



Axio Power Canada Inc./
SunEdison Canada

Draft Design and Operations Report

For

Belleville TS Demorestville
Solar Energy Project

H335467
Rev. D
September 15, 2011

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Project Report

September 15, 2011

Axio Power Canada Inc./SunEdison Canada
Belleville TS Demorestville - 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 Belleville TS Demorestville Solar Energy Project (the "Project"). The Project Location¹ is situated on an approximately 36 hectares (ha) of land on Part of Lot 51, Concession 1, geographic Township of Sophiasburgh, Prince Edward County (single tier municipality).

The Project is proposed to be constructed on privately owned land currently used for agriculture crops. The Project is located immediately north of Black Road, approximately 4.9 km west of the hamlet of Demorestville and 400 m east of Doxsee Road.

The 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 (via pad-mounted inverter transformers and a main substation transformer) to a voltage of 44 kV prior to being connected to the existing local distribution line. In order to meet 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 8 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 situated on approximately 36 ha of land on Part of Lot 51, Concession 1, Prince Edward County. The latitude and longitude coordinates for the approximate center of the Project Location are 44°19'21.08" N and 76°33'52.24" W.

The site plan (Figure 2.1) identifies the Project's property boundary (i.e., Project Site²), the Project Location, existing local roads, topographic contours, existing local transmission 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 area, access roads, solar PV module arrays, inverters, the substation 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, 2011c).

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, substation 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.

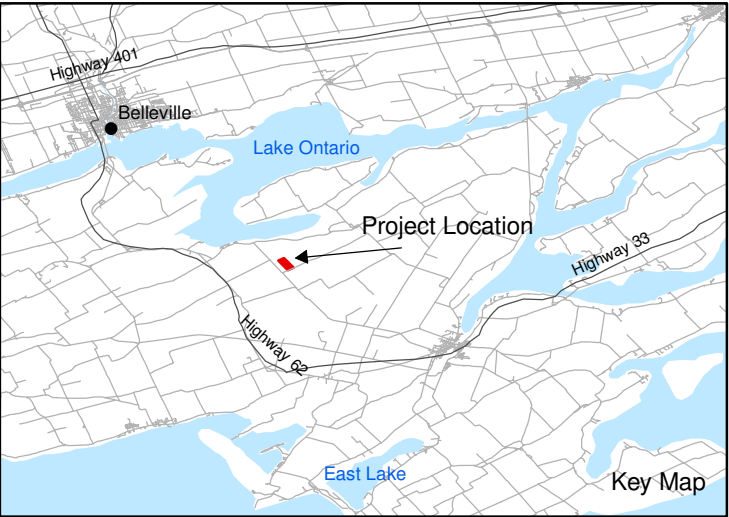
² Project Site (upper case) refers to property boundary. Project Location includes the Project infrastructure footprint including lands temporarily required for construction such as vehicle parking and materials laydown. References to the 'site', 'construction site' are synonymous with Project Location 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 within 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 (ES, 2011a), Natural Heritage Assessment Evaluation of Significance Report (ES, 2011b) and Natural Heritage Assessment Environmental Impact Study Report (ES, 2011c).
- **Waterbodies** can be found in the Water Body Records Review Report (Hatch, 2011b) and Water Body Site Investigation Report (ES, 2011d).
- **Construction and decommissioning** activities and timelines, facility components, environmental effects, mitigation and monitoring can be found in the Construction Plan Report (Hatch, 2011c) and the Decommissioning Plan Report (Hatch, 2011d).
- **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, transforms), noise receptors and the simulation results of noise modeling of the Project during its operation can be found in the Noise Study Report (Hatch, 2011e).
- **Archaeological resources** and an assessment of potential effects can be found in the Stage 1 and 2 Archaeological Assessment Report (TAI, 2010).
- **Geotechnical conditions** (e.g., soils, groundwater, bedrock) can be found in the Geotechnical Report (GENIVAR, 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 Proposed Groundwater Monitoring Scoping Report (McIntosh Perry, 2011d).



LEGEND

Existing Features

- Road
- Topographic Contour (5 m interval)
- Transmission Line
- Watercourse
- Project Location
- 300 m from Project Location
- Project Site
- Parcel
- Unevaluated Wetland
- Unevaluated Woodland
- Non-significant Hedgerow

Significant Natural Features / Significant Wildlife Habitat (within 120m of Project Location)

- Significant Woodland / Significant Wildlife Habitat (Shrub / Early Successional Bird Breeding)

Proposed Project Components

- Inverter
- Communication Tower
- Substation
- Panel Layout
- Access Road
- Fence
- Transmission Line
- Laydown Area

Notes:
1. Produced by Hatch under licence from Ontario Ministry of Natural Resources, Copyright (c) Queens Printer 2011.
2. Spatial referencing UTM NAD 83.
3. Ortho photos obtained from First Base Solutions, flown 2008.
4. Significant natural features and wildlife habitat depicted within 120 m of Project Location obtained from Ecological Services (2011c).

Heritage and Archaeological Resources

- Historic Site (Stage 1/2 Archaeology)

0 37.5 75 150 225 Meters



Scale 1: 7,000

Figure 2.1
Axio Power Canada Inc./SunEdison Canada
**Belleville TS Demorestville
Site Layout Plan**



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 nor are there any lake trout lakes at development capacity within 300 m of the Project Location (ES, 2011b). The nearest water body is Demorestville Creek about 190 m north of the Project location. This feature does not pose a constraint to the Project since it is located greater 120 m from 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, provincial parks, conservation reserves or Areas of Natural and Scientific Interest (ANSIs) on or within 120 m of the Project Location (Hatch, 2011a and ES, 2011b).

The majority of the Project Location and adjacent lands to the west and south of the Project Location are used for agricultural crops. The lands north and east of the Project Location are covered by forested woodlands. There are no woodlands on the Project Location.

There is a woodland situated approximately 140 m west of the Project Location and another woodland situated about 165 m southeast of the Project Location. Neither of these woodlands were identified as significant in the County of Prince Edward Official Plan. These woodlands do not pose a constraint to the Project since they are located greater 120 m from the Project location.

There is a woodland that encroaches to within 8 m of the eastern edge of the Project Location. This woodland was identified as significant based on its size and ecological functions (e.g., proximity to other woodlands and habitat linkages) (ES, 2011b). This woodland also provides significant wildlife habitat for species of conservation concern (e.g., shrub/early successional breeding bird habitat) (ES, 2011b). Under the REA Regulation, an environmental impact study (EIS) is required for Project facilities proposed within 120 m of significant woodlands or significant wildlife habitat. Based on the assessment findings of the EIS, the Project will not result in significant adverse impacts to the woodland or its wildlife (ES, 2011c) and no defined setback from this feature is required for the Project.

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.

Stage 1 and 2 Archaeological Assessments were completed by The Archaeologists Inc. in 2011 and a report (TAI, 2011) was submitted to the Ministry of Tourism and Culture (MTC). Three Euro-Canadian historic sites were identified in the southern portion the Project Location (Figure 2.1). A Stage 3 archaeological assessment will be completed to recover and document the sites as per the requirements of the MTC. Following the completion of the Stage 3 work, the three sites are expected to be cleared of any further archaeological concern and therefore will not pose a constraint to the Project.

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 is currently used for agriculture field crops. There are no water wells on the Project Location and there are no municipal potable water services or sewer services supplying the Project Location (McIntosh Perry, 2011c). There is an abandoned house and barn within the south-central portion of the Project Location. A grassed access road runs through the centre of the Project Location in a north-south direction.

Land uses to the south and east of the Project Location are agricultural with rural residential homes situated along Doxsee and Black Roads. The lands to the north and east of the Project Location are predominantly woodlands. The Project Location and adjacent lands are designated Rural in the County of Prince Edward Official Plan (2006) (Schedule E). Review of the Official Plan maps Schedule A (Environmental Sensitive Areas) and Schedule B (Environmental Constraints) did not identify any land use constraints pertaining to natural heritage features on or adjacent to the Project Location. There are no known landfill sites, petroleum wells 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 of contamination of the Project Location from past land uses, several areas of potential environmental concern (e.g., tires, miscellaneous wastes, garbage) were identified by the study along with mitigation and/or improvement measures to address such concerns (McIntosh Perry, 2011c).

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: Black Road immediately south of the Project Location.
- A Hydro One Network Inc. (HONI) distribution line is situated south of the Project Location along the north side of Black Road.

2.2.7 Traffic Considerations

A Traffic Impact Study (McIntosh Perry, 2011b) was prepared, which assessed the potential traffic-related impacts on local roads during construction and operation of the Project. The study concluded that the Project will have a negligible impact (i.e., delays to local community traffic flow) to the surrounding road network given the low anticipated vehicle trips generated by the Project, as well as the low existing traffic volumes.

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, 2011e) 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 Geotechnical Investigation Report (GENIVAR, 2011) determined that the Project Location is underlain by limestone bedrock covered by a 0.5 m to 0.8 m thick layer of overburden comprised of sandy silt or silty clay topsoil. Bedrock was encountered at depths ranging from 0.5 m to 1.0 m below the ground surface within all six investigatory boreholes (GENIVAR, 2011). Geotechnical investigations conducted by Inspec-Sol (2011) encountered bedrock at depths ranging from 0.4 m to 1.2 m below the ground surface within all 12 investigatory test pits. Light groundwater seepage was noted at the soil-rock interface in some of the boreholes (GENIVAR, 2011). Based on the expected excavation depths, significant excavation dewatering is not anticipated. However, if required, dewatering should be controllable with sumps and filtered pumps within the excavations (GENIVAR, 2011).

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 constructed related environment effects and mitigation measures is provided in the Construction Plan Report (Hatch, 2011c).

