BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Union Electric Company d/b/a Ameren Missouri for Permission and Approval and a Certificate of Public Convenience and Necessity Authorizing it to Offer a Pilot Distributed Solar Program and File Associated Tariff.	)))))	File No. EA-2016-0208

AMEREN MISSOURI'S SITE DOCUMENTATION SUBMISSION

COMES NOW Union Electric Company d/b/a Ameren Missouri ("Ameren Missouri" or the "Company"), and hereby submits the documentation required by the Commission's December 21, 2016 *Report and Order* ("Report and Order") for a Solar Partnership Pilot site and, with respect to the documentation, states as follows:

1. The Report and Order authorizes Ameren Missouri to construct solar generation facilities meeting certain parameters pursuant to long-term (25-year) leases under which such facilities will be located on customer premises. The terms and conditions under which such facilities can be built are set forth in the stipulation attached to the Report and Order. The Report and Order would have allowed the construction of multiple facilities (with a cap on total Ameren Missouri investment of $10 million).

2. The Office of the Public Counsel ("OPC") appealed the Report and Order. That appeal was resolved when the Company and OPC agreed on a more limited pilot. *See* Notice of Agreement and Dismissal of Appeal, EFIS Item No. 136 (May 30, 2017). Ultimately, after a second agreement with OPC and the Company, the Company agreed to construct just one facility at a capital investment not to exceed $4 million. *See* Notice of Amended Agreement, EFIS Item No. 13 (August 24, 2017).

3. That project has now been identified, which triggers the Company's obligation under ¶ 5 of the above-referenced stipulation to submit certain documentation for review by the stipulation's signatories. The specific documentation and the process to be followed upon its submission is outlined in Appendix A to the stipulation. That process contemplates a review period of between 45 and 90 days,

and the submission of a report by the Commission's Staff verifying whether the chosen site does (or does not) meet the criteria agreed upon in Appendix A to the stipulation.

4. The site of the project is BJC's and Washington University's East Parking Garage, 4466 Duncan Avenue, St. Louis, Missouri. The facility will be constructed on the top level of the parking garage at that location. Construction is slated to commence in January 2020, after submission of the above-referenced Staff report. Given delays in finalizing commercial terms with BJC, who is in charge of the partnership effort for the owners, the Company was unable to submit the documentation a full 90 days prior to the date upon which the certificate of convenience and necessity ("CCN") issued by the Report and Order will expire (January 20, 2019). However, the Company has consulted with the Staff and OPC and believes that submitting the documentation that accompanies this submission now, to be followed by additional documentation to be submitted no later than December 19, 2018 as outlined below, allows sufficient time to verify that the site does meet the agreed-upon criteria and for the Staff to file its report. Based on the communications the Company has had with the Staff to-date, Staff presently believes it is possible that its review and report can be completed by January 17, 2019 (construction is slated to begin on Friday, January 18, 2019). To expedite Staff's review, the Company agrees to respond to any data requests within five (5) calendar days, with three (3) business days to object or to notify Staff more time is required, along with the date by which the response can be expected. Under the above-referenced stipulation, if there is agreement that the site meets the agreed-upon criteria and upon submission of the Staff report, the Company may proceed with the project. Further Commission action is not required.

5. In addition to certain agreed-upon site criteria, Appendix A to the above-referenced stipulation requires that the information required by 4 CSR 240-3.105(B) be submitted. That information is submitted as follows:

a. 4 CSR 240-3.105(B)1: The proposed construction does not cross any electric or

telephone lines of regulated or unregulated utilities, any railroad tracks, or any underground facilities.

b. 4 CSR 240-3.105(B)2: Plans and specifications for the project will be submitted by December 19, 2018, but certain information is submitted herewith, as follows:

   i. Request for Proposal (Exhibit 1).

   ii. Design, Installation and Equipment Specifications (Exhibit 2).

   iii. Conceptual drawings of the solar facility (Exhibit 3).

c. 4 CSR 240-3.105(B)3: The Company will finance the project using existing treasury funds.

6. Appendix A to the stipulation also requires an assessment that the identified site meets the "Minimum Application Conditions" set forth therein. That assessment is attached hereto and incorporated herein by this reference as Exhibit 4.

WHEREFORE, the Company submits documentation under the Report and Order respecting the site of its Solar Partnership Pilot facility.

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Dated: November 16, 2018

CERTIFICATE OF SERVICE

I do hereby certify that a true and correct copy of the foregoing has been e-mailed, this 16th day of November 2018, to counsel for all parties of record.

/s/ James B. Lowery

Request for Proposal (RFP)

for

Solar Partnership Project at BJC Healthcare East Staff Parking Garage

Exhibit 2

EXHIBIT 1

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EXHIBIT 1

A. PROJECT SCOPE OF WORK

The primary scope of work for the Solar Partnership Project includes the engineering, procurement and installation of a solar photovoltaic panel array to produce the following objectives:

- Maximize power capacity given the site location boundaries and topographical restrictions

The Project location is 4466 Duncan Avenue, St. Louis, Missouri. An overhead view and has been included as Exhibit 2A.

B. PROJECT SPECIFICATION

B.1 Detailed Scope of Work

As listed in Section A, the scope of work for this project is to engineer, procure, install and commission an integrated solar generation array.

For the purpose of this Project, Contractor shall procure and install data acquisition and storage equipment for operating conditions of the solar PV array. This equipment shall aggregate available data for Ameren Missouri's use on its network infrastructure. Physical communication infrastructure shall support either Cat5e/Cat6 STP copper or single mode fiber connecting to an Ameren Missouri provided Local Area Network and shall integrate with standard TCP/IP stack protocols including Ethernet, IP TCP, UDP and MPLS. Fiber cable shall be single mode cable rated for outdoor use. Cellular wireless communication technology may also be utilized to maintain cost control, if available. Any connection to Ameren Missouri's network infrastructure is subject to a full cyber security review.

The following data collection points shall be monitored by the SCADA system:

- Inverters (procured by Contractor)
  - AC Voltage
  - DC Voltage
  - AC Current
  - DC current (may be multiple values)
  - Kilowatt
  - Kilowatt-hour
  - Photovoltaic (PV) module temperature

Contractor shall complete all engineering and planning. Engineering and design shall follow the latest approved National Fire Protection Association (NFPA) 70 – National Electric Code standards. Engineering shall include, without limitation, the following activities:

- Conduct 100% Design Review with Owner to review all design details, drawings and plans completed. Meeting shall include Contractor's engineering and construction team along with Ameren Missouri's project team. Meeting will be held at an Ameren Missouri office.

