FINAL OUTCOMES REPORT

BROOKS #1 SOLAR FACILITY

ERA Project ID: R140196
Submission Date: July 20, 2018
Project Completion: June 30, 2018
Total Project Budget: $ 33,700,000
ERA funds received: $ 14,820,292

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1 EXECUTIVE SUMMARY

This Non-Confidential Final Report (the "Report") fulfills the requirements set forth in the Contribution Agreement between Brooks Solar Corporation ("BSC" or "Owner") and Emissions Reductions Alberta ("ERA"), formerly Climate Change and Emissions Management Corporation ("CCEMC").

ERA contributed grant funding to complete the development, construction and commissioning of the Brooks #1 Solar Facility (the "Project"), the first utility-scale solar project in Alberta and western Canada. The Project capacity is 15.0MWac, consisting of approximately 48,500 Jinko Mono-PERC solar panels and eight Power Electronics 2.2MW central inverters.

The Project was energized as a load on November 28, 2017, fully export capable on December 16, 2017, and completed final testing and commissioning on March 28, 2018.

The project is expected to generate approximately 24,000 MWh annually, enough clean electricity to power the equivalent of 3,000 homes. As a result of generating approximately 24,000 MWh/year of electricity, the Project will have the direct impact of reducing carbon emissions by an estimated 14,160 tCO_2e /year, or the equivalent of taking over 3,000 cars off the road. Over the span of the Project's 30-year life, emissions reductions of over 400,000 tCO2e will be achieved.

All electricity and environmental attributes are being sold to a confidential corporate purchaser under a long-term power purchase agreement. This is amongst the first utility-scale corporate power purchase agreements in Canada.

The Project created significant local and provincial employment as well as opportunities for technical skill development and capacity-building in a rapidly growing industry. It will produce emission-free electricity for sale into the Alberta Electric System Operator ("AESO") electricity pool for the duration of its expected 30 year life.

Project innovations and achievements include:

(1) Securing a long-term, financeable corporate power purchase agreement.

(2) The first project of its kind to navigate the FortisAlberta, Altalink, and AESO interconnection process from high level study through to project commissioning.

(3) Co-operative shared land use agreements with five different companies having established interests on the project site, including collaborative site layout optimization taking into account all parties' land use needs and rights.

(4) Design and installation of a cost effective foundation system to mitigate risk of frost heave.

(5) Development of a commercial solution to extreme cold weather constraints of inverters.

(6) Detailed analysis of the economic and technical value proposition of solar energy production in Alberta as it relates to the correlation between time of generation and market demand.

(7) Participation in ERA's first ever "Lessons Learned" event to publicly and dynamically disseminate key project learnings to a wide spectrum of stakeholders

The project has successfully demonstrated that utility-scale solar electricity generation is technically and commercially viable in Alberta. Since the project commenced construction, dozens of new solar projects have been proposed across the province of Alberta accounting for thousands of prospective new megawatts of clean energy.

The proactive and transparent dissemination of project learnings throughout project construction and commissioning has greatly improved the industry's understanding of how to effectively and responsibly develop solar energy projects in the province. Additionally, numerous agencies, notably FortisAlberta and the AESO, have leveraged the experience to review and revise their processes in the interest of best serving their objectives while acknowledging the needs of project developers.

In conclusion, the Project has paved the way for the development and expansion of Alberta's utility scale solar industry.

2 INTRODUCTION

This Report meets the requirements of ERA, as set out in the Contribution Agreement as executed between BSC and ERA (formerly CCEMC). This specifically includes a concise summary of what the Project has achieved and conclusions and recommendations for further fields of research together with the status and performance of the project in terms of process, output, outcomes and impact measures. The Report also delineates all Project Technology developed in the course of the project in sufficient detail to use or adapt the results for research and analysis purposes.

3 PROJECT DESCRIPTION

3.1 Project Background

The Brooks Solar Project is a 15MWac / 17MWdc solar energy project located in the County of Newell near the city of Brooks, Alberta. The Project and lands are owned by Brooks Solar Corporation, which is a wholly owned subsidiary of Elemental Energy Inc. ("Elemental").

The Project was originally conceived by GTE Solar Inc. ("GTE") who applied for and received a funding contribution commitment from CCEMC. The corresponding Contribution Agreement was signed between the parties on September 19, 2016. The Project received a total contribution from of $14,997,000 to cover 50% of eligible Project costs. Elemental acquired the Project in February of 2017.

The Project is located on approximately 78 acres of land, immediately adjacent to Highway 1, east of the city of Brooks. The Project consists of over 48,000 PV modules, eight inverters, nearly 300km of electrical cables, and a variety of associated civil, mechanical and electrical equipment. The Project is interconnected to the FortisAlberta distribution system at 25kV, with power being fed to Altalink's 121S substation, approximately 3km (linear) from the point of interconnection.

The Project layout is set out in Figure 1 and 2 on the following page.