3.1.1 Civil Components

3.1.1.1 Fencing and Security Gate

The perimeter of the Project will be fenced and the Project entrance from Black 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 2,700 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

A new site access road, about 5-m wide will be constructed of asphalt from Black Road into the Project Location 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. 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 (i.e., solar arrays).

- 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 substation electrical building 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 precast concrete pad foundations for the building enclosures that will house the inverters and transformers.
- A 9.0 m by 5.0 m precast concrete pad foundation for the substation electrical building.
- A 7.0 m by 7.0 m precast concrete pad foundation for the substation transformer pad.

Based on these quantities, the total amount of impervious area associated with concrete foundations will be approximately 350 m² corresponding to less than 0.10% of the 36 ha Project Location area.

3.1.1.5 *PV Module Mounting System, Supports and Foundations*

The solar PV modules will be mounted on a single-axis, ground mount, tracker system. 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. The lattice structures will be assembled on-site and typically hold 44 individual solar PV modules mounted two high, in a portrait orientation. When in the fully "down" position, the bottom of the rack will be about 1.0 m off the ground and the height of the rack will be about 3.0 m off the ground. The racks of modules will be arranged in rows about 80 m to 130 m long, spaced about 6.54 m apart. In total, an estimated 1030 racks will be used to support a total of 45,000 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 5,000 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 0.10% of the 36 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.

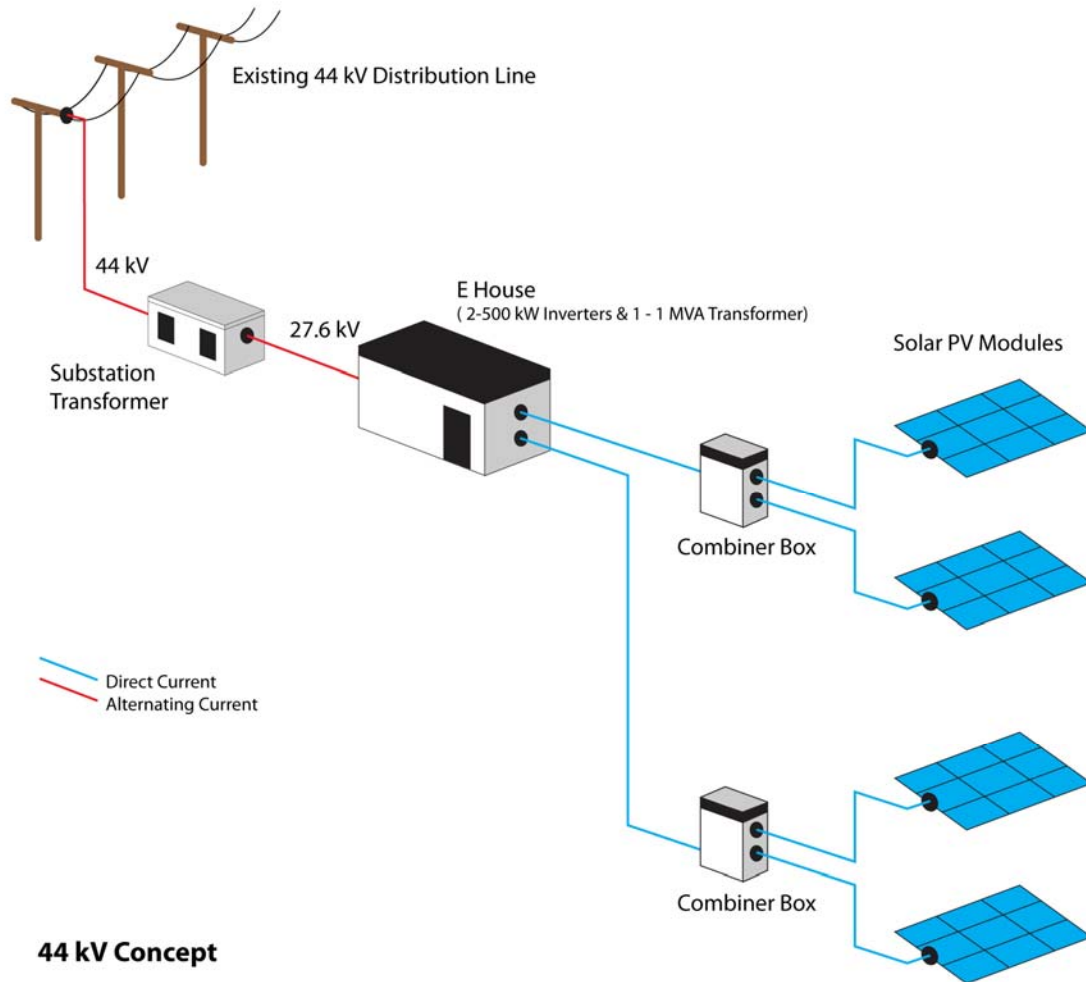


Figure 3.1 Generalized Schematic of Electrical Equipment Connectivity

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 (DC) to 27.6 kV (AC). The 27.6 kV (AC) current will then be transmitted through underground cabling to the main transformer situated in the substation yard, which will step up the voltage from 27.6 kV to 44 kV. Electricity will then flow from the substation yard through overhead electrical lines and connect to the local 44 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 45,000 solar PV modules, each 265 watts to 295 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 litres 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 substation 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 substation 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

The Project will have a single main step-up transformer located within the substation yard to step-up the voltage from 27.6 kV to 44 kV. At this stage, the specific make and model of the substation transformer has not been finalized, but would typically be a three-phase, liquid-filled, medium voltage transformer with a nominal rating of 10 MVA. A typical substation transformer is approximately 2.86 m long by 2.84 m wide by 2.52 m high and weighs about 20,000 kg. A typical 10 MVA transformer will contain about 7000 to 9000 litres of liquid dielectric coolant fluid, which is typically mineral oil. An example of a typical substation transformer is provided in Appendix B.

Operationally, the transformer will be oil filled and will sit on a concrete slab surrounded by a spill containment area that will provide emergency secondary containment in the unlikely event that the transformer encounters an oil leak (Section 3.1.3.2). In addition, to minimize the risk to the environment, final transformer selection will use an organic based vegetable oil (e.g., BIOTEMP®, Envirotemp® FR3™), which is non-toxic and readily biodegradable. The transformer will be equipped with gauges to monitor pressure, temperature and oil levels. Unusual pressure and/or oil levels will trip an alarm to a remote monitoring station, notifying facility personnel to immediately respond to the site. As noted in Section 3.1.2.3, spill control kits will be stored on-site and spill response/cleanup procedures implemented if a spill or oil leak is detected.

3.1.2.8 Substation Yard, Transformer and Electrical Building

The substation yard will be located in the southwest corner of the Project Location (Figure 2.1). The substation yard will contain the main step-up transformer and electrical equipment including the electrical control, switchgear, protection and monitoring systems, which will be housed in a weatherproof building enclosure. The electrical building will be prefabricated and brought to 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.

The power from the inverters will run underground to the substation yard. Power will then be run overhead from the substation yard to the existing Hydro One Networks Inc (HONI) 44 kV distribution line situated along Black Road.

3.1.2.9 Electrical Distribution Line and Connection Point

Connecting to the existing HONI 44 kV distribution line along Black Road will require about 30 m long overhead 44 kV transmission line be constructed between the Project substation and the point of interconnection (POI) with the HONI distribution line (Figure 2.1). The Proponent will construct the transmission line from the substation to Project property line in accordance with its standards and practices and the Ontario Electrical Safety Code. HONI 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 substation yard (Figure 2.1). During operation of the Project, the tower will provide transfer of facility operation data to the HONI.

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	0.44	0.51	17.1
100-yr	0.76	0.88	15.8

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's Site Grading and Drainage Plan to mitigate the potential for adverse off-site effects (e.g., 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 quality as well as providing mitigation benefits to the quantity of 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 reduce the potential for erosion. As noted above, 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 *Transformer Spill Containment / Oil-Water Separator*

Spill containment will be provided around the main transformer within the substation area to provide emergency secondary containment in the unlikely event that the transformer encounters an oil leak to protect the surrounding environment. The specifics of the transformer spill containment will be established during detailed design and may include a raised concrete wall and/or a depressed sump around the transformer sized to contain 110% of the (oil) volume of the transformer, plus an allowance for precipitation.

As part of the spill containment's storm water drainage piping, an oil-water separator may be installed to separate and trap any oil possibly present in the runoff water from the containment area prior to its discharge into the Project's surface drainage system (e.g., grassed swales). The oil-water separator would be a prefabricated design such as a Stormceptor® model EOS or equivalent (product brochure provided in Appendix B). The oil-water separator would be routinely inspected as part of the Project's maintenance and if necessary, any accumulated oil would be pumped out by tanker truck and disposed of at a registered hazardous waste facility.

3.1.3.3 *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, 2011c).

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. A small waste disposal bin(s) will be provided on-site to collect any trash, debris or equipment parts replaced during routine maintenance of the Project during its operation. Periodically, when 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 contaminants 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 contaminants 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, 2011e) 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 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 reseeded 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. 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 left on-site and in the maintenance trucks should leaks be 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 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.
- 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.
- Proposed Groundwater Monitoring Scoping Report, which identifies a proposed groundwater monitoring program for water wells in proximity to the Project before and after construction.

5.2 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 sediment and erosion 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 is 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 (e.g., Demorestville Creek) 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 given effective mitigation.
Aquatic Habitat and Biota	Erosion, increases in surface water runoff, accidental spills on Project Location.	Indirect effects to aquatic habitat and biota in receiving watercourses (e.g., Demorestville Creek) due to increased turbidity in runoff, sedimentation or accidental spills.	Mitigation measures for Soils, Surface Water and Spills will mitigate any potential adverse impacts to aquatic features located on or off-site.	No residual effect given effective mitigation.
Wildlife	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 released off-site. If possible, maintenance activities (e.g., grass cutting) to 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.

