 degrees.

D. Contractor shall provide provisions at accessible panels in 7.2C for monitoring power quality. Owner should be able to interconnect monitoring device to all panels. The Owner utilizes Power Monitoring Incorporated’s Eagle and Revolution style power quality recording devices.

E. Glass laminates or glazing with low reflectivity are preferred.

7.3 Panel Support Structure
A. The module support structures shall be designed and constructed to provide a stable support system for the life of the Project. Module support structures shall meet all applicable codes and standards.

B. Foundation shall be appropriate strength concrete (spread or augured) utilizing galvanized or equivalent corrosion-resistant steel members (corrosion-resistance defined by geo-technical report).

C. 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 IBC 2009 and ASCE 7-05 codes.

7.4 Solar Shingles

<table>
<thead>
<tr>
<th>Solar Shingle Specifications</th>
<th>Requirements</th>
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<tbody>
<tr>
<td>Maximum DC System Voltage</td>
<td>600V</td>
</tr>
<tr>
<td>Sustainable Wind Rating</td>
<td>Class F ASTM D3161 (best wind rating)</td>
</tr>
<tr>
<td>Resistance to Environmental Damage</td>
<td>Per IEC 61215 / IEC 61646 requirements</td>
</tr>
<tr>
<td></td>
<td>Class 4 ANSI FM 4473 (best hail rating)</td>
</tr>
<tr>
<td>Guaranteed Performance Degradation (25 years)</td>
<td>No more than 3% of maximum power lost at the end of year 1. No greater than 0.7% reduction in power output at the end of each following year up to 25 years.</td>
</tr>
<tr>
<td>UL/IEC Certifications¹</td>
<td>UL 1703 and IEC 61730</td>
</tr>
<tr>
<td></td>
<td>UL 790 Class A Fire Rating ASTM D3161</td>
</tr>
<tr>
<td></td>
<td>Class F IEC 61215</td>
</tr>
<tr>
<td></td>
<td>IEC 61215 (mono- or poly-crystalline)</td>
</tr>
<tr>
<td></td>
<td>IEC 61646 (thin film)</td>
</tr>
</tbody>
</table>

¹ The listed IEC/UL certifications are applicable to all technologies, except as noted. Several Nationally Recognized Testing Laboratories (NRTLs) besides UL are authorized to test to UL standards.
8.0 INVERTER

8.1 Inverter Specifications

Table 8-1. – Inverter Specifications

<table>
<thead>
<tr>
<th>Inverter Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>97% minimum CEC efficiency</td>
</tr>
<tr>
<td>Output Current Harmonics</td>
<td>&lt;3%</td>
</tr>
<tr>
<td>Warranty</td>
<td>Minimum 15 years</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Capable of full rated output at 50 C</td>
</tr>
<tr>
<td>Maximum DC voltage</td>
<td>1000 (shall match Panel output)</td>
</tr>
<tr>
<td>Guaranteed Performance Degradation (25 years)</td>
<td>Inverters shall have a 25 year operating life.</td>
</tr>
<tr>
<td>UL/IEC/IEEE Certifications</td>
<td>IEEE 1547</td>
</tr>
<tr>
<td></td>
<td>UL 1741</td>
</tr>
<tr>
<td>Communications</td>
<td>MODBUS, DNP3.0, SCADA</td>
</tr>
</tbody>
</table>

8.2 Inverter Characteristics

A. Contractor must use only those inverters as specified in Proposal Form. No alternatives will be accepted unless approval by Owner is received prior to Contractor purchase.

B. No more than one third of all panels that constitute any given Project may be on the same inverter. The use of micro-inverters is permitted but discouraged for roof-mounted array.

C. Preference for Inverters installed on tracking solar array to be hardened from all natural disasters.

D. Inverters shall be physically mounted so as to avoid direct sun exposure and in a location that offers the best protection possible from other weather elements.
9.0 COMBINER BOX

9.1 Combiner Box Specifications

A. Combiner boxes shall be NEMA 4 rated with continuous hinge single door.

B. Combiner boxes shall be rated for the maximum system design voltage and the maximum continuous current as well as the maximum short circuit current.

C. All fuses in the combiner box shall have blown fuse indication.

D. Combiner boxes shall be at the end of the row and above ground.

E. All combiner box electrical systems, both inside and outside the combiner box itself, must meet NEC and UL standards and listings.
10.0 TRANSFORMERS (IF REQUIRED)

Three phase transformers to be provided by Owner if required.
11.0 COMMUNICATIONS

11.1 Monitoring System Specifications
A. Contractor shall specify and install a fully functional, web-based monitoring software for each Project as outlined in this RFP.

