INTERIM GUIDELINES FOR CONNECTION OF PRIVATE SOLAR (PHOTOVOLTAIC) SYSTEMS TO THE ELECTRICITY GRID IN ST HELENA

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Acronyms and Abbreviations

AC	Alternating Current
BESS	Battery Energy Storage System
BS	British Standards
CSH	Connect Saint Helena Ltd
CT	Current transformer
DC	Direct current
FiT	Feed-in Tariff Scheme
Grid	Also referred to as the electricity grid or electricity network or supply network. The term 'grid' refers to the electrical infrastructure that Connect Saint Helena Ltd operates, i.e. generators, switchboards, 11kV bus bar cables, cables, conductors, switches, circuit breakers, transformers, and all components and equipment used to generate and distribute electricity.
Hz	Hertz, a unit for frequency.
I	Current
IEC	The International Electrotechnical Commission
IEEE	The Institute of Electrical and Electronics Engineers Standards Association
IET	Institution of Engineering and Technology
kW	Kilowatts
kVA	Kilo volt-amperes
HV	High voltage electricity networks that include conductors, cables, overhead switches, network breakers, power factor correction equipment, transformers and other components or equipment installed on the 11kV network.
LV	Low voltage electricity network includes conductors, cables, distribution boards, switchboards, and other components or equipment installed on the 400V electricity network.
PV	Photovoltaic panel (also referred to as a solar panel).
PV systems	Solar photovoltaic inverter systems comprising of a solar PV panel, cabling junction boxes, inverters, protective equipment, distribution boards, switchboards, metering equipment, combiner boxes, junction boxes and any other component necessary to complete a PV system installation.
V	Voltage

Executive Summary

A photovoltaic system is a renewable energy technology that has been designed to capture energy from the sun and transform this into electricity using photovoltaics (solar panels).

The Guidelines contained within this document are to be applied in all cases where the owner of a private PV system also consumes electricity from the main electricity grid operated by Connect Saint Helena Ltd (CSH). In such cases it is necessary for the private PV system to be connected to the electricity grid. This enables the owner of the private PV system to consume electricity from the grid when the private PV system is not in operation.

These Guidelines are interim only, pending a wider Grid Impact Assessment of the electricity grid in St Helena. The purpose of this work is to understand how the grid is affected as increasing numbers of private PV systems are connected to the grid. The Grid Impact Assessment will quantify the safe maximum amount (i.e. the hosting capacity) of photovoltaic generated electricity that could potentially be connected to the grid on St Helena.

The Grid Impact Assessment will provide detailed technical guidance for each zone of the electricity grid. This will enable the advice provided to the owners of private PV systems to be tailored to the particular location of the installation. This will enable CSH to ensure the safety and stability of the electricity grid and to ensure that all installed private PV systems are safe and minimise risk.

The target date for completion of the Grid Impact Assessment is December 2022. These Interim Guidelines shall apply between the period August 2022 up to the completion of the Grid Impact Assessment and the publication of updated Guidelines.

During this interim period, pending the result of the Grid Impact Assessment:

- no further connections of private PV systems to the electricity grid will be approved. However, persons contemplating the installation of private PV systems may still continue with the application process (see Section 3) in readiness for the completion of the Grid Impact Assessment. The Grid Impact Assessment will then determine whether such connection is viable.

- existing private PV systems will be required to undergo a Technical Audit to ensure compliance with the standards and technical requirements contained within these Guidelines (see Section 4).

It is emphasised that these are interim measures only. Further guidance will be published following completion of the Grid Impact Assessment.

1. INTRODUCTION

1.1 Purpose of the Guidelines

A photovoltaic system is a renewable energy technology that has been designed to capture energy from the sun and transform this into electricity using photovoltaics (solar panels).

The Guidelines contained within this document are to be applied in all cases where the owner of a private PV system also consumes electricity from the main electricity grid operated by Connect Saint Helena Ltd (CSH). In such cases it is necessary for the private PV system to be connected to the electricity grid. This enables the owner of the private PV system to consume electricity from the grid when the private PV system is not in operation.

The objectives of establishing guidelines for the installation and connection of private PV systems to the electricity grid are to:

- ensure that all installed PV systems are safe and minimise risk;
- ensure the stability of the electricity grid;
- mitigate the impact of PV systems on the quality of power to other users;
- ensure that best practice, particularly the requirements under the British/IET Electrical Wiring Regulations, is adhered to;
- establish common standards, processes and procedures so that there is an open and transparent system in place for consumers seeking to install and connect PV systems to the grid.

1.2 CSH's Commitment to Renewable Energy

The St Helena Energy Strategy states:
St Helena's energy strategy will aim to improve the social and economic well-being of its population, and minimize the impact on the environment. It will increase the production of energy through renewable sources, and reduce the island's reliance on imported fuels, increase fuel security and prize stabilization.

Connect Saint Helena Ltd (CSH) fully supports the principles of the St Helena Energy Strategy. CSH's Renewable Energy Policy states that CSH will *…"support the uptake of renewable energy by residents and businesses in St Helena".*

1.3 CSH's Commitment to Safety

Safety is the primary consideration for all matters pertaining to the electricity grid.

Failure to adhere to best practice in the installation, operation and maintenance of PV systems can result in situations that can cause electric shock or even electrocution. This poses risk to personnel, property and to the electricity grid. The Guidelines are therefore intended to ensure that all grid-

connected PV systems are correctly designed and specified from the outset, followed by correct installation, operation and maintenance.