Contractor shall prepare and submit drawings and documents to Ameren Missouri necessary for full review of the equipment and installation. All equipment submittals from vendors and manufacturers shall be submitted to Ameren Missouri as Foreign Print Manuals or Foreign Print Drawings per Ameren Missouri Drafting Specification, Exhibit 2C. Drawings shall be submitted in AutoCAD native file format. These drawings and documents shall include, but shall not be limited, to the following:

- General site plans
- Foundation / Structural drawings
- Electrical one-lines

EXHIBIT 1

- Electrical wiring diagrams
- Electrical schematic diagrams
- Cable and conduit layouts
- Grounding plan layouts
- Communication diagrams
- Spare parts list

Contractor shall be responsible for all required Project permitting. Permitting may include, but is not limited to, air, water, land disturbance and zoning, as well as any other applicable permits required by the City of St. Louis, Missouri or the State of Missouri.

Contractor shall procure and install solar PV array equipment with the following minimum requirements:

- Maximum power capacity based on available space
- Monocrystalline-Silicon, Polycrystalline-Silicon or Cadmium-Telluride panels
- Available site area: approximately 2.50 acres
- Structural supports shall accommodate a canopy solar PV array
- Solar panels shall be fixed mount and oriented to produce maximum yearly energy output.
- Inverters shall be sized to maximize efficiency of the site energy production.
- Combiner boxes shall be fused with finger-safe terminal blocks and fuse blocks.
- Solar panel racking design shall include wire management system that shall mitigate all wire and cable cuts, nicks and fraying due to normal operation after project is in service.
- Solar panel racking design shall include varmint prevention such as screens or enclosures to deter all nuisance varmints from interfering with installation and on-going equipment operation.
- Solar panel racking design shall include water management for rain, snow, sleet and ice. This water management shall include water collection from the solar array into planned water collection systems existing within parking garage.
    - Please provide optional pricing for solar panel array configuration in a single-plane and as tiered racks.
- All outdoor equipment shall be NEMA 3R rated, at a minimum.

Contractor shall procure and install electrical equipment with the following minimum requirements:

- The electrical equipment shall be rated for the proper voltage and current output of all generation.
- Electrical switchgear shall interface with Ameren Missouri's 12-kV electrical distribution system. This point of common coupling (PCC) is located at the Ameren-owned transformer near the southwest corner of the parking garage.
    - A separate metering cabinet and disconnect switch shall be installed near the Ameren-owned transformer allowing for working space at the transformer, disconnect switch and metering cabinet.
    - Conduit containing home-run cabling from solar array to PCC shall travel down the existing electrical riser location.

Contractor shall procure and install lighting underneath the solar array canopy with the following minimum requirements:

- The lighting shall produce a minimum of 5 foot-candles on the entire garage deck.
- Lighting power shall be provided by existing electrical lighting panel.

Contractor shall procure and install all materials to complete the above objectives including, but not limited to:

- Cables: power, grounding, control and instrumentation

EXHIBIT 1

- Equipment racking and supports
- Miscellaneous hardware for connection and securing equipment
- Special tools and instruments to install, test and commission equipment
- Structural support systems within the parking garage to support equipment, if applicable.

During construction, Contractor shall maintain at least 75% of all parking spaces as available on the top deck of the East Staff Parking Garage. Contractor will be required to coordinate access and security requirements with BJC and Washington University School of Medicine. Laydown areas at site are limited; deliveries must be just-in-time.

All construction shall follow NFPA 70 – National Electric Code standards. Solar PV racking system shall be designed and constructed for typical wind and snow loading for the location specified. Contractor construction labor shall follow the National Maintenance Agreement (NMA). All labor tasks and activity responsibilities shall fall under these guidelines. All electrical contractors shall be International Brotherhood of Electrical Workers (IBEW).

During construction, Contractor is required to follow Ameren Missouri's Rules to Live By. Employees and contractors found to be in violation of these rules will receive appropriate disciplinary action. These rules are as follows:

- Fall Protection – Failure to use proper fall protection when there is a risk of a fall that is greater than 6 feet.
- WPA (Lock Out / Tag Out) – Violation of a tag, lock or tag-out device that is used for employee protection.
- Electrical Safety – Failure to follow the proper procedures and wear proper personal protective equipment when working on energized equipment.
- Confined Space Entry – Failure to evaluate a confined space and perform air monitoring checks prior to entry.
- Rigging / Hoisting – Walking or working under a suspended load.
- Trenching and Shoring – Entering an excavation greater than 5 feet deep that has not been properly sloped or shored.

The Ameren Missouri Power Operations – Rules to Live By document is included as Exhibit 2B.

All equipment shall be fully tested at the factory and field tested to ensure it is fully functional per manufacturer's instructions.

Contractor is responsible for all aspects of testing, commissioning and startup prior to turnover of the Project to Ameren Missouri. Contractor shall supply commissioning, testing and startup plan no later than thirty (30) days prior to planned execution.

Contractor shall provide both hands-on operator training for Ameren Missouri technicians during start-up. Ameren Missouri shall have the right to videotape training sessions for Company use.

- Field training shall be designed to provide instruction on health and safety, equipment operation, Project Site design and layout (as built) and all other topics specific to the Project Site. Field training shall be provided for up to ten people in one scheduled training session. Ameren Missouri shall have the right to reproduce all training materials at its own cost, solely for the use of Company's employees.

Contractor shall follow performance guarantees per Exhibit 2E – Performance Standards and Liquidated Damages.

Contractor shall pass all equipment warranties to Ameren Missouri. Contractor shall also supply a one-year warranty for all parts and labor for the remainder of the site installation.

C. APPROVED SUPPLIER/SUBCONTRACTOR LIST

- Solar Panels

    - Tier 1 Panel Manufacturers
- Solar Panel Racking
    - Meets UL 2703 Standard
- Inverters
    - ABB
    - Eaton
    - Power One
    - Schneider Electric
    - SMA

Any vendor or subcontractor not on this list shall be submitted to Ameren Missouri for qualification, together with such quality and safety information with respect to such subcontractor or vendor as Ameren Missouri may reasonably request, prior to bid submittal.

DESIGN

1.0 INTRODUCTION

1.1 Scope

1.1.1 Scope of supply shall include furnishing and installation of the solar inverter equipment as specified herein to be connected to photovoltaic panels as described in Section 16240.