B. Contractor shall also supply, install and commission the system hardware necessary for all monitoring activities.

C. Contractor is responsible for providing data connection for each Project at POI. Communications shall be transmitted via a fiber optic communications infrastructure.

D. System shall display data in real time and record and log performance data at regular intervals from the Project. The data shall be directed through Owner’s interface and then to the internet for remote access, monitoring and data collection.

11.2 SCADA Integration
A. Contractor shall install system that uses DNP 3.0 communication protocol.

B. Communications network: Ethernet via fiber optic multi-mode.

C. Contractor shall install (one) Schweitzer Engineering Laboratories (SEL) RTAC Remote Terminal Unit (RTU) on the Energy Facility array and (one) Schweitzer Engineering Laboratories (SEL) RTAC Remote Terminal Unit (RTU) on the Parking Canopy array.

D. RTU shall be capable of concentrating any and all operation data from solar array and allow for any control.

E. Contractor shall house the RTU in a stainless steel or aluminum weather proof cabinet. If outside.
12.0 EQUIPMENT AND MATERIALS

12.1 Availability

A. Contractor shall furnish all equipment and materials as required to construct a fully functioning Project. All equipment and materials used for Project shall meet applicable standards and shall be products generally available for purchase through a reputable vendor in the United States of America.

12.2 Spare Parts Inventory

A. Contractor shall provide Owner with a list of recommended spare parts needed for routine maintenance as well as parts which may need to be replaced during the life of the Project.

B. The spare parts list shall include an item description, original equipment manufacturer, supplier, identification/part number, quantity, equipment tag number, lead time, and price.

C. Contractor shall provide two spares of each component for post project owner use.
13.0 ELECTRICAL INSTALLATION

13.1 General
A. All above grade outdoor electrical conduits shall be rigid galvanized steel with NEMA 4 enclosures. All transitions to below grade conduit shall be rigid galvanized steel. Any deviation shall be reviewed and accepted by the Owner prior to proceeding.

B. All electrical systems must meet applicable codes and standards to ensure proper and safe operation.

13.2 DC System Wiring
A. Series string connections between modules will be via locking multi-contact connectors and jumpers factory-supplied with modules.

B. All DC system wiring must meet NEC requirements and local codes.

C. DC cabling may run above grade where allowed by code: method to be reviewed and accepted by Owner.

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

E. Any fuses shall be readily accessible and replaceable.

F. Wiring harnesses and cabling shall be UL listed.
   1. Wiring harnesses shall use tee tap connectors and in-line fuses when required for paralleling circuits outside DC combiner boxes.
   2. Materials used for cable fastening shall have a life expectancy of 25 years.

13.3 AC System Wiring
A. All conductors, lugs and cable accessories shall be UL listed.

B. All AC system wiring must meet NEC requirements and local codes.

13.4 Grounding
A. All ground conductors and grounding systems shall be UL listed, if appropriate, and shall meet all NEC and local code requirements.

B. Inverters/ISAs shall be bonded to a ground ring.
13.5 Labeling and Identification

A. For diagnostic and troubleshooting purposes, all wires shall have a label affixed to each end stating origination point.

B. For diagnostic and troubleshooting purposes, all multi-string harness inputs to each combiner box and the combiner boxes themselves shall be uniquely tagged and identified with such tagging on the record construction drawings.

C. As part of the deliverables that the Contractor must deliver prior to Final Completion, Contractor shall provide to the Owner a database including all module serial numbers which can be sorted by array, combiner box and harness.

13.6 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.

13.7 Lightning Protection for Field Enclosures

A. Lightning protection shall only be provided at each ISA if enclosures are used.

B. Lightning protection (where required) shall comply with the requirements of NFPA 780 Standard for the Installation of Lightning Protection Systems.
14.0 MECHANICAL

14.1 General Requirements
A. This section provides requirements for major mechanical equipment, mechanical systems and mechanical interfaces with other Project systems and off-site facilities.

14.2 General Arrangements
A. The location of equipment shall be based on safety, economics, ease of maintenance, and operation. Sufficient space shall be provided for maintenance of all equipment including equipment removal without excessive rigging or removal of surrounding equipment.