1.4 Relevant Legislation

The Electricity Ordinance 1961 and the Electricity Regulations 1995 refer. In particular:

- Regulation 4(1) (b) states:
  (1) It is an offence for a person to—
  (b) connect any electrical apparatus to the Utilities Provider's supply line without first obtaining the written approval of the Utilities Provider.

  Section 3 of the Guidelines sets out the procedures consumers and installers need to follow to obtain approval for the connection of a PV system to the electricity grid. Sections 3, 4 and 5 of the Guidelines provide further technical advice for the installer.

- Regulation (8)(1) states:
  The Utilities Provider may by notice in writing served on a consumer require the consumer to rectify a fault or deficiency in the consumer's electrical installation within the period stated in the notice.

  Section 6 of the Guidelines sets out the circumstances in which CSH may decline approval of an application to connect a PV system to the electricity grid. CSH will provide advice on the steps to take in this event.

1.5 When to Apply the Guidelines

The Guidelines apply to:

- PV systems that can be connected to the electricity grid.

- PV systems that are capable of importing electricity from the grid, regardless of whether they have systems preventing export of electricity back into the grid.

- PV systems that have an inverter of a continuous rating of not more than 3.68kW rating for single-phase systems and 11kW rating for three-phase systems regulated under UK Engineering Regulation G98. PV inverter systems with inverter ratings above these ratings will not be permitted in any event.

- PV systems with battery storage, ensuring that all power is used by the consumer and no excess power should be exported back to the grid.

- Grid-connected PV systems that have received prior approval from Connect but where amendment or modification is now planned.

These Guidelines do not apply in the cases of PV systems that are standalone or off-grid systems that are not connected to the electricity grid. Nevertheless, the guidance provided here may be of interest to the owners and installers of standalone systems as examples of best practice.

2. IMPORTANT INFORMATION ABOUT PV SYSTEMS

2.1 Introduction

A PV system will usually consist of an array of solar PV panels mounted on the roof of a building or mounted on a purpose-built structure. A PV system usually also has a grid-connected inverter connected to a metering box to allow access to electricity from the grid when the PV panels do not supply sufficient power for the consumer's needs. Such systems normally also include a permanent reserve power flow blocking facility.

In some cases, these systems will be standalone and off-grid, meaning that the PV system does not require connection to the electricity grid. Off-grid systems do not require further approvals from CSH.

In most cases, however, the private PV system is used in conjunction with electricity from the electricity grid. The consumer continues to consume electricity supplied by Connect Saint Helena Ltd when the consumer's PV system is not operational (for example, at night, during bad weather, or when the PV system is undergoing maintenance).

These Guidelines are primarily intended for consumers who have PV systems connected to the electricity grid. However, the Guidelines may also provide useful examples of best practice to anyone with a private PV system.

2.2 The Benefits of Private PV Systems

The key benefits from PV systems are:

- They utilise renewable energy.
- They are low maintenance.
- The cost of investment in the system can be recovered over time through reduced electricity bills.

CSH supports the use of Renewable Energy. Currently around 20% of the electricity generated by CSH comes from renewable energy (wind and solar). Planning is underway for a Renewable Energy Project to increase electricity generation from renewable energy: this will benefit all electricity consumers on St Helena.

2.3 The Risks Posed by Private PV Systems

The connection of private PV systems to the grid can pose risk to persons, property and to the grid. For example, this arises due to:

- Unmanaged export of electricity from the private PV system into the electricity grid. Variable generation sources from multiple locations around the island have the potential to destabilise the electricity grid. This has implications for all electricity consumers on St Helena.

- Unmanaged surges in demand for electricity from the grid. This can occur at peak points during the day when private PV systems are not generating electricity and the consumer needs to draw down electricity from the grid. This has the potential to destabilise the electricity grid. This has implications for all electricity consumers on St Helena.

In order to mitigate the identified risks:

- CSH is investing in a Grid Impact Assessment. This will enable us to understand how the grid is affected as increasing numbers of private PV systems are connected to the grid. The Grid Impact Assessment will quantify the safe maximum amount (i.e. the hosting capacity) of photovoltaic generated electricity that could potentially be connected to the grid on St Helena.

- In the interim, pending the outcome of the Grid Impact Assessment:

    - **Approval will <u>not</u> be granted for any new private PV system to be connected to the grid.** However, persons contemplating the installation of private PV systems may wish to continue with the application process (see Section 3) in readiness for the completion of the Grid Impact Assessment. The Grid Impact Assessment will then determine whether such connection is viable.

    - **Existing private PV systems will be required to undertake a Technical Audit.** This is to ensure compliance with the standards and technical requirements contained within these Guidelines (see Section 4).

2.4 Exporting Electricity to the Grid

When connected to the grid, a PV system can supply a consumer's power requirements. It also has the technical capability to export excess electricity (i.e. electricity in excess of the requirements of that property) back into the grid.

It is important to note that currently there is no provision to allow privately owned PV systems to generate electricity and export it back to the electricity grid.

This decision has been taken to ensure the safety and stability of the electricity grid. As discussed above, the Grid Impact Assessment will assess the risks associated with exporting electricity from private PV systems into the grid. This decision will therefore be kept under review.

At present, however, as a result of this decision:

- All the electricity generated by grid-connected PV systems must be consumed to avoid reverse power flow i.e. to prevent the export of power back into the electricity grid.

- There is no provision in the Electricity Ordinance for a Feed-in-Tariff (FiT) scheme or to permit consumers to wheel (i.e. transport) excess electricity to other consumers.

