

Proposal for the Installation of Grid-tied Solar Power for G1000 at Waterford School, Mbabane, Swaziland

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1. Introduction

Shift Innovation (Pty) Ltd was invited by Wundersight G1000 to tender on the supply, installation and commissioning of a solar power solution on a number of rooftops at Waterford College near Mbabane in Swaziland.

Wundersight G1000 provided the specifications and number of solar modules to be mounted on each of the respective roofs, as well as the roof covering. Shift Innovation has designed a mounting system which would meet the loading requirements for the mounting of solar modules on roof tops of this type.

Framed Canadian Solar 330 watt modules have been incorporated in the design as per the tender document. This is a slight variation (improvement) from the 320 Watt modules specified.

The required solar inverters to be supplied have been specified as Solar Edge. Shift innovation have designed the solar DC cabling and AC distribution cabling and equipment to suit the Inverter power output, with guidance from the specified wire runs included in the tender document.

2. Key Information

Client	Wundersight G1000
Project Description	Turn-key roof-top Solar PV at Waterford Kamhlaba College
Rated PV power (DC)	207 kWp
Rated back-up power (existing)	2 Generators, 1 x 100 kVA, 1 x 60 kVA
Installation address	Waterford Kamhlaba College, Mbabane, Swaziland
Installed price	E 3 031 294 ex VAT

Contractor	Shift Innovation, Swaziland (Pty) Ltd
Address	Lot 682, 7 th Avenue, Matsapha, Swaziland
Project Specific Expertise	<ul style="list-style-type: none"> - 100 kWp solar roof-top PV installation at Ngwenya Glass, Swaziland, etc. - Service partner for Kaco New Energy GmbH, for Swaziland

Major Equipment specifications and Manufacturers	
Solar modules	628 x 330 Watt, polysilicon modules, Canadian Solar
Mounting structures	Schletter mounting structures, aluminium sections, stainless steel fixings
Solar Inverters	9 (total) SolarEdge, USA
Data logger	SolarEdge, USA

3. Evaluation of Electricity Consumption

3.1 Historical Electricity Consumption

Historical consumption data has been captured and analysed by G1000, on the basis of which, the solar system has been designed. From our knowledge of this data, the energy consumption of the College is far in excess of the output of the solar system.

Further discussion on this subject is beyond the scope of this phase of the project, however, should the requirement for battery storage be considered, Shift Innovation would be willing to make recommendations in this regard based on analysis of the energy consumption history.

4. Solar System Performance

This proposal consists of 207 kWp of solar panels connected to 9 x grid-tied solar inverters which produce mains compatible 3-phase power for injection into the mains electricity supply. Any power required by the building in excess to that produced by the solar system would be seamlessly drawn from mains. The effect of solar is to reduce the amount of power drawn from mains, resulting in cost savings. The following should be noted:

1. Any solar power in excess to demand could be fed into the SEC grid for later use. SEC would be required to install bi-directional metering to accommodate this. However, at this time a control system will prevent feed-in into the grid
2. In case of mains failure, the solar inverters are designed to disconnect from the grid and shut down.
3. Mains failure back-up is provided by the existing diesel generators. In the case of mains failure, these generators start automatically, and the Solar Inverters will **not** distinguish between mains and generator supply, unless external means is provided to do this. There is potential for the Inverters to feed excess power into the *islanding* network at these times, potentially causing damage to the Generators.
4. We have not included equipment to switch off the inverters in case of back-up generators being in operation, however, this could be provided if requested, for minor additional cost.

5. Equipment offered

5.1 Solar panels

Manufacturer	Canadian Solar CSU-330P
Specification	- Poly-silicon, 330 Watt @ STC
Orientation and Pitch	Various
Expected Yield	Per Wundersight-G1000 simulations
Track Record	- Top 5 solar module producer globally

5.2 Mounting system

Manufacturer	Schletter, GmbH
Specification	- mounting structure with extruded aluminium mounting rails -Stainless steel roof fixings, with stainless steel self-tapping screws -designed to cater for wind-loadings on site
Track Record	Widely used Globally and in South Africa

5.3 Solar Inverters

Manufacturer	SolarEdge, USA
Specification	- SE 27.6 K D2 and SE 15.0K - 98.1% <i>European</i> efficiency - 400 volt, 50Hz, Three phase AC - No tracking, fixed input voltage, requires optimizers - 27,6000VA and 15,000VA AC Output
Configuration	13 to 15 x P700 optimizers per string, 2 modules per Optimizer

5.4 Monitoring and Control System

The solar system is designed and installed to perform for 25 years, directly exposed to harsh weather conditions. During this period, performance must be monitored to ensure that any deviation from optimum is detected and rectified so that at all times, the maximum solar energy is harnessed for consumption. The SolarEdge Inverters incorporate a system to monitor and compare the performance of each pair of solar modules connected to a Power Optimizer.

The live output from each Power optimizer is transmitted via the internet to a portal where the system performance can be viewed on line.