Environmental Component	Sources of Negative Effect	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
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 movers).	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 procedures. 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 Black 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.	Potential visual disturbance to adjacent observers for short periods of time under site-specific conditions and viewing angles between March and September.	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.
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.	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.	None. Mitigation and procedures for transformer equipment inspection, monitoring and spill response/cleanup are anticipated to be effective in preventing residual negative effects.

Environmental Component	Sources of Negative Effect	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
	Accidental spills of transformer oil from inverter transformer.		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.	

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 operations 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 operations 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 operations 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 operations 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 substation 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 substation 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.

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 substation 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:II

Appendix A

Project Drawings

BELLEVILLE TS DEMORESTVILLE SOLAR PROJECT

PART OF LOTS 51 & 52 CONCESSION 1, SOPHIASBURGH TOWNSHIP, ON

SOLAR ELECTRIC SYSTEM PROJECT - 10 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 44 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:

G-001	TITLE SHEET
ES-101	EXISTING SITE PLAN
ES-102	ARRAY PLAN
EP-701	EQUIPMENT SPECIFICATIONS
EP-801	SINGLE LINE DIAGRAM
S-101	TRACKER DETAILS

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
FOR REVIEW ONLY
NOT FOR CONSTRUCTION

DATE: X-XX-XXXX

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Axio Power Canada Inc/
SunEdison Canada

945 PRINCESS STREET, SUITE 252
KINGSTON ON K7L 3N6

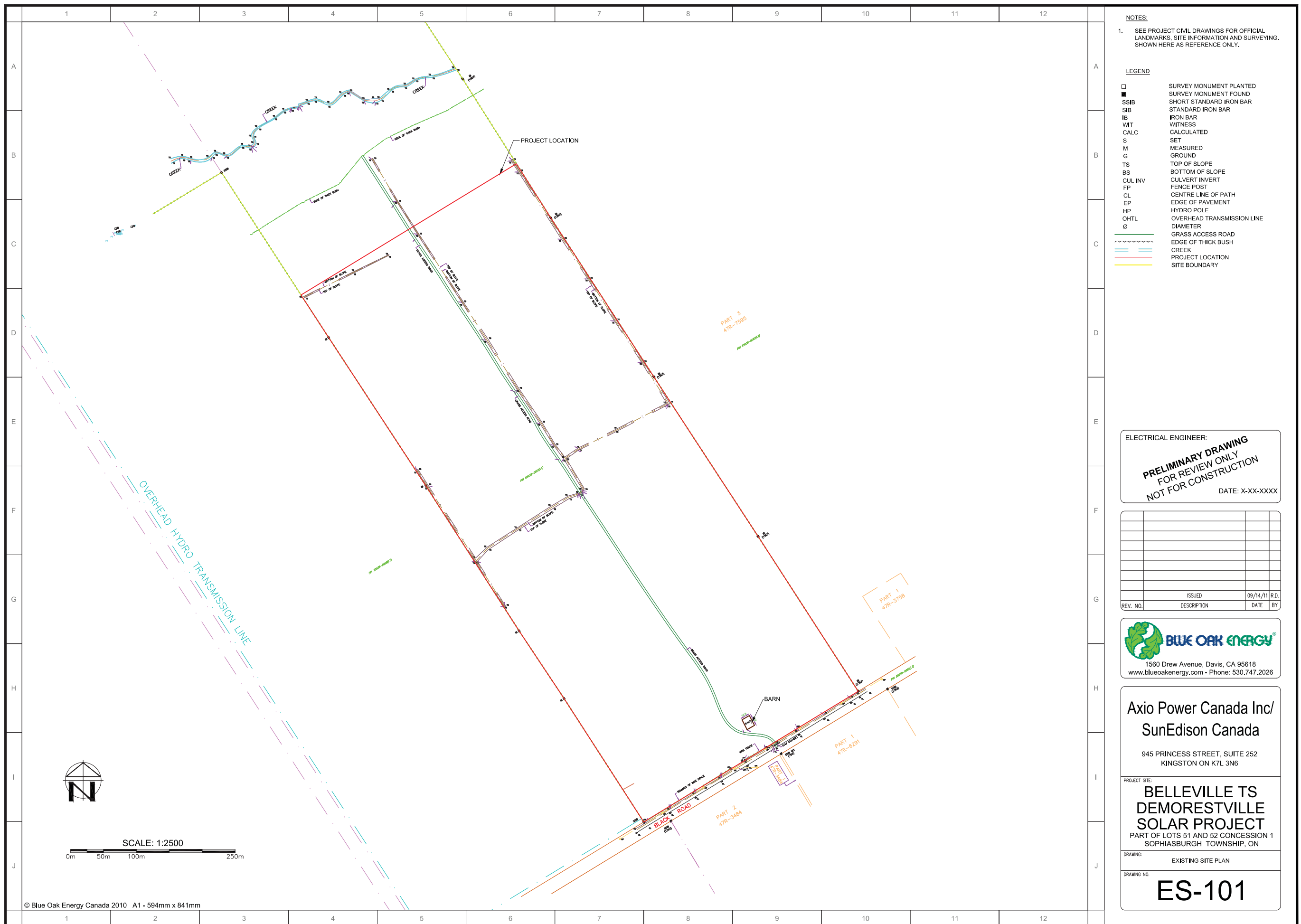
PROJECT SITE:

**BELLEVILLE TS
DEMORESTVILLE
SOLAR PROJECT**
PART OF LOTS 51 AND 52 CONCESSION 1
SOPHIASBURGH TOWNSHIP, ON

DRAWING:	TITLE SHEET
----------	-------------

DRAWING NO.

G-001





High Yields

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

Low System Costs

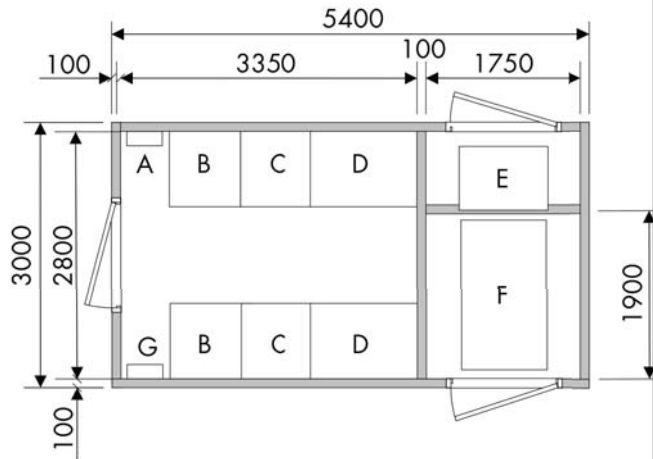
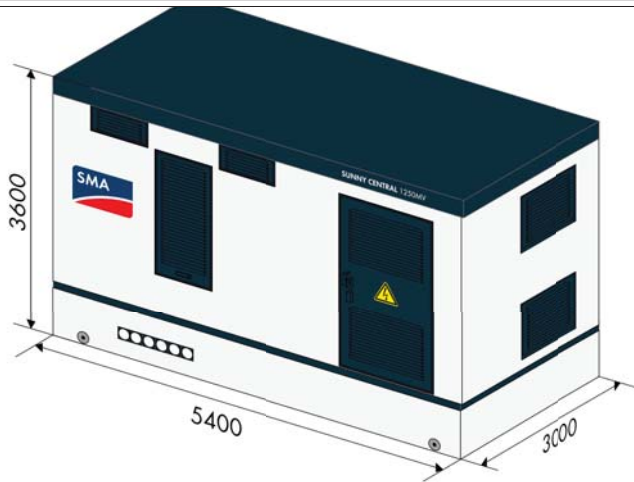
- Outdoor-rated enclosure
- Couples to medium-voltage external transformer
- Available as integrated solution

Strong Peripherals

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

UL Certified

- UL 1741 / IEEE-1547 compliant



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

Technical data

Input data

Max. DC power	565 kW _p 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	○ / ○ / ○
Display: text line / graphic	- / ●
Communication protocols	Modbus / TCP
SSM-US connection	RS485
Plant monitoring	Sunny Portal

EQUIPMENT SPECIFICATIONS

SCALE: NTS

NOTES:

1. NONE.

KEYED NOTES:

- ①. NONE.

ELECTRICAL ENGINEER:

PRELIMINARY DRAWING
FOR REVIEW ONLY
NOT FOR CONSTRUCTION

DATE: X-XX-XXXX

REV. NO.	ISSUED	09/14/11	R.D.
	DESCRIPTION	DATE	BY

 **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:
**BELLEVILLE TS
DEMORESTVILLE
SOLAR PROJECT**
PART OF LOTS 51 AND 52 CONCESSION 1
SOPHIASBURGH TOWNSHIP, ON

DRAWING: EQUIPMENT SPECIFICATIONS

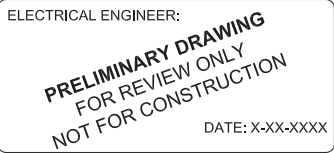
DRAWING NO.

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	3608	36080
DC RATING	1.12 MW	11.2 MW
AC NAMEPLATE RATING	1.0 MW	10 MW
NUMBER OF SOURCE CIRCUITS	328	3280
SOURCE CIRCUIT COMBINERS	22	220

MODULE	MEMC 310W (TYPICAL)	
MODULE STC POWER	280 - 310Wp	
MODULE TILT	SINGLE-AXIS TRACKER	
ARRAY AZIMUTH	180°	
	GENERATOR, TYPICAL OF 10	SITE TOTAL
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1. THIS DRAWING IS FOR PRELIMINARY DESIGN PURPOSES ONLY. THE DESIGN SHOWN HERE IS NOT FOR CONSTRUCTION.

