The Highland Council

Agenda Item	7.
Report No	CCC/6/25

Committee: **Climate Change**

Date: **29 January 2025**

Report Title: **Net Zero – Building Technical Standards Solar PV and Metering**

Report By: **Assistant Chief Executive - Place**

1 Purpose/Executive Summary

1.1 The purpose of this paper is to update Members of the work undertaken in relation to the updating of technical briefing documents with regard to Net Zero.

2 Recommendations

2.1 Members are asked to **agree** the technical specifications set out in Appendices 1 and 2.

3 Implications

3.1 **Resource** - there are no ongoing resource implications, delivery of future work will be met from existing resources.

3.2 **Legal** - there are no legal implications arising from this report

3.3 **Risk** - There is no risk directly relating to this paper.

3.4 **Health and Safety (risks arising from changes to plant, equipment, process, or people)** – There are no implications arising from this workstream

3.5 **Gaelic** - There are no Gaelic implications arising from this workstream.

4 Impacts

4.1 In Highland, all policies, strategies or service changes are subject to an integrated screening for impact for Equalities, Poverty and Human Rights, Children's Rights and Wellbeing, Climate Change, Islands and Mainland Rural Communities, and Data Protection. Where identified as required, a full impact assessment will be undertaken.

4.2 Considering impacts is a core part of the decision-making process and needs to inform the decision-making process. When taking any decision, Members must give due regard to the findings of any assessment.

4.3 This is an update report and therefore an impact assessment is not required.

5 Net Zero – Building Technical Standards

5.1 As defined within the action plan for the Net Zero Thematic Group – Built Estate & Energy there is a requirement to determine and agree net zero design standards applicable for non-domestic new builds and refurbishments.

6 Solar PV

6.1 Following internal liaison, and consultation with relevant external parties, a Highland Council technical specification for Solar PV has been developed and is now a requirement for all applicable projects. It will provide consistency and conformity for all new installations of Solar PV, for both existing and new build projects.

6.2 This will assist both the design process and ongoing maintenance and inspection requirements. The specification has been created as guidance to ensure designers and contractors meet Highland Council's expectations for the design, installation, operation, commissioning, and maintenance of solar photovoltaic (PV) systems on the Council's properties and grounds

6.3 The specification is relevant to all applicable domestic / non-domestic properties and projects and will be updated as required in line with industry good practise and legislation.

7 Utility Metering

7.1 A Highland Council technical specification for Utility Metering, including sub-meters, has been developed and is now a requirement for all applicable projects.

7.2 Accurate metering is a fundamental energy monitoring and targeting tool, an essential part of energy management.

7.3 Metering by itself does not save energy. It is the actions taken as a result of installing and monitoring meters that can realise quantifiable energy savings. It is essential that meters are selected, installed and commissioned correctly, to provide appropriate information for monitoring and targeting processes

7.3 The purpose of this document is to set out the guidelines and standards that apply to the THC Estate and its design requirement for Metering as set out by the Climate Change & Energy Team. This document will apply to new build and refurbishments in existing buildings.

7.4 The specification is relevant to all applicable non-domestic properties and projects and will be updated as required in line with industry good practice and legislation.

Designation:	Assistant Chief Executive - Place
Date:	6 January 2025
Author:	Ronnie Macdonald, Energy Manager
Background Papers:	None
Appendices:	Appendix 1 – Solar Photovoltaic Technical Specification Appendix 2 – Utility Metering Technical Specification

Appendix 1

The Highland Council
Comhairle na Gàidhealtachd

Solar PV

Technical Specification

Original			
Version	**Author**	**Note**	**Date**
1.0	JG	Developed from 'Solar Photovoltaic and Battery Storage System Specification'. Author: Terry Morton	06/06/2023
Revisions			
Version	**Author**	**Note**	**Date**
1.1 - 1.5	GM, JH, RM, NO	General Amendments	Aug-23 – Jul-24
1.6	RM	Final	19-07-2024

Table of Contents

1 Introduction

This document has been created as guidance to ensure designers & contractors (the Contractor) meet Highland Council's (the Authority) expectations for the design, installation, operation, commissioning, and maintenance of solar photovoltaic (PV) systems on the Authority's properties and grounds.

The Contractor will be contracted to the Authority and will be responsible for managing the entirety of the project. As part of the contract, the contractor will have responsibility for appointing and managing all sub-contractors or organisations as necessary to complete the works as. The contractor will have responsibility for the costs associated with the involvement of all such parties. Such organisations may include but are not limited to the following:

- Design and Engineering Consultants
- SSEN (District Network Operator)
- Mechanical and Electrical Equipment Suppliers
- Mechanical and Electrical Engineering Contractors
- Scaffolding Suppliers
- Plant Hire Suppliers

2 Standards

To ensure consistency across the property portfolio the Authority has taken the approach that all PV installations will fully comply with MCS, IET code of practice for Grid connected Solar photovoltaic systems and relevant British Standards, regardless of the size of generation installed. This includes the design, supply, installation, testing, commissioning, and handover in accordance with the following documentation:

- All relevant MCS guidance and documentation, including but not limited to:
    - MIS 3002 Issue 5: The Solar PV Standard (Installation)
    - MIS 3012 Issue 1: The Battery Standard (Installation)
    - MGD 003 Issue 2: A method to determine the Electrical Self-Consumption of Domestic PV Installations with and without Storage
    - MGD 005 Issue 1: Solar PV Shade Evaluation Procedure: A method to determine Shade Factor
    - MCS001-MCS-Contractor's certification scheme document.
- The latest version of BS 7671 2018 IET Wiring Regulations 18th Edition, 2nd amendment or later.
- IET Code of Practise for Grid Connected Solar Photovoltaic System (ISBN 978-1-84919-722-9 Electronic)
- IET Code of Practise for Electrical Energy Storage System (ISBN 978-1-78561-279-4 Electronic)
- Engineering Recommendation G98 – Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16Amps (3.68kW) per phase) in parallel with public Low Voltage Distribution Networks on or after 27 April 2019

- Engineering Recommendation G99 – Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019, above 16A (3.68kW) per phase or energy storage
- Engineering Recommendation G100 Issue 1 - Amendment 2 May 2018 - Technical Requirements for Customer Export Limiting Schemes
- BS 5839-1:2017 – Fire Detection & Fire Alarm Systems for Non-Domestic Buildings
- BS 5839-6:2019+A1:2020 – Fire Detection & Fire Alarm Systems for Domestic Buildings
- Scottish Building Standards – Non-Domestic 04/24 & Domestic 04/24
- Manufacturer's Instructions
- The Authority's supplied site specifications and documentation must be read in conjunction with the above this document.

