HATCH™

Axio Power Canada Inc./
SunEdison Canada

Draft Design and Operations Report

For

Welland Ridge Road
Solar Energy Project

H335467
Rev. F
October 13, 2011

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Project Report

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Welland Ridge Road - Solar Energy Project

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1. Introduction

1.1 Project Description

Axio Power Canada Inc./SunEdison Canada ("Axio/SunEdison") is proposing to develop a 10-megawatt (MW) solar photovoltaic project titled Welland Ridge Road Solar Energy Project (the "Project"). The Project Location[1] is situated on approximately 38 hectares (ha) of land on Part of Lots 14 and 15, Concession 7, City of Welland (lower tier municipality) and Regional Municipality of Niagara (upper tier municipality).

The Project is proposed to be constructed on privately owned lands currently used for agricultural crops. The Project is located immediately south of Ridge Road and west of Doans Ridge Road. Strawn Road crosses through the centre of the Project in a north-south direction.

The proposed Project is a renewable energy generation facility which will use solar photovoltaic technology to generate electricity. Electricity generated by solar photovoltaic panels will be converted from direct current (DC) to alternating current (AC) by inverters and then stepped-up to a voltage of 27.6 kV via pad-mounted transformers prior to being connected to the existing local distribution line. In order to meet the Ontario Power Authority (OPA)'s Feed-In-Tariff (FIT) Program requirements, a specific percentage of equipment will be manufactured in Ontario.

The construction of the Project will begin once the Renewable Energy Approval (REA) has been obtained. The construction period is estimated to be approximately 6 months, with Project commissioning anticipated in October 2012. Operationally, the lifespan of the Project will be at least 20 years, which can be extended up to 30 years or more with proper maintenance, component replacement and repowering.

1.2 Renewable Energy Approval Legislative Requirements

Ontario Regulation (O. Reg.) 359/09 – *Renewable Energy Approvals Under Part V.0.1 of the Act*, (herein referred to as the REA Regulation), came into force on September 24, 2009 and identifies the Renewable Energy Approval (REA) requirements for renewable energy generation facilities in Ontario. The REA Regulation has since been amended by O. Reg. 521/10, which came in effect as of January 1, 2011. As per the REA Regulation (Part II, Section 4), ground mounted solar facilities with a name plate capacity greater than 12 kilowatts (kW) are classified as Class 3 solar facilities and require an REA.

Section 13 of the REA Regulation requires proponents of Class 3 solar facilities to complete a Design and Operations Report to identify:

- The site plan.
- The design of the facility and the equipment to be used.
- How the Project will be operated.

[1] "Project Location means, when used in relation to a renewable energy project, a part of land and all or part of any building or structure in, on or over which a person is engaging in or proposes to engage in the project and any air space in which a person is engaging in or proposed to engage in the project" (O. Reg. 359/09, s. 1 (1)).

- How environmental effects will be monitored and mitigated.
- How emergencies and communications will be managed.

A draft of the Design and Operations Report must be made available to the public, the local municipality and identified Aboriginal communities, at least 60 days prior to the final public consultation meeting in accordance with O. Reg. 359/09.

1.3 Purpose of Report

This Report serves several purposes. First, it provides a site plan illustrating the location of the various Project components and, second, it describes the operational aspects during the Project operation phase so that all potential negative environmental effects may be identified. The Report describes the actions that are anticipated to mitigate any identified significant negative environmental effects due to the operation of the Project. Note, separate reports have been prepared that describe the activities, negative environmental effects, and mitigation for the construction and decommissioning phases of the Project. Finally, the Report functions as a communication tool for public, agency, municipal and Aboriginal consultation to convey to these groups the design and operating aspects of the Project.

Section 2 of the Report provides the site plan and describes the Project area features. Section 3 provides the plan for the facility design including a description of the facility components. Section 4 describes the facility operation plan and Section 5 provides the environmental effects monitoring plan for the operation of the Project. Section 6 describes the emergency response and communications procedures planned for the Project and Section 7 provides the references.

2. Site Plan

Figure 2.1 provides a conceptualized depiction of the site plan and the proposed Project facilities that are discussed throughout this report. The Project Location is situated on about 38 ha of land on Part of Lots 14 and 15, Concession 7, City of Welland. The latitude and longitude coordinates for the approximate center of the Project Location are 42° 58′ 20.21″ N and 79° 11′ 38.44″ W.

The site plan (Figure 2.1) identifies the Project's property boundary (i.e., Project Site[2]), the Project Location, existing local roads, topographic contours, existing local electrical distribution line, land uses, cultural and natural features and waterbodies on and within 300 m of the Project Location. In addition, Figure 2.1 depicts the proposed facility components including the construction staging/laydown areas, access roads, solar PV module arrays, inverters, the switch house yard and the connecting electrical line. Setback distances from identified significant natural features and waterbodies are also shown. For Information regarding the construction and installation of these components, please refer to the Construction Plan Report (Hatch, 2011g).

More detailed drawings of the site plan and the proposed Project facilities have been prepared as part of this REA application. These drawings are provided in Appendix A and listed in Table 2.1.

Table 2.1 Project Drawing List

Drawing	Title	Information Depicted
G-001	Title Sheet	Project Location including existing land uses and roads.
ES-101	Existing Site Plan	Existing features including: topographic contours, Project Location boundaries, utilities, easements, roads, etc.
ES-102	Array Plan	Proposed facilities including: solar PV module layout, inverter locations, switch house yard, construction laydown area, site entrance, communications tower, interior roads and perimeter fence.
EP-701	Equipment Specifications	General equipment drawings and specification details for 500 kW inverter and inverter building enclosure.
EP-801	Single Line Diagram	Electrical wiring schematic.
S-101	Racking and Anchor Details	Solar PV module tracker details, array spacing, foundation support and road subgrade construction details.

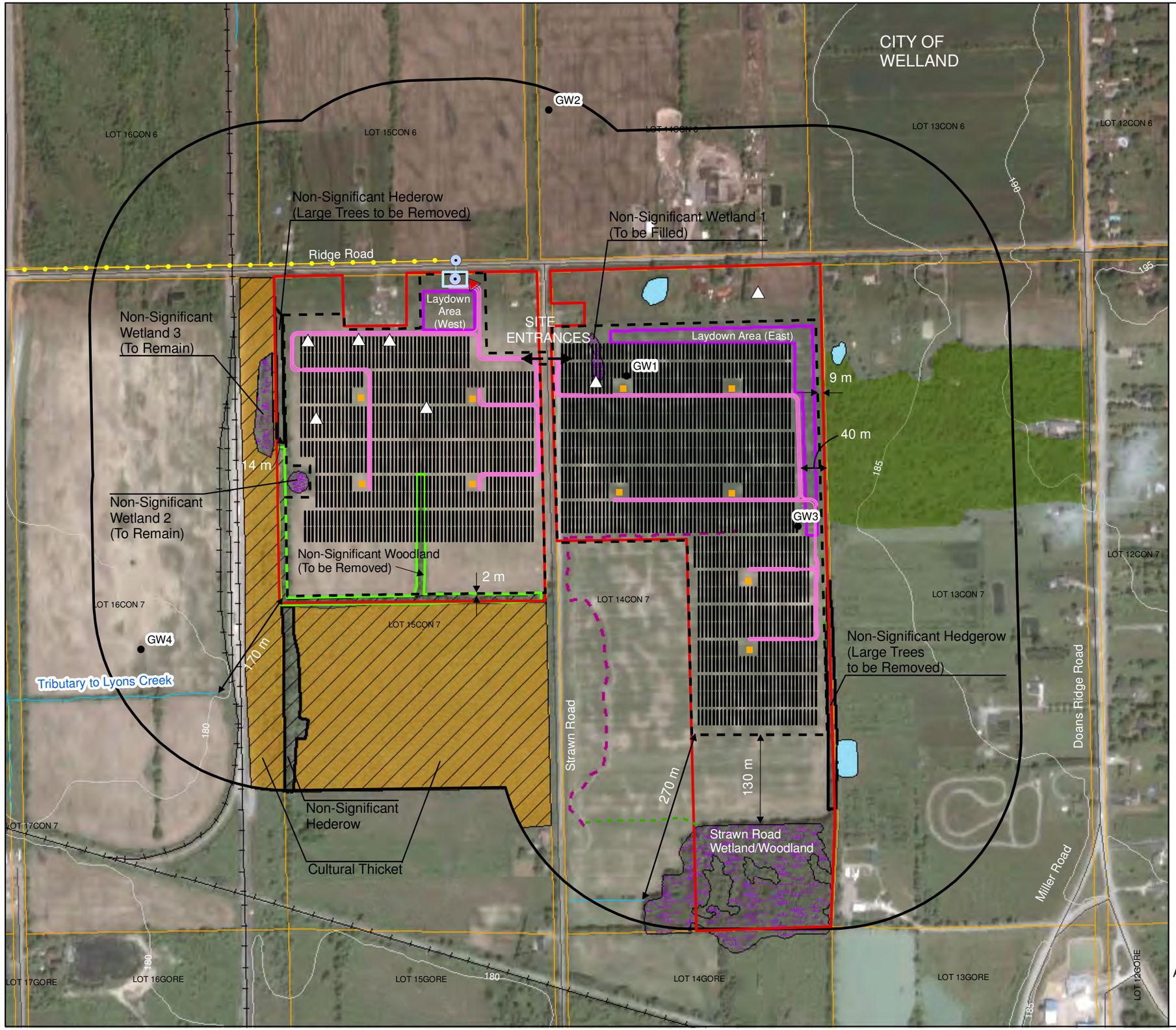
[2] Project Site (upper case) refers to property boundary. Project Location includes the Project infrastructure footprint including lands temporarily required for construction such as vehicle parking and materials laydown. References to the 'site', 'construction site' are synonymous with Project Location in the context of this Report.

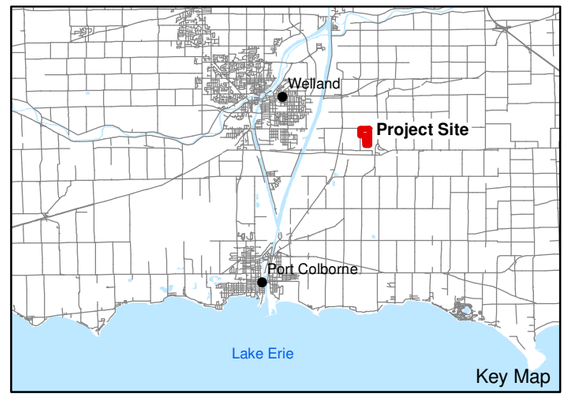
2.1 Supporting Reports

Several reports have been prepared as part of the REA application and are provided under separate cover or as appendices to this report. These reports provide detailed information on the various natural and socio-economic features on and in proximity to the Project Location. Some of the reports include an assessment of the potential effects of the Project's construction, operation and decommissioning phases along with recommendations for mitigation measures to ensure that there will be no significant residual negative effects.

Information relevant to this Design and Operations Report has been summarized from these reports, where appropriate. These reports are considered supporting reports and should be referred to by persons seeking further detailed information.

- **Natural heritage features** can be found in the Natural Heritage Assessment Records Review Report (Hatch, 2011a), Natural Heritage Assessment Site Investigation Report (Hatch, 2011b), Natural Heritage Assessment Evaluation of Significance Report (Hatch, 2011c) and Natural Heritage Assessment Environmental Impact Study Report (Hatch, 2011d).
- **Waterbodies** can be found in the Water Body Records Review Report (Hatch, 2011e) and the Water Body Site Investigation Report (Hatch, 2011f).
- **Construction and decommissioning** activities and timelines, facility components, environmental effects, mitigation and monitoring can be found in the Construction Plan Report (Hatch, 2011g) and the Decommissioning Plan Report (Hatch, 2011h).
- **Socio-economic conditions** (e.g., land use, municipal infrastructure) are discussed in this report.
- **Protected properties and heritage resources** are discussed in this report.
- **Noise conditions** including the noise sources associated with the Project electrical equipment (inverters, transformers), noise receptors and the simulation results of noise modeling of the Project during its operation can found in the Noise Study Report (Hatch, 2011i).
- **Archaeological resources** and an assessment of potential effects can be found in the Stage 1 and 2 Archaeological Assessment Report (TAI, 2011).
- **Geotechnical conditions** (e.g., soils, groundwater, bedrock) can be found in the Geotechnical Report (Inspec-Sol, 2011).
- **Storm water runoff conditions** (e.g., existing and proposed runoff peak flows) can be found in the Conceptual Storm Water Management Report (McIntosh Perry, 2011a).
- **Traffic conditions** (e.g., road classifications, expected traffic volumes) can be found in the Traffic Impact Study Report (McIntosh Perry, 2011b).
- **Environmental conditions** and potential areas of environmental concern related to previous and current uses of the Project Location lands can be found in the Phase I Environmental Site Assessment Report (McIntosh Perry, 2011c).
- **Groundwater conditions** and existing water wells, including a proposed groundwater monitoring program can be found in the Groundwater Monitoring Report (McIntosh Perry, 2011d).
- **Reflectivity aspects** related to potential visual disturbance from reflections from the solar PV modules can be found in the Reflectivity Study Report (IBI, 2011).





LEGEND

Existing Features

- GW1 Natural Gas Well (Plugged and Abandoned)
- Field Drainage (Non Water Body)
- Grassed Waterway (Non Water Body)
- Watercourse
- Railway
- Road
- Topographic Contour (5 m interval)
- Transmission Line
- Dugout Pond (Non Water Body)
- Parcel
- Project Location
- 300 m from Project Location
- Project Site

Significant Natural Features / Significant Wildlife Habitat

- Non-Provincially Significant Wetland
- Significant Woodland
- Significant Wildlife Habitat (Amphibian Breeding / Eastern Ribbonsnake, Overwintering Snapping Turtle)
- Significant Wildlife Habitat (Raptor Winter Feeding and Roosting)

Proposed Project Components

- Communication Tower
- Inverter
- Switch House
- Connection Point
- Access Road
- Fence
- Panel Layout
- Transmission Line
- Laydown Area

Heritage and Archaeological Resources

- Historic Site (Stage 1/2 Archaeology)

Notes:
1. OBM and NRVIS data downloaded from LIO, with permission.
2. Spatial Referencing UTM NAD 83, August 2010.
3. Satellite imagery from Google Earth Pro, June 2003.

0 50 100 200 300 Metres

NORTH

Scale 1:6000

Figure 2.1

Axio Power Canada Inc./SunEdison Canada

Welland Ridge Road Site Layout Plan

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2.2 Site Plan Considerations

Based on survey data and information provided by the Proponent, and the results of the natural heritage and water body environmental studies, the archaeological assessment study, the heritage and protected properties review, the noise study and the geotechnical investigations, the following identifies the various site related features, setback requirements and potential constraints on and within 300 m of the Project Location that have been taken into consideration in the development of the site plan and facility design plan for the Project. Where applicable, these features and any identified setbacks have been shown on the site plan (Figure 2.1).

2.2.1 Waterbodies

Water body features (e.g., permanent and intermittent streams, lakes, seepage areas) on and within 300 m of the Project Location are shown in Figure 2.1.

There are no waterbodies on or within 120 m of the Project Location (Hatch, 2011f). The nearest waterbodies are a tributary of Lyons Creek about 170 m southwest of the Project Location and an intermittent watercourse draining into the Strawn Road wetland about 270 m south of the Project Location. These features do not pose a constraint to the Project since they are located greater than 120 m from the Project Location. There are three dugout ponds within 120 m of the Project Location situated north, northeast and southeast of the Project Location (Hatch, 2011f). According to the definition of "water body" within the REA Regulation, dugout ponds are not waterbodies. Therefore, no defined setback under the REA Regulation is required for the Project from these features.

Currently, the Project Location is agricultural with fairly level topography. Site drainage is generally from north to south by overland (sheet) flow and grassed swales. Lyon's Creek is situated about 1 km north of the Project. The southeast portion of the Project Location and adjacent lands to the west, drain southward towards the Strawn Road wetland via overland flow, a non-vegetated drainage ditch and a grassed waterway. Lyon's Creek and the Strawn Road wetland are under the jurisdiction of the Niagara Peninsula Conservation Authority (NPCA). Based on the Water Body Site Investigation Report (Hatch, 2011f), there are no waterbodies on or within 120 m of the Project Location. The nearest water body is a tributary to Lyon's Creek about 170 m southwest of the Project Location Figure 2.1). In addition, two dugout ponds, not deemed water body features, are present on or within 120 m of the Project Location.

2.2.2 Natural Heritage Features

Natural heritage features on and within 300 m of the Project Location are shown in Figure 2.1.

There are no provincially significant wetlands, valleylands, provincial parks, conservation reserves or Areas of Natural and Scientific Interest (ANSIs) on or within 120 m of the Project Location (Hatch, 2011a and b).

The Strawn Road Wetland is situated about 130 m south of the Project Location. This unevaluated wetland is considered to be a non-provincially significant wetland (Hatch, 2011c). This feature does not pose a constraint to the Project since it is located greater than 120 m from the Project Location.

There is a 9.7 ha woodland situated immediately east of the Project Location that is within 120 m of the Project Location. The woodland was assessed as a significant woodland based on its size (Hatch,

2011c). The woodland is also identified as a Significant Woodlot in Schedule C1 of the City of Welland's Official Plan (Welland, 2010). Under the REA Regulation, an environmental impact study (EIS) is required for Project facilities proposed within 120 m of significant woodlands. The Project will not encroach into this woodland and the perimeter fence has been setback 9 m from this feature. Based on the findings of the EIS, the Project will not have a significant adverse impact to the woodland (Hatch, 2011d).

There is a 1.1 ha woodland situated within the western portion of the Project Location. Although the woodland was assessed as a non-significant woodland due primarily to its small size, it does provide significant wildlife habitat for raptor winter feeding and roosting (Hatch, 2011c). Under the REA Regulation, an environmental impact study (EIS) is required for Project facilities proposed within 120 m of significant wildlife habitat. Based on the assessment findings of the EIS, removal of the central portion of the woodland will not result in adverse impacts to wildlife (Hatch, 2011d).

There is a hedgerow situated along the southeast side of the Project Location. The hedgerow was assessed as non-significant (Hatch, 2011c) and large trees from within the hedgerow will be removed.

There are two small wetlands identified as cattail organic shallow marshes situated on or within 120 m of the Project Location (Figure 2.1, Wetlands 1 and 2) and one small wetland identified as a reed-canary grass organic meadow marsh situated west of the Project Location (Figure 2.1, Wetland 3). These wetlands were evaluated and assessed as non-provincially significant wetlands due primarily to their small size (Hatch, 2011c). Wetland 2, and the three dugout ponds were assessed as providing wildlife habitat for amphibian breeding, eastern ribbonsnake and overwintering snapping turtle. Under the REA Regulation, an EIS is required for Project facilities proposed within 120 m of significant wildlife habitat. Wetland 1 will not be retained and will be filled in. Based on the assessment findings of the EIS, removal of Wetland 1will not result in adverse impacts to wildlife, which will be captured and moved to Wetland 2 prior to infilling (Hatch, 2011d). Wetland 2 will be retained and a 5 to 10 m setback will be provided around the wetland to serve as a protection buffer (Hatch 2011d). Wetland 3 will not be affected since it not located on the Project Location and a 14 m setback will been provided between the wetland and the Project fence (Hatch 2011d).

2.2.3 Cultural Heritage, Protected Properties and Archaeological Resources

The Project is not located on a protected property (e.g., cultural heritage property designated under the *Ontario Heritage Act*) as defined in Column 1 of the Table in Section 19(1) of O. Reg. 359/09. In addition, research and consultation with the municipality and completion of the Ministry of Tourism and Culture (MTC) – *Check Sheet for Environmental Assessments: Screening for Impacts to Built Heritage and Cultural Heritage Landscapes* has not identified the need for a heritage impact assessment under Section 23 of the REA Regulation.

Six historic sites on the Project Location were identified from the Stage 1 and 2 archaeological study (TAI, 2011). The sites represent potentially significant archaeological resources that will be subject to a Stage 3 archaeological assessment to recover and document the sites as per the requirements of the Ministry of Culture and Tourism.

2.2.4 *Areas Protected Under Provincial Plans and Policies*

The Project Location is not located within any of the following Provincial Plan areas:

- Protected Countryside or Natural Heritage System of the Greenbelt Plan and *Greenbelt Act*
- Oak Ridges Moraine Conservation Plan Area
- Niagara Escarpment Plan Area
- Lake Simcoe Watershed Plan Area.

2.2.5 *Land Use and Resources*

Land uses and resources on and within 300 m of the Project Location are shown in Figure 2.1.

The Project Location has historically been used for, and is currently used for, agricultural crops. There are no structures or water wells located on the Project Location and there are no municipal potable water services or sewer services supplying the Project Location (McIntosh Perry, 2011c). There are four abandoned and plugged Consumers Gas Company natural gas wells present within 300 m of the Project Location (McIntosh Perry, 2011c). Two of the wells are within the Project Location.

Land uses adjacent to the north and east of the Project Location are active agriculture lands and farmsteads and rural residential dwellings along Ridge Road. An active commercial trucking company is present north of the Project Location on the north side of Ridge Road. There is a woodland situated east of the Project Location and there are three dugout ponds to the north, northeast and southeast of the Project Location. West of the Project Location, the lands are actively used for agriculture and there is a railway line and siding yard. Lands to the south are agricultural and there is the forested Strawn Road wetland.

The Project Location and adjacent lands are designated Agricultural in the City of Welland Official Plan (2010) (Schedule B) and the commercial trucking company to the north is designated Rural Employment. Official Plan Schedule B identifies the Strawn Road wetland south of the Project Location and the woodland east of the Project Location as Core Natural Heritage System. Further, Schedule C1 identifies the Strawn Road wetland as Other Evaluated Wetlands and the woodland as Significant Woodlots. There are no known aggregate resources, landfill sites or recreational areas on or within 300 m of the Project Location.