Figure 1: Brooks Site Layout - Regional

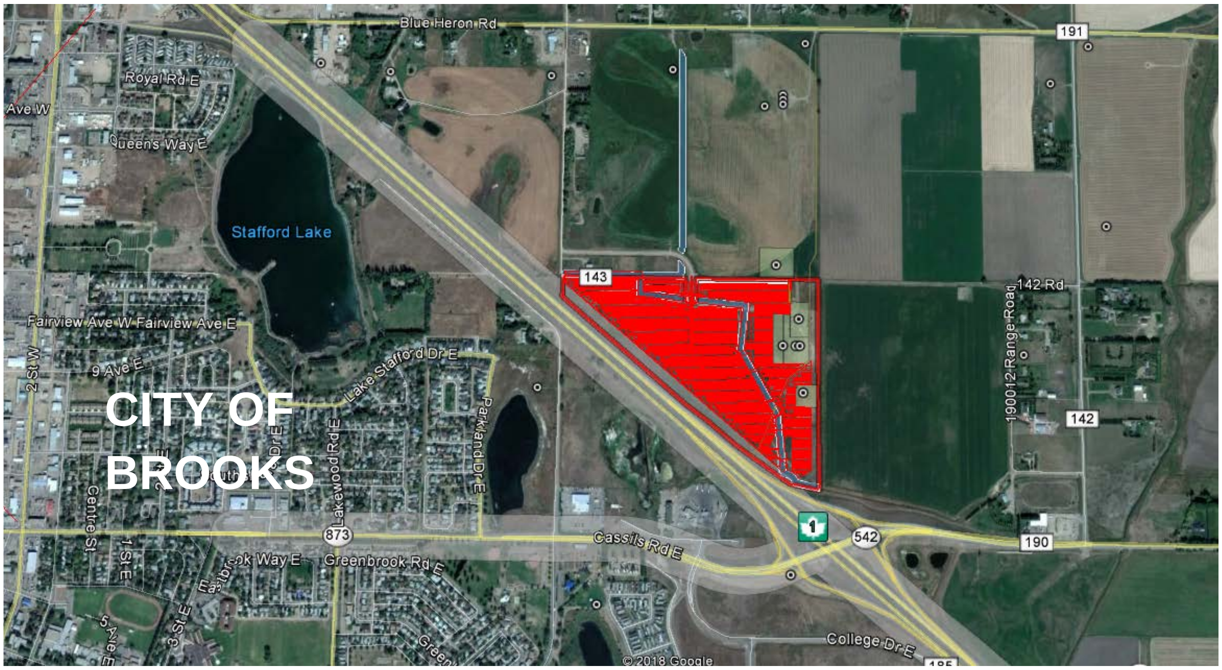
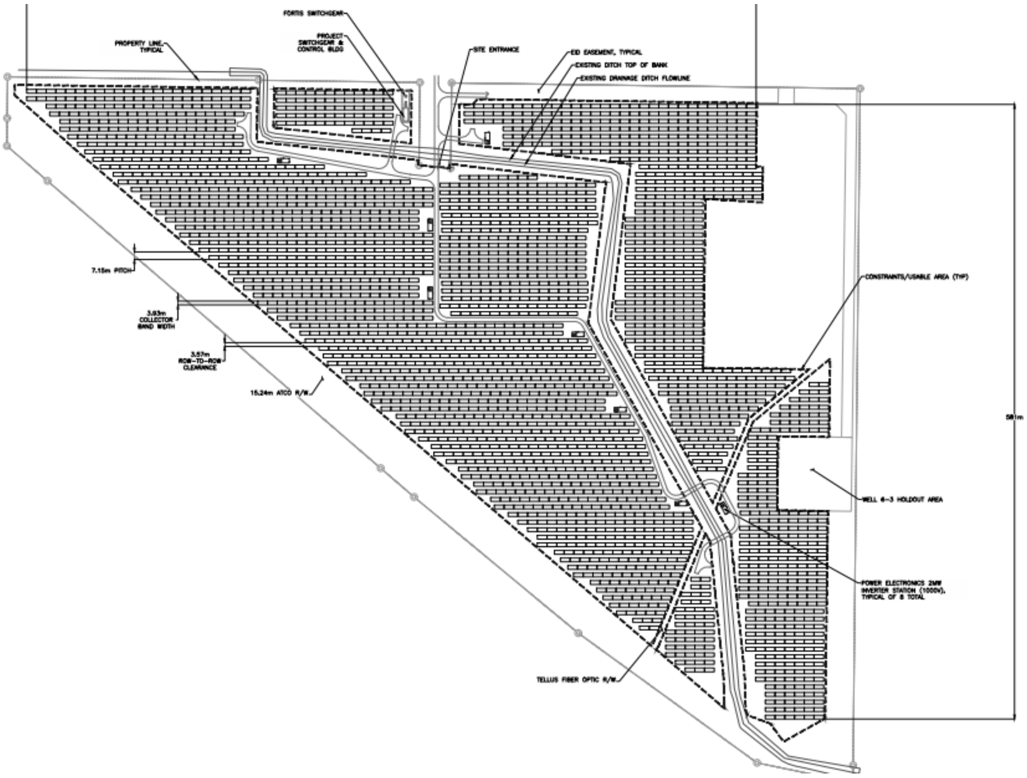


Figure 2: Brooks Site Layout - Detail



3.2 Construction Scope

Onsite construction kicked off June 1 2017 with the leveling and graveling of the laydown yard leased from an adjacent landowner. Civil works site cutting and filling for drainage on the build site started for phase 1 June 23 and was completed on July 10. A second phase 2 civil was required for a nesting Swainson's Hawk found on the far west side of the project. Working with an environmental biologist and Alberta Environment a 100m set back was established for the hawks and fledglings to become independent from each other. This change in schedule required the civil contractor to remobilize back Aug 15 for 2 days and focus site construction to the south east of the project. There was no impact to overall schedule completion date.

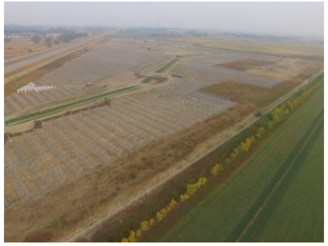
On July 7 the mechanical install was kicked off with surveying for the 5398 piles followed by the pre-drilling for the PVC sleeves and pile install and was completed on September 28. One challenge that was encountered when driving piles was the potential high vibration levels that could affect the currently installed site stakeholder pipelines in the area. A threshold of 50mm/sec was the limit of concern. A test site was set up for demonstration and was witnessed and monitored by a 3rd party engineer, stakeholder representatives, and site construction team. Results found the vibration levels detected were less than 5mm/sec. The results found would have no impact on the pipelines in the area and the pile install process was then approved by all concerned parties with no further monitoring required. Racking system install started on August 10 on the completed piles and finished Nov 8th.

Electrical scope was started Aug 21 with trenching of the AC and DC cable collector system from the 8 Inverters to the Control House and out the field Combiner boxes and down the PV racking system. Once the PV panel wire was installed the panels could be then mounted on the racks. Consultation was done with Alberta Industry Training to verify panel installs by non-electricians to be compliant with the AIT act. Solar panel modules install and field wiring was completed Nov 14th with a peak install rate of 1200 panels a day. Inverter skid and control house installation started on October 20 and was energized as a load with Fortis Alberta on November 28th. Mechanically at this point construction looks complete with testing and commissioning ongoing till the end of March 2018.

3.3 Schedule & Tasks

Milestone	Tasks	Start Date	Completion Date	Progress During Reporting Period	Photos
#1 – Project Development & Administration	1. Project origination, development & administration 2. Completion of Geotechnical assessment 3. Permitting Design 4. Undertaking interconnection studies and work 5. Ongoing project management, administration and oversight 6. Initial Deposit made on modules	July 15, 2015	May 1, 2017	1. The Project was formally originated & initiated. Project development was substantially completed. Ongoing project administration was performed. 2. Geotechnical assessment was completed 3. Permitting design was completed with final design materially advanced. 4. Pre-construction Interconnection studies were completed, with a binding quote letter executed, a $915,000 interconnection deposit was made, and a draft Interconnection Agreement in hand. 5. Project management, administration and oversight activities were active and ongoing 6. The initial deposit was made on the modules (supplier is Jinko Solar).	
#2 – Engineering, Design & Procurement	1. Completion of LNTP design & engineering 2. Material permits substantially received 3. Substantial completion of EPC contract negotiations 4. Ready to issue Notice to Proceed 5. Ready to place procurement deposits on major equipment 6. Completion of preliminary construction management plan 7. Ongoing project management, administration and oversight	May 1, 2017	May 15 2017	1. LNTP design & engineering was completed. This included all design and engineering required to obtain and/or update project permits as well as all design and specifications needed for critical component ordering (notably inverters, piles, racking, and switchgear). Final engineering was completed under full Notice to Proceed, which was issued to the Contractor contemporaneously with the execution of the EPC Contract. 2. Material permits were all in hand and in good standing, notably including a Development Permit with the County of Newell and a project approval from the Albert Utilities Commission (AUC). Elemental sought and received on May 25th 2017 an amendment to the AUC approval to allow for the inclusion of additional schedule buffer (to March 31 2018) to provide additional comfort to the Project's lender. 3. A fixed price, turn-key EPC Contract was executed on May 8th 2017 with Borea Construction. The Contract included the procurement, installation and commissioning of all Project components and includes a guaranteed completion date of January 24th 2018.	