1.2 Reference Sections

1.2.1 Section 16240 – Photovoltaic Panels

1.3 Codes and Standards

1.3.1 Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

1.3.1.1 UL 508C – Power Conversion Equipment

1.3.1.2 IEEE519 – IEEE Harmonic Control in Electrical Power Systems

1.3.1.3 UL50E – Enclosures for Electrical Equipment

1.3.1.4 IBC – Seismic Zones

1.3.1.5 UL1741 – Ground Fault Indicator

1.3.1.6 IEEE C62.41.2 – Surge Location Categories

1.3.1.7 UL1547 – Interconnecting Distributed Resources with Electrical Power Systems

2.0 SOLAR INVERTER EQUIPMENT REQUIREMENTS

2.1 Design

2.1.1 Solar inverters shall be sized to the full continuous capacity of the PV array and at maximum peak output and based on the panel manufacturer’s information. String voltage shall not exceed 1500V DC.

2.1.2 Solar inverters shall be supplied in a weather-proof enclosure with a hinged door and seamless door gaskets. NEMA 12 enclosure shall be required for option where inverters are supplied in a temperature controlled building.

2.1.3 Enclosure must have a door interlock system to prohibit the doors from being opened while energized.

2.1.4 Inverters shall incorporate a no-load, two (2)-pole, lockable disconnect switch for main DC power disconnect for maintenance personnel safety.

2.1.5 Equipment enclosure shall have a suitable means for dissipation of heat suitable to the environment where located.

EXHIBIT 2

2.1.6 Inverter output shall be protected by a circuit breaker with short and long time adjustable over current protection. This circuit breaker shall be locally and remotely operated from the control system.

2.1.7 Inverters shall be equipped with all hardware for data collection and communication to the central control system. Data collection points shall be integrated into the inverter monitoring and communications package.

2.1.8 Inverters shall be equipped with multiple fused, disconnect able, DC inputs with built in current and fault monitoring for input to the control system.

2.1.9 Inverter shall have integral protection devices and standard alarms for trouble in the form of dry contacts, local indication, and communications including volts, amps, etc.

2.1.10 Inverters shall have all the necessary equipment to monitor and communicate loss of a PV array. It shall have the option to monitor combiner zone current.

2.1.11 Local indication and remote indication of status, communications, and metering shall be included. Remote indication involves Modbus/TCP monitoring and a conduit to transferring those signals to control system for distribution through Ameren Missouri.

2.1.12 Surge protection withstand shall be included for equipment protection from over-voltage caused by lightning strikes or other conditions.

2.1.13 Inverters shall include flicker mitigations.

2.1.14 A 480VAC output breaker shall be provided for local disconnecting means to completely disconnect AC power from the inverter for protection. The breaker symmetrical short circuit current fault analysis shall be used to determine requirements.

2.1.15 Multiple inverter devices if connected in parallel shall be rated for such as well as balanced load sharing.

2.1.16 Inverter shall have space heaters controlled by a thermostat for condensate control.

2.1.17 Engraved nameplates shall be furnished for the front and rear of each inverter and for equipment and devices within each inverter. Inverter equipment and devices shall be identified on 3” plastic laminate engraved nameplates with white background with black lettering. Nameplate inscriptions will be furnished by the Company. Name plates shall be mechanically fastened to equipment.

END OF 16250 DESIGN SECTION

EQUIPMENT

1.0 INTRODUCTION

1.1 Scope

1.1.1 Scope of supply shall include furnishing and installation of the solar inverter equipment as specified herein to be connected to photovoltaic panels.

1.2 Reference Sections

1.2.1 Section 16240 – Photovoltaic Panels

1.3 Codes and Standards

1.3.1 Work performed under these specifications shall be done in accordance with the codes and standards outlined below:

1.3.1.1 Listed in Design Section.

2.0 SOALR INVERTER REQUIREMENTS

2.1 Equipment

DESCRIPTION	PARAMETER
Environmental:	
Location	Outdoor 3R
Ambient Temperature	0° C - 50° C
Altitude	441ft (0 – 3300ft)
Cooling	TBD by Vendor
Humidity	0-95% Non-Condensing
Noise Level	<85dB
Mechanical:	
Mounting	Floor Mount
Enclosure Type	NEMA 4
Finish	Galvanized Steel
Electrical:	
Rated Input DC Voltage	Up to 1500VDC
Voltage Ripple	< 3%
Protected DC inputs	Yes

Nominal AC Output Voltage	Less or Equal to 480VAC, 3-Phase
Nominal Output Frequency	60 Hz
Minimum Power Factor @ Full Load	0.99
Minimum Efficiency @ Full Load	96%
Power Factor Compensation	Yes
AC Output Grounding Switch	Yes
Cabinet Heating	Yes
Remote Connection Type	Ethernet (Modbus over TCP)
Grid Support & Compliance	
Reactive power compensation	Yes
Power reduction	Yes
Low voltage ride through	Yes
Grid Tie Capabilities	Yes
Protection	
AC Short Circuit and Over-current Protection	Yes
DC Short Circuit and Over-current Protection	Yes
AC Overvoltage and Temperature Protection	Yes
DC Overvoltage and Temperature Protection	Yes
DC reverse polarity	Yes
Grid Monitoring	Yes
Ground Fault Monitoring	Yes
Redundant Relay Protection	Yes

END OF 16250 EQUIPMENT SECTION

INSTALLATION

1.0 INTRODUCTION

1.1 Scope

1.1.1 This specification includes all field installation requirements for Solar Inverter Equipment.

1.2 Reference Sections

1.2.1 Section 16240 – Photovoltaic Panels

1.3 Codes and Standards

1.3.1 Work performed under these specifications shall be done in accordance with the codes and standards outlined below:

1.3.1.1 Listed in Design Section

2.0 SOLAR INVERTER REQUIREMENTS

2.1 Installation

2.1.1 When a secondary unit substation transformer is integral to the medium voltage switchgear assembly, Contractor shall connect the switchgear ground bus to the power transformer neutral (solidly grounded).

2.1.2 When a unit substation transformer is integral to the inverter equipment, the neutral bus shall be connected by bus bar to the neutral of the transformer.

2.1.3 Main Bus

2.1.3.1 Bus bars shall be bolted together and Contractor shall ensure they are clean and free of corrosion, welding slag and other foreign matter.

2.1.4 Installation of solar inverter equipment shall be in accordance with manufacturer's instructions and design documents.

2.1.5 Inverter shall be oriented where displays shall face north and be protected from the sun.

2.1.6 Comply with mounting and anchoring requirements specified in design documentation.

2.1.7 Temporary Lifting Provisions: Remove temporary lifting eyes, channels and brackets and temporary blocking of moving parts from switchgear units and components.