A Phase I Environmental Site Assessment (ESA) was conducted for the Project by McIntosh Perry (2011c) that provided a qualitative assessment of the environmental condition of the Project Location lands based on published records (e.g., land title, historical aerial photographs), landowner interviews and a site reconnaissance. Although the study found no direct evidence that indicates contamination of the Project Location from past land uses, several areas of potential environmental concern (e.g., waste piles of shingles, drums and tires) were identified along with mitigation and/or improvement measures to address such concerns (McIntosh Perry, 2011c).

Potential adverse effects on availability of resources and current land uses during construction, operation and decommissioning are summarized in Table 4.1. Additional information on adverse effects and mitigation is provided in the Construction Plan Report (Hatch, 2011g) and the Design and Operations Report (Hatch, 2011h).

2.2.6 *Roads, Rights of Way, Utility Corridors and Easements*

Local infrastructure within 300 m of the Project Location is depicted on Figure 2.1 and includes:

- Municipal roads and associated rights of ways within 300 m of the Project Location include: Ridge Road immediately north of the Project Location and Strawn Road which crosses through the centre of the Project in the north-south direction.
- A railway line and siding is located approximately 60 m west of the Project Location.
- A Welland Hydro-Electric System Corp. (WHESC) 27.6 kV distribution line is situated north of the Project Location along Ridge Road.
- An Enbridge natural gas pipeline is present along Strawn Road.

2.2.7 *Traffic Considerations*

A Traffic Impact Study (McIntosh Perry, 2011b) was prepared to assess the potential traffic-related impacts on local roads during construction, operation and decommissioning of the Project. The study concluded that the Project operation will have a negligible impact (i.e., delays to local community traffic flow) to the surrounding road network given that only occasional visits by maintenance staff (i.e., typically monthly) will occur over the anticipated 20 year lifespan of the Project.

2.2.8 *Operational Noise Considerations*

The only noise emissions associated with the Project operation will be from the inverters and transformers, which will only operate during daylight hours. The locations of the inverters and transformers within the Project Location have been designed to minimize off-site effects to nearby noise receptors. A Noise Study Report (Hatch, 2011i) involving computer modeling simulations has confirmed that the applicable Ministry of Environment noise level limits will not be exceeded at the locations of the nearest noise receptors. A plan showing the locations of the noise receptors and the simulation results of noise modeling is provided in Appendix A.

2.2.9 *Geotechnical Considerations*

The Project Location is underlain by native clay soils covered by organic topsoil. Bedrock was not encountered within the 6.5 m depth of the eight investigatory boreholes and is expected to lie at depths ranging between 25 m and 30 m below grade based on review of surficial geology data for the area (Inspec-Sol, 2011). A review of the Ontario Well Registry data indicates that groundwater levels in the area range from about 4.0 m to 5.0 m below the ground surface (Inspec-Sol, 2011). Although no groundwater or surface water seepage was observed within the side walls of any of the 12 investigatory test pits, the study noted that some surface water infiltration into construction excavations is expected during wet seasons or precipitation events (Inspec-Sol). If present, this water will require adequate handling (e.g., pumping) to minimize interference with construction.

3. Facility Design Plan

3.1 Facility Components

The following section describes the principle facility components that will be used during the operation of the Project. At this stage in the Project, the specific make, model and dimensions of the various electrical equipment has not been finalized. Therefore, where applicable, typical sizes and descriptions of how the various components will operate along with examples of manufacturer brochures and typical equipment specifications have been provided.

Information describing how these components will be constructed and installed in the Project, and the potential construction-related environment effects and mitigation measures is provided in the Construction Plan Report (Hatch, 2011g).

3.1.1 Civil Components

3.1.1.1 Fencing and Security Gate

The perimeter of the Project Location will be fenced and the two Project entrances from Strawn Road will be gated. The fence will be galvanized steel chain link about 2.7 m high with barbed wire on top of the fence. An estimated 4,100 m of fence will be required to enclose the perimeter of the Project Location. Fence posts will typically be spaced every 2.5 m. A set of lights will be installed near the entrance to the facility.

3.1.1.2 Access Roads

Two new site access roads, each about 5 m wide, will be constructed of asphalt from Strawn Road into the Project to support construction activities and provide vehicle access into the site during the Project's operation (Figure 2.1). In addition, several smaller interior roads, about 3.7 m wide and constructed of gravel, will provide maintenance access during Project operation.

Culverts will be installed beneath the access roads at locations where conveyance of surface drainage is required. No new watercourse crossings by roads will be required. As part of the site drainage plan, parallel side ditches may be constructed along the access roads to collect and convey runoff. Design of roads, culverts, swales and ditches will be in accordance with Ontario Provincial Standard Specifications (OPSS) and local municipal engineering guidelines.

3.1.1.3 Surface Drainage System

The basic components of the Project's surface water drainage system are provided in the Storm Water Management Study Report (McIntosh Perry, 2011a). The details of the components will be further refined as part of detailed design and will consist of:

- Overland runoff (i.e., sheet flow) on grassed and vegetated areas to convey runoff from the solar PV modules.
- Constructed shallow triangular shaped grassed swales 0.3 m to 0.5 m deep by 0.5 m to 1.0 m wide situated along the access roads to convey runoff from interior areas of the site.

- Constructed trapezoid shaped, flat-bottomed, grassed swales 0.5 m to 1.0 m deep by 1.0 m to 1.5 m wide situated along the access roads (if required) and possibly along the site perimeter to convey runoff to receiving watercourses and/or defined discharge locations.
- Installed corrugated metal or high density polyethylene (HDPE) culverts situated beneath access roads to convey surface water laterally beneath roadways where required.

Overall, major alteration to the existing surface drainage patterns is not expected as part of the Project's construction and operation nor are significant negative effects to existing drainage conditions and/or surface water features expected to occur.

3.1.1.4 Inverter Building and Electrical Equipment Foundations

Support foundations for the inverters and pad-mounted transformers and the switching equipment will be precast or cast-in-place concrete pads. If precast concrete foundations are used they will be transported to the site by truck, unloaded and set into position by crane. If cast-in-place concrete foundations are used they will be constructed on-site by means of excavation and removal of in-situ material, placement of granular material, formwork construction, installation of reinforcing steel and electrical grounding grid, and pouring of concrete into the forms.

Subject to the completion of detailed design, it is expected that the Project will consist of:

- Ten 6.4 m by 4.0 m concrete pad foundations for the building enclosures that will house the inverters and transformers.
- A 7.0 m by 7.0 m concrete pad foundation for the switch house.

Based on these quantities, the total amount of impervious area associated with concrete foundations will be approximately 305 m^2 corresponding to less than 0.09% of the 38 ha Project Location area.

3.1.1.5 PV Module Mounting System, Supports and Foundations

The solar PV modules will be mounted on single-axis, ground mounted, tracker systems. At this stage, the specific make and model of the tracker system has not been finalized, but it will typically consist of a steel lattice structure attached to a rotating sleeve on a single horizontal beam supported by steel uprights (refer to Appendix A, Drawing S-101). The lattice structures will be assembled on-site and typically hold 44 individual PV modules. When in the fully inclined position, the bottom of the module will be about 1.0 m off the ground and the top of the module will be about 3.0 m off the ground. In total, an estimated 830 trackers will be used to support a total of approximately 36,500 PV modules.

The tracker systems will be supported by steel uprights mounted on driven steel piles, steel helical screw piles or cast-in-drilled-hole foundations depending on the soil conditions within the Project Location. Approximately 9,960 piles will be installed within the Project Location to a design depth of up to 3 m below the ground surface to support the racking structures and the PV modules. Based on an assumed pile diameter of 300 mm, the total area occupied by the piles will represent less than 0.19% of the 38 ha Project Location area.

3.1.2 Electrical Equipment

The main electrical components of the Project include the solar PV modules, inverters, transformers switchgear and cabling along with the various protection, control and monitoring equipment.

Figure 3.1 depicts a generalized schematic illustrating how electricity will be generated, inverted, transformed and transmitted by the electrical equipment used for the Project. Drawing EP-801 in Appendix A provides a detailed single line wiring diagram.

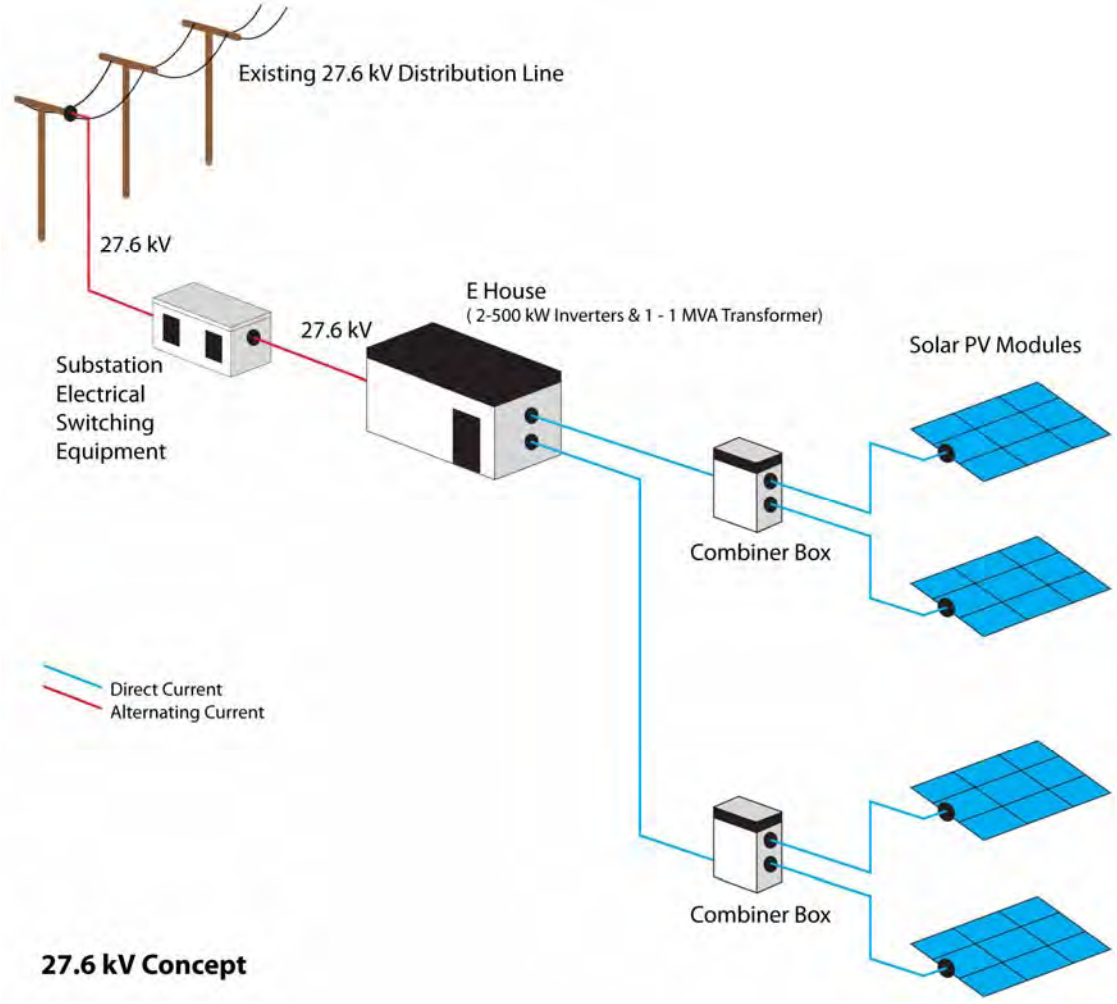

Figure 3.1 Generalized Schematic of Electrical Equipment Connectivity

For the Project, the solar PV modules will be mounted on single-axis tracker systems arranged in rows facing north-south. Each tracker system will be able to rotate 90° to track the sun as it moves east to west across the sky. The tracker units and rows of PV modules will be supported by steel supports that will extend into the ground.

Upon exposure to sunlight, the solar PV modules convert solar radiation into direct current (DC) electricity through a process referred to as the photovoltaic effect. This effect occurs when the sunlight energy is transferred to semiconductors in the modules to create a corresponding electric

current. The DC electricity from the solar PV modules will be transmitted across the back of the modules by wires, which will connect to combiner boxes. The combiner boxes merge the multiple incoming wires from the racks of modules into a reduced number of outgoing electrical cables.

The DC electrical current from the combiner boxes will be transmitted through underground cables connected to one of two 500 kW inverters housed in a building enclosure ('E-House'). Each inverter will convert the DC electrical current to alternating current (AC) and a pad-mounted inverter transformer will step-up the voltage from 480 V to 27.6 kV. The 27.6 kV (AC) current will then be transmitted through underground cables to the electrical switching equipment situated in the switch house yard. Electricity will then be transmitted from the switch house yard through overhead electrical lines to connect to the local 27.6 kV distribution line.

The following provides more specific information regarding the main electrical components of the Project.

3.1.2.1 Solar PV Modules

The Project will have a total of approximately 36,500 solar PV modules, each 280 to 310 watts (W) and weighing about 23 kg, with approximate dimensions of 1980 mm long by 990 mm wide by 50 mm thick. Each module contains 72 poly-crystalline cells and is covered by 3.2-mm thick tempered glass, surrounded by an anodized aluminum alloy frame. The materials that comprise the solar modules are inert in their manufactured state. Manufacturer's product information is provided in Appendix B.

3.1.2.2 PV Inverters

The Project will have a total of twenty 500 kW AC inverters that will convert the direct current supplied by the PV modules to alternating current. Two inverters and a single pad-mounted intermediate transformer will be installed together inside a prefabricated enclosure building which will sit on a precast or cast-in-place concrete pad. At this stage, the specific make and model of the inverters have not been finalized. However, the SMA Sunny Central® 500HE-US has been selected as a representative example of a typical 500 kW inverter. The dimensions of the SMA Sunny Central® 500HE-US inverter are 2.56 m long by 0.96 m wide by 2.28 m high, and weighs 1,800 kg. Manufacturer's product information is provided in Appendix B.

3.1.2.3 Pad-Mounted Transformers

The Project will have a total of ten pad-mounted transformers that will use electromagnetic induction to transform (i.e. 'step up') the voltage from 480 V to 27.6 kV. At this stage, the specific make and model of the transformers have not been finalized, but they would each typically be a three-phase, liquid-filled, medium voltage transformer with a nominal rating of 1000 kVA. A typical pad-mounted transformer is approximately 2.26 m long by 1.50 m wide by 1.63 m high and weighs about 4500 kg. An example of a typical pad mounted transformer is provided in Appendix B. Each transformer will be shared by a pair of 500 kW inverters and will sit on a concrete pad foundation inside the building enclosure that will house the inverters (Section 3.1.2.4).

A typical 1000 kVA transformer will contain about 1800 to 2400 litres of liquid dielectric coolant fluid, which is typically mineral oil. Operationally, the oil is entirely contained inside the transformer and cools the transformer by absorbing heat from the electrical windings, which in turn is dissipated

by a series of radiators or cooling fins mounted on the transformer. Gauges on the transformer allow for visual monitoring of the oil level, temperature and pressure inside the transformer. The transformer selected will have an organic based vegetable oil (e.g., BIOTEMP®, Envirotemp® FR3™), which is non-toxic, non-bioaccumulating and readily biodegradable in the environment.

Given that there will be no direct hydraulic connection (e.g., drains, sumps or piping) from the intermediate transformers (which are of a sealed unit pad mount type) to surface or groundwater and the planned use of an environmentally-friendly, biodegradable transformer oil, specialized secondary spill containment (e.g., concrete walls around each transformer) is not considered necessary. The pad mounted transformers will be installed according to the requirements of the Canadian Electrical Code. Mitigation measures implemented as part of the facility's operating plan will include the monthly inspection of all transformers by facility maintenance personnel for signs of oil leakage. Spill control kits will be stored on-site and spill response/cleanup procedures implemented if a spill or oil leak is detected. Any faulty equipment that could result in an oil leak will be repaired or replaced by maintenance personnel. Implementation of these measures will ensure that significant adverse impact to the environment will be minimized.

3.1.2.4 Inverter Enclosures

The Project will have a total of ten prefabricated enclosures that will each house two 500 kW inverters, one shared 1 MVA pad-mounted transformer, switchgear and monitoring equipment. At this stage, the specific make and model of the enclosures have not been finalized. The SMA Sunny Central® 1000 MV enclosure has been selected as a representative inverter enclosure for the purposes of initial design and noise modeling. The dimensions of the enclosure are 5.4 m long by 3.0 m wide by 3.6 m high, and it weighs 35,000 kg. Manufacturer's product information is provided in Appendix B.

The enclosure will protect the inverters, transformer and switchgear from weather and provide sound insulation for the noise emanating from the inverters and the transformer. The enclosures are typically constructed with steel frames, galvanized metal wall posts and aluminum cladding. Each enclosure will sit on either a precast or a cast-in-place concrete pad and will have electrical power for lighting, heaters, cooling fans and equipment monitoring.

Air required for cooling the inverters will be drawn into the enclosure through ventilation openings in the exterior walls of the enclosure. Warm air generated from the inverters will be vented to the outside via ventilation openings in the enclosure.

3.1.2.5 Electrical Cabling

Electrical cabling, including DC cables from the solar PV modules to the inverters and AC cables from the inverters to the switch house yard, will be run underground in trenches. Trenches will typically be 1 m deep by 0.5 m wide and will be excavated using a 'ditch-witch' plough, backhoe or similar equipment. The cabling will be buried to a minimum depth of 915 mm and caution tape will be buried in the trench above the cables to warn of the presence of the underground cables. Once the cabling is laid, the trenches will be backfilled and levelled to match the existing grade. Where necessary, high density polyethylene (HDPE) conduits will be installed beneath road crossings and in areas of shallow bedrock to house and protect the cables.

3.1.2.6 AC Switch

An AC switch will be provided to integrate power flowing from the inverters into the switch house yard. The specific make and model of the switch have not been finalized, but is likely to be a S&C Vista switch or equivalent. The switch will be enclosed by a steel cabinet and sit on a concrete pad.

3.1.2.7 Main Step-Up Transformer

A main step-up transformer is not required for the Project since the Project will connect to the existing 27.6 kV local transmission line.

3.1.2.8 Switch House Yard and Switch House

The switch house yard will be located in the north-central portion of the Project site (Figure 2.1). Electrical equipment including the electrical control, switchgear, and protection and monitoring systems will be housed in a weatherproof switch house building enclosure. The electrical building will be prefabricated and brought on-site by transport truck and will sit on a precast or cast-in-place concrete pad. Any outdoor electrical cabinets, not housed in the electrical building, will be NEMA 4X rated weatherproof cabinets.

Power from the inverters will run underground to the switch house yard. Power will then be run overhead from the switch house yard to the existing Welland Hydro-Electric System Corp. (WHESC) 27.6 kV distribution line along Ridge Road.

3.1.2.9 Electrical Distribution Line and Connection Point

Connecting to the existing WHESC 27.6 kV distribution line along Ridge Road will require that about 40 m long overhead 27.6 kV distribution line be constructed between the Project switch house yard and the point of interconnection (POI) with WHESC distribution line (Figure 2.1). The Proponent will construct the transmission line from the switch house yard to the Project property line in accordance with the Ontario Electrical Safety Code. WHESC will construct the section of the line from the Proponent property line to the POI.

3.1.2.10 Communication Tower

A communication tower approximately 25 m high will be constructed adjacent to the switch house yard. During operation of the Project, the tower will provide transfer of facility operation data to WHESC.

3.1.3 Storm Water Management / Sediment and Erosion Control

As noted in Section 3.1.1.3, drainage works including grassed swales, ditches and roadside culverts will be designed and constructed as part of the facility civil components. Following construction, the entire site, with the exception of the access roads, will be re-vegetated with native grass or other suitable ground cover to promote surface water infiltration, filter storm water runoff and to prevent erosion. Overall, major alteration to the existing surface drainage patterns is not expected as part of the Project's construction and operation.

3.1.3.1 Storm Water Management

A conceptual storm water management study has been prepared for the Project (McIntosh Perry, 2011a), which estimated the following potential changes to storm water runoff flows as a result of the construction and operation of the Project:

Return Period	Existing Conditions Peak Flow (m^3/s)	Proposed Project Peak Flow (m^3/s)	Change (%)
5-yr	0.69	0.77	11.6
100-yr	1.33	1.49	12.0

Based on the predicted increases to runoff peak flows, the storm water management study recommended that storm water quantity controls be implemented as part of the Project Site Grading and Drainage Plan to mitigate the potential for adverse off-site effects such as erosion. This mitigation would consist of small concrete weirs constructed in the drainage swales to provide temporary, on-site storage of storm water runoff and peak flow attenuation to control the post-development peak flows to pre-construction levels.

The study also concluded that specialized storm water quality enhancement measures (e.g., extended detention storm water management pond) would not be necessary as the small amount of impervious surfaces and extensive vegetative cover within the Project Location will not result in any significant increase in sediment loading (i.e., suspended solids in the runoff) relative to pre-construction conditions (McIntosh Perry, 2011a).

The following storm water management practices are expected to effectively mitigate the potential minor effects of the Project on storm water runoff during operation of the Project:

- Existing drainage patterns within the Project Location will be maintained to the extent possible and/or as required to maintain the common law drainage rights of upstream or downstream riparian landowners.
- New drainage swales and channels will be constructed as enhanced (flat-bottom) grassed swales to provide extended flow times, filtering of runoff and reduction of the potential for erosion. As noted, small concrete weirs will be constructed within the drainage swales to provide temporary storage of storm water runoff to control the post-development runoff peak flows to existing condition levels (McIntosh Perry, 2011a).
- The vehicle parking area for maintenance personnel and all interior access roads will be constructed with gravel (i.e., no asphalt) to promote infiltration and reduce the quantity of storm water runoff.
- Rainfall runoff from the solar modules, inverter building rooftops, transformer concrete pads (if not enclosed in the inverter building), interior roads and parking area will be directed to grassed or vegetated areas, a minimum of 15-m wide, to promote infiltration and filtering of runoff by vegetation prior to its conveyance to on-site grassed swales.
- All transformers will use an organic based vegetable oil (e.g., BIOTEMP®, Envirotemp® FR3™), which is non-toxic, non-bioaccumulating and readily biodegradable in the environment. All

transformers will be routinely inspected and any faulty equipment that could result in an oil leak will be repaired. Spill response equipment will be left on site and any observed leaks will be cleaned up immediately by maintenance personnel.