Milestone	Tasks	Start Date	Completion Date	Progress During Reporting Period	Photos
#2 – Engineering, Design & Procurement				4. Notice to Proceed ("NTP") was issued on May 8th 2017 at the same time the EPC Contract was executed. Issuance of NTP provides the Contractor with a formal green light to proceed with all elements of project execution. 5. Procurement deposits in excess of $1.5M were placed on all major components, including modules, inverters, piles, and racking. A deposit for switchgear is expected to be made imminently. All other procurement was for items which have substantially smaller capital outlays and/or are not on the Project's critical path. 6. A draft preliminary construction management agreement was completed. This includes the execution of a Construction Management Services Agreement with Elemental Energy Renewables Inc. and an Owner's Engineer Services Agreement with UGE, a solar engineering firm who will be acting as Owner's Engineers throughout construction. Elemental Energy Renewables hired a Construction Coordinator who provided full-time site presence to monitor quality control, health & safety, and contractor progress. 7. Project management, administration and oversight activities were active and ongoing.	
#3A – Mobilization , Civil & Equip Deliveries	1. Orders placed on all major equipment 2. EPC mobilization to site 3. Commencement of civil works 4. Commencement of foundation and racking deliveries 5. Ongoing project management, administration and oversight	May 15 2017	July 15, 2017	1. Procurement deposits in excess of $1.5M were placed on all major components, including modules, inverters, piles, racking and switchgear. All other procurement will be for items which have substantially small capital outlays and/or are not on the Project's critical path. 2. EPC mobilization to site occurred on June 5th, 2017 3. Civil works, including clearing, grading, and roads were commenced and were significantly advanced (approximately 75% complete for grading and 35% complete for roads). 4. Foundation (piling) deliveries have commenced with piles and PVC sleeves being staged on site for systematic installation in accordance with stamped civil and foundation design. 5. Project management, administration and oversight activities were active and ongoing.	

Milestone	Tasks	Start Date	Completion Date	Progress During Reporting Period	Photos
#3B - Mobilization , Civil & Equip Deliveries	1. Commencement of major component delivery 2. Ongoing civil and site works 3. Ongoing project management, administration and oversight	July 15 2017	August 15 2017	1. 100% of piling and racking was delivered; approximately 60% of modules were delivered, with the balance delivered by mid-October. All DC and AC cabling and combiner boxes have been delivered. Inverter and control house were delivered before the end of October. 2. Civil works were 100% complete with only installation of the final road cap outstanding completed in the spring 2018. 3. Project management, administration and oversight activities were active and ongoing.	
#4 – Construction Progress 1	1. Substantially all racking delivered to site 2. Racking installation has commenced 3. Low-voltage electrical installation has commenced 4. Module delivery has commenced & is ongoing 5. Module installation has commenced & is ongoing 6. Ongoing project management, administration and oversight	August 15, 2017	September 30, 2017	1. 100% of racking was delivered to site and was ready for installation 2. Racking installation was completed. 3. Low voltage electrical installation was completed. 4. Module delivery commenced in early September and was completed by the first week of October. 5. Module commenced shortly after start of deliveries and was completed in early November. 6. Project management, administration and oversight activities were active and ongoing.	
#5 – Construction Progress 2	1. Racking Installation substantially complete 2. A significant portion of Low-voltage electrical installation substantially complete 3. A significant portion of inverters delivered to site 4. Module installation ongoing 5. Ongoing project management, administration and oversight	September 30, 2017	December 15, 2017	1. Racking installation was 100% complete. 2. Low voltage electrical installation, including underground DC cabling, PV wiring, and all low-voltage terminations were completed prior to the end of November. 3. All 8 inverters were delivered in early November. 4. Module installation commenced in mid-September and was completed by mid- November 5. Project management, administration and oversight activities were active and ongoing.	

Milestone	Tasks	Start Date	Completion Date	Progress During Reporting Period	Photos
#6 – Construction Progress 3	1. Substantial completion of project 2. Commissioning activities are ongoing 3. Draft Issuance of punch-list 4. Ongoing project & construction management, administration and oversight, including but not limited to legal, accounting and financial services	December 15, 2017	January 15, 2018	1. Mechanical completion of the project has been achieved, with the Mechanical Completion Certificate executed on Jan 23 2018. 2. Commissioning activities commenced on November 29th and were completed in mid-January, with SCADA and control system testing being the most time-intensive activities. Short-Term performance testing has been completed, with the site passing on Jan 30th 2018. Long-term testing will be completed in mid/late March 2018. 3. A punch-list for Final Completion under the EPC Contract has been provided, with the bulk of items to be completed in the spring of 2018 when weather conditions will allow for civil work 4. Project management, administration and oversight activities were active and ongoing.	
#7 – Construction Progress 3	5. Commissioning activities have been completed 6. Completion of Punch List items 7. Final Technology Transfer Report to ERA 8. Final Financial Report to ERA 9. Ongoing project & construction management, administration and oversight, including but not limited to legal, accounting and financial services	January 15, 2018	June 30, 2018	1. Commissioning activities were completed. 2. Punch list items were completed in the spring/summer of 2018, when weather conditions allow for completion of civil works (notably road capping) 3. Final Technology Transfer Report was completed and submitted. 4. Final Financial Report was completed and submitted. 5. Project management, administration and oversight activities were active and ongoing.	

3.4 Technology Description

The Project technology can be generally characterized as utility-scale photovoltaic (PV) electricity generation for injection into the Alberta electricity grid. Notable technology subcomponents include:

PV Modules	48,530 x Jinko MonoPERC 355W
Inverters	8 x Power Electronics FS2000CU
Combiner Boxes	128 x Bentek 1000V Combiner Boxes
Racking	2,699 x Sunlink fixed-tilt racks
Foundations	5,398 x 21' galvanized steel H-beams
Control House	1 x Enerquest E-House

Subsequent sections provide additional detail on the technology deployed as part of the Project.

3.4.1 Foundations

A solar energy project requires a reliable foundation which can reliably support racking and modules for the life of the project. A critical consideration in northern climates is the ability of the foundation design to mitigate frost heave, the circumstances in which frozen ground thaws, expands, and lifts embedded foundations upwards.

Substantial geotechnical analysis was undertaken to verify subsurface conditions across the entire site prior to finalizing foundation design for the Project. The risk of frost heave at the Project, and in southern Alberta generally, is fairly substantial. To address this risk, an innovative design was developed to balance efficacy of frost heave mitigation and overall foundation cost.

The final foundation design includes a 21' driven galvanized H-pile (approximately 16' embedded), encased in a 6' PVC sleeve which is filled with pea gravel. The PVC sleeve is intended to reduce friction (and thus adherence) between soil and the foundation such that as the ground moves, it moves around the sleeve as opposed to gripping the foundation and driving it upwards. The portion of the pile embedded below the PVC sleeve is below the frost line and is thus expected to maintain a strong and consistent tension within the unfrozen ground.

This is the first application of this innovative design in Canada, and only the second known application in North America. Figure 3 provides a visual depiction of the foundation design, including its installation.