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**Axio Power Canada Inc/
SunEdison Canada**

945 PRINCESS STREET, SUITE 252
KINGSTON ON K7L 3N6

PROJECT SITE:

**BELLEVILLE TS
DEMORESTVILLE
SOLAR PROJECT**

PART OF LOTS 51 AND 52 CONCESSION 1
SOPHIASBURGH TOWNSHIP, ON

DRAWING: SINGLE LINE DIAGRAM

DRAINING NO.

EP-801



- Sub Substation Transformer
- 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

Belleville TS Demorestville –
Solar Energy Project –
Noise Map at 4.5m



Figure C.1



Appendix B

Manufacturer's Brochures and Technical Information

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

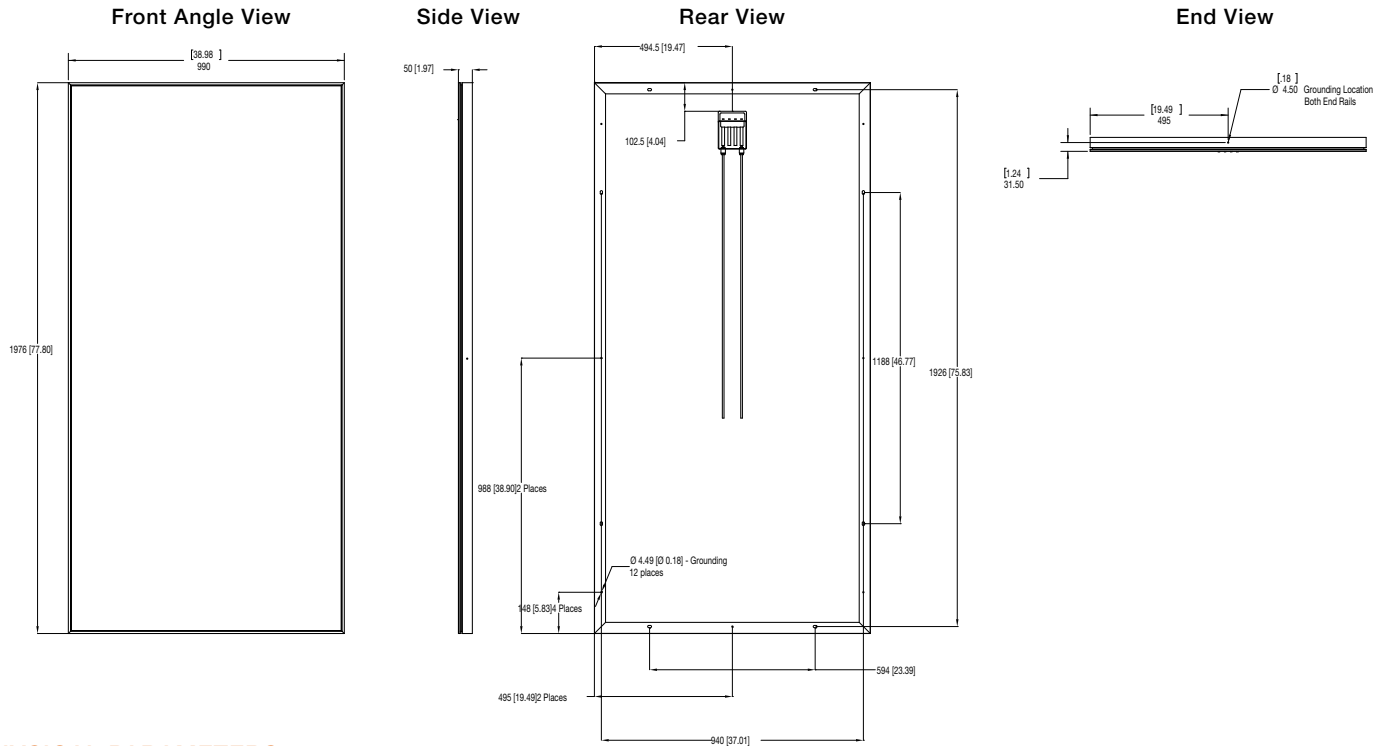
WARRANTY INFORMATION

- 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

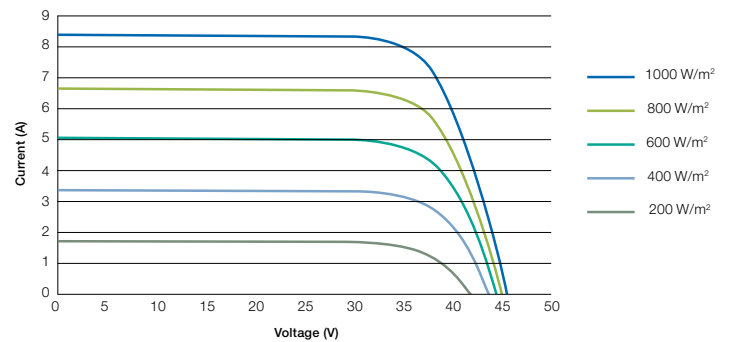
Nominal Operating Cell Temperature (NOCT) (°C)	45± 2
Temperature Coefficient of P_{max} (%/°C)	-0.45
Temperature Coefficient of V_{oc} (%/°C)	-0.33
Temperature Coefficient of I_{sc} (%/°C)	0.06
Operating Temperature (°C)	-40°C to +85
Maximum System Voltage (V)	1000
Limiting Reverse Current (A)	8.40
Maximum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

ELECTRICAL CHARACTERISTICS

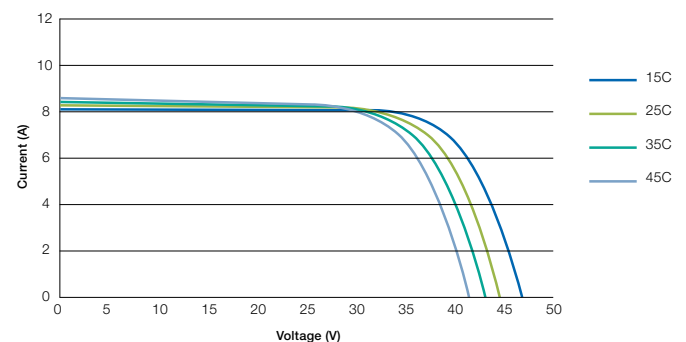
Model #	MEMC-P270ACA	MEMC-P275ACA	MEMC-P280ACA
Rated Maximum Power P_{max} (W)	270	275	280
Open-Circuit Voltage V_{oc} (V)	44.4	44.8	45.1
Short Circuit Current I_{sc} (A)	8.28	8.31	8.34
Module Efficiency (%)	13.9	14.2	14.3
Maximum Power Point Voltage V_{mpp} (V)	35.2	35.5	35.9
Maximum Power Point Current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

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

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.

SUNNY CENTRAL 800MV / 1000MV / 1250MV



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)

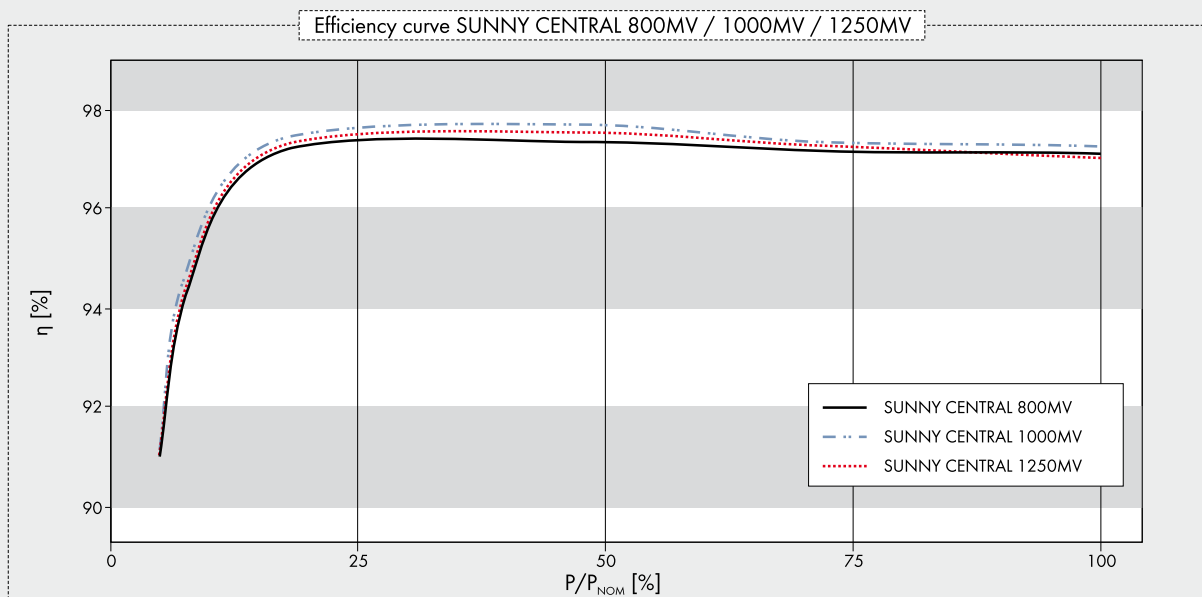
SUNNY CENTRAL for Direct medium-voltage feed-in 800MV / 1000MV / 1250MV

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 kW ¹⁾	1120 kW ¹⁾	1410 kW 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
Efficiency²⁾			
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	○	○	○
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 ○ 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 $U_{DC} = 500 \text{ V}$

3) 2x inputs for the external nominal value specification for active power and reactive power, 1x external alarm input, 1x irradiation sensor, 1x pyranometer