3.1.3.2 Sediment and Erosion Control

A Sediment and Erosion Control Plan has been prepared for the Project (McIntosh Perry, 2011b), which identifies sediment and erosion control measures such as silt fence barriers, straw bale flow checks, rock flow check dams and rip rap protection at culvert outlets. These mitigation measures will be installed in accordance with OPSS to prevent soil erosion from occurring and to ensure that receiving watercourses are protected from erosion and sedimentation during construction of the Project. Further details of the Plan are provided in the Construction Plan Report (Hatch, 2011g)

Following the completion of construction, sediment and erosion control measures that are no longer required will be removed and disposed of off-site. Measures, such as rip rap protection at culvert outlets and rock flow checks in ditches will remain in place to provide erosion protection during operation of the Project. All sediment and erosion control measures will be routinely inspected, cleaned of sediment and debris, and repaired (as necessary).

3.1.4 Water Supply Facilities

The Project does not require any on-site facilities to supply groundwater (wells) or surface water (ponds, watercourses) for operation of the Project. It is anticipated that water from rain and snow will be sufficient for cleaning the solar PV modules. If not, the Proponent will contact local suppliers to provide water in tankers from off-site sources for this purpose. No chemicals will be used in the cleaning of the PV models.

3.1.5 Wastewater (Sewage) Facilities

The Project will not generate any wastewater (sewage) or discharge any liquid effluent from its operation nor does not the Project require any on-site facilities for the collection, transmission, treatment or disposal of wastewater for operation of the Project. During operation, since only two people will work at the Project on an intermittent/regular basis, sanitary facilities (e.g., permanent washrooms with a septic disposal system) are not required. If sanitary facilities are determined to be required, portable toilets, provided and serviced by a local sanitation company, will be used.

3.1.6 Waste Disposal Facilities

The Project will not generate significant quantities of waste from its operation. Small waste disposal bin will be provided on-site to collect any trash, debris or equipment parts replaced during routine maintenance of the Project during its operation. Periodically, as required, the Proponent will arrange for a licensed waste disposal company to empty the bins and haul the waste to an appropriate waste disposal facility off-site.

3.1.7 Exhaust Equipment

The Project has no facilities or equipment that will discharge contaminates or pollutants to the air (e.g., exhaust gases from emergency back-up diesel generators) during operation of the Project.

4. Facility Operation Plan

4.1 Operations

The Project will operate year round and generate electricity during daylight hours. The amount of power generated will depend on daily weather conditions and sufficient solar irradiation. The Project will be operated remotely and does not require a permanent on-site operator. Any damage or faults with the PV modules, trackers and electrical systems will be alerted to staff remotely and repaired (or replaced) by facility staff or qualified professionals. To ensure the safety and integrity of the Project facilities, access to the site will be limited to Project personnel and unauthorized public access to the site will be prevented by fences, gates and security measures.

A Project Facility Manager, appointed by the Proponent will be responsible for the day-to-day management of all Project facilities, including supervising site activities, site inspections, facility maintenance and repair. The Project Facility Manager, or his/her designate and/or other Proponent staff will be responsible for staff training, health and safety training and compliance, environmental regulatory compliance and public/municipal communications. For general monitoring and site maintenance purposes (Section 4.2), two part time or full-time local personnel will be hired and would be dispatched from a central operations office as needed. Proper health and safety procedures for on-site maintenance personnel will be in place as per provincial and federal regulations.

Operationally, there are no significant hazards involved in the operation of the Project, nor are hazardous materials stored on the site or created by the Project during its operation. The Project will not generate significant quantities of waste from its operation nor will the Project generate any wastewater (sewage) or discharge any liquid effluent from its operation.

Project operation will not result in the discharge of contaminates or pollutants to the air. The only noise emissions associated with the Project operation will be from the inverters and pad-mounted transformers, which will only operate during daylight hours. A Noise Study Report (Hatch, 2011i) involving computer modeling simulations of the Project has confirmed that the applicable Ministry of Environment (MOE) noise level limits will not be exceeded at the locations of the nearest noise receptors. Sound level monitoring, if required by MOE, as a condition in the REA for the Project will be implemented and annual compliance reports submitted to the MOE. In addition, the Proponent will use feedback obtained from nearby noise receptors to confirm that noise emissions are within allowable levels.

The Project operation will not result in significant visual disturbance due to reflectivity from the solar PV modules. A Reflectivity Study (IBI, 2011) has determined that all reflection from the modules will be directed upwards above the height of vehicles and residents in the area. The only exception to this would be when the PV modules receive routine maintenance and are left in a static position horizontal to the ground. In this position, light may be reflected horizontally from the panels at sunrise and sunset when the sun is low in the sky. These conditions would only be present during a bright sunny day and the duration of the impact would be between 10 to 15 minutes (IBI, 2011). The reflection would only affect specific viewing locations such as along Strawn Road and at locations west and east of the Project. Buildings located north and south of the Project would not be impacted due to the orientation of the PV modules and the angle of the sun (IBI, 2011). The presence

of the 2.7 m high security fence around the Project Location and the existing vegetation along the west and east sides of the Project Location will effectively mitigate any potential reflections that may impact the lands to the west and east of the Project Location (IBI, 2011).

The implementation of appropriate mitigation measures and the effects monitoring plan identified in Section 5 of this report will ensure that there will be no significant adverse on-going or residual effects to the environment from the operation of the Project.

4.2 Site Inspection and Maintenance

The Project solar PV modules, trackers, inverters and transformers and other electrical equipment as well as wiring and electrical connections will be routinely inspected, typically on a monthly basis. Any broken or malfunctioning PV modules, electrical cabling or components will be repaired or replaced by qualified facility staff. Trash, debris and equipment parts replaced during maintenance and repair activities will be collected and properly stored in a small waste disposal bin(s) provided on the site. All waste collected during operation of the Project will be removed from the site and managed according to provincial and municipal requirements.

The Project site grounds including vegetation coverage, drainage systems and trees will be monitored and maintained regularly. Since suitable ground cover will be established under the PV modules, some form of vegetation abatement such as grass cutting may be required several times throughout the summer months. No hazardous chemicals would be used for this vegetation control.

The site, including any constructed drainage features (e.g., grassed swales, culverts) and any sediment and erosion control measures (e.g., rip rap protection, rock flow checks) will be visually inspected for signs of erosion or sedimentation and recorded in a log book. Regular maintenance such as the cleanout of accumulated sediment and/or the removal of any debris blockage would be conducted at that time. If required, remedial works (e.g., stabilizing and/or reseeding of identified erosion areas) and repairs to any drainage features or sediment and erosion control measures will be promptly implemented to prevent environmental impacts.

The need to clean the solar PV modules will be determined by local weather conditions, such as the quantity and frequency of rain and snow at the Project Location. At the very most, it is expected that the modules will require cleaning quarterly, but it is possible that cleaning the modules will not be necessary at all. If required, water trucks will bring water to the site to supply the water required. No chemicals will be used for the cleaning of the modules.

The transformers will be visually inspected on a monthly basis and their status recorded in a log book. Any faulty equipment that could result in an oil leak will be repaired and any observed leaks will be cleaned up immediately by maintenance personnel. Spill response equipment will be stored on-site and kept in the maintenance trucks for use if a leak is observed.

During the winter, Project access roads will be ploughed to maintain access of personnel to Project facilities within the site. Under most winter conditions, snow on the modules is expected to either melt off due to the module heating in response to solar radiation or simply fall off as a result of the tracker motion. Under some conditions, manual snow removal may be performed by maintenance personnel who will clear the snow using a brush attached to a long pole.

5. Environmental Effects and Monitoring Plan

5.1 Environmental Effects and Mitigation Measures

Table 5.1 provides a summary of the potential negative environmental effects and proposed mitigation measures to prevent or minimize effects. Based on the assessment findings of potential effects conducted as part of this Design and Operations Report and implementation of the recommended mitigation measures, no significant residual negative effects are expected as a result of operation of the Project.

As previously noted, several other Project reports have documented potential negative environmental effects and mitigation measures. Persons seeking additional information on specific environmental resource features are referred to these reports. These reports and the context of the potential negative environmental effects are as follows:

- Project Description Report, which summarizes potential negative environmental effects for features within 300 m of the Project for construction, operation and decommissioning phases.
- Construction Plan Report, which identifies potential negative environmental effects caused by construction and installation of the Project for features within 300 m of the Project.
- Design and Operations Report, which identifies potential negative environmental effects caused by operation of the Project for features within 300 m of the Project.
- Decommissioning Plan Report, which identifies potential negative environmental effects caused by decommissioning the Project.
- Water Body Environmental Impact Study, which identifies potential negative effects to water body features including aquatic habitat and biota within 120 m of the Project for construction, operation and decommissioning phases.
- Noise Study Report, which identifies potential negative environmental effects (noise emissions) caused by the Project's electrical transformers and inverters during operation.
- Stage 1 & 2 Archaeological Assessment, which identifies potential negative effects to archaeological resources from construction activities.
- Natural Heritage Assessment Environmental Impact Study, which identifies potential negative effects to significant natural heritage features within 120 m of the Project for construction, operation and decommissioning phases.
- Conceptual Storm Water Management Report, which identifies potential negative effects to surface water runoff peak flows and water quality for construction and operation phases.
- Traffic Impact Study, which identifies potential negative effects to local traffic patterns from vehicles travelling to and from the Project Location for construction, operation and decommissioning phases.
- Groundwater Monitoring Scoping Report, which identifies a proposed groundwater monitoring program for water wells in proximity to the Project before and after construction.

- Reflectivity Study, which identifies potential visual disturbance from reflections from the solar PV modules during operation.

5.2 Environmental Effects Monitoring Plan

Table 5.2 presents the environmental effects monitoring plan for the Project operation, which includes the following information:

- The potential negative environmental effects, carried forward from Table 5.1, that have an ongoing risk of occurrence during Project operation.
- The performance objectives and mitigation strategies to address those effects.
- Monitoring protocols to confirm that performance objectives are being met.
- Contingency measures in the event that objectives are not met i.e., if monitoring reveals that negative effects are continuing to occur.

Mitigation measures identified in Table 5.2 are expected to either completely mitigate or reduce the scale of potential effects to such a minor level that quantifiable detection of residual effect(s) through specialized field measurements, sampling or laboratory analyses are not considered possible or necessary. Therefore, the recommended monitoring methods are based solely on qualitative, visual inspections and reporting methods to ensure compliance with the mitigation measures identified herein.

Monitoring will typically consist of monthly inspections of the Project Location throughout its operational life by Project maintenance personnel who will report directly to the Project Facility Manager. Maintenance personnel will ensure that all mitigation measures (e.g., sediment and erosion controls) are in place and functioning according to design specifications. If required, repairs will be made to mitigation measures and if necessary, remedial action such as implementing additional mitigation measures will be undertaken.

Table 5.1 Summary of Potential Negative Environmental Effects and Proposed Mitigation – Operation Phase

Environmental Component	Sources of Negative Effect	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
Natural Environment Components				
Soils	Wind and/or water erosion of soils within the Project Location.	Loss of soils from the Project Location, potentially affecting other environmental components (e.g., air quality, vegetation, surface water quality).	Standard erosion and sediment controls (e.g., proper slope grading, surface contouring, reseeding and replanting vegetation on exposed areas) typically installed during construction and maintained throughout Project's operation. Drainage features with erosion protection (e.g., grass lined or rip rap protection).	No residual effect given effective mitigation.
Groundwater	Decreased groundwater recharge (i.e., infiltration) due to addition of impervious (e.g., inverter buildings) and less pervious areas (e.g., gravel roads).	No adverse effect on groundwater recharge conditions is expected since the amount of impervious and less impervious areas is small. Effects to groundwater quality due to spills are discussed below.	Vegetation cover beneath solar modules and around Project components to promote infiltration and maintain soil moisture conditions will help offset minor reduction in infiltration due to addition of impervious and less impervious areas.	No residual effect given effective mitigation.
Surface Water Quantity	Increased surface water runoff from impervious (e.g., inverter buildings) and less pervious areas (e.g., gravel roads) and installation of new drainage swales, ditches and culverts.	Minor increase in runoff from Project Location to off-site receiving drainage swales, ditches and/or watercourses resulting in erosion (McIntosh Perry, 2011a). Potential adverse effects to receiving water quality due to increased turbidity in runoff due to soil erosion.	Vegetation cover beneath solar modules and around Project components to promote infiltration and reduce quantity of runoff. Sediment and erosion controls (e.g., rip rap protection) to prevent erosion. Storm water management measures (e.g., grassed swales with flow check dams) to control increases in runoff peak flows from the Project Location to pre-construction levels.	No residual effect given effective mitigation.
	Washing of solar panels during maintenance activities.	Minor increase in surface water runoff from the Project Location if all of the wash water does not infiltrate into the underlying soils.	Amount of water used for cleaning will be limited to the extent possible. Natural infiltration of wash water into underlying soils and storm water management measures will prevent any adverse off-site increase in runoff.	No residual negative effects anticipated. Washing of panels during summer will be positive benefit to vegetation and subsoils beneath the solar panels.
Surface Water Quality	Wind and/or water erosion of soils within the Project Location.	Erosion of soils from the Project Location could result in adverse effects on surface water quality in receiving waterbodies, with associated effects on aquatic biota and habitat.	Sediment and erosion controls installed and maintained during construction and decommissioning. Dense non-invasive vegetation ground cover planted throughout disturbed areas of the Project Location following construction. Drainage features with erosion protection (e.g., grass lined or rip rap protection) during operations.	No residual effect given effective mitigation.
	Washing of solar modules during maintenance activities.	Adverse effects on the quality of the surface water running off the panels if cleaning agents used.	Rainfall is expected to be sufficient for cleaning purposes otherwise water will be brought on-site. If water from off-site is required, the amount used will be less than that occurring during a normal rainstorm event. No cleaning solutions will be used.	No residual effect given effective mitigation.
	Runoff of herbicide residue if used to control vegetation.	Adverse effects on surface water quality due to potential use of herbicides to control vegetation communities.	Vegetation will be properly managed and maintained using mechanical methods (grass mowing, tree branch trimming); no chemical herbicides will be used for vegetation control. Some very limited herbicide use may be required to control weeds around electrical equipment and if so, in accordance with all local and provincial procedures.	No residual effect given effective mitigation.
Aquatic Habitat and Biota	Erosion, increases in surface water runoff or accidental spills on Project Location.	No direct effects since no watercourses within 170 m of the Project Location. Adverse effects on aquatic habitat and biota if indirect effects occur in watercourses off the Project Location.	Mitigation measures for other environmental components (e.g., Soils, Surface Water, Spills) will mitigate any potential adverse impacts to aquatic features located off-site.	No residual effect given effective mitigation.
Wildlife	Presence of Project components and long-term alterations in habitat conditions on Project Location.	Altered wildlife habitat use within the Project Location. No adverse effects on the form or function of the woodland habitat east of the Project Location.	Ground cover vegetation in and around the solar panel arrays will provide wildlife habitat for bird, reptile and small mammal species. Sediment and erosion controls and storm water management mitigation measures implemented during construction will prevent adverse off-site effects to wildlife habitats.	Long-term wildlife use of the Project Location will be altered, but no overall change in local composition or population is anticipated to occur. No residual negative effects to off-site wildlife habitats.

Environmental Component	Sources of Negative Effect	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
	Maintenance vehicles and activities (e.g., grass cutting) and installation of the fence around the Project Location.	Disturbance of wildlife due to maintenance equipment noise and human presence resulting in wildlife avoidance of Project Location. Restricted wildlife movement across Project Location due to fence. Incidental take of wildlife due to collisions with maintenance vehicles or activities (e.g., grass cutting).	Vehicle speeds on Project access roads will be restricted. Maintenance workforce will be alerted to the potential for wildlife and that measures should be taken to avoid wildlife wherever possible. If wildlife are observed on the Project Location, they will be either directed off of the site or collected by a designated employee using approved handling procedures and released off-site. If possible, maintenance activities (e.g., grass cutting) will avoid breeding bird season of ground nesting birds May through early July.	Minor potential for incidental take of wildlife due to maintenance vehicles or vegetation mowing. Overall, disturbance to wildlife due to maintenance activities is expected to be less than existing disturbance due to agricultural activities.
Socio-Economic Environmental Components				
Air Quality	Emissions from Project operations and maintenance vehicles.	Project operation will not discharge any pollutants into the air and emissions from maintenance vehicles or equipment (e.g., grass mowers) will be negligible.	None required.	None.
Noise	Noise emissions from transformers and inverters and/or from maintenance vehicles or equipment (e.g., grass mowers).	Disturbances to nearby sensitive receptors (i.e., houses and institutions) due to noise emissions.	Inverters and transformers will be housed in a building enclosure that will provide mitigation of noise emissions from this equipment. Proponent will conduct auditory monitoring and obtain feedback from nearby noise receptors to confirm that noise emissions are within reasonable levels. Facility personnel to ensure maintenance vehicles and equipment have proper sound baffling equipment (e.g., mufflers) and work is done in compliance with municipal Noise Control By-Law.	Noise emissions will meet Ministry of Environment's requirements for rural area sound levels of 45 dBA for day time and 40 dBA for night time at the nearest noise receptors.
Public and Facility Safety	Facility equipment malfunction, fire or accidents resulting in injury to public or maintenance personnel.	Personal injury to the public if trespassing on-site or to facility maintenance personnel due to accidents, fire or equipment malfunction.	Public access to the site will be prevented by fences, gates and security measures. Proper health and safety procedures for on-site maintenance personnel will be implemented as per provincial and federal regulations.	Mitigation will reduce risk to public and facility safety, but some risk to maintenance personnel will remain throughout Project operation.
Traffic and Municipal Roadways	Facility operation and maintenance personnel travelling to and from the Project.	None. The number and frequency of facility personnel travelling to the Project is negligible (McIntosh Perry, 2011b).	None required.	None.
Change in Visual Landscape	Presence of facility.	Portions of the facility will be visible from Ridge Road and Strawn Road and from adjacent properties. This may be perceived as a negative effect.	Retain trees and vegetation along Project Location to extent possible to provide natural screening. If necessary, plant trees or shrubs or construct landscaping berms or fences to provide a visual barrier based on viability and effectiveness.	Long-term change in local visual landscape. Visual disturbance reduced with implementation of visual barriers.
Reflectivity	Reflection from solar PV modules during early morning and late day when sun is low if the modules are left in a horizontal static position (i.e., for maintenance).	Some minor potential for reflections to vehicles on Strawn Road and lands west and east of the Project Location for short periods of time if the modules are left in a horizontal static position for maintenance (IBI, 2011).	The 2.7 m high fence and existing vegetation will prevent/minimize any adverse reflectivity effects. If complaints from adjacent landowners are received, areas of potential human impact will be assessed and the area screened with vegetation.	None.
Property Values	Presence of the Project within the local rural community and changes due to visual aesthetics and noise emissions from the site.	Installation of the facility has the potential, though unproven, to result in a change in the value of nearby properties based on aesthetic preference of potential landowners. Though subjective, the potential reduction in property values for the purpose of this assessment is considered a potential negative effect.	Mitigation measures to minimize visual disturbance to neighbouring properties and noise emissions that could potentially be audible will minimize the impact of the facility on neighbours, which will in turn, reduce impacts on property values.	Potential reduction in property values if buyers subjectively feel that the Project poses a potential impact to them.
Availability of Resources	Presence of the Project within an area identified as a potential aggregate, petroleum or mineral resource area.	None expected since these resources are not known to be present on the Project Location. If present, the impact would be a potential loss of access to these resources during the life of the Project. The future availability of the resources would not be changed.	None required.	Loss of access to potential aggregate, petroleum or mineral resources within the Project Location during the life of the Project. Actual potential to develop those resources during that time period is unknown.
Recreational Land Use	Presence of the Project and associated fencing.	None expected since no recreational resources (e.g. trails) are present on the Project Location.	None required.	None.

Environmental Component	Sources of Negative Effect	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
Effects due to Accidental Spills				
Groundwater, Surface Water, Soil Quality, Vegetation, Aquatic Habitat and Biota	Accidental spills or leakage of fuel, oil, hydraulic fluid, etc., from maintenance vehicles or equipment, on-site refuelling or storage of toxic liquids on-site. Accidental spills of transformer oil from inverter transformer.	Impairment of groundwater, soil and/or surface water quality due to contamination. Potential adverse effects to aquatic habitats and vegetation.	Facility personnel will be trained in spill response procedures. Spill control kits will be stored on-site and spill response/cleanup procedures implemented if a spill or oil leak is detected and MOE notified if required. No refuelling or storage of toxic liquids on-site within 30 m of a watercourse. Inverter transformers will sit on a concrete pad with no hydraulic connection (e.g., piping, drains) to surface or groundwater. Substation transformer will have secondary spill containment around the transformer. All transformers will use an organic based oil (BIOTEMP®, Envirotemp®FR3™) that is non-toxic and biodegradable. All transformers will be inspected by facility maintenance personnel for signs of oil leakage.	None. Mitigation and procedures for transformer equipment inspection, monitoring and spill response/cleanup are anticipated to be effective in preventing residual negative effects.