Figure 3: **Foundation Installation with a Pile Driver**

3.4.2 Racking

Selection of racking technology and design requires detailed cost-benefit analysis taking into equipment costs, installation efficiency, operational requirements and system performance. Both fixed tilt and single axis trackers were considered for the Project, however fixed tilt were deemed the most cost effective based primarily on the irregular shape of the Project site.

Racking is mounted to the foundation to provide a stable platform upon which to install modules. The Project used Sunlink fixed-tilt racking, each rack occupying 2 H-piles and able to support 18 modules, 9 on each of the upper and lower purlins.

Figure 4: Installed Racking

Racking was installed such that the plane of array was set at an angle of 25^o and inter-row spacing of approximately 7 meters. This configuration is specifically designed to optimize production in the spring, summer and fall, while intentionally allowing for modestly increased winter losses associated with snow accumulation and winter inter-row shading when irradiation is relatively low anyways.

3.4.3 PV Modules

In selecting PV modules for the Project, it is critical to procure from a top tier manufacturer to ensure bankability of the technology and the manufacturer's warranty and guarantees. From the leading suppliers of modules, it is then critical to undertake a detailed cost-benefit analysis taking into account supply cost and production efficiency. This requires balancing the economic impacts of cheaper older and lower-efficiency modules with the higher cost of high efficiency units.

After careful analysis, Jinko 355W MonoPERC high efficiency modules were used for the Project, making it the first solar project in Canada to use Mono PERC panels. In addition to cost, several key features of these modules were factored in when selecting the Jinko 355W MonoPERC modules:

- Jinko is one of the world's largest Tier 1 module manufacturers and provides strong warranty coverage;
- High module conversion efficiency of 18.3%;
- Test reports suggested low light induced degradation losses;
- Excellent low light performance and good antireflection properties;

The datasheet for the modules selected is included in Appendix 1.

The PV modules are interconnected into strings, with most strings aggregating 36 panels, or two racks. Wire management is a key consideration in the installation of PV modules to ensure cabling is organized, safe, and resilient.

Figure 5: Labourers install modules at the Project

3.4.4 Combiner Boxes & DC Cabling

Combiner boxes are used to aggregate PV module strings into larger voltage DC cabling which feeds power to the inverters. The Project used 128 combiner boxes, with each combiner boxes receiving between 10 and 14 PV module strings (approximately 380 modules per combiner box). DC cabling then runs underground via trenches to connect to inverters.

Figure 6 – Combiner Box & DC Cables in Trench

3.4.5 Inverter & AC Cabling

The inverter is a critical component of any solar project. It converts electricity from direct current (DC), which is the form of electricity generated by the panels, to alternating current (AC), which is the form of electricity used in households and businesses.

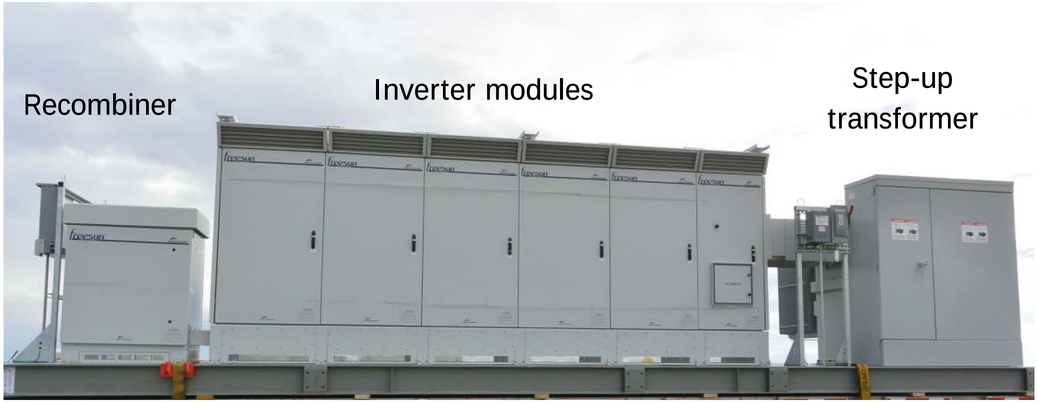
The Project procured eight Power Electronics FS2000CU inverters, each one capable of handling approximately 2MW of generation. The inverter has three primary components: the recombiner, the inverter modules, and the step-up transformer. The recombiner aggregates incoming DC cabling from each of the approximately 16 combiner boxes feeding each inverter. The inverter modules are in effect ten small inverters which individually convert electricity from DC to AC. The step-up transformer increases voltage from low voltage to high voltage (400V AC to approximately 25,000V AC). The system interconnects to the FortisAlberta grid at 25,000 volts.

Power Electronics is a Spanish-based manufacturer who consistently ranks among the top global utility scale inverter manufacturers by leading market research firms. In addition to cost considerations, several key features were factored in when selecting the Power Electronics FS2000CU inverters:

- Power Electronics offered strong warranty coverage for extreme weather conditions;
- Power Electronics offered a 1000V model which was required for electrical code compliance in Alberta;
- The FS2000CU model integrates the latest grid interface technology such as dynamic grid support, low voltage ride through (LVRT), zero voltage ride through (ZVRT), frequency regulation system (FRS), and anti-islanding protection;
- The advanced grid interface technologies are considered best in class.

The datasheet for the inverters selected is included in Appendix 1.

Figure 7 – Power Electronics Inverter Skid



3.4.6 Control House & Interconnection

The Project consists of a number of subcomponents, all of which need to be controlled centrally to ensure safe, efficient and optimal operations. This specifically includes all hardware required to control the logic of the systems operation and the SCADA infrastructure required for remote monitoring and trouble shooting. The control house is shown in Figure 8.

The control house also contains critical high voltage components, including the consolidation of AC cabling from the eight inverters, the main disconnect switch, and electrical grounding. This equipment ultimately facilitates the safe interconnection with FortisAlberta's grid. The physical interconnection is shown in Figure 9.

Figure 8 – Control House

Figure 9 – Point of Interconnection with FortisAlberta Grid

3.5 Project Goals

The goal of the Project was to successfully develop, construct and commission the first utility-scale solar project in Alberta and western Canada. In doing so, the Project has demonstrated the viability and requisite regulatory, technical and commercial steps required to successfully deliver such a project.

The Project will produce approximately 24,000 MWh per year of clean electricity. According to the Carbon Offset Emission Factors Handbook produced by the Government of Alberta (2015), the electricity grid displacement with renewable energy is 0.59 tCO_2e, which equates to the Project reducing greenhouse gas emissions by over 14,000 tCO_2e per year.

Through its validation of southern Alberta's solar resource and demonstration of the successful path to utility-scale solar project completion, the Project is expected to be a catalyst for the further growth of the utility-scale solar industry in Alberta.

4 OUTCOMES

4.1 Economic Development

The Project resulted in substantial direct and indirect economic development for the local community and province of Alberta.

Of the over 50,000 direct labour hours required to construct the project, more than 60% were attributable to workers from the County of Newell, and more than 90% from the Province of Alberta. This translates to a$4.5M of direct economic investment in the County of Newell and over $7.0M in the province of Alberta. These figures exclude the significant hours and cost of 3rd party technical consultants, legal counsel, lender employees, and members of the owner's team.