3. NEW APPLICATIONS FOR CONNECTIONS TO THE GRID

3.1 Introduction

Whilst there is a current freeze on new connections of private PV panels to the grid, this measure is for a limited time pending the outcome of the Grid Impact Assessment. Persons considering the installation of a private PV system may still wish to make application but should note that final approval of the connection will be based on consideration of the Grid Impact Assessment.

CSH will not approve any new connections of private PV systems to the grid until the completion of the Grid Impact Assessment. Applications can proceed in the interim but approval will be pending the recommendations arising from the Grid Impact Assessment. The Grid Impact Assessment will allow advice to be tailored to the specific part of the grid where the connection is proposed.

This section therefore presents the steps consumers and installers need to follow when considering installing a PV system and requesting the connection of a PV system to the electricity grid. It is important that this guidance is considered prior to purchase of the PV system and at all stages of installation and commissioning.

All new PV installations are required to complete the following 7 step process. Historic installations (i.e. those already in operation prior to publication of these Guidelines) will be subject to a Technical Audit (Step 6 below) and will only receive final approval for connection to the electricity grid following confirmation that all requirements within the Guidelines have been met.

Safety is the primary consideration with all electrical installations.

Consumers and Licenced Electricians/Installers must carefully read all sections of these guidelines before buying, installing and requesting connection of their PV system to the electricity grid.

CSH will not be held responsible for a PV system purchased and later assessed to be non-compliant with requirements and standards.

3.2 The 7 Step Process

Step 1: Choose the Right PV System for Your Needs

It is the responsibility of the consumer to ensure that the supplier correctly sizes the PV system to meet your energy needs and that the system meets all of the technical requirements. In particular, the PV system must comply with British and IEC Standards. Further detail is provided in Appendix 1 and in Section 5 of this document.

It is important to note the requirements of UK Engineering Recommendation G98 (EREC98). This sets out recommendations for the connection of generating plant to the distribution systems of licensed distribution network operators. The procedures described in this standard are designed to facilitate the connection of embedded generators whilst maintaining the integrity of St Helena's public Low and High Voltage Distribution Networks in terms of safety and supply quality. This recommendation is adopted from the UK standard.

UK Engineering Recommendation G99 (EREC99) shall apply only with the prior approval of CSH. This process is also adopted from the UK standard whereby EREC99 applies in the case of larger PV systems, approval for which is granted by exception.

Step 2: Submit Your Application to Connect Your PV System to the Electricity Grid

Consumers wishing to connect their PV system to the grid must submit an application to CSH. Only consumers with standalone or off-grid PV systems are exempted from this requirement.

The application form is shown at Appendix 2. A copy can also be obtained by contacting the CSH Administration Office at Seales Corner, Jamestown on enquiries@connect.co.sh or tel. 22255.

Please ensure that the fully completed application form together with any accompanying documents (e.g. specifications) are submitted to CSH. Incorrect and incomplete forms will not be considered and a new application will be required.

Installers who are submitting applications on behalf of the consumer must ensure that they have the consumer's consent. Proof of such consent must be submitted with the application.

Step 3: Preliminary Evaluation

CSH will conduct a preliminary evaluation of the application and return any initial queries or comments within 5 working days.

The preliminary evaluation will focus on the size of the inverter and whether a type test certificate is available. This is the first step in determining whether the PV system complies with British and IEC standards.

The preliminary evaluation will also consider the local grid where the installation is planned, particularly whether there might be any adverse impacts to the grid, the consumer's premises, and surrounding premises. This is an initial safety check prior to moving onto a detailed technical assessment.

Step 4: Technical Assessment

The detailed technical assessment will assess the information provided by the consumer in response to Form 1 (see Appendix 2). CSH's response will be tailored to the specific location that the installation is planned and will incorporate the outcome of the Grid Impact Assessment.

CSH will recommend that a private PV system be downsized or will decline an application if it is found that the technical requirements contained within these Guidelines are not met. To proceed with installation in such cases could present risk to persons, property and the grid.

More information on what to do if a system is non-compliant is contained in Section 5 of the Guidelines. Those applications that are approved move on to Step 5 below.

It is emphasised that the technical requirements within these Guidelines are not onerous and follow best practice in the interests of safety. It is therefore expected that the requirements within these Guidelines can be met by all applicants.

Step 5: Installation

The installer must be a competent individual who is appropriately licenced under the Electricity Ordinance to carry out work of this nature.

Once an application for the connection of a PV system has been approved, the installer can proceed to install the PV system.

The installer is responsible for ensuring the system and equipment installed at the consumer's premises meets all standards shown at Appendix 1.

Step 6: Technical Audit

When the installer finishes installing the customer's PV system, they need to inform CSH that they are ready for connection to the grid. CSH will then carry out a technical audit prior to undertaking the connection.

The checklist of items covered in the technical audit is shown at Appendix 3. This checklist assesses compliance of the PV system installation to British and IEC standards. If non-compliances are identified, CSH will advise the installer and will offer advice on rectification.

If the customer has received approval from Connect to install a three-phase inverter system, then the output power must be distributed evenly across the three phases. This is a very important requirement and CSH technicians will check to verify that there is a phase power balance.

CSH will produce a Technical Audit Report and a recommendation presented on the findings. The customer will be given a copy of the Technical Audit Report.

Step 7: Connection to the Grid

The installer will notify CSH when any non-compliances identified have been rectified and the PV system is ready for inspection and connection to the grid.