Where contradictory information exists between this specification and the above documentation and standards, clarity shall be sought from the Authority before proceeding.

Note: *Additional publications, reference and further reading is provided in Appendix A.*

3 Health and safety

To minimise risk, the designer and/or contractor is required to carefully consider potential hazards and produce appropriate (RAMS) Risk Assessments & Method Statements. These will include both mitigating potential hazards during installation and ongoing operation.

The design and specification of proposed PV systems requires to account for and define appropriate H&S considerations associated with the installation, operation, maintenance, and monitoring aspects of the system - relevant and specific to individual buildings and locations.

As part of the works both the designer and contractor must identify site specific hazards and provide, to the Authority, suitable precautionary actions. Though not exhaustive, the following aspects should be considered:

- Roof structure
    - Weight of panels and mounting frame
    - Installation routes and walkways
    - Fragile elements
- Roof Access
    - Staff, tools, and materials
    - Distributing materials and tools across the roof
    - Barriers & Exclusion zones
    - Working from heights
- Overhead power lines
    - Proximity to areas of work
- Ground level
    - Vehicular access
    - Site containment
    - Security of access to scaffolding
    - Pedestrian access and obstructions.

- Asbestos
- Lone working
- Hazardous substances
- Confined spaces
- Services onsite and any excavation.
- Builders work associated with services passing through building fabric.
- Fire access and escape.

4 Design – Existing Sites

4.1 Site inspection

To confirm the suitability of the proposed PV system installation, the Designer & contractor shall arrange to undertake a site inspection. To assist with the site inspection the Designer shall employ additional forms of expertise as required, such as a Structural Engineer.

The site inspections will include, but not be limited to:

- The construction of the proposed mounting location
- The physical size, layout, and condition of the roof and/or area of installation
- The existing electrical installation and cable routing
- The asbestos register
- Any potential impact of Solar PV system on the weather tightness of the building or structure.
- Other site services.

The Designer and contractor shall provide site specific performance and technical information as per MCS standards (MIS3002 and MIS3012) to the Authority for acceptance and authorisation prior to the procurement or installation of any PV system (and if applicable battery storage).

A full list of documents required for submission to the Authority for approval is detailed in Section 9. An indicative table of information requirements is contained in Appendix D.

4.2 Internally located equipment

The following considerations must be taken prior to selecting the equipment's location.

a) For all components, the selected location shall satisfy the spatial and environmental requirements (temperature, humidity etc.) detailed in manufacturer's literature.
b) Equipment should not be installed in an area which exceeds 30°C during summer months. Any variance from this requires written acceptance by the Authority.
c) Equipment shall not be installed or located within 2 metres of any heat emitting source.
d) The same location should be deemed/constructed as a Fire Compartment and protected by a fully automatic fire alarm/smoke detector.
e) The space must be capable of offering the following:

I. Full access for the purposes of Maintenance / expansion
II. Security from potential damage / misuse

f) If the equipment is to be installed in a shared space, consideration should be made for installing a form of protective barrier / cage with ample space for access.

4.3 Roof Structure

4.3.1 Structure

All proposed locations for roof-mounted PV Arrays must be assessed by a suitably competent person, confirming that the roof structure is suitable for the installation. Photographs of the roof area pre-installation must be taken and shared with the Authority as part of the proposal documentation.

Fixing systems shall be designed with due consideration to site specific requirements and weather-related conditions, including snow load, wind, hail, rain, and ice. Lifespan of fixing system shall exceed that of the PV array, require minimal maintenance and allow for potential panel expansion under thermal stress.

Where there are uncertainties regarding the existing roof structure, an inspection and assessment by a Qualified Structural Engineer shall be undertaken. Copies of any associated assessments and recommended remedial actions and costings shall be provided to the Authority.

All associated calculations shall be provided to the Authority as part of the proposal documentation.

4.3.2 Material composition

Determination of suitability of roofing material shall be taken to ensure that it is of a Non-Combustible composition meeting Class A1/A2 s1, d0 to BS EN 13501-1. Liaison with the Authority's Property Department should be undertaken as required.

4.4 PV Panels

Panels should conform to BS EN 61215 or BS EN 61646 in conjunction with BS EN 61730-1 and BS EN 61730-2 so that they may withstand inclement weather conditions. The panels should be certified by a company with third party accreditation to BS EN 17025.

The PV module layout shall be designed to maximise the use of the available roof area with consideration of size, location, orientation, roof pitch (inclination) and over-shadowing.

Panels shall not be installed above the ridgeline and should project no more than 400mm (Domestic) and 1 metre (Commercial) from the roof or wall surface. *Note: these conditions will be satisfied if panels are mounted parallel to the roof on a sloping roof*.

The contractor shall calculate the solar performance of the proposed system, utilising *Appendix B – Performance Estimation Method* of MCS standards document *MIS 3002* to establish the performance of the proposed PV system.

4.4.1 Shade Evaluation

The contractor shall conduct a shade evaluation to establish the impact of over-shadowing by nearby objects and to determine the shading from the horizon. The contractor shall follow MCS guidance document MGD 005: Solar PV Shade Evaluation Procedure: A method to determine Shade Factor. Any design implemented shall be designed to reduce shading impact to improve generation.