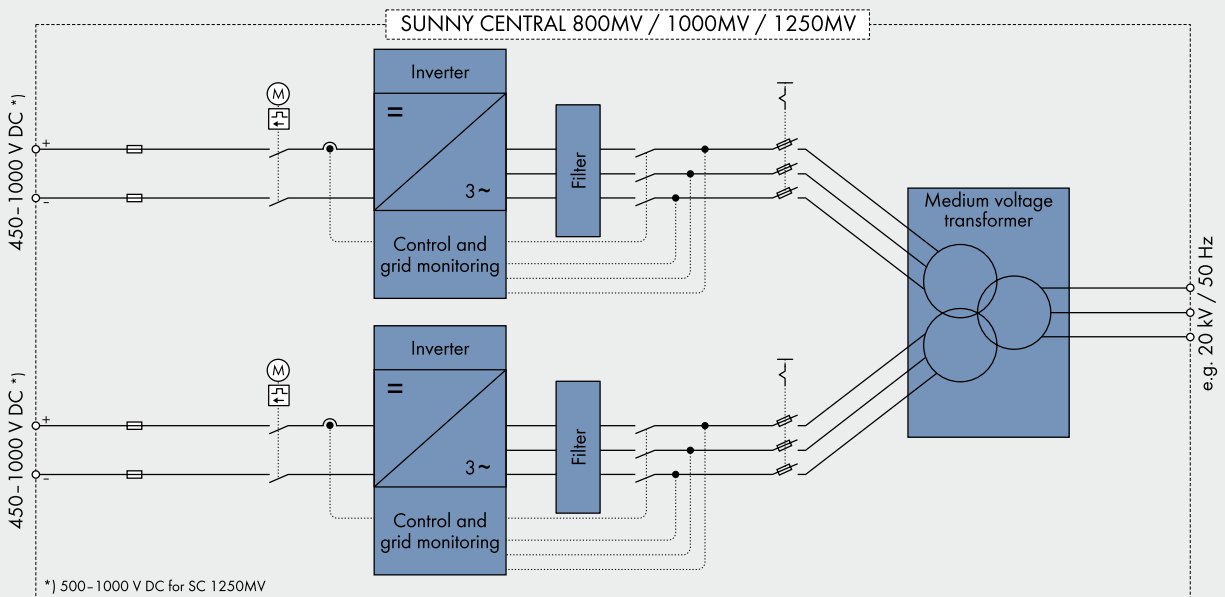
4) Internal consumption at nominal power

5) At $1.05 U_{AC, nom}$ and $\cos \varphi = 1$

6) With limited dynamic grid support

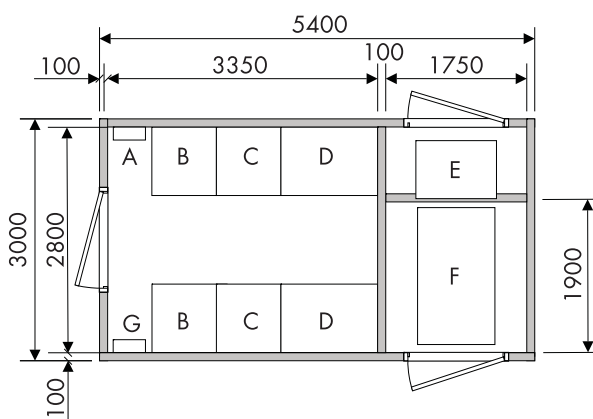
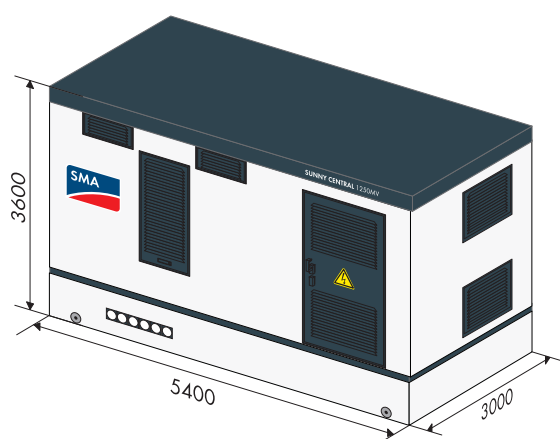
7) At $f_{grid} = 60 \text{ Hz}$: $510 \text{ V} - 820 \text{ V}$

Please note: in certain countries the substations may differ from the substations shown in the images



1 Mechanical data

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

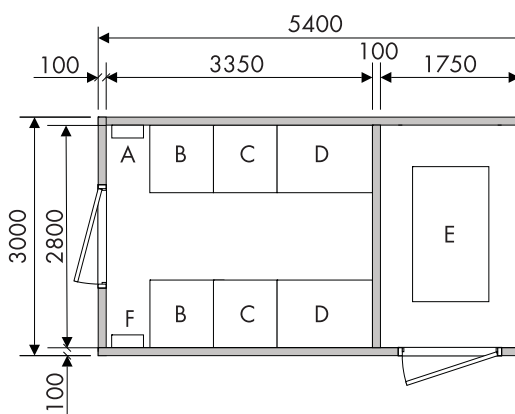
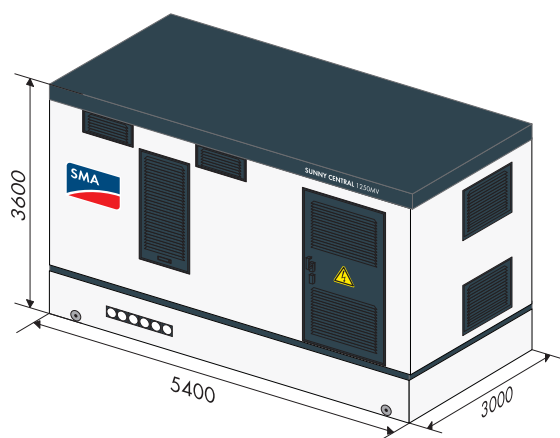


All figures in mm.

- A COM-B, optional
- 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

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



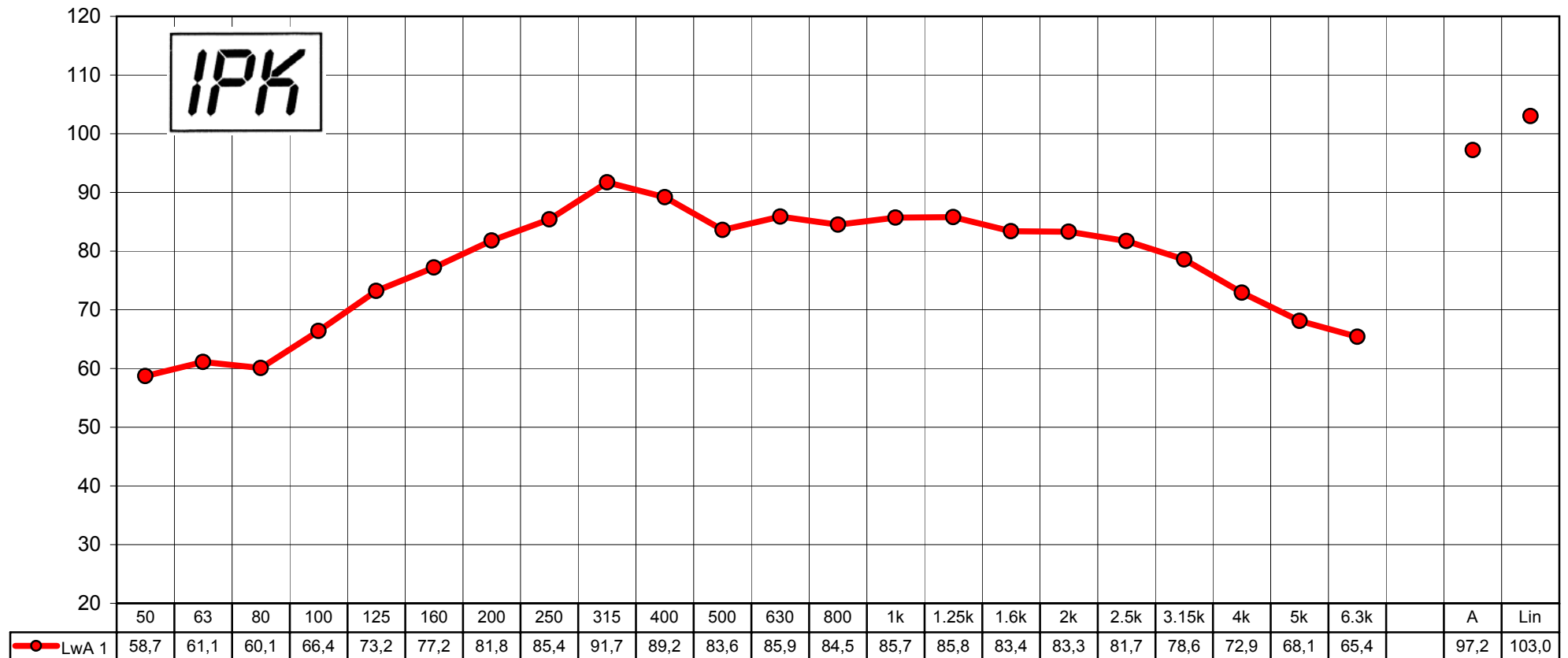
All figures in mm.