Table 5.2 Environmental Effects Monitoring Plan – Operation Phase

Negative Effect	Mitigation Strategy	Performance Objective	Monitoring Plan					Contingency Measures
			Methodology	Monitoring Locations	Frequency	Rationale	Reporting Requirements	
Erosion and sedimentation resulting in increased turbidity in site runoff.	Vegetation to prevent erosion due to storm water runoff.	No long term erosion from site over and above existing conditions	Visual monitoring of vegetated areas and drainage features that convey runoff to identify areas of erosion (e.g., rills, gullies).	Throughout Project Location.	Monthly during site inspections.	Visual monitoring of erosion would identify potential areas of concern.	Reported in annual operational environmental monitoring report.	Erosion remediated as necessary to ensure no long-term erosion issues.
Potential for adverse surface water, groundwater and soil quality due to accidental spills.	Standard mitigation to prevent spills and minimize magnitude of spills if they occur.	No long-term environmental effects due to spills.	Visual monitoring where hazardous liquids may be stored, maintenance areas and at transformer locations and monitoring of spill prevention measures.	Throughout Project Location.	Monthly during site inspections.	Visual monitoring would identify potential areas of concern and ensure that spill prevention and control measures are functioning as designed and protocols are being implemented as specified in plans to meet performance objectives.	Reported in annual operational environmental monitoring report.	Spill contingency measures implemented as necessary in the event of a spill. Following spill event, response will be reviewed to determine if additional or altered response protocols are necessary to meet performance objectives.
Increases in surface water runoff from Project Location.	Storm water management measures including enhanced vegetated swales, ditch flow controls and filter strips.	Minimize changes to surface water runoff conditions to receiving waterbodies.	Visual assessment of structural stability of mitigation measures and identification of unintended impacts.	Throughout Project Location.	Monthly during site inspections.	Visual monitoring will confirm that storm water management measures remain as designed and allow identification of deficiencies.	Reported in annual operational environmental monitoring report.	Storm water management measures will be remediated as necessary to ensure that they are functioning as designed.
Incidental take of wildlife.	Speeds to be limited on Project location and maintenance workforce to be made aware of potential for wildlife on the Project location.	Avoid occurrences of incidental take.	Visual monitoring of access roads and other site areas will be conducted by maintenance personnel and occasions of incidental take reported as they are identified.	Throughout Project location.	Ongoing during maintenance activities.	Incidental take will be reported by maintenance staff to the on-site personnel responsible for environmental protection if incidents occur.	No requirement; unless the incident involves a species of conservation concern in which case reporting will be immediate to the MNR/Environment Canada.	If incidental take of species of conservation concern are recorded, work will be ceased until such time as a trained biologist can state that the species is no longer present in the area.
Noise levels disturbing nearby noise receptors.	Inverters and transformers to be enclosed in sound dampening buildings to minimize noise emissions.	To minimize noise emissions at nearby noise receptors to the provincial guideline values.	Sound level monitoring, if required by MOE, as a condition in the REA for the Project. Otherwise, auditory monitoring and feedback from nearby noise receptors will confirm that noise emissions are within allowable levels.	At the closest sensitive receptors.	As per the frequency documented in the REA issued for the Project.	Auditory monitoring will confirm that noise emissions from the Project meet performance objectives.	Reported in annual operational environmental monitoring report.	If Project components are not meeting performance objectives, noise barriers will be installed as necessary.
Personal injury to public if trespassing or maintenance personnel due to accidents or malfunctions.	Public access to site will be prevented by fences, gates and security measures. Proper health and safety procedures for maintenance personnel.	Elimination of risk of personal injury to public and workers due to accidents or mishaps.	Site security monitoring will be ongoing to confirm adequacy of security measures.	Throughout the Project Location and facility perimeter.	Continuously, throughout operation.	Site security monitoring will identify any breach in facility security.	Incidents of trespassing or vandalism will be reported to local police and recorded by the Proponent.	Additional security measures or health and safety protocols will be implemented as required.

Negative Effect	Mitigation Strategy	Performance Objective	Monitoring Plan					Contingency Measures
			Methodology	Monitoring Locations	Frequency	Rationale	Reporting Requirements	
Installation of the Project will result in a change to the local landscape. This may be perceived as a negative environmental effect.	Visual barriers will be implemented as necessary.	Elimination/reduction in visual disturbance to nearby property owners.	Concerns and complaints regarding visual disturbance and adequacy of visual barriers will be documented by the Proponent	To be determined.	As required.	Documentation of visual disturbance and adequacy of visual barriers by local residents will result in evaluation of visual barrier necessity or effectiveness.	Internal reporting to be determined by the Proponent.	Visual barriers will be installed/upgraded as necessary.
Potential visual disturbance to adjacent observers due to reflections from solar panels.	The 2.7 m high fence and existing vegetation will prevent/minimize reflectivity effects.	To minimize reflectivity during early morning and late day when the sun is low.	If complaints from adjacent landowners are received, areas of potential human impact will be assessed and the area screened with vegetation.	Throughout Project Location.	As required.	Documentation of visual disturbance complaints will identify potential areas of concern that may require remediation.	Internal reporting to be determined by the Proponent.	Vegetation screens will be remediated as necessary to ensure that they are successfully blocking reflections.

6. Emergency Response and Communications Plan

The following describes the implementation of the Project Emergency Response and Communications Plan as it pertains to the construction and operation phases of the Project. A similar plan is provided for the decommissioning phase of the Project in the Decommissioning Plan Report.

6.1 Emergency Response

The Project Emergency Response Plan will be implemented through the construction and operations phases of the Project. The purpose of the plan is to establish and maintain emergency procedures required for effectively responding to accidents and other emergency situations, and for minimizing associated losses. Potential emergency scenarios which could occur during the construction and operation phases include fire, personal injury and spills incidents. The following provides the emergency response and communications procedures to be used in response to these three potential emergency scenarios.

All Project personnel will be trained in the following emergency response and communications procedures. Any non-Project personnel visiting the site will be required to participate in a safety awareness induction process prior to entering the site, wear appropriate personal protective equipment (e.g., safety shoes, hard hats) and will be required to be accompanied by Project personnel when on-site.

Note that during the operation of the Project, the Proponent will establish a 24-7 remote monitoring system to react to any Project specific emergencies. In the event of an emergency, the Proponent will mobilize its resources to the site to respond to the event.

6.1.1 Fire

Fire extinguishers will be located in strategic locations such as Project vehicles, the switch house electrical building and inverter/transformer buildings. During construction and operation, a sign will be erected near the front gate of the facility. The sign will include instructions to call 911 and to call a Project phone number should a passerby notice an emergency.

If a fire occurs, Project personnel will attempt to extinguish it, only if it is safe to do so. If there is any risk of personal injury, extinguishing the fire will not be attempted. If a fire cannot be extinguished using the hand-held extinguishers, the Project area will be evacuated and Project personnel will immediately call 911 to summon the local fire department (and ambulance if required). Project personnel will notify inhabitants at all adjacent properties if the fire appears able to move off of the Project site. All staff on site during the life of the Project will be trained in the procedure to deal with a fire and the use of an extinguisher.

All incidents will be documented and kept on file. Documentation will include date of incident, date of reporting, name of reporter, description of the incident, cause of the incident, actions taken, communications to outside groups and internal personnel and follow-up required.

6.1.2 Personal Injury

During the construction phase, the work will be completed by Contractors, who will establish their own Health and Safety (H&S) program in accordance with the *Ontario Occupational Health and*

Safety Act. During operations, the Proponent will similarly established their own H&S program to be followed by facility personnel.

Should a personal injury occur on site that does not require an ambulance, the injured person will be treated on-site and if necessary, transported to the hospital. First-aid supplies and maps to the local hospitals will be kept in the construction trailer (Construction phase) and in the switch house electrical building (operations phase). If the injury is more severe, Project personnel will call 911 and assist the injured person until emergency personnel arrive.

In all cases of personal injury, the Project Construction Manager and the Project Facility Manager will be notified immediately. All incidents will be documented and kept on file. Documentation will include date of incident, date of reporting, name of reporter, name of injured, description of the incident, cause of the incident, actions taken, communications to outside groups and internal personnel and follow-up required, as required by Health and Safety Regulations.

6.1.3 Spills

The following spills procedures are as outlined in the Ministry of Environment's (MOE) "Spills Reporting – A Guide to Reporting Spills and Discharges" dated May 2007. Spills and the types of spills that require reporting are defined in the Ontario Environmental Protection Act and Ontario Regulation 675/98 Classification and Exemption of Spills and Reporting of Discharges.

Spills are the unintended release/discharge of material to air, land or water. The most likely spill scenarios could include sewage from portable washrooms, an oil leak from a transformer, a fuel or oil leak from a vehicle or a spill from improper handling, or a hazardous material leak from a container (if stored on the site) or a spill from improper handling.

Spills prevention measures are documented in the Natural Heritage Assessment Environmental Impact Report (Hatch, 2011d). Should a spill occur, the following procedures will be implemented by the Project personnel trained to respond to spills:

- Evaluate the scene for risks to human health and safety.
- Stop the spill, if it is safe to do so.
- If there is immediate danger to human health, contact 911 for assistance, and notify anyone who may be directly impacted or is in harm's way.
- During the operation phase, notify the Project Facility Manager of the incident. During the construction or decommissioning phase, notify the Contractor and the Project Manager.
- Contain and clean-up the spill using the on-site spill kit.
- If required, contact the outside spill response contractor for assistance.
- Document and report the spill to outside agencies, as required.

A spill kit will be available on-site during the construction, operation and decommissioning phases and will contain equipment necessary for spills response. This will include absorbent pads, absorbent boom, polyethylene bags, neoprene gloves, protective goggles, plastic bins or metal drums, and multi-purpose granular sorbents.

Spills that could potentially occur during the life of the Project, and may need to be reported to the MOE include:

- Non-approved releases/discharges (including those to land, air and water)
- Discharge of fluids greater than 100 L from a vehicle
- Mineral oil releases greater than 100 L from an electrical transformer
- Discharges (including sediment) to waterbodies.

The Ministry of the Environment Spills Action Centre phone number (1-800-268-6060) will be posted in the main construction trailer during construction and in the Project switch house electrical building or equivalent building during operation.

Documentation for all spill incidents will be kept on file and sent to the Ministry of the Environment, as required. Documentation will include date of incident, date of reporting, name of reporter, description of the incident, cause of the incident, type and amount spilled, actions taken, disposal of contaminated material, communications to outside groups and internal personnel and follow-up required.

6.2 Communications Plan for Non-Emergencies

During the construction and operation phases of the Project, a sign will be erected at the gate of the facility which will include the Proponent's contact information (telephone number, e-mail and mailing address) should the public have any questions, inquiries or complaints. All inquiries will be directed to the Proponent's Project Manager who will respond to the inquiry accordingly. All inquiries will be logged electronically with the following information: date of question, inquiry or complaint, name, phone number, email address of the individual, response, date of response, and any follow-up issues.

Should such conditions arise that the general public requires notification (such as Project changes requiring notifications), the public will be notified through newspaper and direct/general mailout, if required. Should agencies such as the local municipality or the Ministry of the Environment require notification, they will be sent the information directly by email, mail or telephone conversation. All communications will be documented and kept on file by the Proponent.

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Paul D. Holmes
PDH:ll

Appendix A

Site Layout Plan

WELLAND RIDGE ROAD SOLAR PROJECT

PART OF LOTS 14 AND 15, CONCESSION 7, CITY OF WELLAND, ON

SOLAR ELECTRIC SYSTEM PROJECT - 10.0 MW AC

VICINITY MAP:

PROJECT SCOPE:

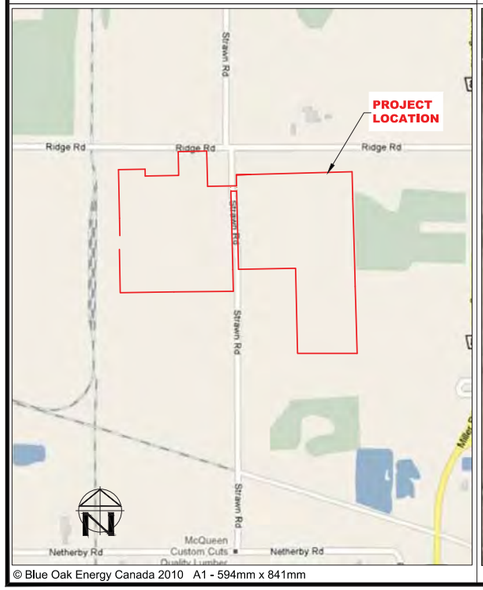
SOLAR ELECTRIC SYSTEM

THE PROPOSED PROJECT IS A RENEWABLE ENERGY GENERATION FACILITY WHICH WILL USE SOLAR PHOTOVOLTAIC TECHNOLOGY TO GENERATE ELECTRICITY. ELECTRICITY GENERATED BY SOLAR PHOTOVOLTAIC PANELS WILL BE CONVERTED FROM DIRECT CURRENT (DC) TO ALTERNATING CURRENT (AC) BY INVERTERS, WHICH WILL ALSO STEP-UP THE VOLTAGE TO 27.6 kV PRIOR TO BEING CONNECTED TO THE EXISTING LOCAL DISTRIBUTION LINE, TO MEET ONTARIO POWER AUTHORITY'S (OPA) FEED-IN-TARIFF (FIT) PROGRAM REQUIREMENTS. A SPECIFIC PERCENTAGE OF EQUIPMENT WILL BE MANUFACTURED IN ONTARIO. THIS PROJECT IS CLASSIFIED AS A CLASS 3 SOLAR FACILITY AND THEREFORE REQUIRES A RENEWABLE ENERGY APPROVAL (REA).

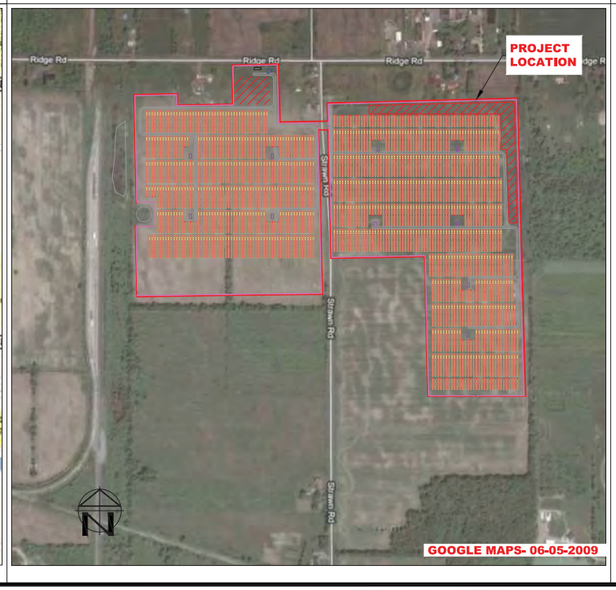
THE SYSTEM WILL BE INTERCONNECTED AND WILL BE OPERATED IN PARALLEL WITH THE ENERGY PROVIDER'S ELECTRIC GRID AS PER THE REQUIREMENTS OF THE ONTARIO ELECTRICAL SAFETY CODE (OESC).

DRAWING INDEX:

STREET MAP:



AERIAL VIEW:



PROJECT TEAM:

PROJECT CONTACT:

PROJECT: BELLEVILLE TS DEMORESTVILLE SOLAR PROJECT
AXIO POWER CANADA INC/SUNEDISON CANADA
945 PRINCESS STREET, SUITE 252
KINGSTON, ON, K7L 3N6
CONTACT: ROBERT BARKLEY
TEL: (613) 545.0215
FAX: (613) 545.0692
EMAIL: rbarkley@sunedison.com

DESIGN ENGINEERING FIRM:

BLUE OAK ENERGY
1560 DREW AVENUE
DAVIS, CA 95618
CONTACT: RYAN ZAHNER, PE
TEL: (530) 747.2026

ELECTRICAL ENGINEER:

PRELIMINARY DRAWING
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NOT FOR CONSTRUCTION

DATE: X-XX-XXXX

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1560 Drew Avenue, Davis, CA 95618
www.blueoakenergy.com - Phone: 530.747.2026

Axio Power Canada Inc/
SunEdison Canada

945 PRINCESS STREET, SUITE 252
KINGSTON, ON K7L 3N6

PROJECT SITE:

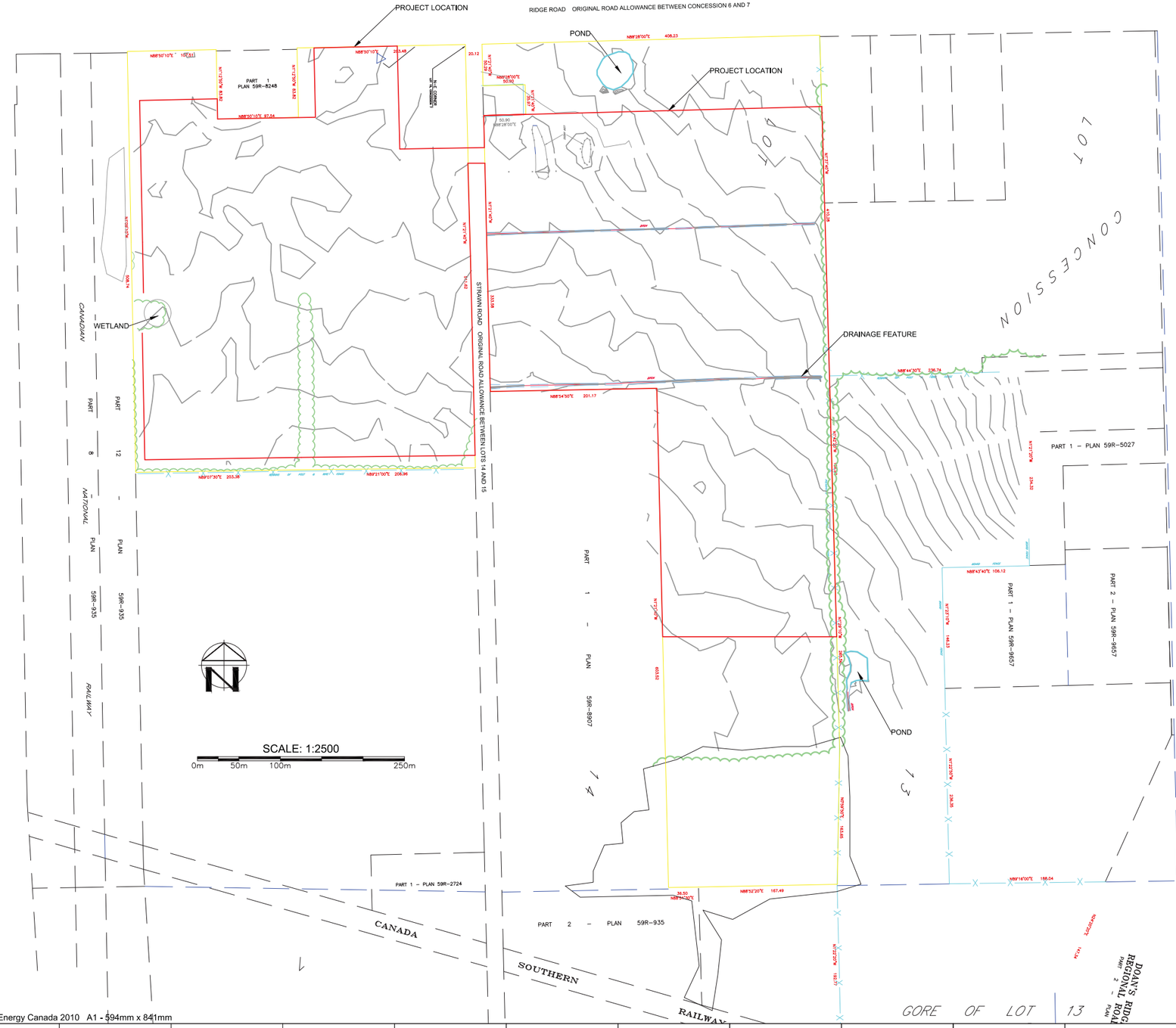
WELLAND
RIDGE ROAD
SOLAR PROJECT
PART OF LOTS 14 AND 15, CONCESSION 7
CITY OF WELLAND, ON

DRAWING:

TITLE SHEET

DRAWING NO.

G-001



© Blue Oak Energy Canada 2010 A1 - 594mm x 841mm

NOTES:

1. SEE PROJECT CIVIL DRAWINGS FOR OFFICIAL LANDMARKS, SITE INFORMATION AND SURVEYING. SHOWN HERE AS REFERENCE ONLY.

LEGEND

- POND
- BUSH BUFFER
- DRAINAGE FEATURE
- PROJECT LOCATION
- SITE BOUNDARY

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PROJECT SITE:

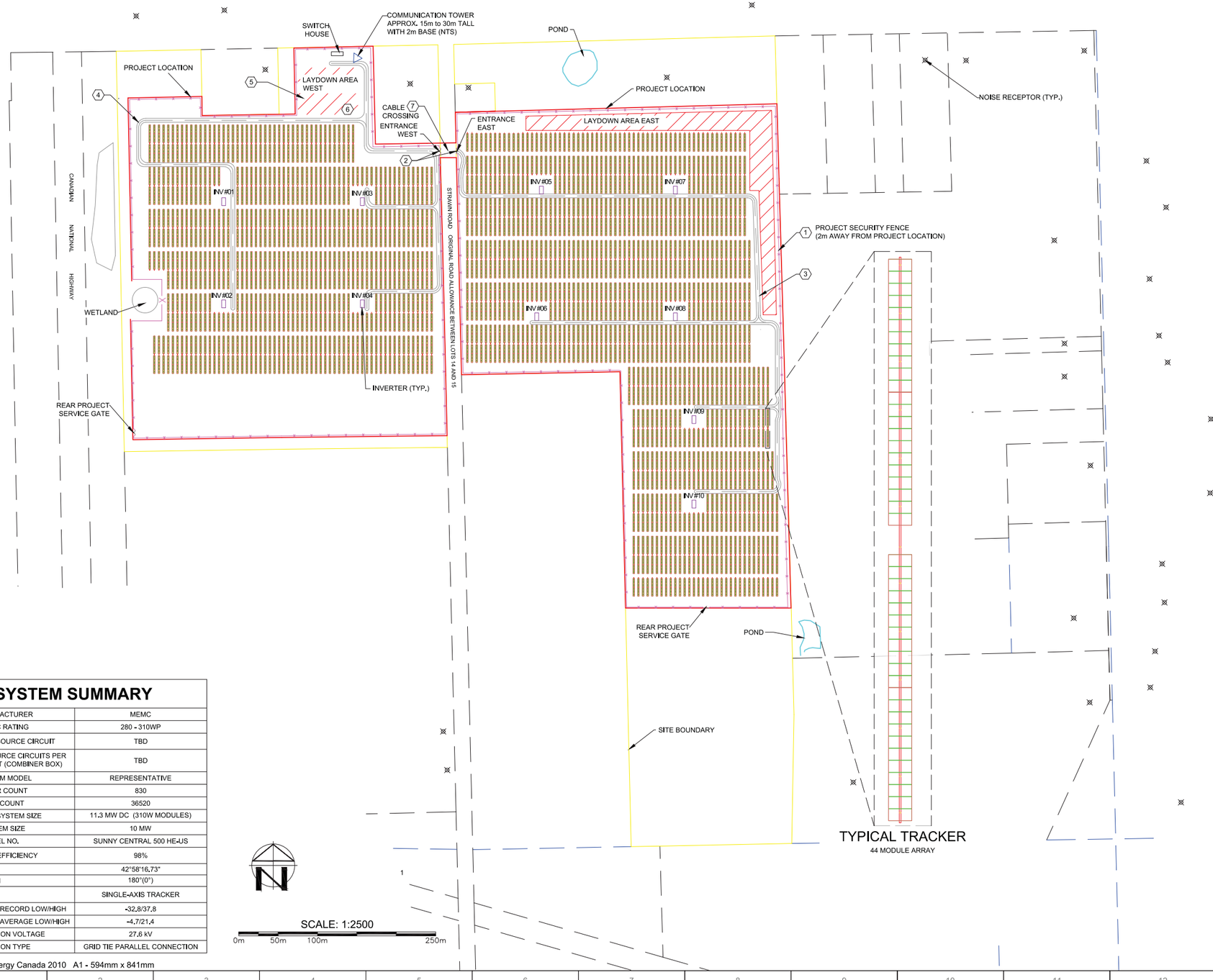
WELLAND RIDGE ROAD SOLAR PROJECT

PART OF LOTS 14 AND 15, CONCESSION 7
CITY OF WELLAND, ON

DRAWING: EXISTING SITE PLAN

DRAWING NO.