4.5 Monitoring & Communication

4.5.1 Monitoring

The Solar PV system must have full remote monitoring capability, including but not limited to:

- Reporting on operation
- Reporting on failure
- The ability to indicate that a "Shut Down" process has taken place - notifying the Authority within 24-hours of the system ceasing to operate or beginning to operate abnormally.
- Historic and current generation

Work is ongoing by the Authority to define a single communications standard and approach for all existing and new Solar PV systems. As such direct liaison with the Authority is required at an early stage to define and agree an appropriate and compliant manner of remote communication for monitoring and reporting purposes.

4.5.2 Communication

The THC IT Network will be utilised as a gateway for all Solar PV system remote communications for both PV Inverters and PV Generation meters.

The required number of network points shall be determined during the design process and highlighted to THC Project Manager, for consideration by the Council ICT service. If additional points are required, they shall be installed/provided within close range to connect via RJ45(network) cables.

Multiple inverters shall be interlinked using compatible communication cables as per manufacturer's instructions. A single accessible portal dashboard shall be provided for the collective generation of the system.

Any proposed deviation must be approved in writing by the Project Manager.

4.5.3 Generation Metering

All energy metering or reporting must be capable of remote monitoring and be compatible with the Authority's existing systems.

Details of generation and export meters, together with details of proposed remote monitoring and data logging system and the accessibility of all real time and historic data shall be provided to the Authority for approval prior to installation.

4.5.4 Security & Access

All keys, passwords, access codes, mac & IP addresses and IDs required for ongoing maintenance and remote access are to be supplied to the Authority prior to handover.

Mac addresses must be provided to the Authority at an early stage to allow for the Authority's ICT Security Team to review and approve devices to the Network Register.

5 Planning permission (if required)

The contractor shall confirm whether planning permission is required for the proposed site to install the system.

Useful links:

Highland Council – Planning Long term and area policies.
https://www.highland.gov.uk/info/198/planning_-_long_term_and_area_policies/152/renewable_energy

Energy Saving Trust
https://www.energysavingtrust.org.uk/sites/default/files/reports/Choosing%20a%20site%20and%20getting%20planning%20permission.pdf

Permitted Development Rights: Non-Domestic Solar PV Panels and Domestic Air Source Heat Pumps
https://www.gov.scot/publications/permitted-development-rights-non-domestic-solar-panels-domestic-air-source/pages/4/

Making changes to a dwelling house - Householder permitted development rights: guidance - updated 2021
https://www.gov.scot/publications/householder-permitted-development-rights-guidance-updated-2021/pages/6/

5.1 Design Proposal

Prior to commencement of site works, the contractors shall submit the proposed design to the Authority for approval, including as a minimum:

- Written confirmation of planning requirements
- Written confirmation of DNO requirements
- Performance estimate calculations, as described in section 4.3.
- Roof loading calculations
- Manufacturer datasheet/s for proposed components, including.
    - PV modules

    - mounting system
    - Inverter
    - EESS or module level power electronic device if applicable
- A drawing with the proposed array layout on the roof, including area covered by panels.
- Photo/s of proposed roof area
- Sun-path diagram used to calculate SF, as described in section 4.5.1.
- Proposed monitoring method
- Photo of the proposed area/s for the internal equipment
- An electrical schematic drawing of the proposed electrical installation
- An electrical containment drawing detailing the proposed cable containment route/s – including both new, existing & containment sizes
- Fire risk and risk assessment for installation
- Fire Stopping - manufacturer & type of fire stopping proposed.
- Lightning protection / surge protection assessment

The use of alternative assessment methods shall be in addition to, rather than instead of, the methods described by MCS. The results of all assessments shall be submitted to the Authority for consideration and approval.

6 Design – New Build

The requirements for Solar PV systems, on new-build buildings and sites, are to match those as detailed in Section 5 above.

Where the installation of a solar PV array is preceded by or run concurrently with the installation of a new slate/tile roof, the preference is that roof integrated solar PV panels should be considered.

The selected system shall be a certified roof covering. All fixings shall be provided as part of the system and be suitable for the specific requirements of the respective building.

A full list of documents required for submission to the Authority for approval is detailed in Section 9. An indicative table of information requirements is contained in appendix D.

7 Installation

7.1 External

Appropriate risk assessments shall be undertaken by the Designer and/or Contractor and supplied to the authority, complete with defined access plans, complying with the relevant working at height regulations.

https://www.hse.gov.uk/work-at-height/the-law.htm

7.1.1 Roof Anchors & Fixing Calculations

The design / specification of roof anchors and fixings shall be determined independently for each property based on snow/wind/structural calculations.

Roof anchors shall be appropriate for the specific property's roof construction, e.g., metal sheeted, rooftiles or slates. If rooftiles or slates are present, the installation shall not displace or create gaps greater than those pre-existing the installation. Any rooftiles or slates that are cracked or damaged during the installation shall be replaced by the contractor on a like-for-like basis.

Fixing design and proposed fixings shall be capable of withstanding the imposed (dead) load and wind uplift loads as calculated, e.g.

- For all systems approved to MCS012 – ensuring that the imposed loads are within the range specified by the product manufacturer – installed to the manufacturer's instructions.
- Using fixing data from Eurocode 5 "design of timber structures".
- Using the fixing brackets test data.
- Applying Safety Factors as described in Eurocode 1 Parts 1-1, 1-3 & 1-4

All fixing calculations must be carried out by a suitably qualified person.

7.1.2 Roof Penetrations

All roof penetrations shall be durably sealed using purpose-made products capable of accommodating movement and temperatures to which they may be subjected. In all circumstances the property's weather tightness shall be maintained, with no detrimental impact to material warranties. Purpose-made roof tiles and/or flashings should be used for all DC cabling routed wires routing through the roof.