To complete the process, CSH will inspect the PV system and determine whether connection can proceed. In assessing and inspecting the installation CSH does not give any warranties or approval that the system is fit for the consumer's needs or requirements or accept any liability for any failures of the installed system. The purpose of the assessment is to confirm that the requirements as per these Guidelines have been met.

If following inspection the system is approved, CSH will install a dual register electricity energy meter. This meter is required to:

- ensure that the PV system does not export electricity back into the grid. This is essential to ensure the safety and stability of the grid.
- determine how much electricity is being used from the grid to enable accurate billing.

CSH considers the dual register electricity energy meter a critical safety feature. As a result, CSH will initially meet the costs of providing and installing this meter. **This will be for a limited trial period up to and including 31 March 2023. This will be kept under review.**

The consumer will be billed for the standard fee for connection to the grid.

3.3 Steps to Take Following Commissioning

Once a PV system has been commissioned and is in operation, it is the responsibility of the consumer to ensure the PV system is adequately maintained. This should be in accordance with the manufacture's guidelines.

CSH will from time to time carry out an audit to ensure that there are no alterations to the PV system and that no electricity is being fed back to the grid.

It is the consumer's responsibility to ensure that any alternations or modifications to the PV system are conveyed to CSH. If such alternation or modification results in a non-compliance, CSH will issue a notice to rectify. The PV system will be disconnected from the electricity grid if non-compliances are not resolved within the time stated in a notice.

CSH will not permit your PV system to export electricity back into the grid. Please ensure that your PV system has Reverse Flow Blocking capability – see Section 5 for further information.

3.4 Further Information

Section 5 of this document provides further detailed information, primarily intended for the installer of the PV system.

CSH is happy to assist with any queries that might arise. Advice can be tailored to individual requirements.

Further information can be obtained by contacting the Technical Manager (Electricity) or the Electricity Distribution Manager in CSH via enquiries@connect.co.sh or on tel. 22255.

4. EXISTING PRIVATE PV SYSTEM INSTALLATIONS

4.1 Requirement to Undertake a Technical Audit

All existing installations of private PV systems must comply with the standards and technical requirements shown in Appendix 1 and Section 5 of this document.

All existing private PV systems that are connected to the grid will undergo a Technical Audit to verify that all technical requirements have been met. The Technical Audit will assess the information provided by the consumer in response to Form 1 (see Appendix 2).

It is emphasised that the technical requirements within these Guidelines are not onerous and follow best practice in the interests of safety. It is therefore expected that the requirements within these Guidelines can be met by all applicants.

A Technical Audit will be conducted by CSH to establish the systems that are currently connected to the grid.

Potentially there are existing systems connected to the grid that exceed the maximum ratings applied in Engineering Recommendation G98. In such cases, these inverters should be type tested to Engineering Recommendation G99 with Engineering Recommendation G100 ELS (Export Limitation Scheme) so that Zero Export to the grid can be configured.

The higher capacity G99 inverters will require special approval and will be subject to a Grid Impact Assessment before approval can be given for connection to the grid. This follows the model applied in the UK.

4.2 Recommendations from the Grid Impact Assessment

The Grid Impact Assessment will enable the advice provided to the owners of private PV systems to be tailored to the particular location of the installation. This will enable CSH to ensure the safety and stability of the electricity grid and to ensure that all installed private PV systems are safe and minimise risk.

Please note that the capacity of the grid to host private PV systems could vary across different zones. Therefore each private PV system will be assessed on a case by case basis.

4.3 Non-Compliant Existing Installations

CSH has previously conveyed the technical requirements shown in Appendix 1 and Section 5 to the main known suppliers of PV systems on St Helena. Therefore there is an assumption that existing installations are compliant.

Should an installation be found to be non-compliant, CSH will recommend steps that can be taken to rectify this.

In some cases it may be necessary for CSH to recommend that a private PV system be downsized if it is found that the technical requirements contained within these Guidelines are not met. In other cases, it may be necessary for the private PV system to be removed: this is a worst case scenario and such step will only be taken in the interests of safety when all other options have been exhausted.

5. INSTALLATION & METERING REQUIREMENTS

5.1 Permitted Ratings of PV Systems

Requirements to be considered for the connection of a PV system to the grid are for the following voltages and maximum inverter ratings (continuous rating) regulated under UK Engineering Regulation G98 (EREC98).

PV inverter system capacities allowed are:

System voltage	Maximum inverter capacity permitted
230V single-phase	3.68kW/4.2kVA
400V three-phase	11kW/13.6kVA

CSH will not allow the connection of higher-rated privately owned PV systems to the electricity grid.

5.2 Fully Type Test Certification

A PV system must have a **Fully Type Test Certificate** in accordance with IEC 62109 (Safety of power converters for use in photovoltaic power systems). The Fully Type Test certificate must accompany an application for the installation and connection of a PV system to the grid.

5.3 Standards

All PV systems must comply with the standards listed Appendix 1 of these Guidelines (Standards for Grid-Connected Photovoltaic Inverter Systems).

Most importantly, the PV system installation must comply with BS7671 Wiring Regulations, current edition.

5.4 Requirement for Reverse Power Flow Blocking

All the electricity generated by grid-connected PV systems must be consumed by the owner to avoid reverse power flow, i.e. to prevent the export of power back into the CSH electricity grid. This requirement is mandatory.

ALL PV SYSTEMS MUST HAVE A PERMANENT RESERVE POWER FLOW BLOCKING FACILITY TO PREVENT POWER FROM FLOWING BACK INTO THE GRID. This is necessary to ensure the safety and stability of the grid.