ES-101



SYSTEM SUMMARY

MODULE MANUFACTURER	MEMC
MODULE STC DC RATING	280 - 310WP
MODULES PER SOURCE CIRCUIT	TBD
MAX NO. OF SOURCE CIRCUITS PER OUTPUT CIRCUIT (COMBINER BOX)	TBD
RACKING SYSTEM MODEL	REPRESENTATIVE
TOTAL TRACKER COUNT	830
TOTAL MODULE COUNT	36520
TOTAL STC-DC SYSTEM SIZE	11.3 MW DC (310W MODULES)
TOTAL AC SYSTEM SIZE	10 MW
INVERTER MODEL NO.	SUNNY CENTRAL 500 HE-US
INVERTER CEC EFFICIENCY	98%
SITE LATITUDE	42°58'16,73"
ARRAY AZIMUTH	180°(0°)
MODULE TILT	SINGLE-AXIS TRACKER
AMBIENT TEMP: RECORD LOW/HIGH	-32,8/37,8
AMBIENT TEMP: AVERAGE LOW/HIGH	-4,7/21,4
INTERCONNECTION VOLTAGE	27,6 kV
INTERCONNECTION TYPE	GRID TIE PARALLEL CONNECTION

NOTES:

1. SINGLE-AXIS TRACKER SOLAR ARRAY WITH DC WIRING AND COMBINER BOXES ABOVE GROUND, DC CABLING FROM COMBINER BOXES TO ROUTE UNDERGROUND TO INVERTER / POWER ENCLOSURES.
2. INVERTER / POWER ENCLOSURES TO BE LOCATED WITHIN ARRAY AREA TO COLLECT DC POWER, CONVERT AND OUTPUT MEDIUM VOLTAGE AC POWER
3. DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
4. SEE TRACKER DETAIL DRAWINGS ON SHEET S-101.
5. CONTACT, COORDINATE AND ATTAIN APPROVAL FROM AGENCIES HAVING EASEMENTS AND ROW SPACING IN PROJECT AREA.
6. PV MODULES TO BE MEMC 310W OR EQUIVALENT.

KEYED NOTES:

1. PROJECT SECURITY FENCE, 2.7m (9 FT) TALL, SET APPROXIMATELY 2m INSIDE PROJECT LOCATION LINE.
2. DOUBLE SWING GATES, 2.5m EACH SECTION.
3. SERVICE ROAD, SEE SECTION DETAILS IN S-101.
4. 9m TURNING RADII AT ROAD CENTER LINES ON PERIMETER SERVICE ROAD AND ON TRANSITIONS TO INTERIOR SERVICE ROADS TO MEET TYPICAL SAFETY AGENCY REQUIREMENTS.
5. AREA AROUND GATES AND SWITCH HOUSE COMPACTED, SLOPED FOR DRAINAGE AND TOPPED WITH 'ROAD BASE' ROCK AND SAND MIXTURE. PROVIDES PARKING FOR APPROX 10 VEHICLES.
6. LAYDOWN AREA TO BE COMPACTED NATIVE SOIL ALLOWING TEMPORARY PARKING, STORAGE, ETC. DURING CONSTRUCTION. TO BE FINISH GRADED AND SEEDED AT END OF CONSTRUCTION.
7. ELECTRICAL CABLE CROSSING BENEATH STRAWN ROAD(BELOW GRADE). NO FENCE CROSSING STRAWN ROAD.

ELECTRICAL ENGINEER:

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PROJECT SITE:

WELLAND RIDGE ROAD SOLAR PROJECT

PART OF LOTS 14 AND 15, CONCESSION 7
CITY OF WELLAND, ON

DRAWING: ARRAY PLAN

DRAWING NO. ES-102

SUNNY CENTRAL 500HE-US INVERTER

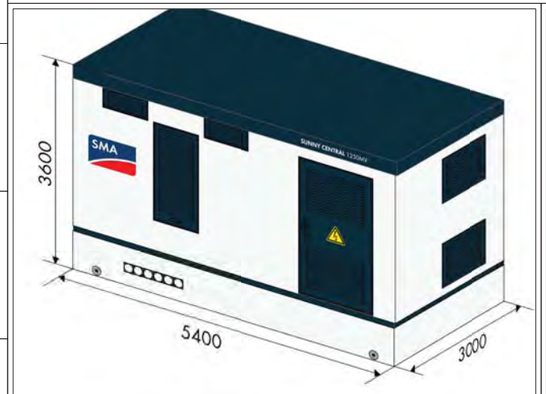
High Yields
- 98% CEC efficiency
- Suitable for ambient temperatures of up to 60 °C (140 °F)
- OptiCool™ intelligent temperature management

Low System Costs
- Outdoor-rated enclosure
- Couples to medium-voltage external transformer
- Available as integrated solution

Strong Peripherals
- Optional DC & AC disconnects
- Optional combiner boxes with string monitoring
- Sunny WebBox, Modbus® & OPC compatible

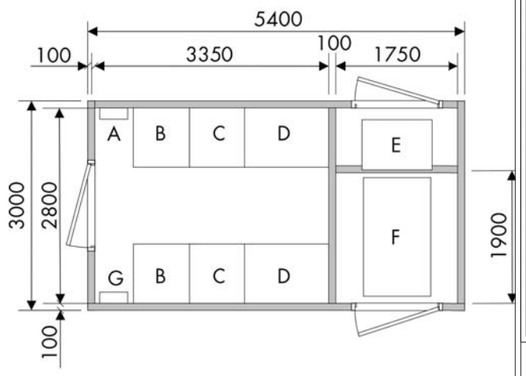
UL Certified
- UL 1741 / IEEE-1547 compliant

Technical data	Sunny Central 500HE-US
Input data	
Max. DC power	565 kWp [1]
MPP voltage range	330 V – 600 V
Max. DC voltage	600 V
Feed starting at [U] / [P]	380 V / 5000 W
Max. DC current	1600 A
Number of DC inputs	6 – 9
Output data	
Nominal AC power	500 kVA @ 45 °C (113 °F)
Max. AC current	1470 A @ 200 V
AC grid frequency	60 Hz
AC voltage range	180 V – 220 V
AC voltage range, full active power	196 V – 210 V
Power factor (cos φ)	> 0.99
Max. THD	< 5%
Efficiency [2]	
Max. efficiency	98.6%
CEC efficiency	98.0%
Euro-eta	97.9%
Ambient conditions	
Operating temperature range	–25 °C ... +60 °C (–13 °F ... +140 °F)
Max. temperature for nominal conditions	+45 °C (+113 °F)
Protection rating	NEMA 3R
Installation indoors / outdoors	●/●
Rel. humidity	15% ... 95%
Fresh air consumption	3000 m³/h
Internal consumption at nominal power	< 1600 W
Standby consumption (P_{night})	< 110 W
Dimensions and weight	
Height	2277 mm (90 in)
Width	2562 mm (101 in)
Depth	956 mm (38 in)
Weight	< 1800 kg (3970 lb)
Certificates / listings	
Certificates	UL 1741, UL 1998, IEEE 1547
EMC conformity	FCC, Part 15, Class A
Interfaces	
RS485 / Ethernet / analog	o/o/o
Display: text line / graphic	–/●
Communication protocols	Modbus / TCP
SSM-US connection	RS485
Plant monitoring	Sunny Portal



All figures in mm.

A COM-B, optional
C Sunny Central, inverter cabinet
E Medium-voltage switchgear
G Station sub-distribution



B Sunny Central, DC cabinet
D Sunny Central, AC cabinet
F Transformer

EQUIPMENT SPECIFICATIONS
SCALE: NTS

NOTES:
1. NONE.

KEYED NOTES:
1. NONE.

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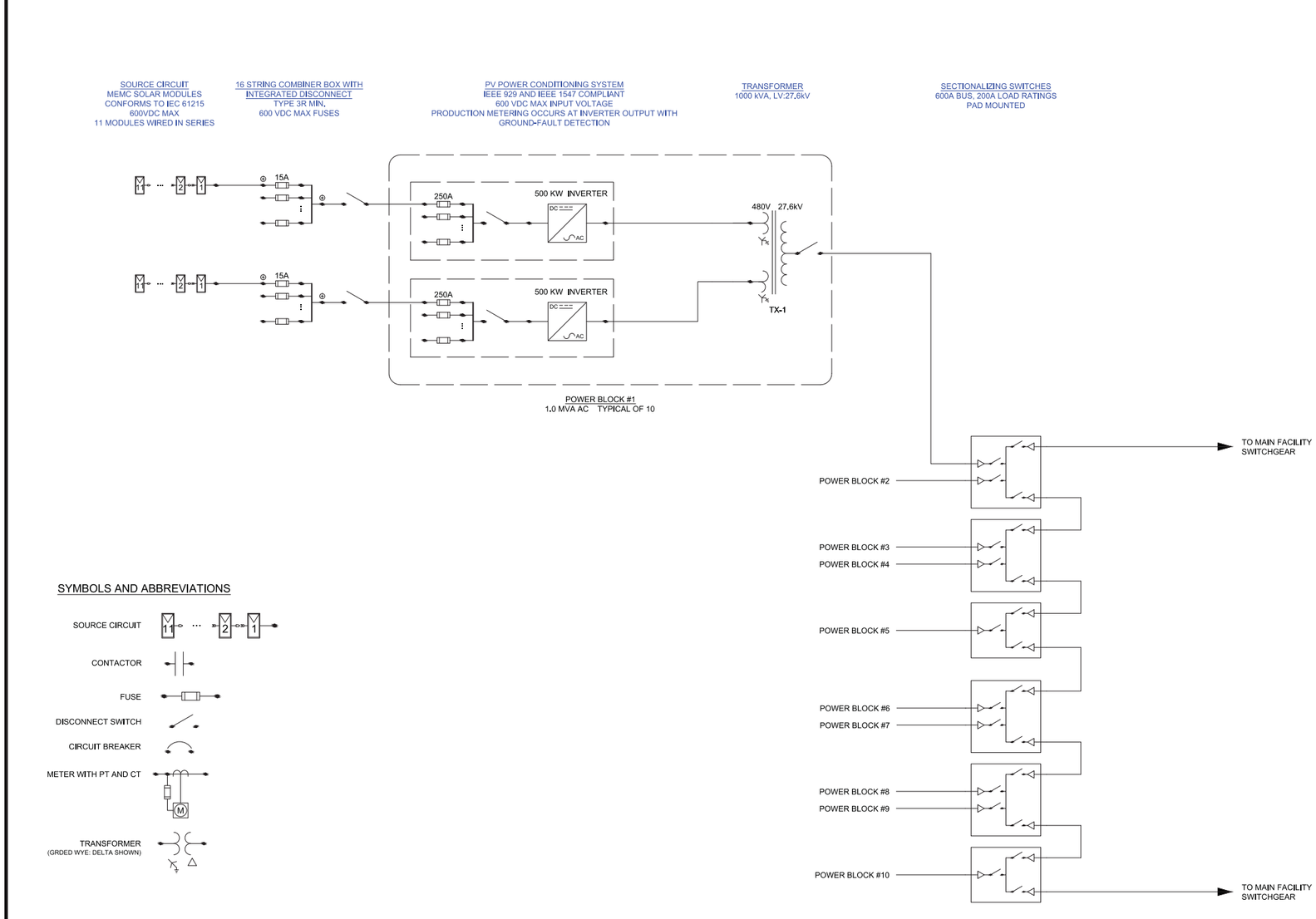
WELLAND
RIDGE ROAD
SOLAR PROJECT
PART OF LOTS 14 AND 15, CONCESSION 7
CITY OF WELLAND, ON

DRAWING:
EQUIPMENT SPECIFICATIONS

DRAWING NO.
EP-701

PV SYSTEM GENERATOR CALCULATIONS

MODULE	MEMC 310W (TYPICAL)	
MODULE STC POWER	280 - 310WP	
MODULE TILT	SINGLE-AXIS TRACKER	
ARRAY AZIMUTH	180°	
	GENERATOR, TYPICAL OF 10	SITE TOTAL
GENERATOR MANUFACTURER	SMA	SMA
GENERATOR MODEL	SUNNY CENTRAL 500HE	SUNNY CENTRAL 500HE
NUMBER OF MODULES PER GENERATOR	3,652	36,520
DC RATING	1.13 MW	11.3 MW
AC NAMEPLATE RATING	1.0 MW	10 MW
NUMBER OF SOURCE CIRCUITS	332	3320
SOURCE CIRCUIT COMBINERS	22	220



SYMBOLS AND ABBREVIATIONS

GENERAL NOTES:

1. THIS DRAWING IS FOR PRELIMINARY DESIGN PURPOSES ONLY. THE DESIGN SHOWN HERE IS NOT FOR CONSTRUCTION.

ELECTRICAL ENGINEER:

PRELIMINARY DRAWING
FOR REVIEW ONLY
NOT FOR CONSTRUCTION

DATE: X-XX-XXXX

REV. NO.	DESCRIPTION	DATE	BY
	ISSUED	09/29/11	R.D.

BLUE OAK ENERGY
1560 Drew Avenue, Davis, CA 95618
www.blueoakenergy.com - Phone: 530.747.2026

Axio Power Canada Inc/
SunEdison Canada

945 PRINCESS STREET, SUITE 252
KINGSTON, ON K7L 3N6

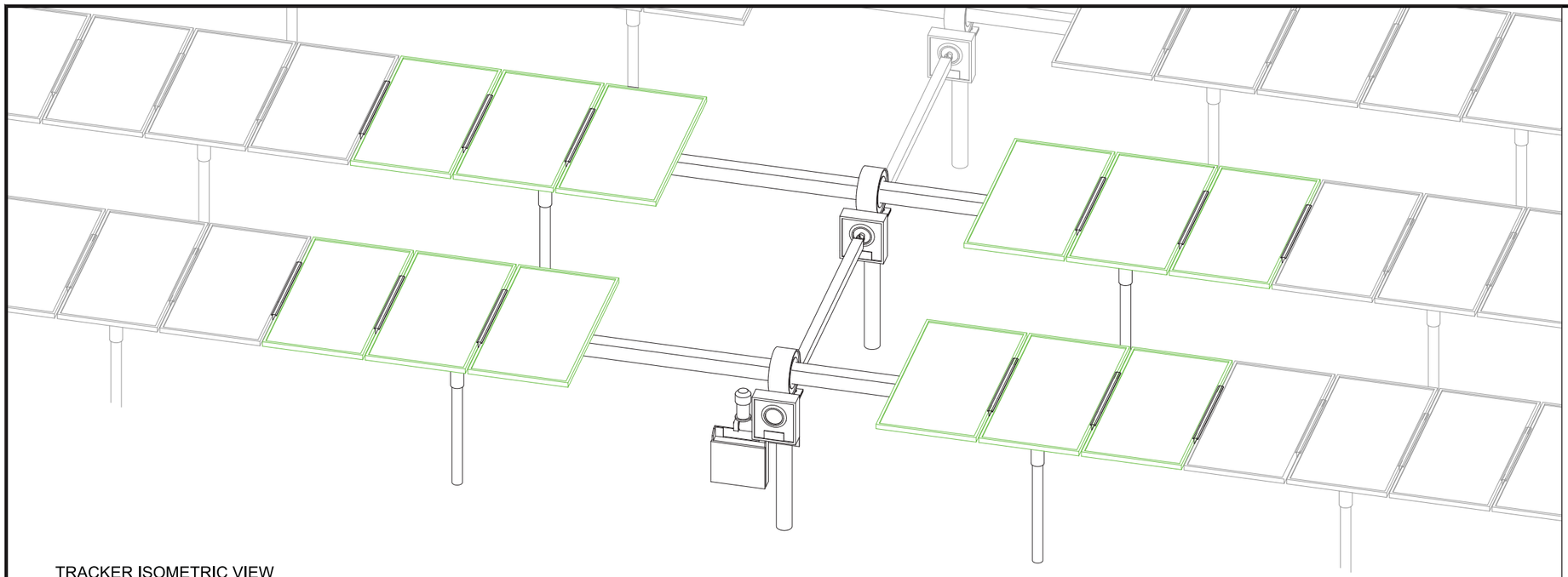
PROJECT SITE:

WELLAND RIDGE ROAD SOLAR PROJECT

PART OF LOTS 14 AND 15, CONCESSION 7
CITY OF WELLAND, ON

DRAWING:
SINGLE LINE DIAGRAM

DRAWING NO.
EP-801



TRACKER ISOMETRIC VIEW

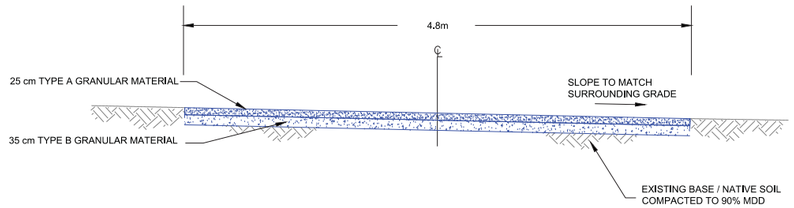
SCALE: NTS

GENERAL NOTES:

1. EACH TRACKER INCORPORATES 44 MEMC MODULES.
2. PV MODULES WIRED IN SERIES-PARALLEL COMBINATIONS ABOVE GROUND ALONG RACK STRUCTURES TO CREATE PV STRING CIRCUITS, 600V DC MAX. STRINGS TERMINATE IN PV COMBINER BOXES.
3. COMBINER BOX OUTPUT (50-150A DC EACH) IS ROUTED UNDERGROUND IN RIGID NON-METALIC CONDUIT OR DIRECT BURIAL 2-CONDUCTOR CABLE TO PV INVERTER STATIONS.
4. DEPTHS ARE APPROXIMATE, PENDING FINAL RACK AND STRUCTURAL ENGINEERING.
5. FOUNDATIONS AND DEPTH OF PILES/POST ARE REPRESENTATIVE ONLY. ACTUAL SPECIFICATION WILL BE DETERMINED BY A LICENSED STRUCTURAL ENGINEER BASED ON THE GEOTECHNICAL STUDY.
6. DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
7. APPROXIMATELY 6 PILES PER 22 MODULES

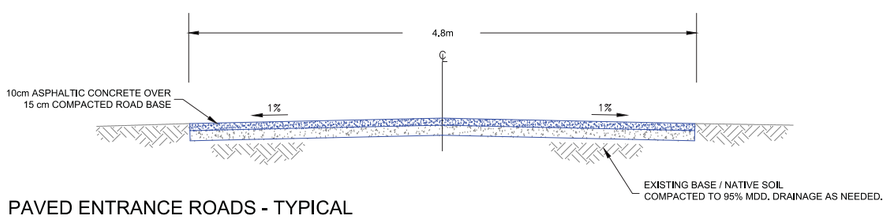
KEYED NOTES:

(1) FOUNDATION OPTIONS INCLUDE DRIVEN PILE, HELICAL GROUND ANCHOR, DRILLED PILE WITH CONCRETE REINFORCEMENT. DEPENDS ON SOIL TYPE AND PROPERTIES.



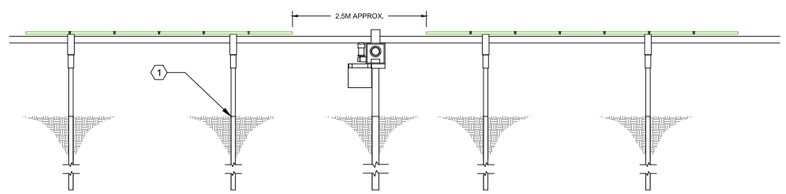
ACCESS ROADS - TYPICAL

SCALE: NTS



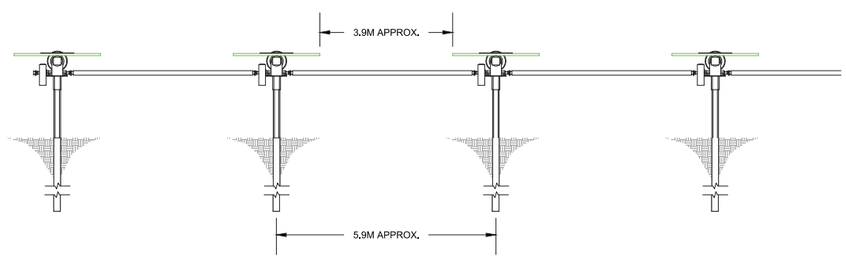
PAVED ENTRANCE ROADS - TYPICAL

SCALE: NTS



TRACKER EAST PROFILE

SCALE: NTS



TRACKER SOUTH PROFILE

SCALE: NTS

ELECTRICAL ENGINEER:

PRELIMINARY DRAWING
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NOT FOR CONSTRUCTION

DATE: X-XX-XXXX

REV. NO.	DESCRIPTION	DATE	BY
	ISSUED	09/29/11	R.D.