7.1.3 DC Cabling

The contractor will calculate and then select a suitably sized conductor, capable of carrying the generated load of the system design. DC cabling must be DC Rated, Double Insulated & UV Resistant to (H1Z2Z2-K-Solar), with a maximum voltage (U max) of 1800V DC.

All cables and connectors must be suitably IP rated and be firmly secured underneath the array to reduce any potential water ingress. All external through connectors must be fitted within an "ArcBox" type enclosure.

All DC cable locations and routes are to be described. and detailed in the fire safety logbook.

Guidance relating to fire protection in section 7.2.1 should be followed.

7.1.4 Bird protection

A system shall be provided around the PV module array/s and cover all positions where a bird could get below the PV modules. The contractor shall ensure that any fixing method does not impact the warranty of the PV system.

7.1.5 Lightning Protection / Surge Protection

A lightning risk assessment shall be undertaken for all proposed systems. Consideration should be made to structures, systems, associated electrical installations and electronics, and should appropriately utilise lighting protection zones

The requirements for Lightning Protection / Surge Protection will be determined by the following guidance:

- MCS Installation of PV Systems 2012 2.2.1 Lightning Protection
- BS 7671:2018 Chapter 53 Section 534.1 Lightning Protection Zones
- BS EN 62305 Protection Against Lightning
- IET Code of Practise for Grid Connected Solar Photovoltaic System Sections 5 5.14 (Protection against lightning & overvoltage on the DC side) & Section 6 (Protection against lightning & overvoltage).

Where required a suitably qualified Electrical Engineer / Lightning Protection Specialist shall be utilised, and in accordance with IET code of practice, where deemed a requirement, system protection should be included for any structure or system in accordance with BS EN 62305 (1-4).

Referenced standards such as BS EN 50539 – 12 and BS EN 50174-3 and BS 6701.

7.1.6 Ground-mounted installations

The contractor shall ensure the ground conditions are assessed by a suitably competent person and provide a recommendation for fixing method. Note: ground-mounted installs may require planning permission, contractor to confirm with appropriate planning authority.

Considerations should include, but not be limited to, the following:

- Growth of vegetation.
- Secure fencing, including provision of appropriate access limitations, with consideration to the local environment
- Cable routes and depths.
- External electrical installation housing.
- Avoidance of services.
- Connection to incoming main and export and import metering.
- Appropriate housing of inverters.
- Communications strategy for meters and inverters.
- Isolation of system from both DC and AC circuits.
- Obstruction of light or views from existing buildings.

As part of the design package a drawing must be submitted showing all cable routes between the service pillar/enclosure and the property.

7.2 Internal

The inverter and its associated electrical equipment shall be sited in a suitable non-combustible compartment, free from any combustible materials within the main electrical switch room and be easily accessible for the purposes of maintenance.

Locating invertors within roof voids must be avoided. Any proposed deviations from this requirement will require written confirmation from the Authority.

The associated equipment, as listed below, must be installed at a suitable work height for the purposes of maintenance and data collection:

- Inverter
- Generation Meter
- DC Isolator/s
- AC Isolator/s
- Import/export meter (smart meter)
- Router

7.2.1 Fire considerations.

PV components must be mounted on a fire-retardant surface / backboard – allowing all equipment to be securely fixed.

The space in which the inverter and its associated equipment is being installed must be protected by an automatic smoke detector - fully integrated with the Property's Fire Alarm System - complying with regulation BS 5839-1 2017.

MCS installation guidance requires that a Fire and Rescue Notification (as shown in appendix B) be affixed in a prominent place close to the electrical isolation point.

For domestic applications compliance with BS 5839-6 2019 is required.

7.2.2 Energy Storage Systems (ESS)

All Energy Storage / Battery Bank Systems must be installed in accordance with BS EN 50272-1 2010, thus ensuring:

- a safe secure form of storage.
- a means of preventing accidental contact with the battery terminals.
- a means of minimising any gas build-up

The Authority's preference of Battery system shall consist of either. a $LiFePO_4$ battery (Lithium iron phosphate battery) or a similar LFP battery (Lithium ferrophosphate) type.

(Lead acid batteries must not be considered)

Appropriate consideration and mitigations should be completed for positioning, fire risk, escape, toxic fumes, COSHH and other risks, incorporating appropriate measures to satisfy standards and regulation.

7.2.3 DNO Application

The Authority requires the designer and/or the contractor to provide evidence of any correspondence made with the DNO (SSEN).

SSEN have created the following link SSEN website which defines 3 classifications of connection for microgeneration, as follows:

- Installations up to 3.68kW per phase at more than one property
- Installations above 3.68kW per phase but 50kW or less
- G99 Fast Track Process

And for systems larger than 50kW

- Generation or storage connections above 50kW.

7.2.4 Generation Meter and inverter data

As part of the initial site assessment the contractor shall inspect existing metering arrangements on the suitability of existing metering arrangements to determine

- Generated electricity (kWh)
- Exported electricity (kWh)
- Consumed on-site electricity (kWh)

Confirmation shall be provided in writing as part of the site appraisal report on

- how the above coverage can be attained either through use of existing equipment or through the provision of additional equipment
- Compatibility of metering arrangements with respect to Smart Export Guarantee scheme requirements
- Remote reporting and monitoring functionality.

Where a meter is deemed to be unsuitable, the Authority shall be informed so that they can review potential for a meter replacement.

Meters, where installed, should be positioned at eye level no higher than 1.6 m) and located in an easily accessible space.

Liaison with respect to the specification of metering requirements shall be undertaken with the Authority's Utility Billing Team (energy.management@highland.gov.uk)

7.2.5 DC Cabling

All DC cabling must be designed and installed in suitable mechanical protection, to BS 7671: 2018. Part 5 Chapter 52.

Cable runs shall be kept to a minimum length and installed with consideration to existing services and spaces. Where required additional mechanical protection shall be provided.

All cable run penetrations must conform to BS7671:2018 Section 527.2

Cable locations and routes are to be described and detailed in the fire safety logbook.