Key contractors that worked under the EPC Borea Construction for the project.

- Broerson Construction (Brooks) for the civil land works.
- Eastern Irrigation District (Brooks) civil for the drainage ditch crossings.
- Dandelion Renewables (Edmonton) for the pile installation.
- Borea self-performed the Racking and Solar panel installations with locally sourced and trained labour from the County of Newell.
- InPhase Electric and Controls (Brooks) AC/DC cabling and low voltage wiring.
- Tarpon Electric and Controls (Brooks) High voltage terminations and testing.

In addition to the economic impact of construction, the project also generates long-term economic impacts through operations. A Calgary-based solar service provider, SkyFire Energy, has been contracted to provide long-term operations and maintenance service. This firm also subcontracts certain task to local labour, further creating local economic investment. The county benefits from annual property tax from the Project, which will amount to several million dollars over the course of the Project's life.

Through both construction and operations, Project participants have had the ability to substantial expand their capacity and transferable skill base. Individual labourers are now amongst the most experienced solar installation professionals in the province and western Canada, positioning them favorably for long-term employment opportunities as the solar sector expands rapidly.

Contractors involved in the construction and operation of the project have become certified technicians on key project equipment (i.e. inverters), allowing them to expand their service offering to the growing solar industry.

The direct and indirect economic impacts of the construction and operation of the Project are truly substantial. This impact will only continue to grow as the solar industry expands in Alberta and additional opportunities are created, in part a result of the success of the Project.

4.2 Construction Safety Record

The Project safety record had no lost time incidents recorded and there we no Medical Aids administered with only one first aid attended to. Site had only one recordable near miss and five incidences of equipment damages.

4.3 Corporate PPA

The Project will sell all produced electricity and environmental attributes to an independent corporate entity through a long-term power purchase agreement (PPA). This marks one of the first non-utility PPAs signed in Canada, and the first for utility-scale solar. Additionally, by securing senior debt financing for the Project, it was further demonstrated that such contracting methods are financeable. Alberta is uniquely positioned to facilitate non-utility PPAs as a result of its deregulated electricity market.

While many of the terms of the Project's PPA are confidential, the fact that such a contracting method was successful for the Project has expanded confidence and interest in such a bilateral power contracting strategy throughout Alberta. It can reasonably be expected that there will be future utility-scale solar (and wind) projects which advance as a direct result of identifying this contracting method as a viable means of project development.

4.4 Interconnection

The Project was the first utility scale solar project to advance through all stages of the FortisAlberta interconnection process, including the AESO's behind the fence (BTF) requirements. Although the process by which a distribution-connected utility-scale energy generating facility was generally prescribed, all stages of the process had never previously been completed by a solar project.

Elemental worked closely and collaboratively with FortisAlberta (distribution system owner), Altalink (substation owner), and the AESO (system operator) to ensure all technical and contractual requirements to interconnect the Project were evaluated, understood, and met. Several of the interconnection stakeholders' forms and processes evolved as we went through the interconnection process. The following are some of the key changes implemented during the development, construction, and operations of Brooks Solar:

- Fortis and AltaLink changed how they evaluated whether a generator required transfer trip protection and controls. This included requirements for detailed technical studies, and providing the protection engineers from each respective organization with detailed information from the inverter manufacturer to demonstrate that the inverter anti-islanding equipment would safely protect the grid in various grid fault scenarios. Elemental was the first solar project to complete the studies, and also to complete the associated forms and checklists. Elemental provided feedback to both Fortis and the AESO on the process.

- The AESO proposed several rule changes designed to accommodate an influx of new solar installations. These changes were proposed in during construction. Elemental provided formal feedback to ensure that technical and commercial issues were being properly considered by the AESO in rolling out their new market rules[1]. The new changes come into effect in September 2018.

- The AESO re-interpreted their tariff with Fortis such that the way they calculated their "Supply Transmission Service" (STS) changed from being assessed at the substation level, to the transformer level. This had the potential to cause Elemental to complete an additional study to analyze the impact of potential reverse power flow, however, Fortis and the AESO determined in the end that this would not be required.

A key outcome for all parties was a better understanding what technical studies and analysis were required to assess the prospective impact the Project would have on the operation of the grid. FortisAlberta has undertaken a detailed review of their processes and requirements and updated them accordingly, directly based on the experiences of interconnecting the Project. The result is expected to be a substantially more efficient and effective process which provides project proponents greater clarity and certainty as to the technical requirements to interconnect a project.

In addition to improving the process of technical analysis and establishment of standardized information requirements, Elemental also worked with FortisAlberta to ensure the interconnection and operations contracts were financeable and in line with market expectations. Notably, the template interconnection agreement had a blanket termination provision which allowed for the contract to be terminated by either party without cause. While this provision was mutual, however, given that FortisAlberta owned the only distribution lines the project could connect to, the risk was much greater for the project owner. Although FortisAlberta confirmed it had never actually made use of this right on previous power projects, the risk profile associated with this provision raised red flags to our lender's independent engineer.

[1] https://www.aeso.ca/assets/Uploads/Market-Participant-Comment-Letter-Wind-Solar-AGF-and-DER-Amendments.pdf

Elemental worked closely with representatives from several FortisAlberta departments on a compromise legal provision, acceptable to all parties. FortisAlberta has confirmed it has since amended its form of interconnection agreement for all new projects directly as a result of these discussions, improving the commercial prospects for future solar project developments.

4.5 Regulations & Standards

The Project, being the first utility scale solar project in Alberta and western Canada, required novel consideration by electrical authorities in two specific areas.

First, Alberta Industry Training had historically required that solar modules were installed by certified electricians. While this was a sensible approach for smaller installations in which mechanical and electrical installations were closely married and each having small scopes, it was not an appropriate requirement for a utility-scale solar project. The mechanical component of module installation includes physically placing modules on racks and securing them with four specifically-torqued bolts. This specific work had no electrical elements and required a mechanical skill set to ensure bolts were properly installed and torqued. The connection of the panels to each other (in series) and ultimately to PV wiring was an electrical scope.

The Project's EPC Contractor hosted representatives of Alberta Industry Training on site to walk through the installation process. The result was all parties agreeing that the design utilized a separate bonded ground strap connection to the earthing system installed by an electrician thus making the PV module install solely a mechanical process which is compliant with the AIT act to be completed by non-electricians..

The second consideration was the design voltage of the project. The Alberta Electrical Code currently specifies that Arc Fault Protection must be used on a DC solar photovoltaic system that operates at a voltage greater than 80V, which is consistent with the Canadian Electrical Code. At the time of construction the highest rated Arc Fault Protection devices currently available were rated at 1000 volts. The U.S. solar industry, however, has largely moved to a 1500V design, which is more efficient and lower cost. The U.S. currently does not have a code requirement for Arc Fault Protection.

The Project owner and EPC contractor worked with the County of Newell's electrical inspector and Municipal Affairs Alberta (who administers the provincial electrical code) to evaluate opportunities to issue a variance to allow the design and construction of the facility at the preferred 1500V.