BLUE OAK ENERGY

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Axio Power Canada Inc/
SunEdison Canada

945 PRINCESS STREET, SUITE 252
KINGSTON, ON K7L 3N6

PROJECT SITE:

WELLAND RIDGE ROAD SOLAR PROJECT

PART OF LOTS 14 AND 15, CONCESSION 7
CITY OF WELLAND, ON

DRAWING:

TRACKER DETAILS

DRAWING NO.

S-101

Inv# Inverter Unit

Noise Receptor

Representative Noise Receptor

From 40 to 45 dBA

From 45 to 50 dBA

From 50 to 55 dBA

From 55 to 60 dBA

Over 60 dBA

Project Site

Parcel

PR # # Parcel ID

Axio Power Canada Inc./SunEdison Canada

Welland Ridge Road Solar Energy Project – Noise Map at 4.5m

0 80 160 240 320 400 m

SCALE 1:5,000

Figure C.1

HATCH™

Rev 2.02

Appendix B

Manufacturer's Brochures and Technical Information

MEMC

TECHNOLOGY IS BUILT ON US

280W SOLAR MODULE

The MEMC 280W family of solar modules combine years of vertically integrated solar experience with the highest quality standards. MEMC modules deliver quick return on investment, providing the perfect choice for large-scale solar power plants.

HIGH EFFICIENCY

MEMC modules are designed to the highest industry standards of efficiency.

QUALITY

Manufactured in highly automated, state of the art facilities certified to ISO9001 and ISO14001.

RELIABLE AND ROBUST DESIGN

High-quality materials, tempered front glass, and high-load capability are part of each module.

KEY FEATURES

- High module efficiency
- Tempered glass to ensure high conversion efficiency
- Wide range of power output modules available
- Tested to conform to UL1703 and CE standards
- Withstands loads up to 5400Pa as tested to IEC standards
- Anodized non-corroding aluminum frame

MODULE FAMILY

MEMC-P270ACA, MEMC-P275ACA, MEMC-P280ACA

QUALITY & SAFETY

- IEC61215 certified by TÜV SÜD to ensure long-term operation in a variety of climates
- IEC61730 certified by TÜV SÜD to ensure electrical safety
- Stringent outgoing quality acceptance criteria benchmarked to industry standards

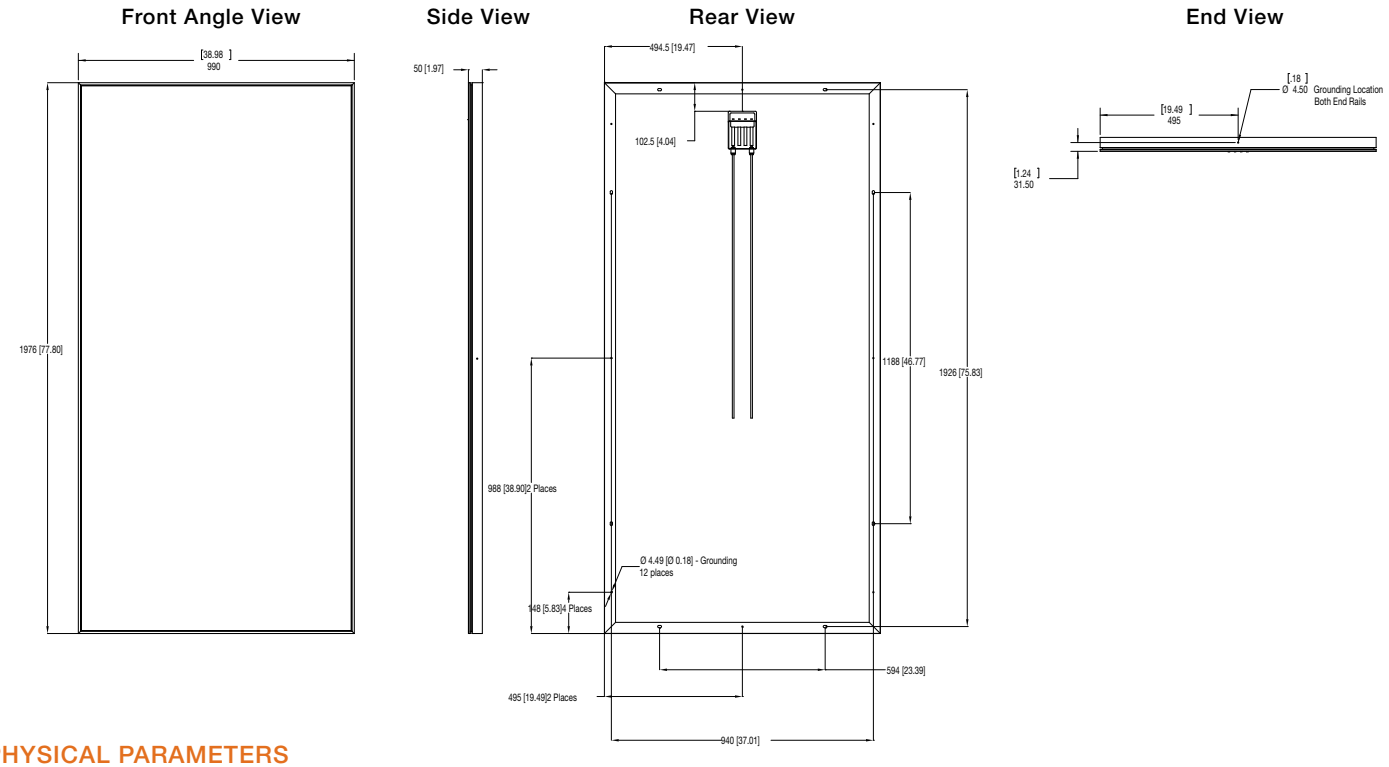
WARRANTY INFORMATION

- 60-month limited warranty for materials and workmanship
- 10 years limited warranty for minimum 90% peak power
- 25 years limited warranty for minimum 80% peak power

280W SOLAR MODULE

MEMC
TECHNOLOGY IS BUILT ON US

280W SOLAR MODULE DIMENSIONS



PHYSICAL PARAMETERS

Module Dimensions (mm)	1976x990x50
Module Weight (kg)	23
Cell-Type	Multicrystalline
Number of Cells	72
Frame Material	Anodized Aluminum
Glass	3.2mm Tempered Glass

TEMPERATURE COEFFICIENTS AND PARAMETERS

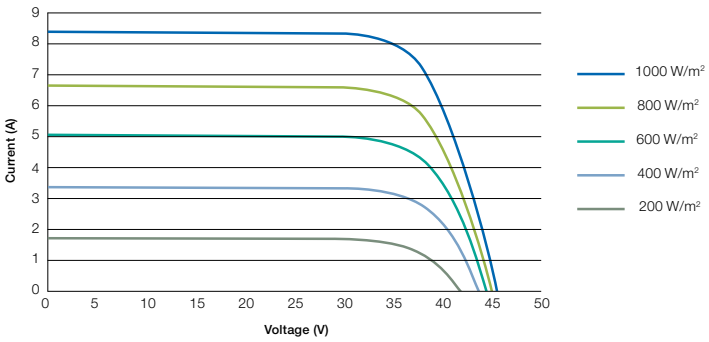
Nominal Operating Cell Temperature (NOCT) (°C)	45± 2
Temperature Coefficient of P_{max} (%/°C)	-0.45
Temperature Coefficient of V_{oc} (%/°C)	-0.33
Temperature Coefficient of I_{sc} (%/°C)	0.06
Operating Temperature (°C)	-40°C to +85
Maximum System Voltage (V)	1000
Limiting Reverse Current (A)	8.40
Maximum Series Fuse Rating (A)	15
Wattage Tolerance (%)	±3

ELECTRICAL CHARACTERISTICS

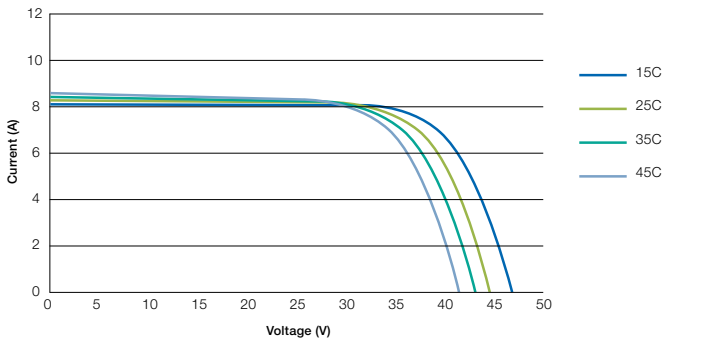
Model #	MEMC-P270ACA	MEMC-P275ACA	MEMC-P280ACA
Rated Maximum Power Pmax (W)	270	275	280
Open-Circuit Voltage V_{oc} (V)	44.4	44.8	45.1
Short Circuit Current I_{sc} (A)	8.28	8.31	8.34
Module Efficiency (%)	13.9	14.2	14.3
Maximum Power Point Voltage V_{mpp} (V)	35.2	35.5	35.9
Maximum Power Point Current I_{mpp} (A)	7.66	7.75	7.80

**All electrical data at STC: 1000W/m², AM1.5, 25ºC*

IV CURVES AT MULTIPLE IRRADIANCES



IV CURVES AT MULTIPLE TEMPERATURES



MEMC is a world leader in semiconductor and solar technology. MEMC has been a pioneer in the design and development of silicon wafer technologies for 50 years. With R&D and manufacturing facilities in the U.S., Europe and Asia, MEMC enables the next generation of high performance semiconductor devices and solar cells. Through its SunEdison subsidiary, MEMC is also a developer of solar power projects and a worldwide leader in solar energy services. For more information about MEMC, please visit www.memc.com.

 Printed on recycled paper

Efficient

- Without low-voltage transformer: greater plant efficiency due to direct connection to the medium-voltage grid

Turnkey Delivery

- With medium-voltage transformer and concrete substation for outdoor installation

Optional

- Medium-voltage switchgear systems for a flexible structure of large solar parks
- AC transfer station with measurement
- Medium-voltage transformers for other grid voltages (deviating from 20 kV)

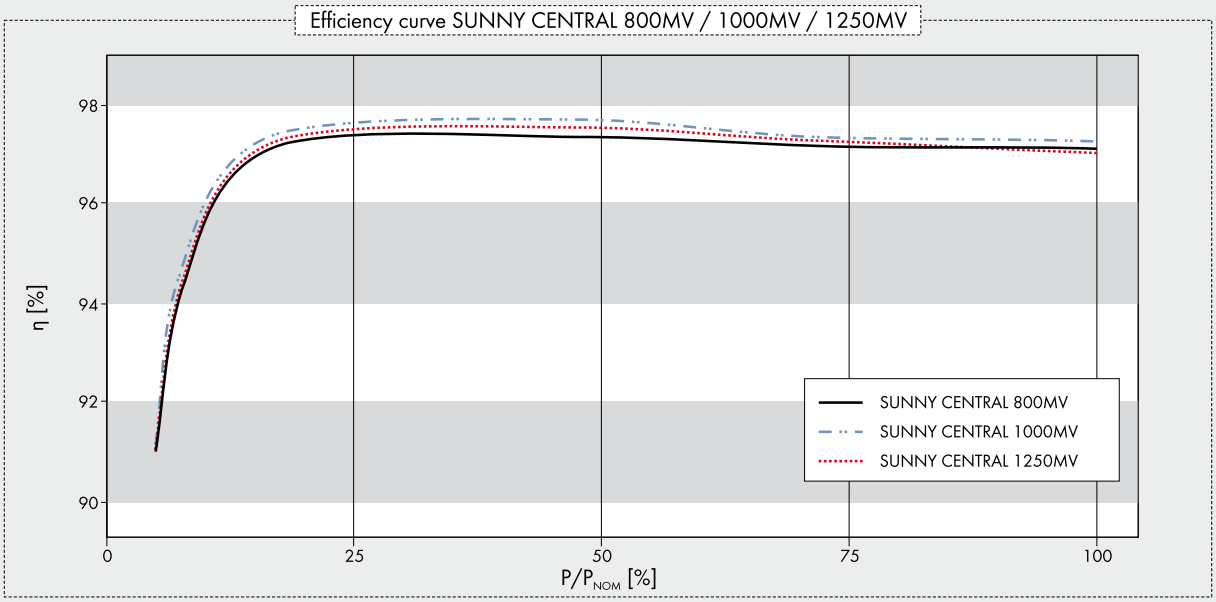
SUNNY CENTRAL for Direct medium-voltage feed-in 800MV / 1000MV / 1250MV

High-performance medium-voltage station

For even more power: Two powerful Sunny Central HE inverters are components of a medium-voltage station (MV) which feeds directly into a shared medium-voltage transformer. In this way, for example, two Sunny Central 630HE inverters are combined into a powerful Sunny Central 1250MV station. The advantage: By removing the need for the low-voltage transformer, the plant operator realizes greater yields and at the same time lower inverter costs. The Sunny Central MV is delivered as a "turnkey" concrete substation for outside installation. On top of that, the Sunny Central MV actively participates in grid management, and thereby fulfils all requirements of the Medium-Voltage Directive valid as of July 2010.

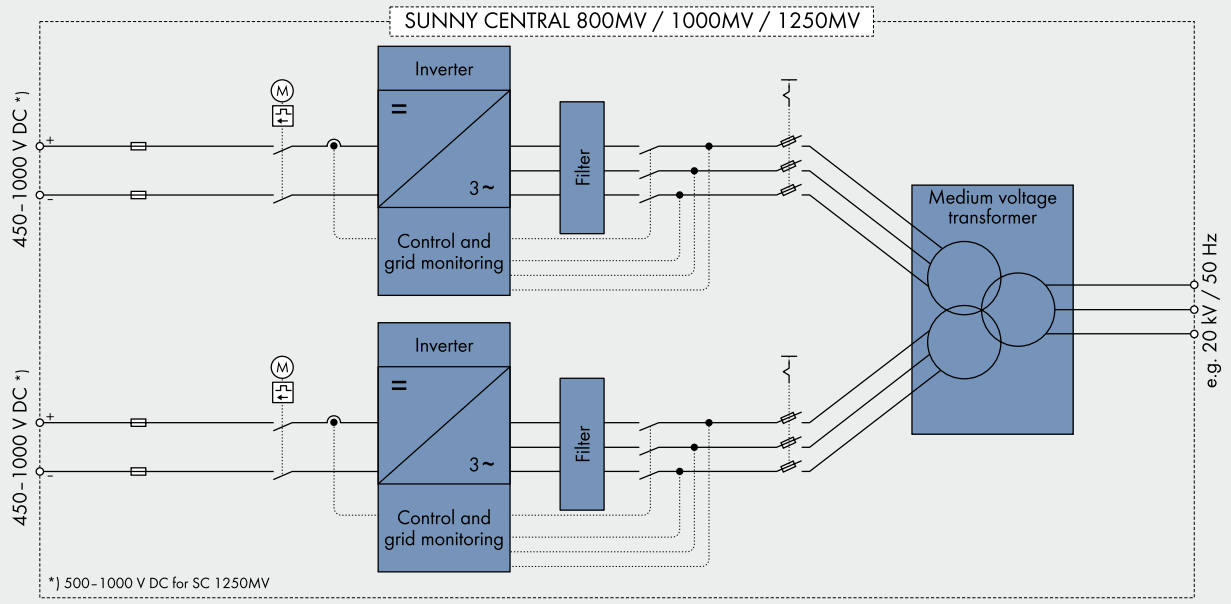
SUNNY CENTRAL 800MV / 1000MV / 1250MV

Technical data	Sunny Central 800MV	Sunny Central 1000MV	Sunny Central 1250MV
Input data			
Nominal DC power	816 kW	1018 kW	1284 kW
Max. DC power	900 kWp[1]	1120 kWp[1]	1410 kWp[1]
MPP voltage range	450 V – 820 V [5]	450 V – 820 V [5]	500 V – 820 V [5] [7]
Max. DC voltage	1000 V	1000 V	1000 V
Max. DC current	1986 A	2484 A	2844 A
Number of DC inputs	(16 + 16) + 4 DCHV	(16 + 16) + 4 DCHV	(16 + 16) + 4 DCHV
Output data			
Nominal AC power @ 45 °C	800 kVA	1000 kVA	1250 kVA
Continuous AC power @ 25 °C	880 kVA	1100 kVA	1400 kVA
Nominal AC voltage	20000 V	20000 V	20000 V
Nominal AC current	23.2 A	28.8 A	36.1 A
AC grid frequency 50 Hz	●	●	●
AC grid frequency 60 Hz	●	●	●
Power factor (cos φ)		0.9 leading ... 0.9 lagging	
Max. THD	< 3 %	< 3 %	< 3 %
Power consumption			
Internal consumption in operation	< 3000 W [4]	< 3000 W [4]	< 3000 W [4]
Standby consumption	< 180 W + 1100 W	< 180 W + 1100 W	< 180 W + 1350 W
External auxiliary supply voltage	3 x 230 V, 50/60 Hz	3 x 230 V, 50/60 Hz	3 x 230 V, 50/60 Hz
External back-up fuse for auxiliary supply	B 20 A, 3-pole	B 20 A, 3-pole	B 20 A, 3-pole
Dimensions and weight			
Height	3620 mm	3620 mm	3620 mm
Width	5400 mm	5400 mm	5400 mm
Depth	3000 mm	3000 mm	3000 mm
Weight	35000 kg	35000 kg	35000 kg
Efficiency [2]			
Max. efficiency	97.7 %	97.9 %	97.8 %
Euro-eta	97.3 %	97.5 %	97.4 %
Protection rating and ambient conditions			
Protection rating (as per EN 60529)	IP54	IP54	IP54
Operating temperature range	–20 °C ... +45 °C	–20 °C ... +45 °C	–20 °C ... +45 °C
Rel. humidity	15 % ... 95 %	15 % ... 95 %	15 % ... 95 %
Fresh air consumption	12400 m³/h	12400 m³/h	12400 m³/h
Max. altitude (above sea level)	1000 m	1000 m	1000 m



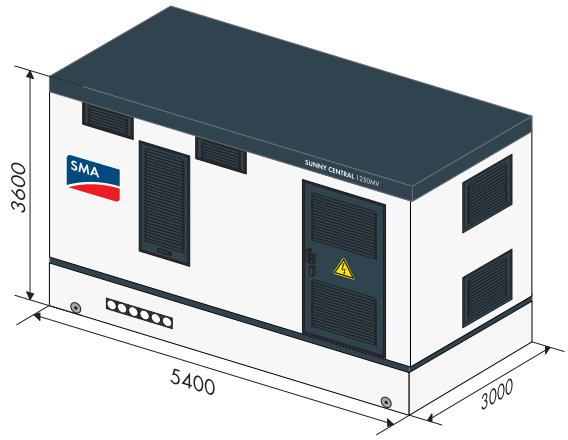
	Sunny Central 800MV	Sunny Central 1000MV	Sunny Central 1250MV
Features			
Display: text line / graphic	●/–	●/–	●/–
Ground fault monitoring	●	●	●
Heating	●	●	●
Emergency stop	●	●	●
Circuit breaker AC side	SI load disconnection switch	SI load disconnection switch	SI load disconnection switch
Circuit breaker DC side	Switch-disconnector with motor	Switch-disconnector with motor	Switch-disconnector with motor
Monitored overvoltage protectors AC / DC	●/●	●/●	●/●
Monitored overvoltage protectors for auxiliary supply	●	●	●
SCC (Sunny Central Control) interfaces			
Communication (NET Piggy-Back, optional)	analog, ISDN, Ethernet	analog, ISDN, Ethernet	analog, ISDN, Ethernet
Analog inputs	10 x A_{in} 3)	10 x A_{in} 3)	10 x A_{in} 3)
Overvoltage protection for analog inputs	O	O	O
Sunny String-Monitor connection (COM1)	RS485	RS485	RS485
PC connection (COM3)	RS232	RS232	RS232
Electrically separated relay (ext. alert signal)	2	2	2
Certificates / listings			
EMC	EN 61000-6-2 EN 61000-6-4		
CE conformity	●	●	●
BDEW-MSRL / FGW / TR8 6)	●	●	●
RD 1633 / 2000	●	●	●
Arrêté du 23/04/08	●	●	●
● standard features O optional features – not available			
Type designation	SC 800MV-11	SC 1000MV-11	SC 1250MV-11

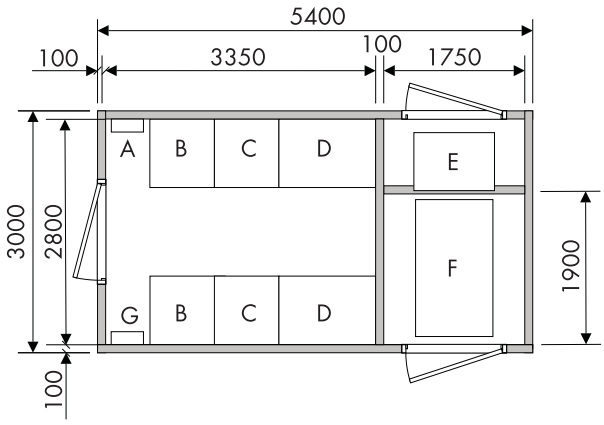
HE: High Efficiency, inverter without galvanic isolation for connection to a medium-voltage transformer (taking into account the SMA specification for the transformer)
1) Specifications apply to irradiation values below STC
2) Efficiency measured without an internal power supply at U_{DC} = 500 V
3) 2x inputs for the external nominal value specification for active power and reactive power, 1x external alarm input, 1x irradiation sensor, 1x pyranometer
4) Internal consumption at nominal power
5) At 1.05 $U_{AC, nom}$ and cos φ = 1
6) With limited dynamic grid support
7) At f_{grid} = 60 Hz: 510 V - 820 V
Please note: in certain countries the substations shown in the images



1 Mechanical data

Sunny Central 800MV / 1000MV / 1250MV with medium-voltage switchgear

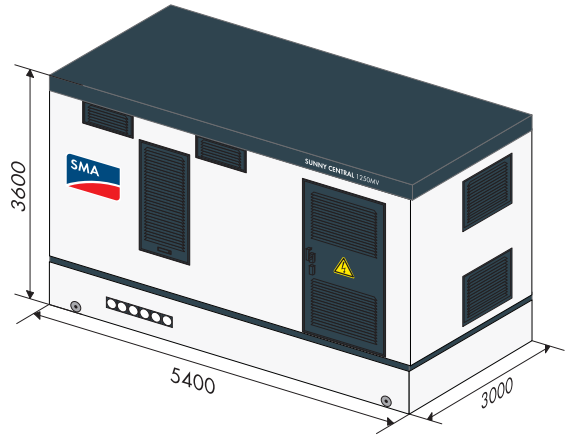


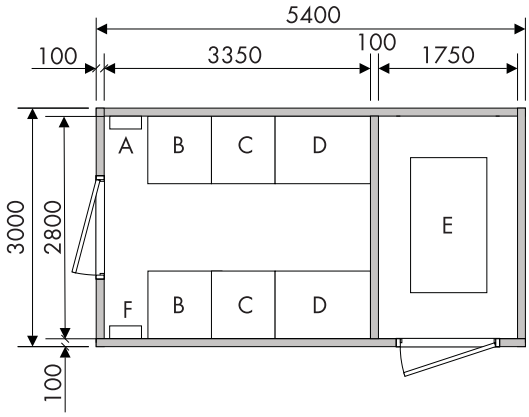


All figures in mm.