- A COM-B, optional
- C Sunny Central, inverter cabinet
- E Transformer

- B Sunny Central, DC cabinet
- D Sunny Central, AC cabinet
- F Station sub-distribution

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

A - bewerteter Schallleistungspegel LwA re 1 pW [dB(A)]



Terz - Mittenfrequenz [Hz]

SUNNY CENTRAL 500HE-US



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

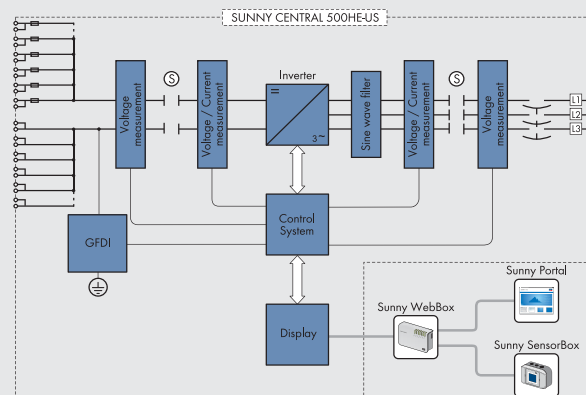
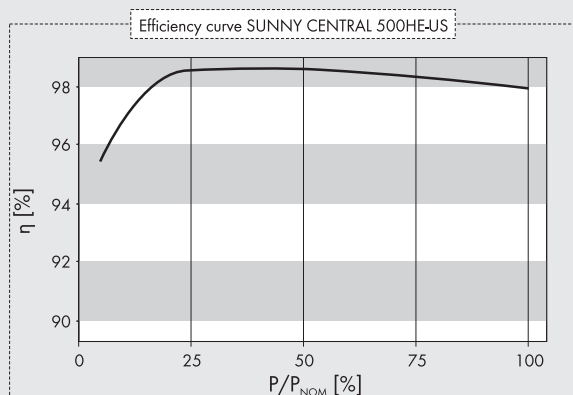
The ideal solution for large-scale North American solar power plants

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	○/○/○
Display: text line / graphic	-/●
Communication protocols	Modbus / TCP
SSM-US connection	RS485
Plant monitoring	Sunny Portal
● Standard features ○ 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



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

Three-Phase Pad-mounted Compartmental Type

Electrical Apparatus
210-12

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).

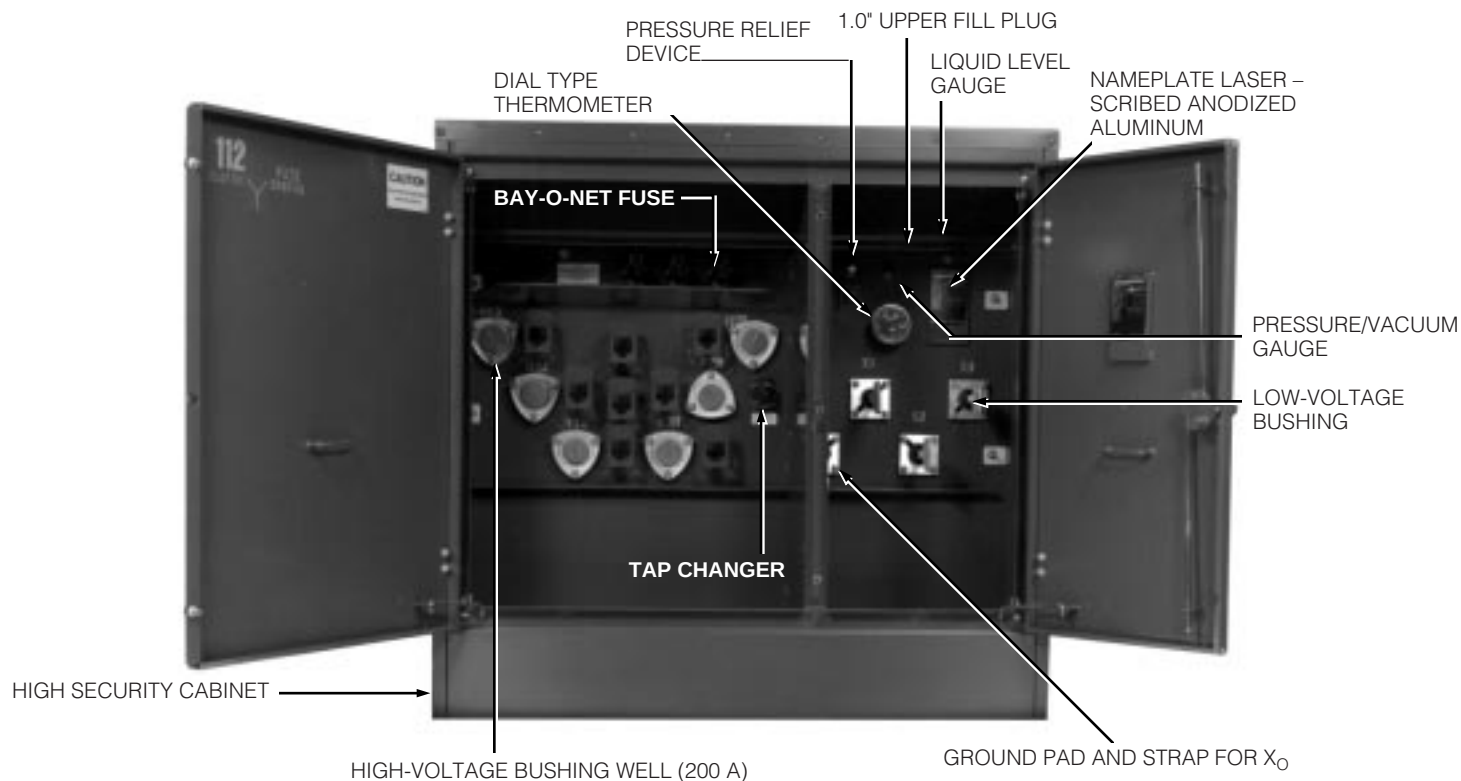


Figure 2.
Three-phase pad-mounted compartmental type transformer.

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 BIL²

Transformer		Electrical Characteristics of the Completely Assembled High-Voltage Connectors		
		High-Voltage Rating	BIL (kV)	60-Hz Dry One Minute Withstand (kV)
High-Voltage Ratings (Volts)	Minimum BIL (kV)	Phase-to-Ground /Phase-to-Phase (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.

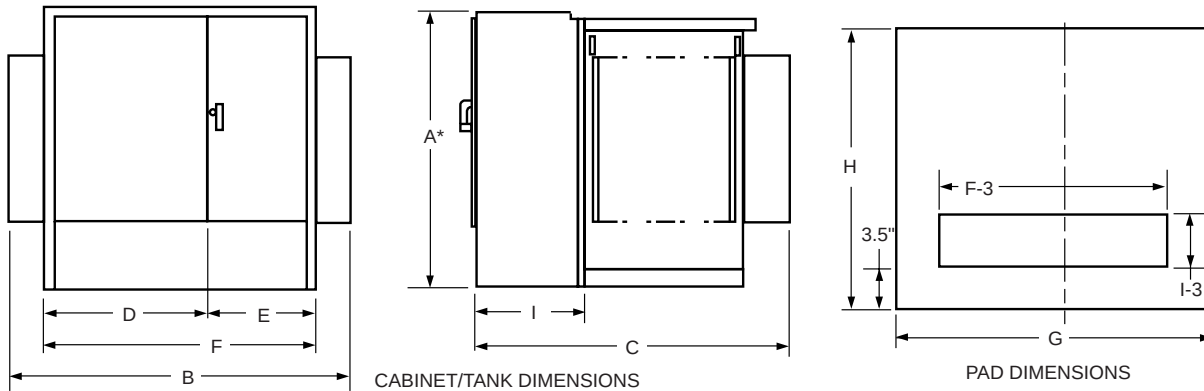


Figure 3.
Transformer and Pad dimensions.

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

TABLE 6
Typical Dimensions and Weights³

65°C Rise	DEAD-FRONT - LOOP OR RADIAL FEED - BAY-O-NET FUSING¹ OIL FILLED -ALUMINUM WINDINGS										
kVA Rating	OUTLINE DIMENSIONS (in.)									Gallons Of Fluid	Approx. Total Weight (lbs.)
	A¹	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
500²	50	89	53	42	30	72	93	57	20	240	5700
750²	64	89	57	42	30	72	93	61	20	380	8200
1000²	64	89	59	42	30	72	93	63	20	480	10,100
1500²	73	89	86	42	30	72	93	90	24	570	13,950
2000²	73	72	87	42	30	72	76	91	24	640	15,000
2500²	73	72	99	42	30	72	76	103	24	760	18,850
3000²	73	84	99	46	37	84	88	103	24	780	19,000
3750²	84	85	108	47	38	85	88	112	24	800	19,500
5000²	84	96	108	48	48	96	100	112	24	930	29,400
7500²	94	102	122	54	48	102	100	126	24	1580	41,900

TABLE 7
Typical Dimensions and Weights³

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 losses 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 interlayered 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.


COOPER Power Systems

Unit Type Substation Transformers

GENERAL

Cooper Power Systems Unit Type Substation Transformers are designed to meet customer specifications.

Flexibility in design, combined with the highest quality manufacturing processes, equipment, and testing procedures enable Cooper Power Systems to provide a product optimized to the customer's requirements. All units meet applicable American National Standards Institute (ANSI®), Institute of Electrical and Electronics Engineers, Inc. (IEEE®) and National Electrical Manufacturers Association (NEMA) standards, as well as National Electric Code® (NEC®), Department of Energy (DOE) and Canadian Electricity Association (CEA) specifications.

Unit type substation transformers are available with enclosed sidewall-mounted bushings for connections to primary and/or secondary switchgear.

Substation transformers are made with a wide range of core steels and winding conductors to optimize efficiency versus cost. Flexible core/coil and tank construction enable your dimensional requirements to be met.

Cooper Power Systems transformers are available with our patented Envirotemp FR3 fluid, a less-flammable and bio-degradable fluid or electrical grade mineral insulating oil. Unit type substation transformers intended for indoor use are solely filled with Envirotemp FR3 fluid. Electrical codes recognize the advantages of using Envirotemp FR3 fluid both indoors and outdoors for fire sensitive applications. Envirotemp FR3 fluid-filled units meet Occupational Safety and Health Administration (OSHA) and Section 450.23, 2008 NEC requirements.