All parties undertook a thorough and earnest evaluation of this option, with Municipal Affairs Alberta and the electrical inspector ultimately deferring to the electrical code, such that the Project was completed at 1000V with Arc Fault Protection.

The Brooks Solar project was the first solar project to receive an AUC Power Plant Approval in Alberta. While much of the development work was already completed when Elemental acquired the site in early 2017, Elemental proactively undertook voluntary and mandatory consultation and permitting work after acquiring the project. Some of the key permits and related activities included:

- Applying for an amendment for the AUC Power Plant Approval via a "Letter of Enquiry" to develop the full parcel rather than the subset as was initially envisioned.
- Consulting with residents and business near the site notifying them that Elemental is the new owner, and showing our plans for the project design and schedule.
- Applying for a new development permit with the County of Newell to develop the full parcel and consider the new project design with more modern equipment.
- Applying for a new roadside development permit with Alberta Transportation.

In each instance listed above, the Brooks Solar project was the first utility scale solar project they had issued permits for.

The regulatory landscape is expected to continue to evolve as more projects move forward in the future.

4.6 Shared Land Use

Alberta is known for its effective development of its vast and diverse land resources. The Project site contained a number of existing uses prior to the development of a solar project. This specifically includes:

(1) An active pump jack (CNRL)
(2) An active gas well (Torxen Resources, formerly Cenovus)
(3) High pressure gas pipelines (ATCO)
(4) A fibre optic cable (Telus)
(5) An irrigation ditch (Eastern Irrigation district)

As a result of these existing uses on a relatively compact site, the Project needed to be developed in a manner which both respected the land use rights of the various organizations as well as optimizing system layout and design to account for required setbacks and access. Elemental proactively engaged with all parties which had land interests on the site to evaluate opportunities to improve cooperative use of the property, while optimizing each party's shared uses footprint to allow for improved site layout.

A variety of site options were considered, including moving both the irrigation ditch and the fibre optic cable from the centre of the site to the perimeter as well as reducing the footprint of the CNRL, Cenovus and pipeline setback as much as possible to maximize usable area for the installation of the Project. The result was positive with the resulting layout reflecting the best balance of cost and layout efficiency. The Project, CNRL and Cenovus share a new access road to the north of the property, which reinforces site security while ensuring all parties have adequate site access.

The key outcome was the demonstration that utility-scale solar projects can be developed to effectively co-exist with other common land uses in Alberta.

4.7 Layout & Design Optimization

Developing utility-scale solar in Alberta requires prudent assessment of site options to determine appropriateness of development. It can be generally concluded that previously disturbed land which his not prime agricultural land is ideally suited for solar project development. The Project is located on land which immediately abuts the TransCanada highway, was originally zoned Fringe (subsequently re-zoned rural industrial) and was irregular in shape (triangle). Additionally, because of the multitude of land uses discussed in Section 4.3, the land was largely industrialized as it was. However with these considerations came a need to invest significant time and resources to consider the optimal project layout and design.

This effort requires evaluation of a multitude of variables while considering equipment costs, installation and construction costs, operating costs, and energy production. One of the critical decisions for the Project was racking design and row spacing, two factors which are closely linked. It was concluded that fixed tilt racking was the only feasible option for the site given the irregular shape (triangle) and numerous encumbrances would result in inconsistent row lengths throughout the site. Single-axis trackers are far more cost effective when installed with consistent row lengths, so it was determined that fixed-tilt racking was best for the Project.

The Project was subsequently designed with a fixed 25^{o} angle, specifically to optimize summer production, when irradiance and generation potential is highest. Steeper angles (35^{o} and higher) are common in northern climates to both increase winter production when the sun is lower in the sky as well as to promote snow shedding. However with a space-constrained site and in the interest of maximizing DC capacity, tighter row spacing and lower angles were determined to be optimal for overall annual production.

The key outcome is that the design considerations for every site need to be considered individually and that industry norms may not be optimal for any given project. The Project warranted an atypical design to optimize for the existing site constraints.

4.8 Foundation Design

The Project's foundation design includes a 21' driven galvanized H-pile (approximately 16' embedded), encased in a 6' PVC sleeve which is filled with pea gravel. The PVC sleeve is intended to reduce friction (and thus adherence) between soil and the foundation such that as the ground moves, it moves around the sleeve as opposed to gripping the foundation and driving it upwards. The portion of the pile embedded below the PVC sleeve is below the frost line and is thus expected to maintain a strong and consistent tension within the unfrozen ground.

The outcome is that this is the first application of this innovative and cost-effective design in Canada, and only the second known application in North America, and a design which can be considered for use on future Alberta solar projects.

4.9 Extreme Cold Weather

Alberta gets cold - colder than many manufacturers expect and provide warrantees for. While the Alberta building code cites -32C as the design consideration for the Brooks area, historical records demonstrate temperatures dropping below that mark is not uncommon. For reference, the air temperature at the Project dropped to -40.5C on January 1st 2018.

The inverters used for the project are well-established technology from a highly reputable and experienced vendor (Power Electronics). While inverters can be purchased with enclosures to reduce the impacts of severe weather, this can add significant capital cost. It was economically advantageous for the Project to procure inverters without enclosures; however to ensure warranty coverage for the inverters to such extreme temperatures, a site-specific cold-weather start-up procedure was developed. This procedure ensured that in the rare event of both sustained extreme cold temperatures (< -25C) and loss of backfeed power, such that the inverter heaters were inoperable, the inverters were restarted in a manner which did not put the equipment or personnel at risk.

The outcome is demonstration that established, cost effective inverter technology can be reliably used in Alberta despite the potential for extreme temperature exposure with the development of an effective cold-weather start up plan.

4.10 Solar Generation & Alberta Load Analysis

As part of Elemental's analysis of project economics, a detailed analysis of the value of electricity produced by a solar facility compared to the average AESO pool price. The AESO electricity pool includes the cost of energy from all generation sources at all hours of the day and year. Solar energy projects only generate electricity during the daytime hours, which is typically when the AESO pool price is higher as a result of increased demand for energy. As such, it can be reasonably concluded that solar energy is valued at a premium because of its alignment of generation when demand (and thus pool prices) are high.

Elemental ran an analysis of the expected hourly production of the Project over the course of a representative year compared with the historical hourly pool price between 2010 and 2015. The results were that the AESO pool price at the times when a solar project would be producing were on average 57% (or $33.50/MWh) higher than those of the average pool price over all hours of the year. This "solar premium" ranged from 44% to 77% over this period. While this premium compressed as wholesale pool prices decreased in recent years, it is the expectation that the trend of higher solar premium will re-emerge if pool prices rise in the coming years, as is widely forecasted.

The outcome of this analysis was to quantify the economic advantage of electricity generated from solar projects in comparison with the overall electricity pool.

4.11 Spring Punchlist Completion

The Project was constructed in the summer and fall of 2017 with commissioning and testing spanning through the winter of 2018. As a result, any punch list items requiring EPC contractor resolution necessitated the expiry of winter weather to facilitate the completion of many of the works. This notably includes completion of civil work, which could not be completed until snow had melted and the ground had dried. As a result, the completion of the Project's final milestone under the ERA contribution agreement was delayed until open punch list items could be resolved.