Cabling will require to be of the LSF (Low Smoke & Fume) type to BS EN 50618

7.2.6 Environmental

To minimise the risk of equipment overheating, adequate ventilation should be considered. This could be either by external wall vents or a suitable form of mechanical ventilation.

Ingress protection of all equipment shall be adequate for the environment. This may require additional protection to reduce the ingress of dust and dirt.

7.2.7 Labelling and Signage

All labelling & PV installation equipment shall conform to the current MCS MS3002 standards. (Refer to Appendix B) and other relevant standards.

7.3 Distribution Network Operator (DNO) and Energy Provider

The contractor is responsible for contacting and completing all documentation to connect the PV system to the grid.

The DNO will require information in advance of the installation - No connection of a PV system is permitted until approved by the DNO. The DNO requires to be informed so that they can assess the potential impact on their network and determine any works required to support the connection.

Note: to connect single or multiple phase generators of up to 16A (3.68kW) per phase, a G98 application form requires to be completed and submitted. Above 16A (3.68kW) per phase or energy storage, a G99 form is required.

8 Inspection, Testing & Commissioning

8.1 Inspection & Electrical Testing – A.C.

All AC electrical installation works must be carried out by suitably qualified electricians in accordance with BS 7671 - Section 712, “Solar PV Power Supply Systems”.

Documentation:

- EIC (Electrical Installation Certificate).
- Schedule of items inspected.
- Schedule of test results.

8.2 Inspection & Electrical Testing – D.C.

All DC electrical installation works must be tested in accordance with BS 7671 & BS EN 62446 “Grid Connected PV Systems”.

Verification Sequence (Part of the PV array test report):

- Inspection Schedule.
- Continuity test of protective earthing and/or equipotential bonding conductors (if fitted).
- Polarity test.
- String open circuit voltage test.
- String short circuit current test.
- Functional tests.
- Insulation resistance of the D.C circuits.

Contractors must be members of either the National Inspection Council for Electrical Installation Contracting (NICEIC), the Electrical Contractors Association (ECA) or SELECT (Scotland).

All commissioning documentation shall be signed off by the same installation electricians.

9 Handover Documentation

A site-specific Handover Documentation pack must be submitted to the Authority for review and approval within one month of the commissioning date, it must include:

- If under 50 kW, a MCS registered certificate
- If over 50 kW, a certificate containing the following as a minimum:
  - Date and signature of the commissioning engineer.
  - A statement confirming that the PV system has been installed in line with the requirements set by MCS Standards
  - Client name and address
  - Site address (if different)
  - Installer name, address etc
  - List of key components installed.
  - Estimation of system performance
- Copy of invoice – marked 'paid in full'.
- Warranty details including start date, duration, and limitations of coverage.
- Recommended maintenance and servicing requirements, including periodic cleaning and inspection schedules.
  - Logbook proforma for ongoing annual servicing
- Electrical:
  - A single line electrical schematic
  - PV Array layout drawing
  - Cable routing
- PV Components:
  - Structural and Wind/Snow loading calculations for array.
  - Manuals and data sheets for the following, together with part and serial numbers:
    - PV modules
    - Inverter
    - Battery/s
    - Mounting equipment used.
    - DC Isolators
    - Dataloggers / displays
    - Additional key components which impact/affect the function and/or the safety of the installation.
- Normal operation description and explanation of common alarms/error messages
- Test results and commissioning data:
  - A copy of the BS7671 EIC (Electrical Installation Certificate) AC System
  - A copy of the DC string test results as described in MCS Solar PV installation MIS 3002
  - A copy of a table detailing the inverter protection settings (under/over voltage, under/over frequency, etc.)

- Operation & Maintenance Data:
  - Procedures for verifying correct system operation.
  - Shutdown/isolation and start-up procedures
    - To include addressing system failure
  - Maintenance & cleaning recommendations (if any)
  - Data sheets and manuals for all equipment to be sent as electronic to the energy team and hard copy documents to be added to the building logbook.

9.1 Site required printed documents.

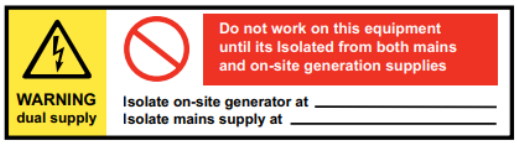
A copy of the documentation pack will be printed and left on site once checked and approved by the Authority:

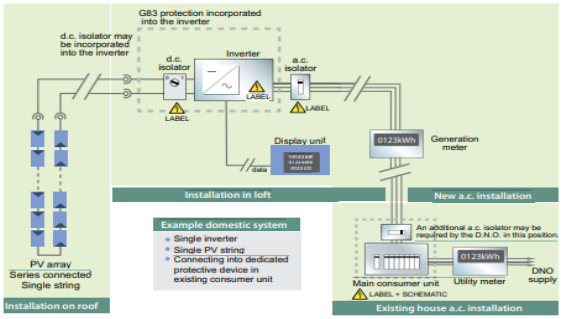
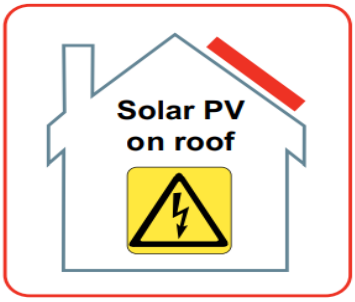
- Test results and commissioning data and certification.
- Structural and loading Wind/Snow calculations.
- Maintenance requirements for periodic cleaning and inspection schedules
- Logbook created for ongoing servicing records.
- Normal operation description and explanation of any common alarms/error messages
- Start-up and shutdown procedures
- Emergency contact details
- Installed hardware data manuals and data sheets of all components along with serial numbers.