2.1.8 If the solar inverter assembly includes a close-coupled transformer, Contractor shall make connections from the main cubicle to the transformer using supplied buswork, flexible links, or cabling as specified on the design documents and manufacturer's assembly documents. Make control wiring connections in addition to necessary ground and neutral tie-ins as required for the transformer.

2.1.9 Ensure adequate ground continuity as outlined in the equipment manual.

2.1.10 Install power, control and instrumentation cable, and raceway as required by the design documentation. Ensure raceway enters into appropriate locations of the switchgear assembly, as dictated by manufacturer and design documentation.

2.1.11 Contractor shall install all items shipped loose as required for complete assembly.

2.1.12 Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

2.1.13 Make the following inspections post-installation and prior to energization:

2.1.13.1 Inspect for proper anchorage, alignment and grounding, and note any physical damage.

2.1.13.2 Megger each bus: phase-phase and phase-ground. Refer to manufacturer's literature and this specification to specific testing procedures.

2.1.13.3 Provide high potential (hi-pot) testing for all bus and cables post-installation.

2.1.13.4 Check the tightness of the accessible bolted bus joints using a calibrated torque wrench per manufacturer's recommended values.

2.1.13.5 Thoroughly clean Solar Inverter assembly and remove any loose materials/debris.

2.1.13.6 Work with Owner or Owner's delegate to coordinate functional check-out.

2.1.14 Openings shall be properly sealed once conductors are installed.

2.1.15 Testing

Table 16210-2 Codes and Standards

Work	In Accordance With
Surge Testing for Low Voltage AC Circuits	IEEE C62.45-2002
Surge Withstand Capability Tests	IEEE C37.90.1

END OF 16250 INSTALLATION SECTION

END OF SECTION 16250

EXHIBIT 2

DESIGN

1.0 INTRODUCTION

1.1 Scope

1.1.1 Scope of supply shall include furnishing and installation of the solar inverter equipment as specified herein to be connected to photovoltaic panels as described in Section 16240.

1.2 Reference Sections

1.2.1 Section 16250 – DC to AC Inverter.

1.3 Codes and Standards

1.3.1 Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

1.3.1.1 UL1741 – Ground Fault Indicator

1.3.1.2 UL98B – Integral Disconnect

1.3.1.3 Article 690 – National Electric Code (PV Systems)

1.3.1.4 Article 490 – National Electric Code (Equipment over 1000 Volts)

2.0 COMBINER BOX REQUIREMENTS

2.1 Design

2.1.1 PV string combiner boxes shall be supplied in a weather-proof NEMA 4 enclosures with a hinged door and seamless door gaskets. The door shall have a viewing window over the fuse blown indication so that the operator does not have to open door to check for blown fuses.

2.1.2 Equipment enclosure shall have a suitable means for dissipation of heat suitable to the environment where located.

2.1.3 Each series string of PV modules shall be independently protected by an isolation fuse before it is connected in parallel with the other string on that PV output circuit.

2.1.4 The isolation fuse or breaker shall be less than the de-rated ampacity of the wiring that it is protecting and greater than 1.56 times the short circuit current rating of the PV modules in that PV source circuit. All other conductors and overcurrent devices shall be sized per the requirements of National Electric Code (NEC) Article 690. Contractor shall supply PV string combiner boxes with the appropriate sized and rated PV fuses and number of input circuits based on the panel manufacturer's information on Solar Circuit Preliminary sketch provided.

2.1.5 PV fuses shall be installed in finger-safe fuse holders in the PV string combiner box. The fuse holder shall have a blown indicator visible through the combiner box door.

2.1.6 Surge protection withstand shall be included for equipment protection from over-voltage caused by lightning strikes or other conditions.

2.1.7 Power Distribution blocks shall be finger-safe and installed in the PV string combiner box.

EXHIBIT 2

2.1.8 Common blown fuse indication, individual fuse blown indication or PV string current shall be included. Associated communication will be applied to remotely monitor blown fuses at the local station and remote location as described in the inverter section. This shall be communicated remotely using the communication protocols Modbus TCP.

2.1.9 PV string combiner boxes shall have an integrated disconnect switch for Company lockout/tagout compliance. Disconnect shall be load break DC rated operated on the outside of the box.

2.1.10 Combiner boxes shall have power distribution blocks rated for the voltage and current for the application. Finger safe covers shall be applied were applicable.

2.1.11 PV combiner boxes shall have negative input and ground terminal blocks.

2.1.12 Combiner box shall withstand rating short circuit rating of 10kA @ 1500 Volts DC rated.

2.1.13 Engraved nameplates shall be furnished for the front of each PV string combiner box and for equipment and devices within each PV string combiner box. PV string combiner box equipment and devices shall be identified on plastic laminate engraved nameplates with white background with black lettering. Nameplate inscriptions will be furnished by the Company. Name plates shall be mechanically fastened to equipment.

2.1.14 Combiner box shall be large enough to accommodate NEC Code bending radius of conductors leaving the enclosure.

2.1.15 Combiner box shall be pre-wired with PV connectors for ease of installation.

2.1.16 A fused disconnect switch shall be used if the inverter does not use fuses to protect the individual combiner inputs regardless if a breaker is used.

END OF 16220 DESIGN SECTION

INSTALLATION

1.0 INTRODUCTION

1.1 Scope

1.1.1 This specification includes all field installation requirements for Photovoltaic Combiner Boxes.

1.2 Reference Sections

1.2.1 Section 16250 – DC to AC Inverter

1.3 Codes and Standards

1.3.1 Work performed under these specifications shall be done in accordance with the codes and standards outlined below:

1.3.1.1 Listed in Design Section

2.0 COMBINER BOX REQUIREMENTS

2.1 Installation

2.1.1 Installation of combiner box equipment shall be in accordance with manufacturer's instructions and design documents.

2.1.2 Comply with mounting and anchoring requirements specified in design documentation or manufacturing directions.

2.1.3 Ensure adequate ground continuity as outlined in the equipment manual.

2.1.4 Contractor shall install all items shipped loose as required for complete assembly.

2.1.5 Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values and record data for turn-over.

2.1.6 Make the following inspections prior to energization:

2.1.6.1 Inspect for proper anchorage, alignment and grounding, and note any physical damage.

2.1.6.2 Insulation Resistance Test each bus: Refer to manufacturer's literature and this specification to specific testing procedures.

2.1.6.3 Check the tightness of the accessible bolted bus joints using a calibrated torque wrench per manufacturer's recommended values.