A utility scale solar project in Alberta should account for this seasonal schedule given the natural inclination to construction in the summer and fall.

4.12 Lessons Learned Event

Elemental and ERA co-organized the first ever "Lessons Learned" event to transparently disseminate the results and learnings of the development, construction and commissioning of the Project. The event was extremely well attended with nearly 200 actively engaged participants, reinforcing the significant interest in the Project and its outcomes.

The event provided attendees with a dynamic and interactive explanation of the Project's path to successful completion in the hopes that other developers and stakeholders could improve their own respective processes and strategies to improve uptake and success of future utility-scale solar projects. ERA has indicated that such events will be used in the future to encourage efficient dissemination of project outcomes and learnings.

5 GREENHOUSE GAS AND NON-GHG IMPACTS

The Project will generate emissions-free, renewable energy for sale to the AESO electricity pool. Approximately 24,000 megawatt-hours of clean power will be generated each year, supporting Alberta's goal of offsetting the generation of electricity from fossil-fuel intensive sources, such as coal. According to the Carbon Offset Emission Factors Handbook produced by the Government of Alberta (2015), the electricity grid displacement with renewable energy is 0.59 tCO2e/MWh. This equates to the Project reducing emissions by approximately 14,160 tCO2e per year.

The Project is expected to have a minimum of a 30 year operating life, resulting in long-term emissions reductions. Solar panels experience performance degradation over time to the tune of between 0.3% and 0.5% of capacity per year. Assuming 24,000 megawatt-hours of production in the first year of production, and taking into account an annual average degradation of 0.4% and a 30 year life, the Project is expected to produce a total of approximately 685,000MWh over its life. Assuming a sustained electricity grid displacement factor of 0.59 tCO2e/MWh, this results in total lifetime Project emissions reductions of over 400,000 tCO2e.

As a result of the Project's demonstration of the economic, technical, and regulatory viability of a utility-scale solar project in Alberta, similar emissions reductions can be expected to be realized through the future development of projects around the province.

6 OVERALL CONCLUSIONS

The Project is the first utility-scale solar project successfully developed, constructed and commissioned in Alberta and western Canada. The Project was constructed on time and on budget and has been producing electricity since mid-December 2017.

Through its success, the Project has showcased the technical, regulatory and commercial viability of utility-scale solar projects in Alberta. This has the direct potential of facilitating the future development of additional solar projects, ultimately supporting Alberta's carbon emission reduction targets. Stakeholders and interested parties have had substantial opportunity to leverage learnings from the Project as ERA and Elemental's proactive and consistent effort to disseminate relevant Project information through both through formal and informal means.

7 COMMUNICATIONS PLAN

Elemental and ERA have proactively sought to communicate Project learnings throughout construction and commissioning with the explicit objective of ensuring all stakeholders had significant opportunity to learn about and from the Project.

During construction and since the commencement of operations, Elemental has public presented at numerous events, including the Solar Canada conference (twice), the Alberta and Saskatchewan Renewable Energy Finance Summit, University of Calgary's Emerging Leaders in Solar panel session, and numerous others.

The marquee component of the Project's communication plan was a formal and highly successful Brooks Solar: Lessons Learned event held on March 9th 2018 in Calgary. Nearly 200 people attended the half day event which covered topics from development, interconnection, construction, commissioning and municipal engagement.

Figure 10 – Elemental Energy presents at the Brooks Solar: Lessons Learned Event

In addition to the Lessons Learned event, Elemental hosted approximately 30 Project site tours for several hundred industry stakeholders, including FortisAlberta, AESO, Medicine Hat College, Lethbridge College, and the Alberta Association of Municipal Districts and Counties. On June 19, 2018, Elemental also hosted a Community Open House to provide an opportunity for the residents of Brooks and the County of Newell to tour the Project while providing an open forum for questions and answers. In all cases, the hands on learnings from site visits can further entrench and solidify the industry's ability to learn from the Project.

8 NEXT STEPS

The lessons learned through the successful completion of the Project will continue to be shared amongst relevant stakeholders, with outcomes and innovations expected to be integrated on future projects developed by both Elemental and other renewable energy developers in the province of Alberta.

The Project's operations will be actively monitoring to identify ongoing areas for performance optimization with the continued goal of maximizing production while ensuring the maintenance of a strong working relationship with the local community.

With the Project's success in the backdrop, Alberta's solar energy sector has grown dramatically, with proposed projects now totaling in the thousands of megawatts. This is a testament to investor and developer interest in the Alberta market and the confidence the industry has gained in the ability to successfully deliver a utility-scale project directly as a result of the Brooks Solar Project. This has the potential to result in substantial economic development, labour capacity building, and substantial emissions reductions through the generation of emissions-free electricity.

Elemental will maintain its commitment to proactive and transparent dissemination of technical, commercial and regulatory lessons learned through the successful development, construction and operation of the Project.

9 Appendix 1 – Key Equipment Data Sheets

![elemental energy]

Module Data Sheet

www.jinkosolar.com

Jinko Solar

Eagle PERC 72
340-360 Watt

MONO CRYSTALLINE MODULE

*1500V Available

Positive power tolerance of 0 ~+3%

KEY FEATURES

High Voltage
1000V standard; 1500V option lowers BOS costs and yields better LCOE

Innovative Solar Cells
Four busbar cell technology improves module efficiency

PID-Free
World's 1st PID-Free module at 85℃/85%RH

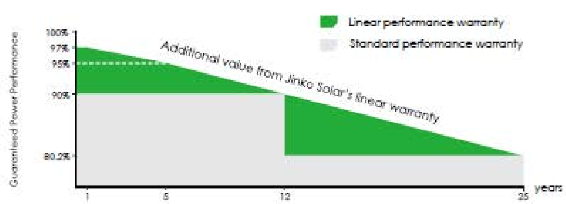
Low-Light Performance
New glass technology improves light absorption and retention

Strength and Durability
Certified for high snow (5400Pa) and wind (2400Pa) loads

Weather Resistance
Certified for salt mist and ammonia resistance

LINEAR PERFORMANCE WARRANTY

10 Year Product Warranty • 25 Year Linear Power Warranty



- ISO9001:2008 Quality Standards
- ISO14001:2004 Environmental Standards
- OHSAS18001 Occupational Health & Safety Standards

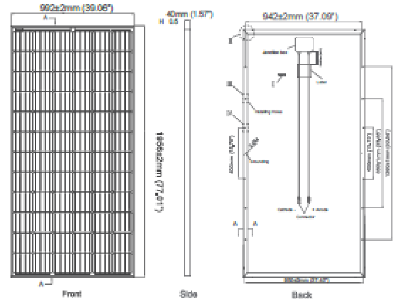
Nomenclature:

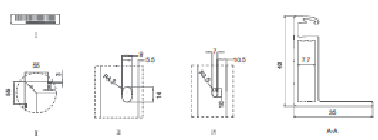
JKM360PP - 72 -

Code	Certification
null	1000V
1500V	1500V

c UL us LISTED

Engineering Drawings





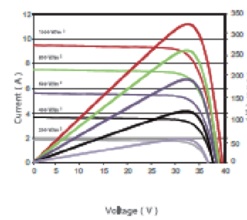
Packaging Configurations

(Two boxes =One pallet)