Appendix A – Selected publications and references

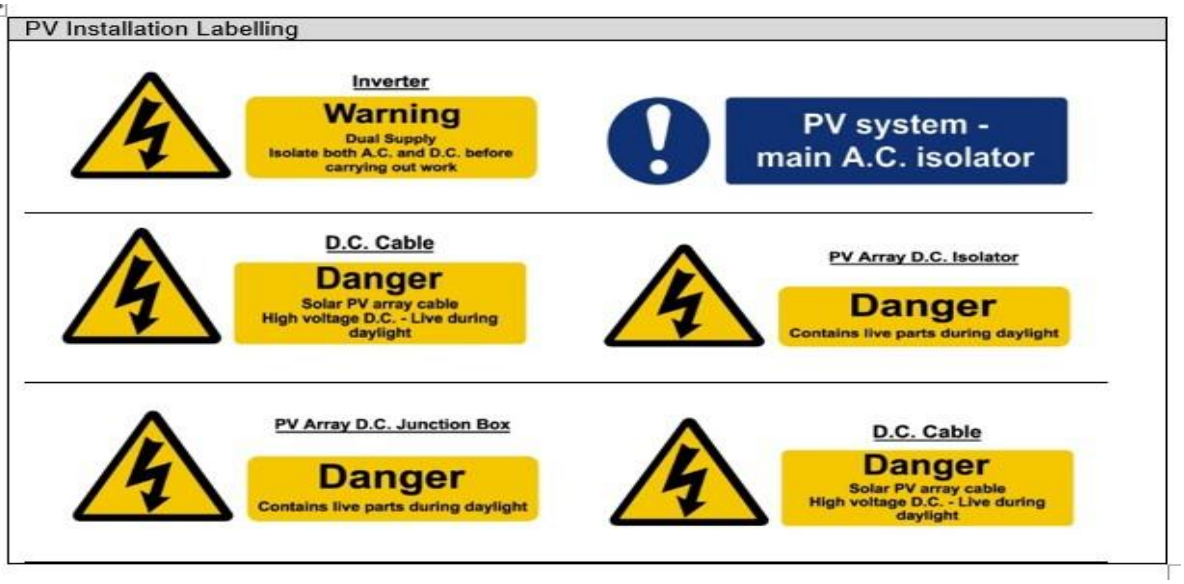
1. BRE Digest 489 - Wind loads on roof-based photovoltaic systems.
2. BRE Digest 495 - Mechanical installation of roof-mounted photovoltaic systems.
3. BS EN 50549-1:2019 – technical requirements for the protection functions and the operational capabilities for generating. Intended to operate in parallel with LV distribution networks.
4. BS EN 1991-1-1:2002 – Eurocode 1: Actions on structures – Part 1-1: General Actions - Densities, self-weight, imposed loads for buildings. Part 1-3: General Actions – Snow Loads, Part 1-4: General Actions – Wind Actions
5. BS EN 1995-1-1:2004 - Eurocode 5: Design of Timber Structures – Part 1-1: General – Common rules and rules for buildings
6. BS EN 62446-1:2013+A1 - Temporary edge protection systems. Product specification. Test methods.
7. BS EN 62446-1:2016+A1:2018 - Photovoltaic (PV) systems. Requirements for testing, documentation, and maintenance. Grid connected systems. Documentation, commissioning test and inspection.
8. Ofgem - Guidance for generators: Co-location of electricity storage facilities with renewable generation supported under the renewables Obligation or Feed-in Tariff schemes (Version 2)
9. BS EN IEC 61730-1:2018 - Photovoltaic (PV) module safety qualification. Requirements for construction and testing
10. RC62 - Recommendations for fire safety with photovoltaic panel installations.
11. ZRSTM60 (12/21) ZUR – ZRS PV Panels – Zurich – Risk Insight: Roof-mounted PV Panels and system
12. Zurich – Managing the risks of roof-mounted PV panel systems on community buildings.
13. Building Standards Division Non-Domestic Building Services Compliance Guide for Scotland 2022 Edition v1.1 - February 2023

Appendix B – Labels and Signage

Dual supply label	
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 generation and indicating the position of the main a.c. switch disconnector.	

Circuit diagram & system information	
At the point of interconnection, the following information is to be displayed (typically all displayed on the circuit diagram): • Circuit diagram showing the relationship between the inverter equipment and supply. • A summary of the protection settings incorporated within the equipment. • A contact telephone number for the supplier/installer/maintainer of the equipment. • It is also good practice for shutdown and start-up procedures to be detailed on this diagram.	
Fire and Rescue Notification	
To ensure the Fire and Rescue Service are aware that a PV system is installed on the roof, the following sign shall also be fitted • Location: next to the suppliers' cut-out in the building • Size: This label shall measure at least 100mm x 100mm • Only required for PV systems fitted on roofs	

PV Installation Labelling



Appendix C – CCFM Request Form

Catering, Cleaning & FM Service Help Desk

The Highland Council
Comhairle na Gàidhealtachd

Name and address

Name:	
Establishment / Company Name:	
Address:	
Postcode:	
E-mail Address:	
Telephone No:	

Is your Request for a single or multiple event? *(tick as appropriate)*

Single Date ☑ Multiple dates ☐

Section 1 – only complete this section if you have ticked 'Yes' to Single Date

Single Date Request

Establishment	Start Date	End Date	Start Time	End Time

Section 2 - only complete this section if you have ticked 'Yes' to Multiple Dates

Multiple Dates Request (please continue on a separate sheet if required)

Establishment	Start Date	End Date	Start Time	End Time

Section 3 – Nature of Request

Is your Request for internal only, external only or both? *(tick as appropriate*)

Internal Only ☑ External Only ☐ Internal & External ☐

Please provide full details of the nature of your Request. This should include a description of any work to be carried out and must detail the internal/external areas that you require access to or will be working in?

Section 4 – Cleaning After Maintenance/Refurbishment/Repair Work – CONTRACTORS ONLY

It is a requirement of any authorised access granted that Contractors ensure all areas are cleaned as per Covid Guidance issued by the Scottish Government & Health Protection Scotland. This applies during the date & times granted and on cessation of work.