A	COM-B, optional	B	Sunny Central, DC cabinet
C	Sunny Central, inverter cabinet	D	Sunny Central, AC cabinet
E	Medium-voltage switchgear	F	Transformer
G	Station sub-distribution		

Sunny Central 800MV / 1000MV / 1250MV without medium-voltage switchgear

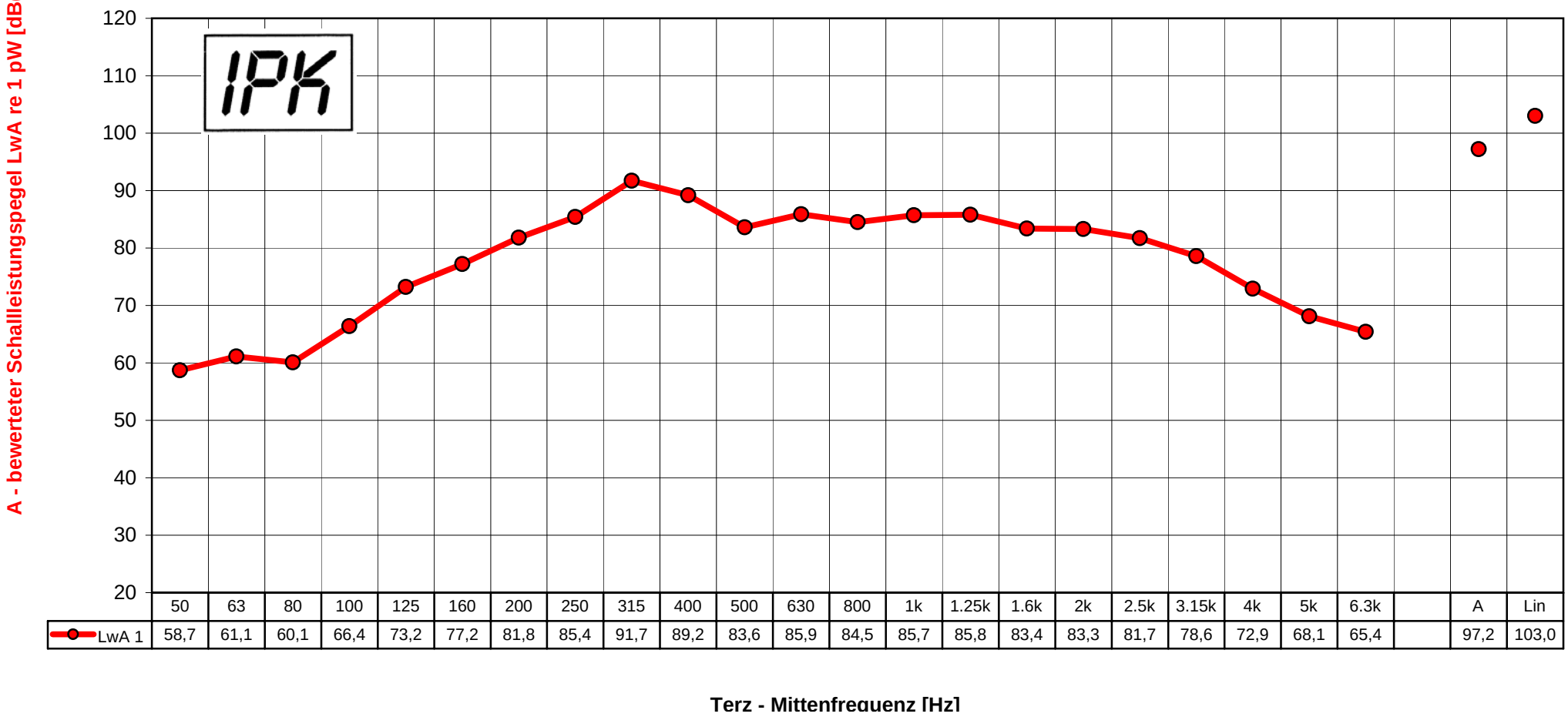




All figures in mm.

A	COM-B, optional	B	Sunny Central, DC cabinet
C	Sunny Central, inverter cabinet	D	Sunny Central, AC cabinet
E	Transformer	F	Station sub-distribution

SMA Solar Technologie Umrichteranlage Sunny Central SC 1000MV
Betrieb bei Nennleistung und 50 Hz; 1000 KW



	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k		A	Lin
LwA 1	58,7	61,1	60,1	66,4	73,2	77,2	81,8	85,4	91,7	89,2	83,6	85,9	84,5	85,7	85,8	83,4	83,3	81,7	78,6	72,9	68,1	65,4		97,2	103,0

Terz - Mittenfrequenz [Hz]

INGENIEURBÜRO PETER KAPOLNEK
Waiblinger Str. 69, 70372 Stuttgart, Tel.: (0711) 567911, Telefax: (0711) 561447

High Yields

- 98% CEC efficiency
- Suitable for ambient temperatures of up to 60 °C (140 °F)
- OptiCool™ intelligent temperature management

Low System Costs

- Outdoor-rated enclosure
- Couples to medium-voltage external transformer
- Available as integrated solution

Strong Peripherals

- Optional DC & AC disconnects
- Optional combiner boxes with string monitoring
- Sunny WebBox, Modbus® & OPC compatible

UL Certified

- UL 1741 / IEEE-1547 compliant

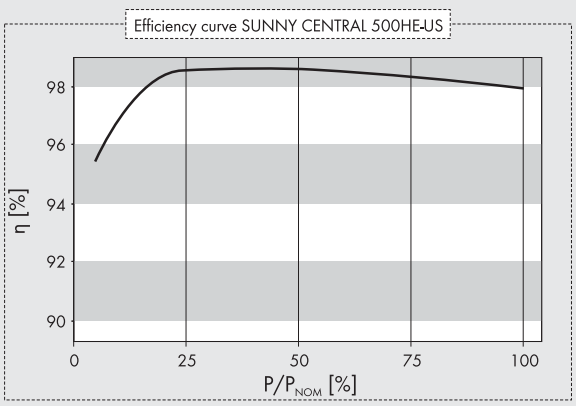
SUNNY CENTRAL 500HE-US

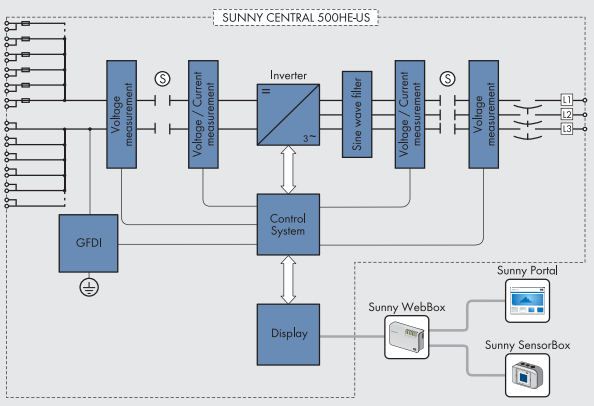
The ideal solution for large-scale North American solar power plants

The Sunny Central 500HE-US couples to an external medium-voltage transformer to accommodate long distance power feeds to distribution substations and delivers the highest efficiency available for large PV inverters. An updated user interface features a large LCD that provides a graphical view of the daily plant production as well as the status of the inverter and the utility grid. Flexible plant monitoring is available through various communications solutions such as Ethernet, Modbus, RS485 and OPC. Designed for easy installation, operation and performance monitoring, the UL-certified Sunny Central 500HE-US is the ideal choice for large-scale PV projects.

Technical data	Sunny Central 500HE-US
Input data	
Max. DC power	565 kWp [1]
MPP voltage range	330 V – 600 V
Max. DC voltage	600 V
Feed starting at [U] / [P]	380 V / 5000 W
Max. DC current	1600 A
Number of DC inputs	6 – 9
Output data	
Nominal AC power	500 kVA @ 45 °C (113 °F)
Max. AC current	1470 A @ 200 V
AC grid frequency	60 Hz
AC voltage range	180 V – 220 V
AC voltage range, full active power	196 V – 210 V
Power factor (cos φ)	> 0.99
Max. THD	< 5%
Efficiency [2]	
Max. efficiency	98.6%
CEC efficiency	98.0%
Euro-eta	97.9%
Ambient conditions	
Operating temperature range	–25 °C ... +60 °C (–13 °F ... +140 °F)
Max. temperature for nominal conditions	+45 °C (+113 °F)
Protection rating	NEMA 3R
Installation indoors / outdoors	●/●
Rel. humidity	15% ... 95%
Fresh air consumption	3000 m³/h
Internal consumption at nominal power	< 1600 W
Standby consumption (P_{night})	< 110 W
Dimensions and weight	
Height	2277 mm (90 in)
Width	2562 mm (101 in)
Depth	956 mm (38 in)
Weight	< 1800 kg (3970 lb)
Certificates / listings	
Certificates	UL 1741, UL 1998, IEEE 1547
EMC conformity	FCC, Part 15, Class A
Interfaces	
RS485 / Ethernet / analog	o/o/o
Display: text line / graphic	–/●
Communication protocols	Modbus / TCP
SSM-US connection	RS485
Plant monitoring	Sunny Portal
● Standard features o Optional features – Not available	
Type designation	SC 500HE-US

1) Specifications apply to irradiation values below STC
2) Measured without an internal power supply at U_{DC} = 330 V



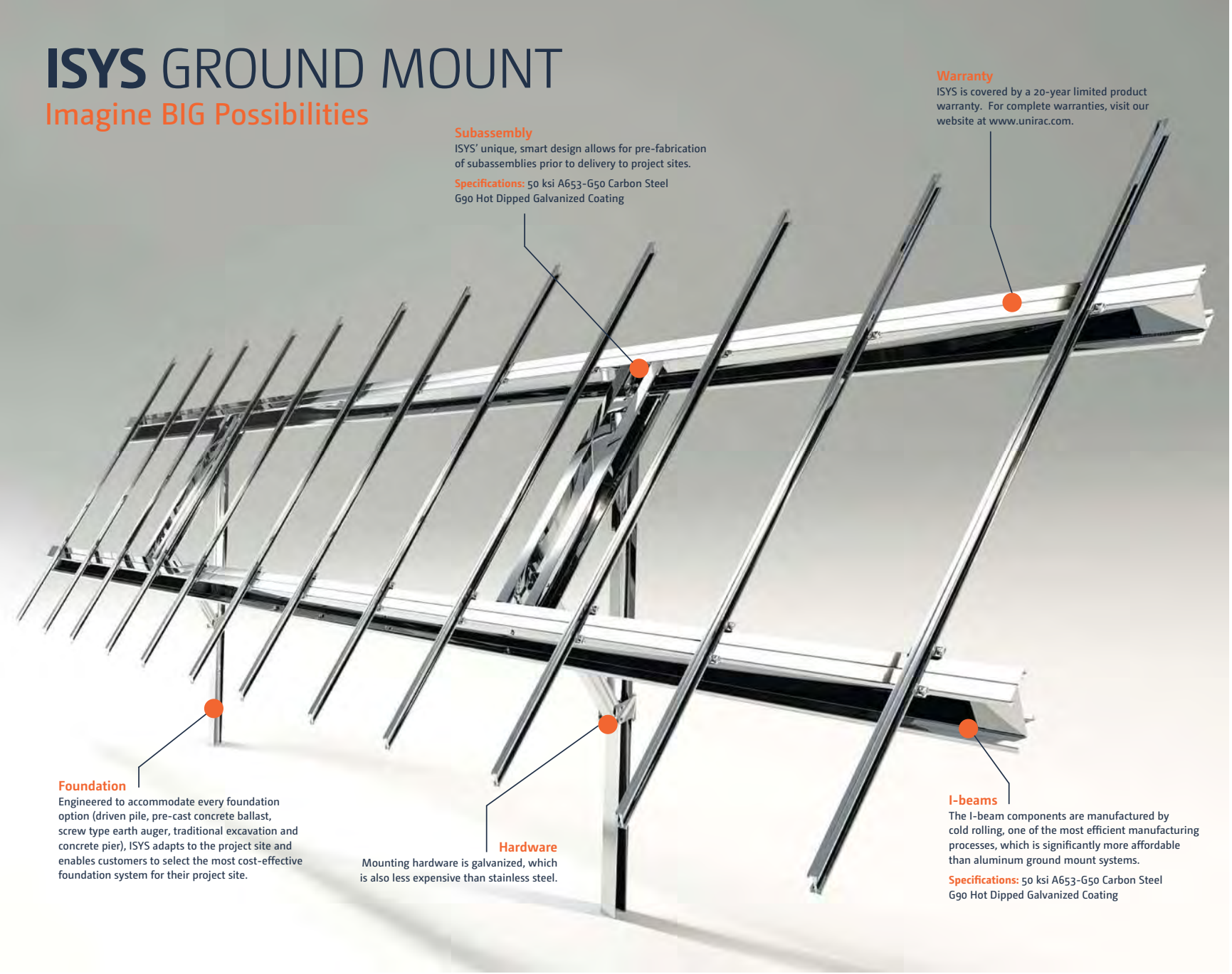


Toll Free +1 888 4 SMA USA
www.SMA-America.com

SMA America, LLC

ISYS GROUND MOUNT

Imagine BIG Possibilities



Subassembly

ISYS' unique, smart design allows for pre-fabrication of subassemblies prior to delivery to project sites.

Specifications: 50 ksi A653-G50 Carbon Steel
G90 Hot Dipped Galvanized Coating

Warranty

ISYS is covered by a 20-year limited product warranty. For complete warranties, visit our website at www.unirac.com.

Foundation

Engineered to accommodate every foundation option (driven pile, pre-cast concrete ballast, screw type earth auger, traditional excavation and concrete pier), ISYS adapts to the project site and enables customers to select the most cost-effective foundation system for their project site.

Hardware

Mounting hardware is galvanized, which is also less expensive than stainless steel.

I-beams

The I-beam components are manufactured by cold rolling, one of the most efficient manufacturing processes, which is significantly more affordable than aluminum ground mount systems.

Specifications: 50 ksi A653-G50 Carbon Steel
G90 Hot Dipped Galvanized Coating

KEY BENEFITS

of ISYS Ground Mount

Bigger and Better

- Extreme strength-to-weight ratio provides longer spans with minimized foundation points
- Bigger components means fewer connections and alignment issues

Superior Value

- Lowest total installed cost in solar
- Installs at a rate of 10 modules per man hour
- Designed to work specifically with your module
- Adapts to any site conditions = cost-effective foundation systems
- Economical steel components and galvanized hardware

Assemble, don't Build

- No fabrication required
- Repeatable installations
- No field drilling or welding

Complete technical support

- Array design, engineering and installation support
- All structural materials from one source

UNIRAC

Bright Thinking in Solar

Three-Phase Pad-mounted Compartmental Type

GENERAL

Cooper Power Systems three-phase pad-mounted compartmental type distribution transformers are designed to withstand all environmental hazards. The transformers are designed to meet or exceed all applicable ANSI, NEMA, IEEE standards, and NEC® and CEA specifications.

All transformers are newly manufactured and are produced expressly to meet exacting customer specifications. Many configurations and accessories are available to meet a wide range of application demands. Transformers from stock are available for any emergency situations that may arise.

Cooper Power Systems three-phase pad-mounted transformers are available in live-front or dead-front designs. Cooper has proven field service with pad-mounted transformers rated 45-7500 kVA, and high-voltage ratings from 2400 volts up to 46,000 volts. Designs offered include; delta and wye configurations, with single- or series-multiple combinations with either taps (for de-energized operation), or no-taps. Step-down designs are also available.

Both radial and loop feed configurations are built to ANSI standards. The dead-front bushing configurations are in accordance with ANSI C57.12.26, live-front per ANSI C57.12.22.

Cooper Power Systems transformers are built to exceed ANSI C57.12.28 for tamper resistance and for corrosion resistance. Each transformer is painted using our state-of-the-art painting system which includes eight pretreatment stages and seven coating and curing processes.

Transformer cores are manufactured from the highest quality grain oriented silicon core steel. Unlike amorphous metal cores, silicon core steel is less susceptible to ferroresonance and exhibits increasingly greater efficiency above 50% loading. Rectangular wound core construction is used offering lower losses, low excitation current, and quiet operation. Rectangular stacked core designs are available for 1500 kVA and above.

Figure 1.
Three-phase pad-mounted transformer.

The best reason to choose Cooper Power Systems three-phase transformers is that they have the lowest failure rate in the industry.

STANDARD CONNECTIONS & NEUTRAL CONFIGURATIONS

- Delta - Wye: For Delta-Wye configurations the low voltage neutral shall be a fully insulated X_0 bushing with a removable ground strap.
- Grounded Wye-Wye: For Grounded Wye-Wye configurations the high voltage neutral shall be internally tied to the low voltage neutral and brought out as the H_0X_0 bushing in the secondary compartment with a removable ground strap.
- Delta-Delta: For Delta-Delta configurations the transformer shall be provided without a neutral bushing.
- Wye-Wye: For Wye-Wye configurations the high voltage neutral shall be brought out as the H_0 bushing in the primary compartment and the low voltage neutral shall be brought out as the X_0 bushing in the secondary compartment.
- Wye-Delta: For Wye-Delta configurations the high voltage neutral shall be brought out as the H_0 bushing in the primary compartment. No ground strap shall be provided (line to line rated fusing is required).

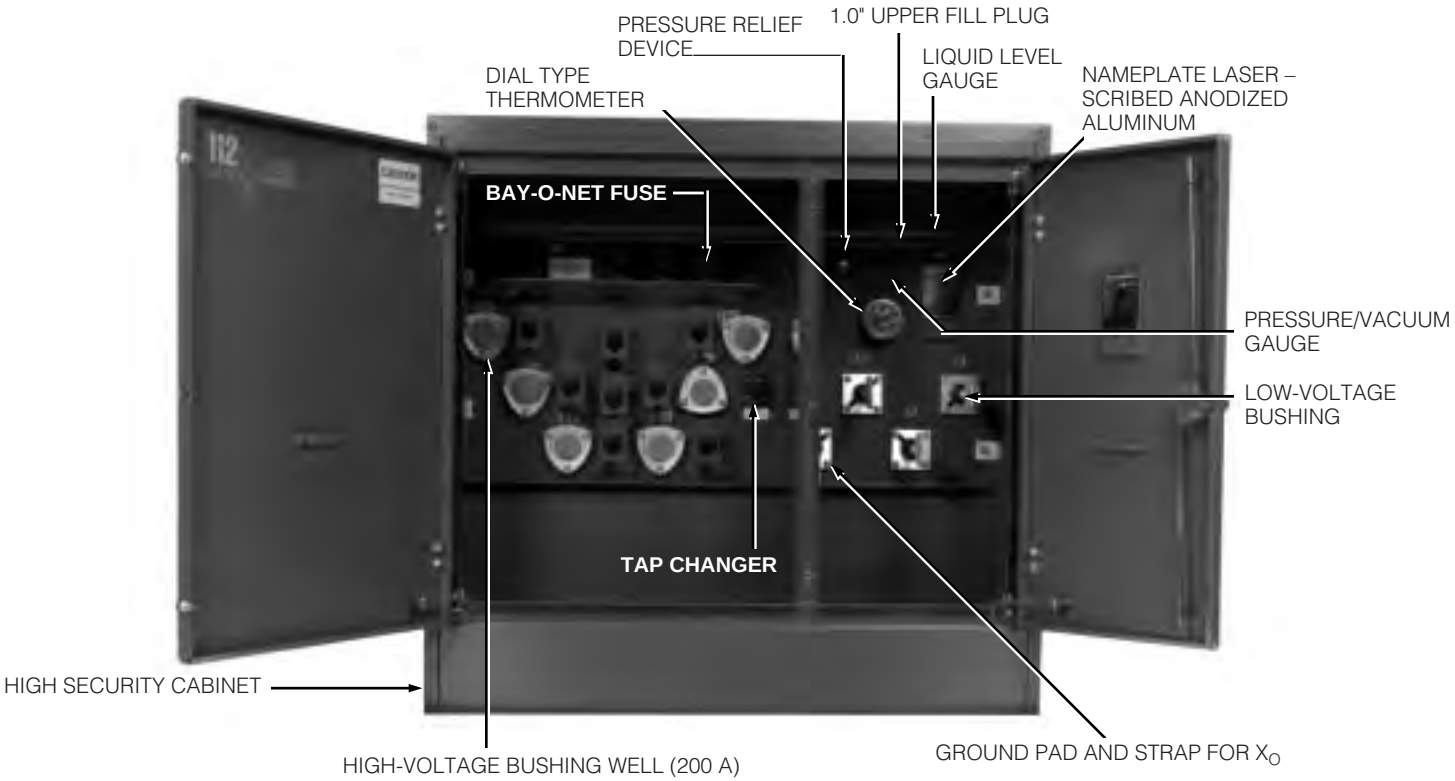


Figure 2.
Three-phase pad-mounted compartmental type transformer.