CSH will install a dual register energy meter: one register to measure electricity consumed by a consumer and the other register to check if any electricity is being fed back into the grid.

If it is identified that electricity is being fed back into the grid by a PV system, this will be considered a deficiency in the installation of the PV system. As discussed above, this can pose risks to persons, property and to the electricity grid, particularly whereby there might be interference with the supply to other users, such as causing the grid or part of it to fail.

In such cases, CSH will issue a notice instructing the consumer to rectify the situation within 7 working days. This is in accordance with Regulation 9 of the Electricity Regulations 1995.

Failure by the consumer to rectify the deficiency or interference with the electricity supply to other users within the 7 day notice period will result in a notice of intention to disconnect the PV system from the grid. Disconnection will be carried out within 7 working days from the date of notice of intent to disconnect.

Whilst the above will apply for the most part, please note that should it be deemed that the PV system poses significant risk, and if CSH is satisfied that the installation is dangerous, in the interests of safety CSH may disconnect the installation at any time. This is in accordance with Regulation 10 of the Electricity Regulations 1995.

5.5 PV System Operation and Maintenance

The PV system shall not have settings changed from those approved or be upgraded or be modified in any way. PV systems found to be operating in such a manner will be disconnected from the grid immediately until restored to their approved status. Should it be necessary to change any parameter of the PV system or replace an inverter as installed and approved, CSH shall be notified for re-approval. CSH will determine whether a new application is required or not.

Owners of PV systems are responsible for the operation and maintenance of their PV systems. Adequately qualified, licensed and competent persons must carry out any electrical installations in accordance with the Regulation 4 of the Electricity Regulations 1995 which states as follows;

4. (1) it is an offence for a person to—
(a) Install any electrical apparatus which is intended to be connected to the Utilities Provider's supply line, while not being the holder of a current licence issued by the Governor which authorises the person to undertake work of that nature.
A qualified and licensed person is any person who has a valid St Helena Electrician Licence issued by CSH.

5.6 Installation and Inspections

Installations that require grid connection will be inspected by CSH once the installation is completed and an application for connection to the electricity grid is submitted. In compliance with Regulation 4 of the Electricity Ordinance, only a person who holds a valid St Helenian Electrician Licence and is knowledgeable in the installation of PV inverter systems and other specialised installations as stated in the Electrical Wiring Regulations (18th Edition) shall carry out installations, modifications and

maintenance of PV installations. BS7671/IET Wiring Regulations (18th Edition) includes a section that deals with requirements for PV installations and specialised installations.

5.7 Logbooks

For safety reasons, customers are required to maintain a logbook detailing inspections and operating activities. This logbook must be kept in a secure place in the meter box and be available for inspection by CSH staff or any person assigned by CSH to do so. Any alterations or modifications carried out on a PV system will need a new Electrical Installation Certificate in accordance with BS7671 IET Wiring Regulations. An example of a simple logbook is shown below.

PV system Logbook

Inverter make and model No.	**Inverter serial No.**	**Inverter rating (in Watts)**
Installer name & signature	**Installer's telephone number**	**Installer's physical address**

5.8 Signage

Labelling of switchboards and relevant equipment shall be done as per British Standards. The quantity and location of signs will depend on the PV installation. This is to make sure any person working on the PV system is aware of the hazards of working on a PV system. The risk of working on a PV system is electrical shock and electrocution, especially during the daytime. Therefore, depending on the PV installation, some or all of the below signs must be installed and should be clear for any person to see before working on the PV system.

a) Main switchboard and distribution boards.

WARNING

DUAL SUPPLY
ISOLATE NORMAL SUPPLY TO THIS SWITCHBOARD AND "SOLAR" SUPPLY
AT THE MAIN METER BOX BEFORE WORKING ON THIS SWITCHBOARD

b) Main meter box where the PV system is connected.

WARNING

DUAL SUPPLY
ISOLATE BOTH SERVICE FUSES AND "SOLAR" SUPPLY BEFORE WORKING ON THIS METER BOX

c) Consumer switchboard or distribution board connected to Solar Meter Box where the PV system is connected.

WARNING

DUAL SUPPLY
ISOLATE BOTH NORMAL AND SOLAR SUPPLIES BEFORE WORKING ON THIS SWITCHBOARD

d) Main switchboard and distribution board(s) upstream of a distribution board connected to Solar Meter Box where the PV system is connected

WARNING

DUAL SUPPLY
ISOLATE BOTH NORMAL AND SOLAR SUPPLIES BEFORE WORKING ON THIS SWITCHBOARD

e) Where long cable runs are necessary (over 20m), labels should be fixed along the d.c. cables as follows.

DANGER

SOLAR PV ARRAY CABLE
HIGH VOLTAGE DC LIVE DURING DAYLIGHT

Labelling fixed every 5 to 10m is considered sufficient to identify the cable on straight runs where a clear view is possible between labels.

f) PV Array D.C. Junction Box

Any D.C. junction box must be labelled as follows;

DANGER

PV ARRAY DC JUNCTION BOX CONTAINS LIVE PARTS
DURING DAYLIGHT

5.9 Protection Arrangements and Settings

CSH requires protective equipment to achieve the following safety objectives:

- to disconnect the inverter from the CSH electricity supply system in the event of loss of CSH supply to the PV system; and
- to prevent the PV inverter from back-energising a de-energised CSH circuit.