PLEASE NOTE:

- **A minimum of 3 working days, not inclusive of Saturday & Sunday must be provided for any school term requests.**
- **A minimum of 7 working days, not inclusive of Saturday & Sunday must be provided for any school holiday requests (N.B. Highland Council Establishments are closed for all the Christmas/New Year Holiday Period, no requests will be authorised for this period)**
- **Submission of this form does not constitute that your request has been authorised. You would receive confirmation if request approved or denied from CCFM Help Desk.**
- **Contractors:**
  - **Risk Assessment must be attached to all requests.**
- **Please return completed form to – CCFM.HelpDesk@highland.gov.uk**

Appendix D – Indicative information requirements

General Information	
Site Name	
Name of Surveyor	
Contractor Name	
Contractor Details	
Date Commissioned	
System No	

Detail	Details Included Yes/No	Location	File Name	Notes
Services Drawing				
Panels proposed				
Mounting system proposed				
Inverter chosen				
SEG Export meter detail				
DC Cabling system and details				
Designer / installer information				
Solar Panel Datasheet				
Inverter Datasheet				
Inverter Installation Manual				
Inverter User Manual				
Roof Mounting System Datasheet				
Roof Mounting Fixing Calculations				
Emergency Shutdown / Isolation Procedures				
Risk Assessments				
Method Statements				
Wind Loading Calculations				
Snow Loading Calculations				
Building Structure Calculations (if any)				
Schematic Wiring Diagram				
Roof Array Layout				
System Design and Specification of Equipment				
Maintenance / Cleaning Recommendations				
Electrical Installation Certificate				
AC Test Results				

Detail	Details Included Yes/No	Location	File Name	Notes
DC Test Results				
Commissioning Certificate				
MCS Certificate				
Warranty Documentation				
Grid Connection Documentation G98 or G99				
Site Checklist				
Location of Inverter				
Location of Isolator				
Location of Meters				
Generation Meter Manufacturer				
Generation Meter Model / Serial Number				
Location of Incoming Electrical Supply				
Signage				
Solar Distribution Board Location				
On Site Labelling (Ref Appendix B)				
Location of Incoming Electrical Supply				
Location of Main Fire Alarm Panel				
Inverter(s)				
AC Isolator(s)				
DC Isolator(s)				
DC Cable Runs				
DC Junction Boxes (if fitted)				
On Site Schematic / Documentation				
System Layout / Wiring Diagram				
DC Cable Runs				
Notes: Single conductor "double insulated" cable. PV DC. cable runs should be kept as short as practicable. Should not be buried in walls, travel through a fire wall without correct transits block.				
Long cables (over 50 m) should be installed in earthed metal conduit or trunking or be screened cables such as armoured.				

Detail	Details Included Yes/No	Location	File Name	Notes
DC Cable Termination				
Note: Correct socket type used, clean terminations, insulation undamaged and routed separately (AC-DC)				
AC Cable				
Note: Correct size routed correctly and mechanical attached. Clean termination into correct IP rated hardware				
Inverter				
Note: Installed on a non-combustible surface, Ventilation as required by Manufacture. Where possible Arc protection in the inverter turned on				
installed in substation or main switch room or for site installations IP 66 rated and installed within weatherproof constructed cabined, raised above flooding level and constructed in such a way so as to be incapable of being set on fire or demolished easily.				
300 mm provision spacing around inverter.				
Fire Safe?				
Inverter protection settings enabled?				
Mounting, ok?				
Documentation on wall main and solar switchboards?				
Meter				
Note: On the inverter output display/record energy delivered by the PV system (kWh). The meter should be located where the consumer can readily observe it without the use of ladders, tools, or torch. As per SEG Guidance. Installed in a location such as a substation or main switch room close to the import/export meter.				
Import export meter?				
Export MPAN?				

Detail	Details Included Yes/No	Location	File Name	Notes
Communications				
Inverter Keys, Passwords and Codes and IP address.				
Portal passwords, keys and codes and addresses.				
Router Keys, Passwords and codes and IP address				
Mobile communication passwords, Codes, addresses and keys.				
Isolators AC & DC				
Note: located in the correct places. switch must isolate all live conductors (typically double pole to isolate PV array positive and negative conductors). Switch must be rated for d.c. or a.c. operation at the system voltage & current maximum as calculated, (Can be inverter intergraded d.c. isolation)				
Roof Work - (if safe to obtain from ground level)				
Note: The provision of access/walkways around the perimeter of the array. Arranging Larger arrays into smaller blocks with access corridors between. The provision of permanent protection over fragile roof elements such as skylights. The provision and type of permanent access ladders				
400mm minimum around the edges. ensure water run off ok. snow shedding				
Cable penetration - (if safe to obtain from ground level / internal attic / avoids)				
Note: Cable penetrations through the roof should not affect the weather tightness of the roof and should be durably sealed to accommodate the movement and temperatures expected.				
Lighting Protection				
Note: Required				

Detail	Details Included Yes/No	Location	File Name	Notes
Earthing				
Note: Class 1, Inverter requirement and external hardware installation.				
Type of RCD or MCB – (if safe to obtain)				
Site installations (not building)				
Site outline drawing marked in red showing boundary of site				
Services drawing for buried services installed				
Services drawing for services onsite				
Electrical schematic showing PV system and its connection to the existing or new system.				
Electrical schematic for the existing electrical installation.				
Planning Approval				
Structural calculations				
DNO Calculations				
DNO Approval				
Fire access drawings				
Fire access route				
Photos				
Picture of panels (if easily and safely obtainable from ground level):				
Full view of internal installation:				
Picture of inverter(s) including Data plate and surface mounted to:				
Picture of generation meter(s) including serial number and meter reading:				
Diagrams & documents left onsite:				
including Distribution				
Board & Fire Panel:				
Cable runs along with any transits between walls:				
Electrical schematic?				