STANDARD FEATURES

- Bolted cover for tank access (45-1000 kVA)
- Welded cover with handhole (1500-7500 kVA)
- Three-point latching door for security
- Lightning arrester mounting provisions (live-front)
- Laser-scribed anodized aluminum nameplate
- One-inch drain valve with sampling device in low-voltage compartment (45-7500 kVA)
- One-inch upper fill plug
- Automatic pressure relief device
- 20" Deep cabinet (45-1000 kVA)
- 24" Deep cabinet (1500-7500 kVA)
- 30" Deep cabinet (34.5/19.92 kV)
- Removable sill for easy installation
- Steel divider between high-voltage and low-voltage compartments
- RTE® (15, 25 kV) 200 A (HTN) bushing wells
- RTE (15, 25, 35 kV) 200 A Integral bushings (dead-front)
- Cooper electrical-grade wet-process porcelain bushings (live-front)
- Lifting lugs (4)
- Stainless steel ground pads (45-500 kVA)
- Stainless steel NEMA 2-hole ground pads (750-7500 kVA)
- Stainless steel cabinet hinges & mounting studs

OPTIONAL ACCESSORIES

- Liquid level gauge
- Pressure vacuum gauge
- Dial type thermometer
- R-Temp® less-flammable fluid and other environmentally desirable fluid options
- One, two, or three On/Off loadbreak switches
- 4-position loadbreak switch – V-blade switch, T-blade switch
- Low-voltage 6-, 8-, 10-hole spade
- Low-voltage 12-, 16-, 20-hole spade (750-2500 kVA)
- Low-voltage bushing supports
- RTE (15, 25 kV) high-voltage 200 A bushing inserts
- RTE (15, 25 kV) high-voltage 200 A feedthru inserts
- RTE (15, 25 kV) high-voltage 200 A (HTN) bushing wells with removable studs
- RTE (15, 25, 35 kV) high-voltage 600 A deadbreak one-piece bushings
- Hexhead captive bolt
- High-voltage warning signs
- Ground connectors
- Drain/sampling valve in high-voltage compartment
- Breaker mounting provisions
- Touch-up paint
- Stainless steel nameplate
- Stainless steel tank base & cabinet
- Stainless steel tank base & cabinet sides and sill
- Service entrance (2 inch) in sill or cabinet side
- Nitrogen blanket with bleeder and purge valve
- Delta-wye switch
- Auxiliary contacts for liquid level gauge
- Auxiliary contacts for dial type thermometer
- All copper windings
- Globe type upper fill valve
- Kyle® Vacuum Fault Interrupter (VFI)
- K-Factor transformer
- Factory Mutual approved transformer

TABLE 1
Three-Phase Ratings

Three-Phase 50 or 60Hz 65°C, or 55/65°C Rise	
kVA Available	
45	1000
75	1500
112.5	2000
150	2500
225	3000
300	3750
500	5000
750	7500

TABLE 2
Percent Impedance Voltage

kVA Rating	Low-Voltage Rating					
	≤150 kV BIL		200 kV BIL		250 kV BIL	
	≤600 V	>600 V	≤600 V	>600 V	≤600 V	>600 V
45-75	1.00-5.00	–	7.25	–	7.75	–
112.5-300	1.20-6.0	5.5	7.25	7.0	7.75	7.5
500	1.50-7.00	5.5	7.25	7.0	7.75	7.5
750-2500	5.75	5.5	7.25	7.0	7.75	7.5
3000-5000	5.75	5.5	7.25	7.0	7.75	7.5
7500	–	6.5	7.25	7.0	7.75	7.5

TABLE 3
Low-Voltage Ratings

208Y/120
240 Delta
240 Delta with 120 Midtap
480Y/277
480 Delta
600Y/347
Other Voltages Under 600V
Other Voltages with 45 kV, 60 kV, 75 kV and 95 kV BIL are also available[1]

[1] See Table 5 for ranges of KVA's with secondaries greater than 600 volts.

TABLE 4
Range of kVA and Voltage Ratings

High-Voltage Ratings (Volts)	KVA Rating		
	Low-Voltage Ratings (Volts) 208Y/120, 240	Low-Voltage Ratings (Volts) 480Y/277, 480, 600Y/347	Low-Voltage Ratings (Volts) >600
Delta or Wye			
2400	45-750	45-750	300-750
4160	45-1000	45-1000	300-1000
4800	45-1000	45-1500	300-1500
7200	45-1000	45-2000	300-2000
12,000, 12,470	45-1000	45-3750	300-7500
13,200, 13,800, 16,340	45-1000	45-3750	300-7500
22,860, 23,900, 24,940	45-1000	45-3750	300-7500
34,500	75-1000	75-3750	300-7500
Wye			
43,800	1000	1000-3750	1000-7500

TABLE 5
High-Voltage and BIL[2]

Transformer		Electrical Characteristics of the Completely Assembled High-Voltage Connectors		
		High-Voltage Rating		60-Hz Dry One Minute Withstand (kV)
High-Voltage Ratings (Volts)	Minimum BIL (kV)	Phase-to-Ground /Phase-to-Phase (kV)	BIL (kV)	
Single High-Voltage				
2400	60	8.3/14.4	95	34
4160	60	8.3/14.4	95	34
4800	60	8.3/14.4	95	34
7200	75	8.3/14.4	95	34
12000	95	8.3/14.4	95	34
12470	95	8.3/14.4	95	34
13200	95	8.3/14.4	95	34
13800	95	8.3/14.4	95	34
14400	95	8.3/14.4	95	34
16430	95	8.3/14.4	95	34
22920	125	15.2/26.3	125	40
26400	150	See note [3]	See note [3]	See note [3]
34400	200	See note [3]	See note [3]	See note [3]
34500	200	See note [3]	See note [3]	See note [3]
43800	250	See note [3]	See note [3]	See note [3]
4160GrdY/2400	60	8.3/14.4	95	34
8320GrdY/4800	75	8.3/14.4	95	34
12470GrdY/7200	95	8.3/14.4	95	34
13200GrdY/7620	95	8.3/14.4	95	34
13800GrdY/7970	95	8.3/14.4	95	34
22860GrdY/13200	125	15.2/26.3	125	40
23900GrdY/13800	125	15.2/26.3	125	40
24940GrdY/14400	125	15.2/26.3	125	40
34500GrdY/19920	150	21.1/36.6	150	50
Series Multiple High-Voltage				
4160GrdY/2400 x 12470GrdY/7200	60 x 95	8.3/14.4	95	34
4160GrdY/2400 x 13200GrdY/7620	60 x 95	8.3/14.4	95	34
4800 x 13200GrdY/7620	60 x 95	8.3/14.4	95	34
8320GrdY/4800 x 24940GrdY/14400	75 x 125	15.2/26.3	125	40
12470GrdY/7200 x 24940GrdY/14400	95 x 125	15.2/26.3	125	40
13200GrdY/7620 x 24940GrdY/14400	95 x 125	15.2/26.3	125	40
23900GrdY/13800 x 34500GrdY/19920	125 x 150	21.1/36.6	150	50

[2] Transformers are available in the standard ratings and configurations shown or can be customized to meet specific needs.
[3] Contact Cooper Power Systems for high-voltage connector information.

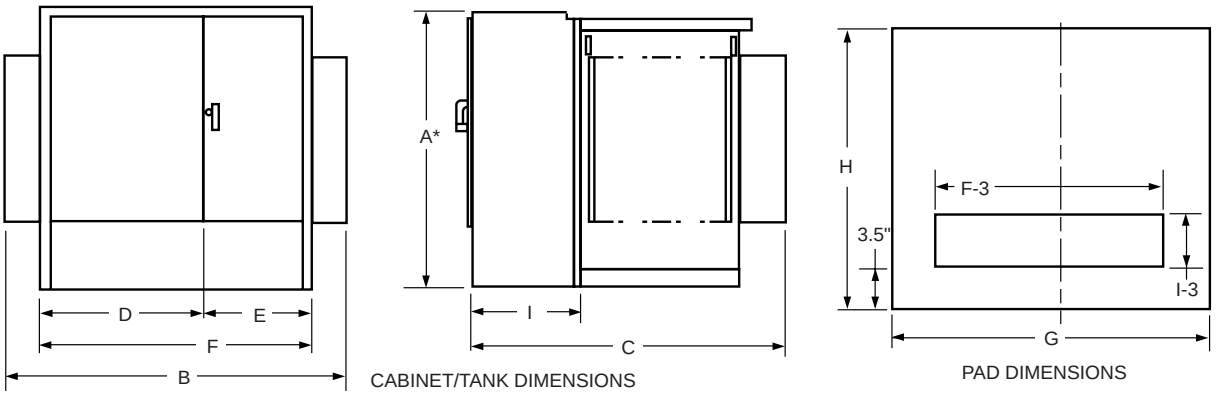


Figure 3.
Transformer and Pad dimensions.

* Add 9" for Bay-O-Net fusing.

TABLE 6
Typical Dimensions and Weights[3]

65°C Rise	DEAD-FRONT - LOOP OR RADIAL FEED - BAY-O-NET FUSING[1] OIL FILLED -ALUMINUM WINDINGS										
kVA Rating	OUTLINE DIMENSIONS (in.)									Gallons Of Fluid	Approx. Total Weight (lbs.)
	A[1]	B	C	D	E	F	G	H	I		
45	50	68	39	42	26	68	72	43	20	150	2600
75	50	68	39	42	26	68	72	43	20	160	2800
112.5	50	68	49	42	26	68	72	53	20	165	2900
150	50	68	49	42	26	68	72	53	20	170	3350
225	50	72	51	42	30	72	76	55	20	180	3800
300	50	72	51	42	30	72	76	55	20	190	4450
500[2]	50	89	53	42	30	72	93	57	20	240	5700
750[2]	64	89	57	42	30	72	93	61	20	380	8200
1000[2]	64	89	59	42	30	72	93	63	20	480	10,100
1500[2]	73	89	86	42	30	72	93	90	24	570	13,950
2000[2]	73	72	87	42	30	72	76	91	24	640	15,000
2500[2]	73	72	99	42	30	72	76	103	24	760	18,850
3000[2]	73	84	99	46	37	84	88	103	24	780	19,000
3750[2]	84	85	108	47	38	85	88	112	24	800	19,500
5000[2]	84	96	108	48	48	96	100	112	24	930	29,400
7500[2]	94	102	122	54	48	102	100	126	24	1580	41,900

TABLE 7
Typical Dimensions and Weights[3]

65°C Rise	LIVE-FRONT - LOOP OR RADIAL FEED - BAY-O-NET FUSING[1] OIL FILLED -ALUMINUM WINDINGS										
kVA Rating	OUTLINE DIMENSIONS (in.)									Gallons Of Fluid	Approx. Total Weight (lbs.)
	A[1]	B	C	D	E	F	G	H	I		
45	50	64	39	34	30	64	69	43	20	150	2600
75	50	64	39	34	30	64	69	43	20	160	2800
112.5	50	64	49	34	30	64	69	53	20	165	2900
150	50	64	49	34	30	64	69	53	20	170	3350
225	50	64	51	34	30	64	73	55	20	180	3800
300	50	64	51	34	30	64	75	55	20	190	4450
500[2]	50	81	53	34	30	64	85	57	20	240	5700
750[2]	64	89	57	42	30	72	93	61	20	380	8200
1000[2]	64	89	59	42	30	72	93	63	20	480	10,100
1500[2]	73	89	86	42	30	72	93	90	24	570	13,950
2000[2]	73	72	87	42	30	72	76	91	24	640	15,000
2500[2]	73	72	99	42	30	72	76	103	24	760	18,850
3000[2]	73	84	99	46	37	84	88	103	24	780	19,000
3750[2]	84	85	108	47	38	85	88	112	24	800	19,500
5000[2]	84	96	108	48	48	96	100	112	24	930	29,400
7500[2]	94	102	122	54	48	102	100	126	24	1580	41,900

[1] For fusing with Bay-O-Net only, see Cooper Power Systems catalog section 240-45 or 240-46. (Add 9" to dimension “A” for Bay-O-Net fusing.)
[2] Available with Kyle Vacuum Fault Interrupter for overcurrent protection. (Minimum height 72" in.)
[3] Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Cooper Power Systems for exact dimensions.

CONSTRUCTION

Core

High efficiency rectangular wound core design offers low excitation current, low losses, and quiet performance. Cores are manufactured in either five-leg or triplex configurations from precision-cut single-turn laminations of high quality, grain oriented silicon core steel. Fully annealed after cutting and forming the lamination joints are precisely stacked, virtually eliminating gaps in the corner joints. These cores are less susceptible to ferroresonance and exhibit lower loses above 50% loading than amorphous cores. Stacked core designs are also available.

Coil

The coils are made compact, rigid, mechanically strong, and electrically balanced with impedances in accordance with ANSI C57.12.26. The wound coils are hydraulically pressed to squeeze the wire and interlayed paper tightly together, then baked to bond the windings into a solid compact coil with excellent dielectric and certified short-circuit strength when tested to ANSI C57.12.90. Extra mechanical strength is provided by diamond pattern, epoxy coated paper insulation, used throughout the coil, with additional adhesive at heavy stress points. The diamond pattern distribution of the epoxy and carefully arranged ducts provide a network of passages through which cooling fluid can freely circulate. The primary coil is manufactured from heavy varnish or paper insulated aluminum or copper wire. Round wire is flattened during winding to provide greater surface contact with the insulating paper and a higher space factor to make a compact, efficient design. The secondary coil is manufactured from full width aluminum strip whose edges are carefully finished to prevent burrs and sharp points, insulated with epoxy-diamond paper between every layer of the conductor. The dielectric insulation levels are per ANSI C57.12.00.

Insulating Fluid

Cooper Power Systems transformers are available with standard electrical grade mineral insulating oil or other dielectric coolants manufactured by Cooper Power Systems. The highly refined oil is tested and degassed to assure a chemically inert product with minimal acid ions. Special additives minimize oxygen absorption and inhibit oxidation. To ensure high dielectric strength, the oil is retested for dryness and dielectric strength, refiltered, heated, dried, and stored under vacuum before being added to the completed transformer. R-Temp fluid, manufactured by Cooper Power Systems under strict quality control for optimum transformer cooling characteristics, provides higher dielectric strength than mineral oil. The special formulation is less-flammable as defined by the National Electric Safety Code, as well as non-toxic and biodegradable. Envirotemp® FR3 fluid, the fluid used in Envirotran® transformers is a fire resistant, natural ester-based fluid. Envirotemp FR3 fluid offers the advantage of a seed oil-based dielectric coolant with food grade additives, in addition to increased fire safety when compared to mineral oil. R-Temp and Envirotemp FR3 fluid can be used in a pad-mounted transformer next to buildings or inside buildings with suitable containment provisions.

Vacuum Processing

A very low level of moisture is a key factor in the dielectric performance and service life of a transformer. Cooper has paid extensive attention to moisture removal and it has resulted in improved reliability and the industry's longest transformer life expectancy. Cooper's vacuum process simultaneously heats and dries the transformer, removing any moisture in the components.

Circulating current, established by energizing the coils under shorted conditions, heats the coils from the inside. Any moisture turns to a gas which is pulled from the chamber by the vacuum. Once the transformer is thoroughly dried, degassed insulating fluid is added while still under vacuum to assure maximum penetration of the fluid into the coil and insulation, minimizing air pockets that can lead to internal corona failure.

Far superior to hot air dryout systems, Cooper's vacuum processing is carefully controlled to monitor actual residual moisture levels. This contrasts with simple timing according to theoretically calculated process cycle time, which is subject to variations in effectiveness due to environmental and system variances. The process maximizes dielectric strength and virtually eliminates the potential for insulation damage.

Tank

Tanks are formed of precision cut cold-rolled steel. Tank bases are constructed to permit rolling in any direction perpendicular to a tank wall. Heavy-duty lifting hooks and jack pads are provided. All tanks are pressure tested to withstand 7 psig without permanent distortion.

The interior of the tanks are painted a light gray to enhance visibility of internal components under oil. For 1000 kVA and below a bolted tank cover is standard. This permits thorough cleaning and complete painting prior to assembly, reducing the potential for contamination due to welding. Also, the tank cover is removable for field service without contaminating internal components and insulating oil. Tank covers are domed to facilitate moisture run-off. High-strength cover bolts are enclosed and concealed by a wrap-around cover guard, accessible only from inside the cabinet.

Cabinet

Patented high security features exceed ANSI requirements. The interlocked low-voltage compartment door has a three-point latching mechanism. Flush-fit doors with concealed latches and heavy-duty stainless steel hinges resist prying or probing. Doors are secured by a captive silicon bronze pentahead bolt.

A 20", 24", or 30" deep cabinet with removable sill is standard depending on kVA rating and accessory configuration. Full height 120° open doors have stops to hold them in the open position for ease of service.

Finish

An advanced multi-stage finish process exceeds ANSI standards. An eight-stage phosphate wash pretreatment assures coating adhesion and inhibits corrosion. Three-step electrodeposited and oven-hardened epoxy primer (E-coat) provides a barrier against moisture, salt, and other corrosives. Polyester powder coat (P-coat) provides resistance to abrasion and impact, and the urethane final coat adds ultraviolet protection.

THREE-PHASE VFI TRANSFORMER

The VFI transformer combines a conventional Cooper Power Systems distribution transformer with the proven Kyle Vacuum Fault Interrupter (VFI). This combination provides both voltage transformation and either transformer or loop overcurrent protection in one space saving, money saving package.

The three-phase VFI transformer with transformer protection protects the transformer and provides proper coordination with upstream protective devices. When a transformer fault or overload condition occurs, the VFI breaker trips and isolates the transformer, leaving the feeder uninterrupted.

The three-phase VFI transformer with loop protection protects the loop or downstream section of a feeder. When a fault occurs downstream, the VFI breaker trips and isolates the fault, leaving the transformer load uninterrupted.

The three-phase VFI breaker has independent single-phase initiation, but is three-phase mechanically gang-tripped. A trip signal on any phase will open all three phases. This feature eliminates single-phasing of three-phase loads. It also enables the VFI breaker to be used as a three-phase loadbreak switch. Because the VFI breaker is resettable, restoring three-phase service is faster and easier.

R-TRAN™ FM APPROVED TRANSFORMER

Cooper Power Systems' R-Tran Transformer is FM Approved for indoor locations. Factory Mutual Research Corporation's approval of the R-Tran transformer line makes it easy to comply and verify compliance with the 1996 National Electrical Code (NEC) section 450-23, Less-Flammable Liquid-Filled Transformer Requirements for both indoor and outdoor locations.

FM Approved R-Tran transformers offer the user the benefit of a transformer that can be easily specified to comply with NEC, and makes FM Safety Data Sheet compliance simpler, while also providing maximum safety and flexibility for both indoor and outdoor installations. Because the "FM Approved" logo is readily visible on the transformer and its nameplate, NEC compliance is now easily verifiable by the inspector.

Three-Phase Pad-mounted R-Tran FM Approved transformers from Cooper Power Systems are manufactured under strict compliance with FMRC Standard 3990, and are filled with FM Approved R-Temp fire-resistant dielectric coolant.

TESTING

Cooper performs routine testing on each transformer manufactured, utilizing our unique Automated Test Program. This integrated, computer controlled, series of tests provides all routine test data in real time, enabling virtually instant generation of certified test reports. The tests include:

- Insulation Power Factor: This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- Ratio, Polarity, and Phase Relation: Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits.
- Resistance: Verifies the integrity of internal HV and LV connections; provides data for loss upgrade calculations.
- Routine Impulse Tests: The most severe test, simulating a lightning surge. Applies one reduced wave and one full wave to verify the BIL rating.
- Applied Potential: Applied to both high-voltage and low-voltage windings, this test stresses the entire insulation system to verify all live-to-ground clearances.
- Induced Potential: 3.46 times normal plus 1000 volts for reduced neutral designs.
- Loss Test: These design verification tests are conducted to assure that guaranteed loss values are met and that test values are within design tolerances. Tests include no-load loss and excitation current along with impedance voltage and load loss.
- Leak Test: Pressurizing the tank to 7 psig assures a complete seal, with no weld or gasket leaks, to eliminate the possibility of moisture infiltration or oil oxidation

Design performance tests include:

- Temperature Rise: Our automated heat run facility ensures that any design changes meet ANSI temperature rise criteria.
- Audible Sound Level: Ensures compliance with NEMA requirements.
- Lightning Impulse: To assure superior dielectric performance, this test consists of one reduced wave, two chopped waves and one full wave in sequence, precisely simulating the harshest conditions.

We are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality transformer for the lowest cost. Cooper Power Systems Transformer Products is working towards ISO9001 compliance, emphasizing process improvement in all phases of design, manufacture, and testing. We are so dedicated to introducing new innovations and technologies to the transformer industry we have invested millions of dollars in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin. Headquarters for the Systems Engineering Group of Cooper Power Systems, this research facility is fully available for use by our customers to utilize our advanced electrical and chemical testing labs.

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