2.1.6.4 Work with Owner or Owner's delegate to coordinate functional check-out.

2.1.7 Openings shall be properly sealed for varmint, insect, water and dust intrusion once conductors are installed.

2.1.8 Testing shall be in accordance to NETA ATS-2017 section 7.3.3 Cables, Medium and High Voltage.

END OF 16220 INSTALLATION SECTION

END OF SECTION 16220

DESIGN

1.0 INTRODUCTION

1.1 Scope

1.1.1 Scope of supply shall include furnishing and installation of the photovoltaic panels specified herein to be installed on a racking system.

1.2 Reference Sections

1.2.1 Not applicable

1.3 Codes and Standards

1.3.1 Work performed under these specifications shall be done in accordance with the following codes and standards. Unless otherwise specified, the applicable governing edition and addenda to be used for all references to codes or standards specified herein shall be interpreted to be the jurisdictionally approved edition and addenda. If a code or standard is not jurisdictionally mandated, then the current edition and addenda in effect at the date of this document shall apply. These references shall govern the work except where they conflict with the Owner's specifications. In case of conflict, the latter shall govern to the extent of such difference:

1.3.1.1 IEC61215 – Crystalline Silicon Terrestrial PV Modules

1.3.1.2 IEC61730 – Photovoltaic Module Safety Qualification

1.3.1.3 UL1703 – Temperature Testing and Analysis of PV Modules

1.3.1.4 IEEEE1262 – Recommended Practice for Qualification of PV Modules

2.0 PHOTOVOLTAIC PANELS REQUIREMENTS

2.1 Design

2.1.1 Panels shall be rated 300 watts or higher.

2.1.2 Cell type shall be monocrystalline or polycrystalline. No thin film photovoltaic panel will be accepted.

2.1.3 Module wiring shall be a minimum of #12 AWG type stranded copper with 1500 volt 90 degree C insulation. Locking MC4 connectors or Company Approved equivalent shall be installed on the panel wiring and mating connectors provided. The connectors shall comply with UL1977. Grounding terminals shall be provided for customer’s ground wire on each panel.

2.1.4 The panels shall have a warranty period of no less than 20 years. In addition the PV Panel shall not exhibit power output less than 90% of peak power after 10 years as specified on the data sheet and 80% of peak power after 20 years as specified on the data sheet.

2.1.5 Modules shall have a class C fire rating.

2.1.6 Modules shall have a junction box that complies with IP65.

2.1.7 Modules shall have 3600 Pa Wind Load and 5400Pa Snow Load ratings.

2.1.8 Modules shall be free of defects between panel and glass, failure of materials, cracking of glass due to foreign objects inside the glass will not be accepted.

2.1.9 All modules shall be flash tested and provide test results linked to module serial number.

2.1.10 All modules shall be RoHS compliant or be tested in a NELAP certified laboratory using Toxicity Characteristics Leach Procedure Test prior to procurement and installation at site.

END OF 16240 DESIGN SECTION

Installation

1.0 INTRODUCTION

1.1 Scope

1.1.1 Scope of supply shall include furnishing and installation of the photovoltaic panels specified herein to be installed on a racking system described in Section 05900.

1.2 Reference Sections

1.2.1 Not applicable

1.3 Codes and Standards

1.3.1 Work performed under these specifications shall be done in accordance with the codes and standards outlined below:

1.3.1.1 Listed in Design Section

2.0 photovoltaic panel REQUIREMENTS

2.1 Installation

2.1.1 Installation of photovoltaic panels installation shall be in accordance with manufacturer's instructions and design documents.

2.1.2 Comply with mounting and anchoring requirements specified in design documentation.

2.1.3 Ensure adequate ground continuity as outlined in the equipment manual.

2.1.4 Contractor shall install all items shipped loose as required for complete assembly.

2.1.5 Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

2.1.6 Make the following inspections prior to energization:

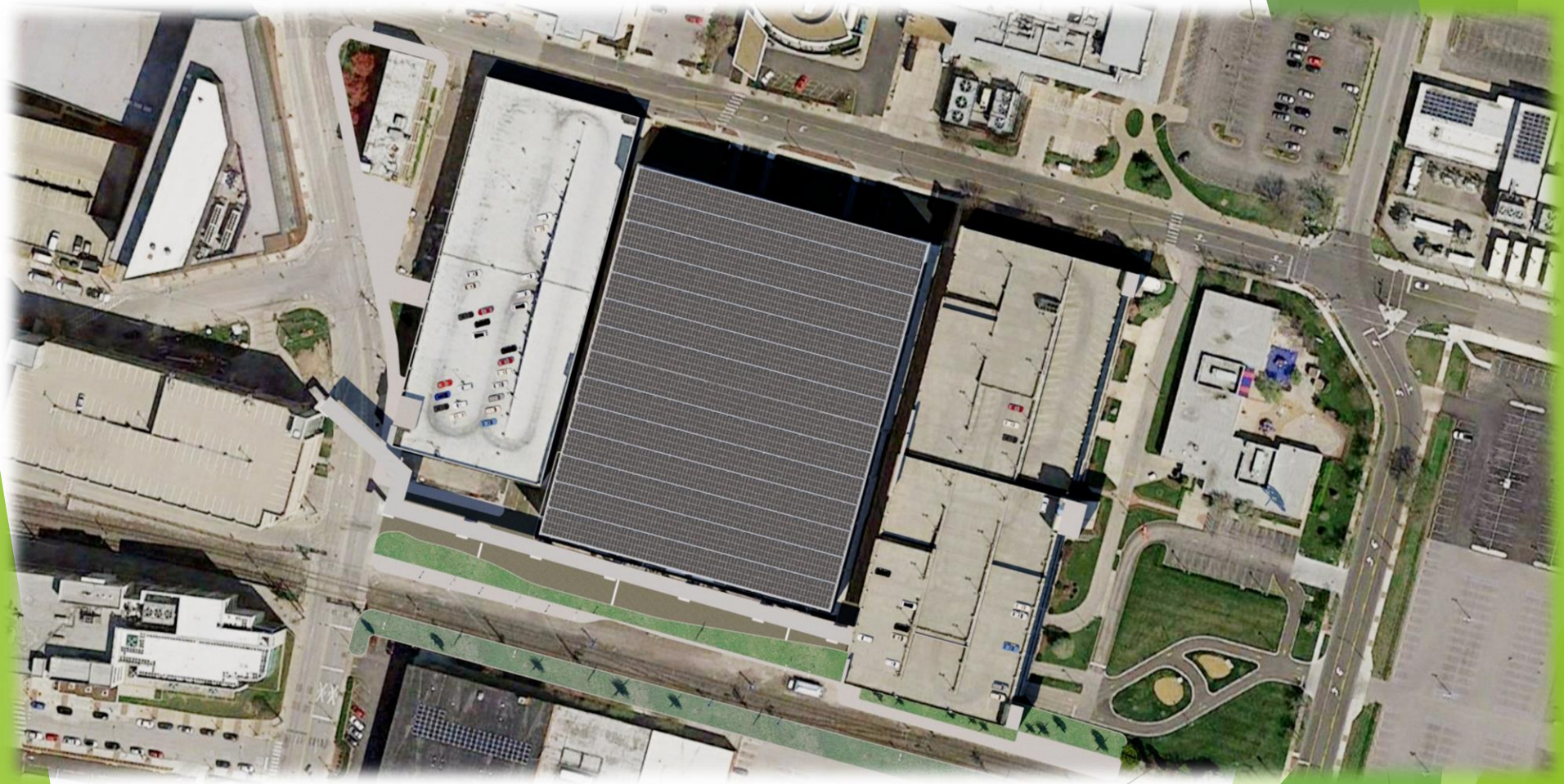
2.1.6.1 Inspect for proper anchorage, alignment and grounding, and note any physical damage.