Figure 1.
Unit type substation transformer equipped with low-voltage transition flange and high-voltage full height air terminal chamber.

PRODUCT SCOPE

Type	Three-Phase or Single-Phase, 50 or 60 Hz, 65 °C (55 °C/65 °C, 75 °C Optional)
Fluid Type	Envirotemp FR3 fluid or Mineral Oil (upon special request)
Size	Three-Phase: 300 – 12,000 kVA Single-Phase: 500 – 6667 kVA
Primary Voltage	2400 – 46,000 V
Secondary Voltage	208Y/120 V to 24,940 V Wye
Specialty Designs	Inverter/Rectifier Bridge Zig Zag K-Factor (up to K-19) Hazardous Location (Class 1 Div 2) Internal Circuit Breaker (VFI) UL Listed & Labeled/ Classified Factory Mutual (FM) Approved Solar/Wind Designs Differential Protection Automation Solutions

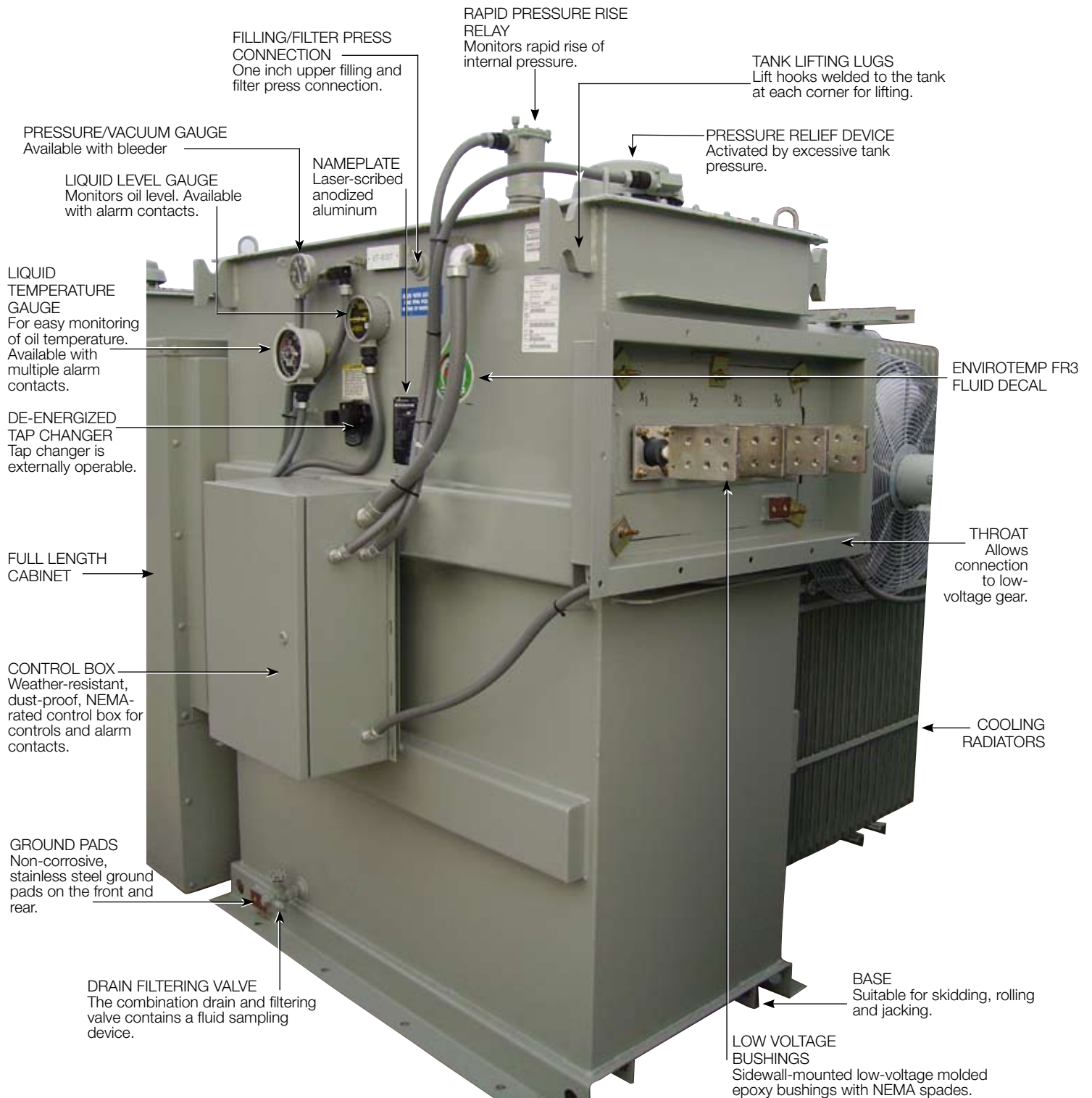


Figure 2.
Unit type substation transformer with standard features and optional accessories.

TABLE 1
Three-Phase, Single Temperature kVA Ratings

Three-Phase kVA Self-Cooled and Forced-Air Cooled with 65 °C Temperature Rise		
65 °C Rise KNAN		65 °C Rise KNAN/ KNAF
500	+15%	575
750		863
1000		1150
1500		1725
2000		2300
2500	+25%	3125
3750		4688
5000		6250
7500		9375
10000		12500
12000	+33%	16000

TABLE 4
Three-Phase, Dual or Triple Temperature kVA Ratings

Three-Phase kVA Self-Cooled and Forced-Air Cooled with Triple Rated 55 °C/65 °C/75 °C Temperature Rise							
55 °C Rise KNAN		65 °C Rise KNAN		75 °C Rise KNAN	55 °C Rise KNAN/ KNAF	65 °C Rise KNAN/ KNAF	75 °C Rise KNAN/ KNAF
500	+12%	560	+9%	610	575	644	702
750		840		916	863	966	1053
1000		1120		1221	1150	1288	1404
1500		1680		1831	1725	1932	2106
2000		2240		2442	2300	2576	2808
2500		2800		3052	3125	3500	3815
3750		4200		4578	4688	5250	5723
5000		5600		6104	6250	7000	7630
7500		8400		9156	9375	10500	11445
10000		11200		12208	12500	14000	15260
12000		13440		14650	16000	17920	19533

TABLE 2
Percentage Impedance Voltage¹

kV BIL Class	Low Voltage	
	< 2400V	≥ 2400V
45-150	5.75 ²	6.5 ³
200	7.25	7
250	7.75	7.5

¹ The standard tolerance is ± 7.5%.

² Option for 6.75% is available.

³ Option for 5.50% is available.

TABLE 3
Audible Sound Levels

Self-Cooled, Two Winding kVA Rating	NEMA Average	
	dB, KNAN	dB, KNAF
500	56	67
501-700	57	67
701-1000	58	67
1001-1500	60	67
1501-2000	61	67
2001-2500	62	67
2501-3000	63	67
3001-4000	64	67
4001-5000	65	67
5001-6000	66	68
6001-7500	67	70
7501-10000	68	71
12500	69	71

TABLE 5
Insulation Test Levels

kV Class	Induced Test 180 or 400 Hz- 7200 Cycle	kV BIL		Applied Test 60Hz (kV)
		Distribution	Power	
1.2	TWICE RATED VOLTAGE	30	45	10
2.5		45	60	15
5		60	75	19
8.7		75	95	26
15		95	110	34
25 (Grd Y Only)		125	150	40
25		150	150	50
34.5 (Grd Y Only)		125	150	50
34.5		150	200	70
46		200	250	95

TABLE 6
Temperature Rise Ratings 0 - 3300 feet (0-1000 meters)

	Standard	Optional
Unit Rating	65 °C	55/65 °C, 75 °C
Ambient Temperature Rise	40 °C	40 °C
Ambient Temperature 24 Hour Av.	30 °C	30 °C
Temperature Rise Winding ¹	65 °C	55 °C
Temperature Rise Hotspot	80 °C	65 °C

¹ Average Rise by resistance. Refer to ANSI/IEEE Std C57.12.00™ standard.

NOTE: Derate kVA by 0.4% for each 100 M (330 ft.) that the altitude is above 1000 M (3300 ft.)

TABLE 7
Fluid-Filled - Aluminum Windings 55/65 °C Rise¹

kVA	Drawing Dimensions (in.)									Gallons Of Fluid	Approx. Total Weight (lbs.) (With Fluid)
	A	B	C	D	E	F	G	H	J		
500	66	51	26	52	45	45	30	60	35	300	5600
750	75	59	26	52	55	55	34	68	35	360	7000
1000	75	67	26	52	55	55	38	76	35	420	8400
1500	75	59	59	80	55	55	34	68	35	400	9500
2000	85	67	67	90	55	55	38	76	39	520	12000
2500	85	75	68	92	55	55	42	84	41	570	14600
3750	85	75	70	120	65	65	42	84	45	790	20500
5000	99	87	72	144	65	65	48	96	49	1050	26000
7500	99	95	74	148	75	75	52	104	53	1320	35000
10,000	99	103	76	152	75	75	56	112	57	1740	43000
12,000	99	103	82	164	75	75	56	112	61	1850	49000

¹ Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Cooper Power Systems for exact dimensions

TABLE 8
Fluid-Filled - Copper Windings 55/65 °C Rise¹

kVA	Drawing Dimensions (in.)									Gallons Of Fluid	Approx. Total Weight (lbs.) (With Fluid)
	A	B	C	D	E	F	G	H	J		
500	66	51	26	52	45	45	30	60	35	310	5900
750	75	59	26	52	55	55	34	68	35	370	7400
1000	75	67	26	52	55	55	38	76	35	430	8800
1500	75	59	59	80	55	55	34	68	35	420	10000
2000	85	63	67	90	55	55	36	72	39	500	12800
2500	85	67	68	92	55	55	38	76	41	590	14900
3750	85	75	70	120	65	65	42	84	45	830	21500
5000	99	87	72	144	65	65	48	96	49	1090	28000
7500	99	95	74	148	75	75	52	104	53	1360	37000
10,000	99	103	76	152	75	75	56	112	57	1780	45000
12,000	99	103	82	164	75	75	56	112	61	1880	50000