The protection arrangements should be as stipulated under Engineering Recommendation G98 guidelines. The following specific voltage and frequency settings must be programmed into the inverter.

Note: These settings may need to be changed in “off the shelf” inverters.

For a single-phase system:

- Maximum voltage trip point will be 253V phase to neutral;
- Minimum voltage trip point will be 216V phase to neutral;
- Frequency MAX will be 52.0Hz; and
- Frequency MIN will be 47.5Hz.

For a three-phase system:

- Maximum voltage trip point will be 440V phase to phase;
- Minimum voltage trip point will be 376V phase to phase;
- Maximum phase voltage trip point will be 253V phase to neutral;
- Minimum phase voltage trip point will be 216V phase to neutral;
- Frequency MAX will be 52Hz; and
- Frequency MIN will be 47.5Hz.

In addition to any protection integrated into the inverter design, external short circuit and/or overcurrent protection must be provided by fuses or circuit breakers. This backup over-current protection function can be provided by the metering fuses or by a circuit breaker located at the connection point of the inverter within the meter box. All protection settings shall be such that satisfactory coordination is achieved with CSH's protective system for the electricity supply network.

5.10 Earth Leakage Protection

A 30mA earth-leakage circuit breaker protective device (ELCB or RCD) needs to be included in the PV system installation. This is a safety device used in electrical installations to prevent electric shock. This is a requirement of BS7671 Wiring Regulations.

5.11 Surge Protection

The CSH electricity grid may experience surges during windy and stormy weather conditions. Since an inverter contains many electronic parts and is directly connected to the CSH grid it may not be able to cope successfully with the surges. The inverter is also directly connected to the PV panels and because PV panels are usually mounted on top of the roof, these are directly exposed to the storms and provide an alternative path for surges.

It is the owner and customer's responsibility to include sufficient surge protection for the PV system. In case of failure of the PV system, CSH shall not be liable in any way.

5.12 Network Connections

CSH will install a dual register electricity energy meter to measure the net electrical energy that CSH supplies to the consumer. Billing arrangements are detailed in our Application for Electricity Supply Agreement (blue form) (Terms and Conditions).

All energy meters will remain the property of CSH as stipulated in the Electricity Ordinance.

The customer's licensed contractor will complete the wiring to the consumer unit. When the work is complete, CSH will certify the wiring, install and commission the electricity meter and connect the PV system to the CSH grid. The steps to follow are listed in Section 2 above. Please follow these steps carefully. If a customer or installer is not sure of any instruction given in the steps, please get in touch with the Electricity Distribution Manager at CSH Office.

5.13 Replacement of Analogue Energy Meters

Some electricity supply points are metered using analogue disc-type energy meters. These types of meters will not be suitable for use with a PV system and will need to be replaced by a dual register electricity meter.

The applicant will meet the full cost of materials for realigning circuits but the cost of the dual register electricity meter and its connection will be met by CSH.

It is anticipated that the dual register electricity meter can be installed in the space occupied by the existing meter. In the unlikely event that there is inadequate space on the meter board, the customer shall meet the cost of any alterations.

5.14 Standard (Type 1) Connection

In this connection, the PV system cable is connected at the existing meter box. Although CSH requires reverse power flow blocking to always be available, we will check to ensure no power is fed back to the electricity grid. A dual element (dual register) meter must be installed before any PV system is

connected to the grid. One register is for electricity consumed from the CSH grid at the premises and will be billed to the customer under the applicable electricity tariff(s). The other register is for checking that there is no electricity being fed back into the grid.

- Single Phase Consumers with Single Phase PV System

  The customer must make a provision for installation of a single-phase, bottom-connect, dual register meter; register 1 for energy consumed from the grid and element 2 for checking energy exported back into the CSH grid.

- Three Phase Consumers with Single-Phase or Three-Phase PV Systems

  The customer must make provision for installation of a dual register three-phase, bottom connect meter or current transformer (CT) operated meter for energy consumed from the grid and for checking if any energy is being exported back into the grid. If the existing metering arrangement consists of three single-phase meters, they will be replaced by a single dual register three-phase meter (upgrade).

6. DOWNSIZING OR DECLINING AN APPLICATION

6.1 Introduction

In certain circumstances, CSH may take a decision to downsize or decline an application for connection of a PV system to the grid.

The term downsized, means that while CSH cannot approve the size of inverter originally applied for, the consumer can re-apply for an inverter up to a maximum size we advise or to explore one of the other options presented below.

6.2 Criteria for Downsizing or Declining an Application

Applications for PV system connections may be downsized or declined if:

- The existing transformer serving the premises is too small to support the amount of electricity that could be generated by the PV system.
- The PV system connection is a relatively long distance away from the existing distribution transformer, which may cause significant voltage fluctuations that could affect the safe operation of the grid.
- Connection of the PV system would result in negative impact on the electricity grid. This may be the case, for example, if there are already several PV system connections that share the same transformer but equally this may be the case if there is only one other PV system.
- The information submitted together with the application is inadequate.
- Non-compliances to standards are identified.

6.3 Grid Impact Assessments

CSH reserves the right to first carry out a PV connection grid impact assessment to evaluate an application for a connection of a PV system to the grid.

The reason for carrying out specific PV connection grid impact assessments is to assess if the proposed PV system would have any negative effect or impact on the local grid and on the grid upstream of the grid section where the intended connection to the grid is required and also to assess any impact on other electrical equipment on the electricity feeder.

6.4 Next Steps

CSH supports the use of renewable energy. If your application for connection of a PV system is downsized or declined, CSH can assist you with further advice and options.