2.1.6.2 Work with Owner or Owner's delegate to coordinate functional check-out.

END OF 16240 INSTALLATION SECTION

END OF SECTION 16240

Single Plane - Option 1
Plan View - Steel Structure



Sachs Electric

Day & Night Solar

EXHIBIT 3

Elevator looking North

Sachs Electric

Day & Night Solar

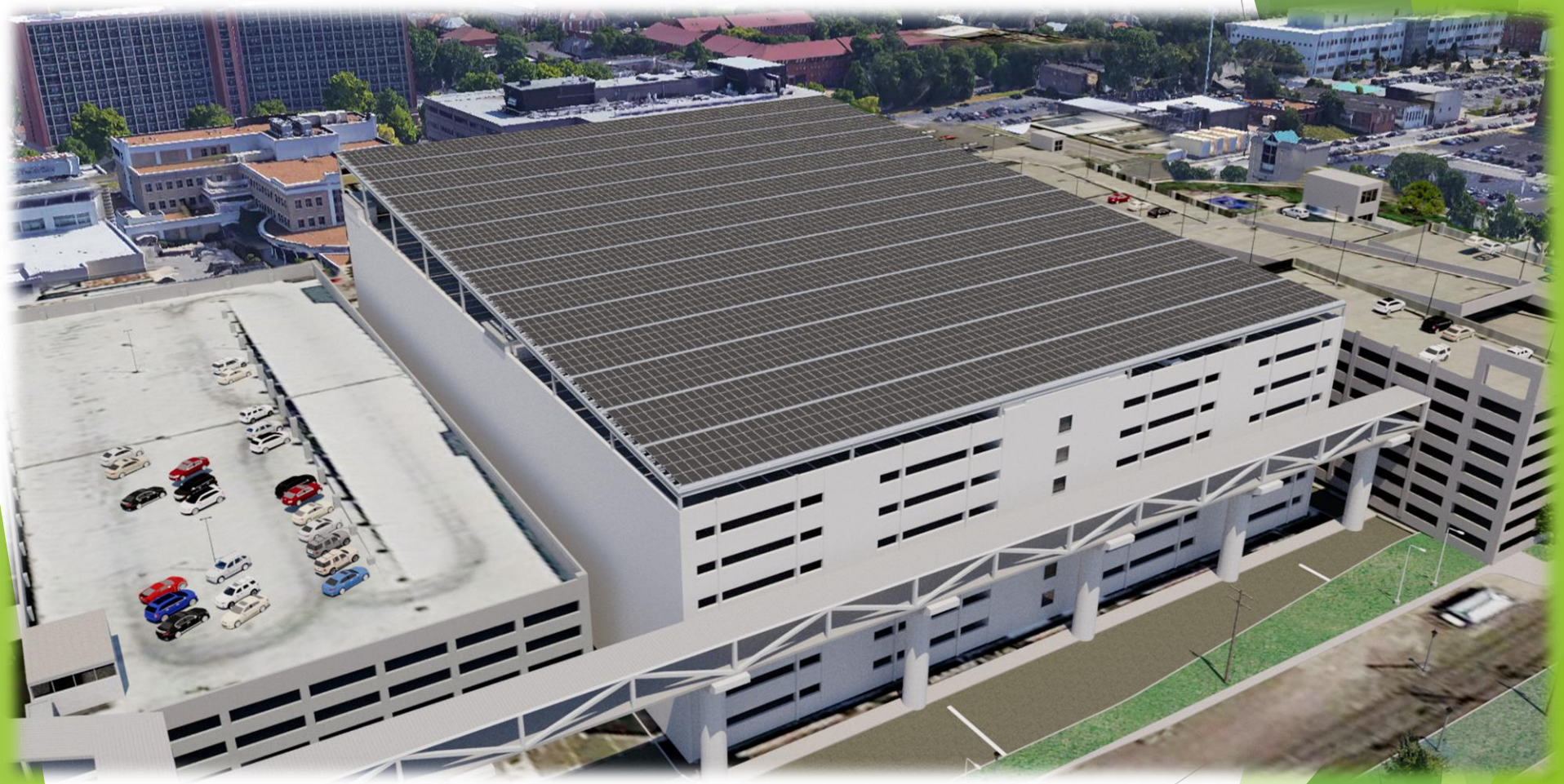
EXHIBIT 3

Elevator looking Northeast

Sachs Electric

Day & Night Solar

EXHIBIT 3



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Day & Night Solar

EXHIBIT 3

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EXHIBIT 3

Installed Project Photos

Sachs Electric

Day & Night Solar

EXHIBIT 3

Ameren BJC Single 380 SMA 7_11_2017 Ameren, 4466 Duncan Avenue, St. Louis, Missouri