14.3 Fire Protection System
A. As necessary, 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 Owner's insurance carrier.

B. General
1. Fire protection during Project 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.
15.0 SITE WORK

15.1 General Requirements

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

B. Contractor is responsible to inspect the Site, to obtain all necessary Site data, to obtain all required geotechnical investigations and to determine all Site data for the design and construction of the Project. 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.

C. 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 Owner and jurisdictional government agencies.
   2. Obtain all necessary permitting associated with civil site work construction such as grading permits, haul permits, dust permits, storm water pollution prevention plans, etc., in compliance with local jurisdictional requirements and other jurisdictional government agencies as may pertain.
   3. Construction of all civil site work (if determined required), including the storm water drainage infrastructure, earth grading, roads, security fencing, etc., unless otherwise noted (see RFP). Construction of any temporary civil site work such as temporary security fencing, temporary construction roads, etc.
   4. If necessary, perform the geotechnical evaluations for the civil site work.
   5. Perform all construction surveys (construction staking).
   6. Prepare as-built record drawings.

D. Contractor shall be responsible for all site preparation including any demolition, soil stabilization, grading, drainage, roadways and temporary parking areas.

15.2 Construction Surveys

A. Owner shall provide the construction surveying for the design of any civil site work that is assumed required.

B. 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 state of Project construction.
15.3 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 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 state where the Project is located. The as-built drawing set shall also contain cut-sheets, containing product data, of all major equipment used in the Project construction.
16.0 STRUCTURAL

16.1 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”.

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, nuts, washers and bolts shall conform to ASTM standards.

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.

16.2 Structural Loading
A. Contractor shall determine all Site data for the design and construction of the Project. This shall include determination of local code requirements for seismic and wind design loads. It is Contractor’s sole responsibility to ensure that the Project structural and architectural facilities comply with all federal, state, and local code requirements and all industry codes and standards. All structures shall be in accordance with applicable codes including the IBC and ASCE.

16.3 Structural Foundations
A. Types 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 Contractor’s geotechnical report.
17.0 COMMISSIONING AND PROJECT ACCEPTANCE TESTING

17.1 Commissioning

A. Overview
   1. 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 systems’ objective and criteria of Owner, as established in the EPC Agreement and this document.
   2. The commissioning agent to be used by Contractor must be proposed to Owner as part of commissioning plan and agreed upon by Owner before start of work.

B. Commissioning Testing
   1. Contractor shall successfully run both Power Capacity Tests (DC and AC simultaneously) in accordance with the approved Commissioning Test Procedures for such test.
   2. Test Duration
      a. Owner shall approve the Power Capacity Test period and data collection intervals prior to execution of the testing.
   3. Performance Verification
      a. If the corrected output measured at the sum of measurements at the inverter input is equal to or greater than the corresponding Power Capacity Guarantee, and assuming the other requirements established to successfully run the applicable Power Capacity Test have been met, then the Power Capacity Test will be deemed to have been successfully run.

C. All commissioning activities shall be executed under a phased approach, as identified below. Activities of each phase shall be documented and submitted to Owner for review, acceptance, and documentation.
   1. Acceptance Phase
      a. Physical Inspections
      b. O&M Manual Review
      c. Warranty Review
      d. Commissioning Manual
   2. Operational Phase
      a. Performance Verification
      b. Operation
18.0 PROJECT AND CONSTRUCTION MANAGEMENT

18.1 Staffing
A. Contractor shall provide adequate and appropriate personnel to manage all aspects of the work.

B. Contractor shall ensure an OSHA “competent” person be present during all work hours and is responsible for maintaining an OSHA compliant worksite during the duration of the Project.

18.2 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 Owner, Contractor and Contractor’s subcontractors.

B. Progress meetings shall be held at the Site on a time interval mutually agreeable to Owner and Contractor.

18.3 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.

18.4 Work Schedule
A. Contractor shall submit a detailed schedule which meets all Owner requirements.

B. The work schedule shall be updated weekly against the baseline schedule and submitted to Owner.

18.5 Project Review and Approval
A. Contractor shall submit design documents and equipment cut sheets at the following intervals to the Cooperative for their review and approval.
   1. Equipment purchase specifications
   2. Equipment cut sheets of selected products
   3. 30% concept design documents
   4. 90% design documents
   5. Issued for Construction design documents
   6. Record documents (as-builts)