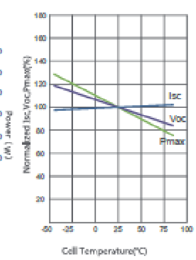
26pcs/ box , 52pcs/pallet, 624 pcs/40'HQ Container

Electrical Performance & Temperature Dependence

Current-Voltage & Power-Voltage Curves (340W)



Temperature Dependence of Isc,Voc,Pmax



Mechanical Characteristics

Cell Type	Poly-crystalline 156×156mm (6 inch)
No.of cells	72 (6×12)
Dimensions	1956x992x40mm (77.01x39.06x1.57 inch)
Weight	26.5 kg (58.4 lbs.)
Front Glass	4.0mm, Anti-Reflection Coating, High Transmission, Low Iron, Tempered Glass
Frame	Anodized Aluminium Alloy
Junction Box	IP67 Rated
Output Cables	12 AWG, Length:1200mm (47.24 inch)
Fire Type	Type 1

SPECIFICATIONS

Module Type	JKM340M-72-V		JKM345M-72-V		JKM350M-72-V		JKM355M-72-V		JKM360M-72-V	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax)	340Wp	254Wp	345Wp	258Wp	350Wp	262Wp	355Wp	266Wp	360Wp	270Wp
	38.7V	36.8V	38.9V	37.0V	39.1V	37.2V	39.3V	37.5V	39.5V	37.7V
Maximum Power Current (Imp)	8.79A	6.89A	8.87A	6.98A	8.94A	7.05A	9.04A	7.09A	9.12A	7.17A
	47.1V	45.5V	47.3V	45.8V	47.5V	46.0V	47.8V	46.2V	48.0V	46.5V
Short-circuit Current (Isc)	9.24A	7.33A	9.31A	7.38A	9.38A	7.46A	9.45A	7.54A	9.51A	7.61A
	17.52%		17.78%		18.01%		18.31%		18.57%	
Operating Temperature(℃)	-40℃~+85℃									
Maximum system voltage	1500VDC(UL)									
Maximum series fuse rating	15A									
Power tolerance	0~+3%									
Temperature coefficients of Pmax	-0.39%/℃									
Temperature coefficients of Voc	-0.29%/℃									
Temperature coefficients of Isc	0.05%/℃									
Nominal operating cell temperature (NOCT)	45±2℃									

*STC: Irradiance 1000W/m² Cell Temperature 25°C AM=1.5

NOCT: Irradiance 800W/m² Ambient Temperature 20°C AM=1.5 Wind Speed 1m/s

* Power measurement tolerance: ± 3%

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

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US-MKT-360M-72-V_v1.0_rev2017

Inverter Data Sheet

HEC-US PLUS 400VAC
TECHNICAL CHARACTERISTICS

		400VAC - MPPt Window 566V-900V					
		FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		5	6	7	8	9	10
REFERENCE		FS1004CU	FS1201CU	FS1401CU	FS1600CU	FS1801CU	FS2000CU
OUTPUT	AC Output Power(kVA/kW) @50°C	1000	1200	1400	1600	1800	2000
	AC Output Power(kVA/kW) @25°C	1110	1330	1550	1770	2000	2220
	Max. Power (kW@PF=0.9, @50°C)	900	1080	1260	1440	1620	1800
	Max. AC Output Current (A) @25°C	1600	1920	2240	2560	2880	3200
	Operating Grid Voltage(VAC)	400Vac ±10%					
	Operating Grid Frequency	60Hz					
	Current Harmonic Distortion (THDi)	< 3% per IEEE519					
	Power Factor (cosine phi)[1]	0.00 leading ... 0.00 lagging adjustable/ Reactive Power injection at night					
	Power Curtailment (kVA)	0...100%/0.1% Steps					
INPUT	MPPt Voltage Window (VDC)[2]	566V-900V					
	MPPt window @full power (VDC)[2]	584V-820V @50°C / 648V-820V @25°C					
	Maximum DC Voltage	1000V					
	Minimum Start Voltage	700V - User configurable					
	Max. DC continuous current (A)	1750	2100	2450	2800	3150	3500
	Max. DC short circuit current (A)	2275	2730	3185	3640	4095	4550
EFFICIENCY & AUXILIARY SUPPLY	Max. Efficiency / CEC (η)	98.6% / 98.0%					
	Euroeta (η)	98.3%		98.4%			
	Max. Standby Consumption (Pnight)	< approx. 40W/per module					
	Control Power Supply	120V / 208VAC-1kVA power supply available for external equipment					
	Max. Power Consumption	2300W	2760W	3220W	3680W	4140W	4600W
CABINET	Dimensions [WxDxH] [inches]	153.5"x40.12"x94.5"		192.9"x40.12"x94.5"		232.3"x40.12"x94.5"	
	Dimensions [WxDxH] [mm]	3900x1050x2400		4900x1050x2400		5900x1050x2400	
	Weight (lbs)	7804	8487	10119	10802	12434	13117
	Weight (kg)	3540	3850	4590	4900	5640	5950
	Air Flow	Bottom intake. Exhaust top vent (Front or Rear option)					
	Type of ventilation	Forced air cooling					
ENVIRON-MENT	Degree of protection	NEMA 3R					
	Permissible Ambient Temperature	-22°F to +122°F / -30°C[3] to +50°C, >50°C / Active Power derating (>50°C/122°F)					
	Relative Humidity	4% to 100%. Active heating and humidity control					
	Max. Altitude (above sea level)	1000m; >1000m power derating 1% Sn (kVA) per 100m					
	Noise level [4]	< 70 dBA					
CONTROL INTERFACE	Interface	Alphanumeric Display (inside cabinet) / Optional Freesun App display or Web display					
	Communication Protocol	RS232 / RS485 / USB / Ethernet, (Modbus RTU, Modbus TCP/IP)					
	Power Plant Controller	Optional					
	Keyed ON/OFF switch	Standard					
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2014 Grounded PV Array: GFDI protection Optional PV Array transfer kit: GFDI and Isolation monitoring device					
	Humidity control	Active Heating					
	General AC Protection & Disconn.	Circuit Breaker					
	General DC Protection & Disconn.	External Disconnecting Unit Cabinet (FSDK)					
	Module AC Protection & Disconn.	AC contactor & fuses					
	Module DC Protection & Disconn.	DC contactor & DC fuses					
	Overvoltage Protection	AC and DC protection (type 2)					
CERTIFICATIONS	Safety	UL 1741; CSA 22.2 No.107.1-01					
	Utility interconnect	IEEE 1547 with Utility Interactive Control functions					

NOTES [1] Consult P-Q charts available: $Q(kVAr)=\sqrt{S(kVA)^2-P(kW)^2}$
[2] Values at 1.00•Vac nom and cos Φ= 1. Consult Power Electronics for derating curves.
[3] Heating kit option required below -20°C.
[4] Sound pressure level at a distance of 1m from the rear part.

POWER ELECTRONICS / SOLAR INVERTER