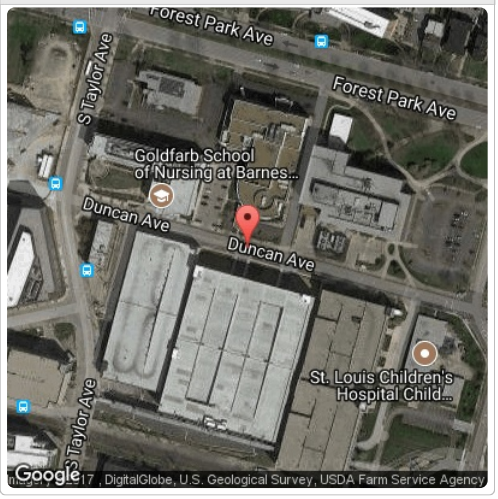
Report

Project Name	Ameren
Project Address	4466 Duncan Avenue, St. Louis, Missouri
Prepared By	Engineering Estimating systemdesign@dayandnightsolar.com

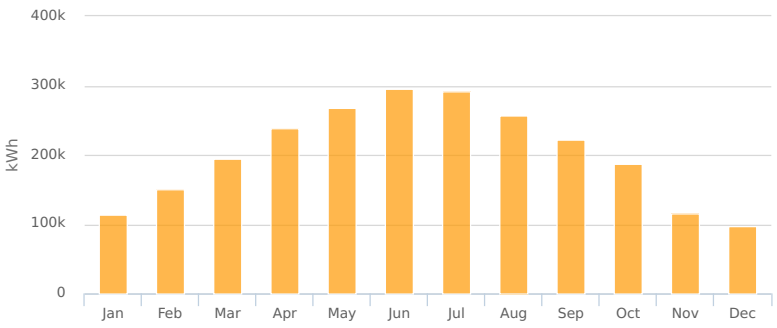
System Metrics

Design	Ameren BJC Single 380 SMA 7_11_2017
Module DC Nameplate	1.81 MW
Inverter AC Nameplate	1.45 MW Load Ratio: 1.25
Annual Production	2.430 GWh
Performance Ratio	84.5%
kWh/kWp	1,343.2
Weather Dataset	TMY, 10km grid (38.65,-90.25), NREL (prospector)
Simulator Version	88e2687ead-a0447e1bad-60a45df119-acaddf2c26

Project Location

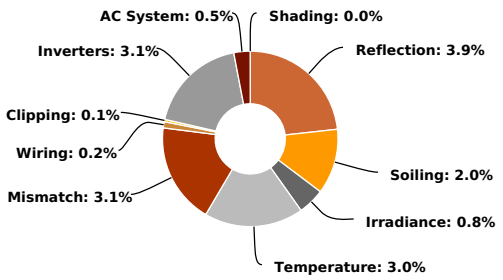


Monthly Production



Month	GHI (kWh/m²)	POA (kWh/m²)	Shaded (kWh/m²)	Nameplate (kWh)	Grid (kWh)
January	64.6	68.7	68.7	114,346.5	113,029.3
February	87.3	91.4	91.4	154,058.0	149,632.2
March	118.0	121.7	121.7	206,950.4	194,597.9
April	151.6	154.3	154.3	264,328.2	238,623.8
May	175.5	177.0	177.0	303,369.5	267,438.8
June	198.8	199.6	199.6	343,120.2	296,153.5
July	196.6	198.2	198.2	340,966.2	290,903.1
August	171.5	173.8	173.8	297,678.0	256,220.3
September	145.4	149.5	149.5	255,494.1	222,195.4
October	115.7	121.0	121.0	204,888.5	186,539.9
November	69.5	74.0	74.0	123,495.8	116,182.2
December	56.7	61.0	61.0	100,946.9	98,022.1

Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,551.1	
	POA Irradiance	1,590.0	2.5%
	Shaded Irradiance	1,590.0	0.0%
	Irradiance after Reflection	1,528.5	-3.9%
	Irradiance after Soiling	1,498.0	-2.0%
	Total Collector Irradiance	**1,498.0**	**0.0%**
Energy (kWh)	Nameplate	2,709,642.4	
	Output at Irradiance Levels	2,687,551.6	-0.8%
	Output at Cell Temperature Derate	2,605,772.4	-3.0%
	Output After Mismatch	2,525,483.9	-3.1%
	Optimal DC Output	2,520,667.4	-0.2%
	Constrained DC Output	2,518,818.4	-0.1%
	Inverter Output	2,441,750.0	-3.1%
	Energy to Grid	**2,429,540.0**	**-0.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		15.8 °C
	Avg. Operating Cell Temp		23.3 °C
Simulation Metrics			
	Operating Hours		4683
	Solved Hours		4683

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, 10km grid (38.65,-90.25), NREL (prospector)											
Solar Angle Location	Meteo Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Sandia Model											
Temperature Model Parameters	Rack Type	a	b	Temperature Delta								
	Fixed Tilt	-3.56	-0.075	3°C								
	Flush Mount	-2.81	-0.0455	0°C								
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	D
	2	2	2	2	2	2	2	2	2	2	2	2
Irradiation Variance	5%											
Cell Temperature Spread	4° C											
Module Binning Range	-2.5% to 2.5%											
AC System Derate	0.50%											
Module Characterizations	Module	Characterization										
	SRP-380-E01A (Seraphim)	Seraphim_PV380_E01A.PAN, PAN										
Component Characterizations	Device	Characterization										
	STP12000TL-US-10 (480V) (SMA)	Modified CEC										

Components

Component	Name	Count
Inverters	STP12000TL-US-10 (480V) (SMA)	121 (1.45 MW)
Strings	10 AWG (Copper)	363 (22,915.8 ft)
Modules	Seraphim, SRP-380-E01A (380W)	4,760 (1.81 MW)