Alternative options include:

- **Installing a small-scale system with an inverter of a lower capacity.** CSH will advise the maximum capacity that can be re-applied for at the premises to ensure the effective operation of the system and to protect the grid in the local area. Customers will need to lodge an updated application form.

- **Exploring the option of upgrading the number of electrical phases of the premises to accommodate the desired inverter size.** There will likely be an additional cost to the consumer as a result.

- **Exploring the option of upgrading the network to accommodate the inverter originally requested**. Consumers have the option of funding upgrades to the grid, where those upgrades are for the benefit of an individual premise.

- **Withdrawing an application.** Customers may choose not to install a system, in which case they should contact CSH to withdraw the application. The withdrawal notice should be in writing and CSH will also respond in writing acknowledging the withdrawal.

If no adverse impacts are identified, CSH will approve the PV system connection.

APPENDICES

Appendix 1: Standards for Grid-Connected PV Systems

The following are the key standards to be applied.

Area	Standard	Standard Title	Outline
Installation	Engineering Recommendation G98	Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks.	This EREC G98 provides guidance on the technical requirements for the connection of Micro-generators in parallel with public Low Voltage Distribution Networks.
General Wiring Standards	BS 7671 (latest edition)	Requirements for electrical installations.	Known as the UK Wiring Rules, BS 7671: Requirements for Electrical Installations IEE Wiring Regulations.
Documentation, Commissioning and Inspection	BS EN 62446	Grid-connected photovoltaic systems.	Outlines minimum requirements for system documentation, commissioning tests and inspection.
Type Test Certificate	IEC 62109	The grid-interactive inverter shall be tested and must carry a Type Test certificate.	Outlines the requirement for type testing a grid-interactive inverter.

List of Standards for Electricity Generation and Electricity Distribution:

The updated list of electricity standards in St Helena Island is as follows;

1. BS7671 Requirements for Electrical Installations, IET Wiring Regulations (as amended), and 18th Edition is currently used. This standard is set and managed by the Institution of Engineering and Technology (IET) and the British Standards Institution (BSI) of the UK.

2. BS-EN-50160 (as amended) - 2010/A3 Edition is currently used - Voltage characteristics of electricity supplied by public electricity networks. This is a European standard adopted by the British Standards Institution.

3. BS EN 62446 - Grid connected photovoltaics. This standard outlines minimum requirements for system documentation, commissioning tests and inspection. This is written for grid-connected PV systems that do not utilize energy storage. This is a European standard adopted by the British Standards Institution (BSI) of the UK.

4. IEC 62109 - Safety of power converters for use in photovoltaic power systems. This standard outlines the requirement for type testing a grid-interactive inverter. This is a standard developed by the International Electromechanical Commission (IEC) and used by most countries.

5. Engineering Recommendation G98 (EREC98) - Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase single or multi-phase, 230/400 V AC, which corresponds to 3.68 kW on a single-phase supply and 11.04 kW on a three-phase supply in parallel with public Low Voltage Distribution Networks. The procedures described in this standard are designed to facilitate the connection of embedded micro-generators whilst maintaining the integrity of St Helena's public Low Voltage Distribution Networks in terms of safety and supply quality. This recommendation is adopted from the UK standard.

6. Engineering Recommendation G99 (EREC99) - Recommendations for the connection of generating plant to the distribution systems of licensed distribution network operators. The procedures described in this standard are designed to facilitate the connection of embedded generators whilst maintaining the integrity of St Helena's public Low and High Voltage Distribution Networks in terms of safety and supply quality. This recommendation is adopted from the UK standard.

7. Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002 (as amended) - These regulations specify safety standards that are aimed at protecting the public and consumers from danger. The Regulations also specify power quality and supply continuity requirements. This is o ensure an efficient and economic electricity supply service for consumers. This regulation is recommended in EREC98 and EREC99.

Appendix 2: Application Form for Grid Connection of PV systems

This form is to be completed and hand delivered at the Administration Office, Connect Saint Helena Ltd Offices at Seales Corner, Jamestown during normal working hours. All fields in this form must be completed. Forms not completed in full may be rejected.

CONNECT SAINT HELENA LTD - ELECTRICITY SECTION
APPLICATION FOR CONNECTION OF PV SYSTEM

I intend to install a grid-connected PV system that will comply with the Electricity Ordinance, Wiring Regulations, and Guideline for connection of private PV systems and to British standards. I authorise CSH to disconnect the PV system if settings are changed or deficiencies are discovered by CSH or if the PV system interferes with the electricity supply to other users.

No.	Particulars	Details			
1	Name of Registered Consumer				
2	Address of Consumer				
3	E-Mail address of Consumer				
4	Telephone Number of Consumer				
5	Mobile Number of Consumer				
6	Address where PV system will be installed				
7	System Designer Name & Contact details				
8	Name, contact and licence details of Installer (Licenced Electrician)				
9	Category (Please tick)	Domestic:		Commercial:	
		Industrial:		Other:	
10	Supply voltage/No. of phases (Please tick)	230V/1 phase:		400V/3 phase:	
11	Proposed PV inverter size (kW)				

No.	Particulars	Details			
12	Type test certificate *(please provide a copy with this application form)*				
13	Make and model of inverter *(please provide details)*				
14	Proposed PV System Electrical diagram *(Please provide a copy with this application to show the proposed full system diagram and how the inverter will be interfaced to the Electricity supply)*				
15	Will the proposed system include battery storage? (*Please tick)*	Yes		No	
16	Is an EREC G100 compliant export limitation scheme present that limits the export to the grid to ZERO EXPORT? *(Please tick)*	Yes		No	
	Date application submitted				
	Signature of applicant				