In addition to the monitoring function, the *SolarEdge system* is able to control the output of the Solar Inverters to prevent feed-back into the SEC grid, in instances when solar output may exceed the consumption of the Estate. (unlikely at this stage)

Our communication system design incorporates an energy meter on the incoming metering point of the Estate, with underground communication cabling wired to each Inverter. This will ensure that the output of each inverter and the consumption of the Estate can be monitored in real time on a single portal. The solar output of the combined solar system can be recorded and viewed, as well as the output of individual inverters, down to individual Optimizers.

6. Product Work Warrantees

PV Modules	25 Years linear power warranty. First year degradation of less than 2.5%. Thereafter annual degradation of less than 0.6% per year. Product Warranty of 10 years.
Inverters	10 Years, extendable to 25 years
Mounting Structures	10 years limited warranty
Monitoring and Control equipment	5 Years
Workmanship Warrantee	12 months

7. Operation and Maintenance

Scope	<p>Shift Innovation are able to provide an operation and maintenance service which includes:</p> <ol style="list-style-type: none"> 1. Module cleaning as required. 2. Monthly performance reports. 3. Bi-annual electrical and mechanical inspections. 4. Continual real-time performance monitoring and error reporting 5. Facilitation of warrantee claims. 6. Ordering, storage and installation of required spare parts. 7. Provision of a real-time user interface to allow the Client to monitor and record the system yields and performance. 8. All required documentation to operate and maintain the facility.
Term	5 Years

Price	6% of value of energy savings generated
Payment Terms	Quarterly in advance (on projected performance)

8. System Cost

The cost of the system is summarised in the table below:

Waterford 207 kWp Solar Power Installation Pricing

<i>Solar modules</i>	1 508 966
<i>Mounting System</i>	241 073
<i>Solar Edge Power Optimisers</i>	318 616
<i>Solar Edge Inverters</i>	321 126
<i>Solar cabling and trunking</i>	50 600
<i>AC Distribution</i>	75 840
Sub-Total Equipment	2 516 221
<i>Cost/kWp</i>	<i>12 142</i>
<i>Communication and Control</i>	59 967
<i>Delivery & Installation</i>	455 107
Total Installed Cost	3 031 294

The above costs are based on a rate of Exchange of R13.50 to the US Dollar, and exclude VAT, clearing and any other taxes and duties which may be applicable.

A detailed breakdown of the costs per solar array/rooftop is given in the appendices.

8.1 Exclusions and assumptions

8.1.1 Bi-directional metering

No provision has been made for the supply and installation of bi-directional metering equipment. We have assumed that this will be specified and supplied by SEC.

8.1.2 AC connection of solar plant to Mains supply

The solar inverters will be wall-mounted on suitable walls of the buildings. Provision has been made to connect each inverter to a surface mounted distribution board. We have provided for a suitable enclosure (housing our switchgear) to be mounted alongside the existing DB's.

8.2 Payment Terms and Conditions

- All prices quoted are exclusive of VAT, and based on a Rate of exchange of E13.50 to One U.S. Dollar (Dollar purchase price). The pricing of imported items will be revised according to the ruling rate of exchange on the day that payment of the deposit for the solar equipment is received.
- 50 % payment of the full contract price in advance with signed contract to proceed. Delivery of equipment will be affected within 30 days of receipt of payment.
- 40 % payment before dispatch of goods to site. Installation will reach practical completion in 30 working days after delivery of equipment.
- The final 10 % is payable within 10 days of successful completion and commissioning.

9. Key Personnel

Carl Meyer – Managing Director

- Specialist in Business Strategy and Business Management
- Construction Site Management and Health and Safety
- Fall Protection Plan Developer (US229994)
- Fall Arrest and Rescue (US229995 + US229998)

Mark Meyer – Technical Director

[BSc (Eng) (Wits)], [Government Certificate of Competency, Mines and Works]

- 35 Years' experience in engineering design, project management and development
- Specialist in innovative and complex engineering solutions

Steve Rugg – MD SD Electrical

["City and Guilds, UK" Electrical Engineering Diploma]

- Owner of SD Electrical Contracting company in Swaziland since 2006
- 30 years electrical contracting experience
- Installation of 5 solar systems in Swaziland, including 93 kWp Ngwenya Glass Factory

References

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10. Occupational Health and Safety and Compliance

Shift Innovation strives to set the standard in all aspects of product and service delivery. We have taken special care to comply and exceed international engineering standards, Occupational Health and Safety and Construction Regulations and SANS Photovoltaic and electrical installation standards. We have assigned competent persons with regard to the OHS Act in the following positions:

- Fall Protection Planner
- First aid
- Fall Arrest and Rescue
- Construction Manager and Project Manager
- Project Engineer
- Plant Operatives
- Health and Safety representatives
- Electricians
- General and skilled workmen competent to work at heights

We are happy to answer any queries you may have and would like to discuss this proposal in person at your convenience.

M.C.G. Meyer

Technical Director-Shift Innovation