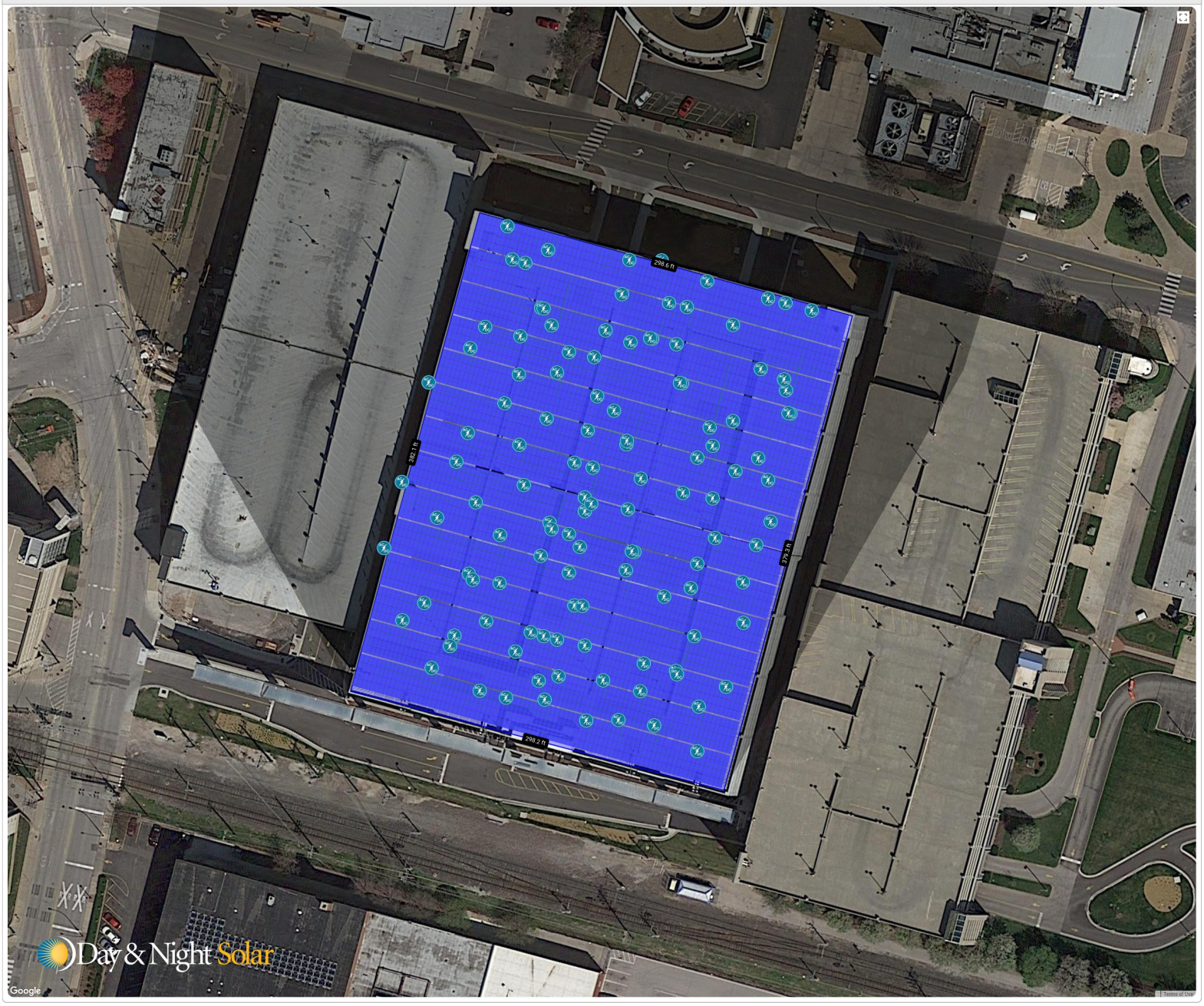
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	5-19	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Carport	Vertical (Portrait)	3°	195.5°	1.5 ft	4x1	1,190	4,760	1.81 MW

Detailed Layout



Sachs Electric

SOLAR PARTNERSHIP PROJECT

Single Plane

Module DC Nameplate	1,808,800	Watts
AC Production Year 1	2,429,540	kWh
Generation Degredation	0.33%	

Year	System Generation
1	2,429,540
2	2,421,523
3	2,413,531
4	2,405,567
5	2,397,628
6	2,389,716
7	2,381,830
8	2,373,970
9	2,366,136
10	2,358,328
11	2,350,545
12	2,342,789
13	2,335,057
14	2,327,352
15	2,319,671
16	2,312,016
17	2,304,387
18	2,296,782
19	2,289,203
20	2,281,649
21	2,274,119
22	2,266,615
23	2,259,135
24	2,251,680
25	2,244,249
Total	***58,393,019***

*See Systems overview from Helioscope

EXHIBIT 3

Exhibit 4 to Site Documentation Submission

Assessment of Minimum Application Conditions:

- BJC and Washington University are non-residential customers.
- The site is within Ameren Missouri's service territory.
- The site can support a minimum of 100 kW of capacity (the project will be a 1.8 megawatt project).
- BJC and Washington University are in good standing with the Company.
- The site is flat, not shaded, and is accessible for construction and maintenance. 100 % of the solar resource is available to the solar photovoltaic system.
- The site is located near a 12 kV distribution circuit.
    - The interconnection will be at the distribution level.
    - The interconnection will not require significant capacity upgrades.
    - The interconnection costs are included in Ameren Missouri's cost cap.
- The site is not in a flood plain.

Additional Considerations for Site Evaluation:

- Price of Bid. The final bid price is not complete, but the estimated cost of the project is $6.5 million (final bid price expected no later than December 31, 2018).
- Price of Interconnection and cost upgrades. It is estimated that the interconnection and upgrade costs will total approximately $50,000, which is included in the $6.5 million project estimate.
- Amount partner is willing to contribute should the project exceed the contribution cap. BJC will cover all costs in excess of the price cap of $2.20/watt-DC.
- Type of installation. This is a rooftop installation on top of a concrete parking garage.
- Creditworthiness. BJC and Washington University are longstanding customers and longstanding members of the St. Louis business not-for-profit community whose accounts are all in good standing.
- History at location and likeliness to remain on control over life of solar facility. The history of this site is that it is part of a complex of BJC and Washington University medical buildings. BJC is one of the largest nonprofit health systems in the United States, and has been providing healthcare services in the greater St. Louis region, southern Illinois, and mid-Missouri since 1993. Washington University was founded in 1853 and has been a fixture in St. Louis since that time. The parking garage at issue was completed in 2015 and is expected to provide parking services for several decades. There is no reason to believe the BJC and Washington University would not own and control the site for decades.
- Quality of site. The site quality if high and is well-suited to house solar generation. Design and engineering will assure that the solar array supporting structure, racking, panels, and electrical equipment are properly constructed to withstand the expected wind and snow loadings as well as manage rain and water.

- Environmental risk of site. The environmental risk at the site is low. The site is part of an urban development that includes surrounding medical buildings, apartment complexes, and commercial and some industrial businesses. Design and construction will utilize existing storm water infrastructure.
- Existing security at site location. The site has physical security in the form of security cameras and timed locks on doors for access to the connected medical facilities.
- Safety risk at location. Any safety risks at the site are similar to such risks at any elevated parking garage. Clearances from concrete walls will be maintained. Furthermore, any work performed on the solar array, once constructed, will ensure proper harnessing to mitigate safety hazards.
- Type of facility. The facility is a parking garage serving the adjacent medical facilties.
- Site status. BJC and Washington University own (BJC 60%; Washington University 40%) the facility.