Appendix 3: Audit Checklist for inspection of Grid-connected PV inverter systems

AUDIT CHECKLIST FOR GRID-CONNECTED PV SYSTEMS			
Consumer or user name:		Consumer or user's address:	
Location where PV system is installed:		Transformer No. where PV system is connected:	
Detail of PV system designer:		Designer's address:	
Installer or Electrician's name:		Installer or Electrician's address:	
Installer or Electrician's Licence No. :		Expiry date of Electrician's licence:	
Date the PV system was checked or audited:		Date PV system connected to the grid:	

Item	Information, Tests and signage	Position / Location / Data / Rating / Size etc	Yes or No	Comments on the requirement or additional information
1	Inverter Type Test Certificate			Required under UK Engineering Regulation G98
2	Size or capacity rating of inverter(s).			As set under UK Engineering Regulation G98
3	Reverse power flow blocking capability?			
4	Electrical Installation Certificate			As per BS7671:2018, 18th Edition
5	Diagram of PV installation			Circuit diagram showing inverter equipment and how connected to the electricity supply
6	Inverter labelled with a CE mark			
7	Number of phases of inverter			
8	Make and model of inverter			
9	Utility energy meter, dual register			

Item	Information, Tests and signage	Position / Location / Data / Rating / Size etc	Yes or No	Comments on the requirement or additional information
10	Inverter protection arrangements and parameter settings			
10.1	Voltage, minimum, in Volts			
10.2	Voltage, maximum, in Volts			
10.3	Frequency, minimum, in Hz			
10.4	Frequency, maximum, in Hz			
NOTE: Please use extra sheets if more PV inverters are connected to the same transformer				
11	PV system automatically shuts down during power outages			
12	PV junction boxes and locations			
13	DC isolator fitted			DC isolation clearly identifiable
14	AC isolator capable of isolating all phases and the neutral and lockable in the off position			AC isolation clearly identifiable, Include location, type and rating where possible
15	AC overcurrent protective device			Include location, type and rating where possible
16	Residual Current Device (RCD) or Earth Leakage Circuit Breaker (ELCB) fitted			Include location, type and rating where possible
17	Short circuit protection incorporated			
	SAFETY WARNING SIGNS			
18	SOLAR or PV EQUIPMENT	Fixed on exterior surface of wiring enclosures		Clearly displayed on exterior surface of wiring enclosures

Item	Information, Tests and signage	Position / Location / Data / Rating / Size etc	Yes or No	Comments on the requirement or additional information
19	WARNING: DUAL SUPPLY ISOLATE NORMAL SUPPLY TO THIS SWITCHBOARD AND "SOLAR" SUPPLY AT MAIN METER BOX BEFORE WORKING ON THIS SWITCHBOARD	Fixed on switchboard to which inverter is directly connected		Dual supply labelling should be provided at the service termination, meter position and all points of isolation between the PV system and supplier terminals to indicate the presence of on-site PV generation and indicating the position of the main a.c. switch disconnector
20	NORMAL SUPPLY MAIN SWITCH	Fixed at the main switch		This is the grid supply isolating switch
22	PV SUPPLY MAIN SWITCH	Fixed at the solar main switch		This is the PV supply isolating switch
23	WARNING: DUAL SUPPLY ISOLATE BOTH SERVICE FUSES AND "SOLAR" SUPPLY BEFORE WORKING ON THIS METER BOX	Fixed above service fuses		To warn service and maintenance personnel
24	WARNING: DUAL SUPPLY ISOLATE BOTH NORMAL AND SOLAR SUPPLIES BEFORE WORKING ON THIS DISTRIBUTION BOARD	Located on main switchboard and all intermediate distribution boards		If the solar system is connected to a distribution board then this sign is required
25	DANGER: SOLAR PV ARRAY CABLE HIGH VOLTAGE DC LIVE DURING DAYLIGHT	To be placed next to the supplier's cut-out		This is to warn service or maintenance personnel about the potential presence of high DC voltage
26	DANGER: PV ARRAY DC JUNCTION BOX CONTAINS LIVE PARTS DURING DAYLIGHT	Placed adjacent to all DC junction boxes		This is to warn service or maintenance personnel about the potential presence of high DC voltage

Item	Information, Tests and signage	Position / Location / Data / Rating / Size etc	Yes or No	Comments on the requirement or additional information
27	WARNING: MULTIPLE DC SOURCES, TURN OFF ALL DC ISOLATORS TO ISOLATE THIS EQUIPMENT	Is placed adjacent to the inverter when multiple		This is very important to ensure that all sources of DC supply are isolated before work can be done

I, the below named person being the person responsible for the Audit of the photovoltaic inverter system installation (as indicated by my signature below), particulars of which are described above, having exercised reasonable skill and care when carrying out the Audit hereby CERTIFY/NOT CERTIFY the PV inverter system is to the best of my knowledge and belief IN ACCORDANCE / NOT IN ACCORDANCE with published Guidelines for Connection of Private Solar Photovoltaic Systems, BS 7671, Electrical Wiring Regulations (18th Edition), BS EN 62446-1, UK Engineering Regulations EREC 98 and other relevant BS and IEC standards.

Signature of person who carried out the audit:	
Name of person who carried out the audit:	
Title and qualifications of technical audit person:	
Date this audit was carried out:	