¹ Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Cooper Power Systems for exact dimensions

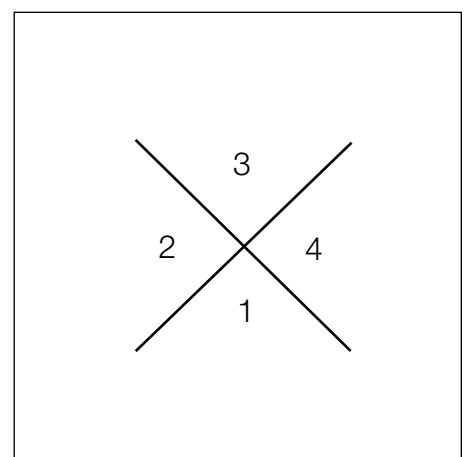
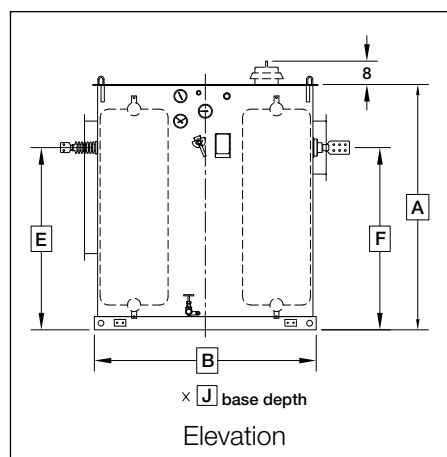
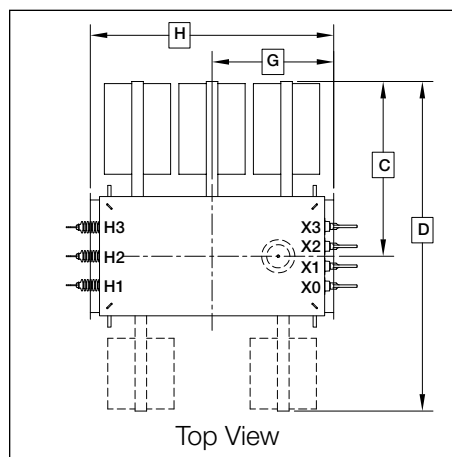


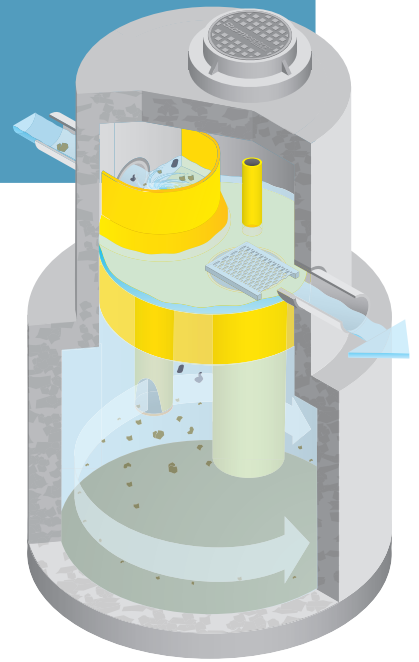
Figure 3.
 High-Voltage left (Segment 2) shown. High-Voltage right (Segment 4) also available.

Figure 4.
 ANSI segment designation.

Extended Oil Storage System

For any business involved in the handling of petroleum hydrocarbons, the threat of spills is serious. The Ontario Ministry of the Environment's Spills Action Centre (SAC) recorded 2,516 hydrocarbon spills in 2006 (crude gasoline, jet fuel, kerosene and petroleum oils). That's seven spills every day.

Accidents happen. Protect the environment and protect your business from costly clean-up, remediation, litigation and fines with the Stormceptor Extended Oil Storage (EOS) system.



Stormceptor EOS – hydrocarbon spill protection in dry and wet weather

- The EOS model features increased storage volume for safe oil containment compared to standard Stormceptor models
- Creates a non-turbulent treatment environment, allowing oil to rise and sediment to settle
- Patented scour prevention technology ensures captured oil and sediment remain in unit for secure storage and easy removal
- Renowned Stormceptor protection from pollutants carried in stormwater runoff
- Ideal for gas stations, airports, garages, loading docks, high-collision intersections and other spill-prone areas

Design flexibility

- Stormceptor EOS systems are sized to meet your individual oil spill containment and stormwater quality needs
- Existing Stormceptor units can be retrofitted to become EOS models

Sized using PCSWMM for Stormceptor

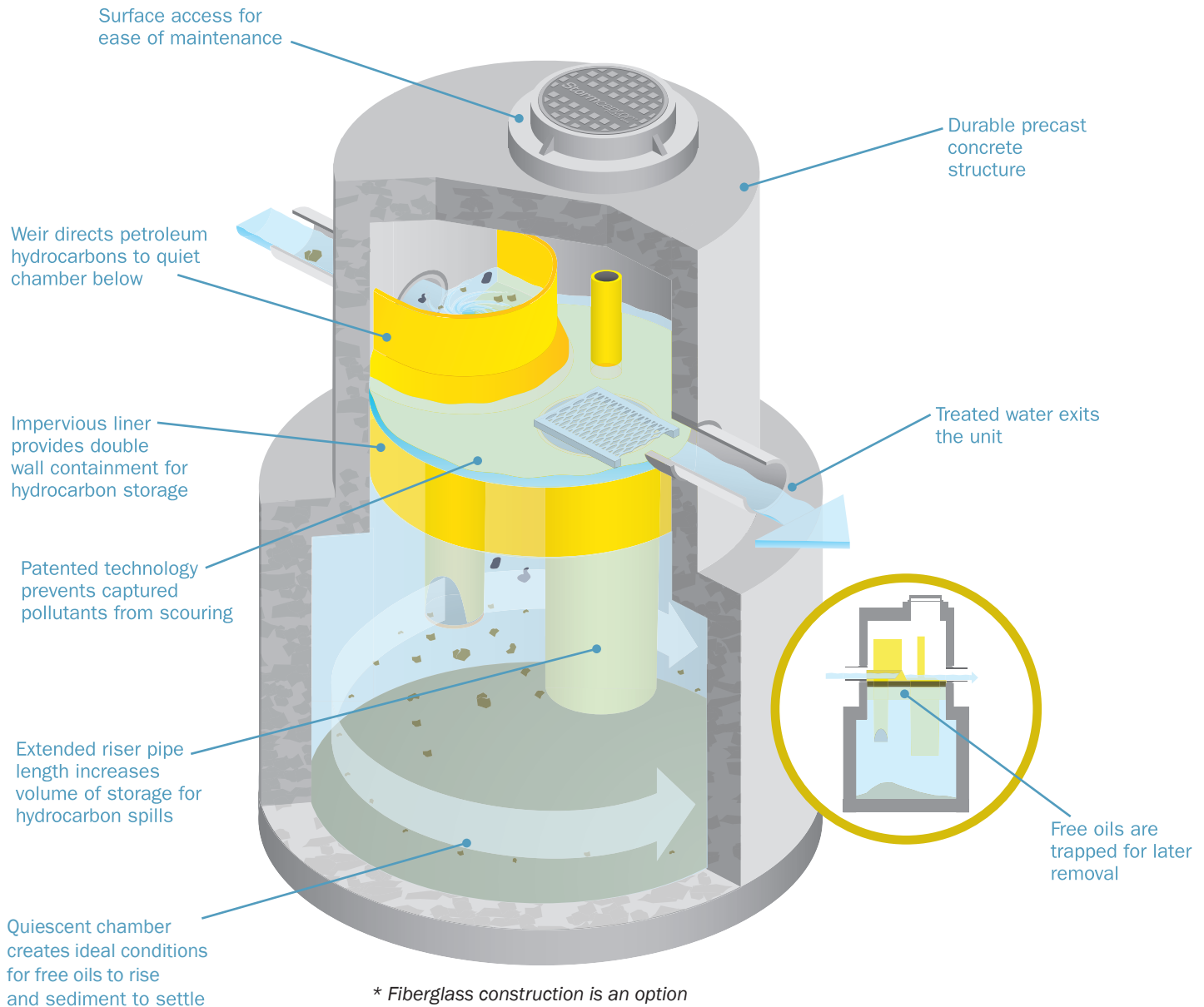
- Industry-leading continuous simulation modeling software projects TSS removal and other site conditions to determine the best system for your site
- Software developed by Computational Hydraulics International (CHI), internationally acclaimed expert, Dr. Bill James and Imbrium Systems

It's still a Stormceptor

- Maintains continuous positive treatment of total suspended solids (TSS) in stormwater runoff year-round, regardless of flow rate
- Easy installation, maintenance and operation, as well as the Stormceptor system's industry-leading reputation for efficiency and reliability

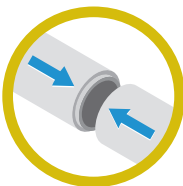
With over 25,000 units operating worldwide, Stormceptor performs and protects every day, in every storm.

Extended Oil Storage System



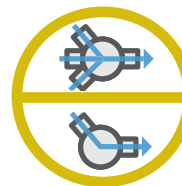
Easy to install

Small footprint saves time and money with limited disruption to your site.



Seamless

Minimal drop between inlet and outlet pipes makes Stormceptor ideal for retrofits and new development projects.



Flexible

Multiple inlets can connect to a single unit. Can be used as a bend structure.



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