Bennifitting

Appendix 2

The Highland Council
Comhairle na Gàidhealtachd

Metering Systems

Technical Specification

October 2024

Original			
Version	**Author**	**Note**	**Date**
2.0	Energy Team	Draft for review	30/10/24

Contents

1 Introduction

1.1 Accurate metering is a fundamental energy monitoring and targeting tool, an essential part of energy management. *Note: references to energy within this document should be read as energy, utilities and/or water.*

1.2 Metering by itself does not save energy. It is the actions taken, as a result of installing and monitoring meters that can realise quantifiable energy savings. It is essential that meters are selected, installed and commissioned correctly, to provide appropriate information for monitoring and targeting processes.

1.3 The purpose of this document is to set out the guidelines and standards that apply to the THC Estate and its design requirement for Metering as set out by the Energy Team. This document will apply to new build and refurbishments in existing buildings. In some cases, this standard exceeds Building Regulation requirements, as it represents desired good practice levels.

1.4 This document applies to all buildings managed or owned by THC. In tenanted buildings any proposed changes to any part of a building which will impact or affect metering systems must first receive permission from the Energy Team and the Landlord/nominated agent and be written in the respective lease.

1.5 This document indicates the Council's generic metering systems Client Requirements. Consultants, designers and contractors must also refer to specific project requirements identified by the Project Manager. Where applicable, they must fully integrate any new design into the Council's BMS and related 3rd party monitoring systems.

1.6 All metering installations shall address the following:

- How energy consumption will be monitored and recorded with reference to a site, a building, a department, specific plant, or end of use
- Provide an improved perspective on building operation.
- Allow patterns of energy use to be monitored.
- Identify erroneous consumptions automatically and quickly, e.g. plant run-overs and water leaks.
- Interaction with BMS, (reference shall be made to the THC BMS Brief)
- Interaction with third party monitoring web portals/dashboards.

1.7 The Energy Team must be consulted at the appropriate time within the design process, initially when the form and function of the building has been established and a schedule of accommodation and adjacencies has been completed.

2 Regulatory Compliance

2.1 Metering and sub-metering shall be designed and installed in accordance with all relevant British and European Standards and shall consider relevant CIBSE publications, in particular:

- CIBSE TM39: 2009 – Building Energy Metering
- CIBSE TM54: 2022 – Evaluating Operational Energy Use at the Design Stage:
    - Section 4.1 Table 1 – Measurement System Limitations
    - Section 7.2.2 – Establishing Floor Areas
    - Section 7.3.2 – Occupancy / POE

2.2 All meters must comply with the Measuring Instruments (Active Electrical Energy Meters) Regulations 2016.

2.3 Section 6.10 of the Scottish Building Standards, “Every building must be designed and constructed in such a way that each building or part of a building designed for different occupation is fitted with fuel and power meters.”

2.4 The Heat Network (Metering and Billing) Regulations 2014 implemented the heat network specific requirements of Articles 9-11 and 13 of the Energy Efficiency Directive (2012/27/EU). The Regulations came into force in December 2014 and were subsequently amended in 2015 and 2020.

3 Metering Strategy

3.1 The objective of the strategy is to ensure the design of metering services and systems meet the needs of THC described within this document, in that they:

- gather accurate and useful utility consumption data (kWh/m3)
- determine where energy and water resources are consumed, e.g. site, building, equipment, activity area, etc
- provide sufficient information for plant commissioning and post-occupancy evaluations, as applicable
- information is provided in an accessible and user-friendly format in order to:
    - manage buildings and improve operational efficiency.
    - isolate and account for items not typically included in energy benchmarks.
    - take account of renewable energy systems by measuring their performance
    - document metering services and systems in the building logbook.

3.2 The site-specific strategy and design shall be developed ensuring that the level of metering is appropriate, practical, and cost effective for the building or design.

3.3 It is recognised that the cost of installing direct metering throughout a large building can be significant, however, blanket coverage it is not always necessary to establish useful end-use energy consumption. In this respect it is essential that the Design Team liaise and consult with the Energy Team, to optimise the cost of metering against practicality, the value of the information gained and future energy savings.

3.4 The Council's Energy Team must be consulted and invited by the Project Manager and Design Teams to comment on the metering aspects of a project and design proposals at an early stage, and throughout the Plan of Work stages. The Energy Team and other relevant persons shall be consulted on a regular basis throughout in an open, transparent manner and the Energy Team, or authorised persons, must be provided the opportunity to review and approve the proposed metering at appropriate stages of the design and construction process.

4 Coverage

4.1 All site incoming utility supplies, fiscal supplies and energy generators are to be metered at either:

- Fiscal meter or generation point
- Building entry point

4.2 Reasonable provision of building or plant sub-metering shall be achieved, in that, for each utility, at least 90% of incoming energy/water to individual buildings be accounted for through the use of sub-metering.

4.3 Example applications which are expected to be metered include:

- Individual buildings
- Electrical motors rated at 10kW or above
- Gas and heat equipment rated at 30kW input or above

Defined Areas
With respect to defined functional areas, it is expected that the areas specified in Table 1. be evaluated for sub-metering.

Teaching	Catering
External	EV Chargers
Process Loads	External Agencies / Clubs, e.g. Nursery
Electric Heating	Tenanted areas

Table 1. Key functional areas

4.4 All new buildings shall have sub-metering provision in accordance with CIBSE TM39, subject to consultation on practicality, effectiveness and approval by the Energy Team.

4.5 It is also a requirement of the Building Regulations that metering be installed when carrying out major refurbishments and changes to plant. An example of the requirements would be heat meters on all main circuits within the plant room for larger projects. Lighting and small power should be separately sub-metered where appropriate.

4.6 For energy centres or low carbon or renewable technology installations sufficient metering to be provided to allow a proper understanding of the efficiency of the technology to be provided. Use of calculated outputs, e.g. for heat pumps and CHP units, based on solely monitoring incoming energy and applying theoretical design plant efficiencies, is not permitted.

4.7 Upon completion of the metering strategy, a schedule of meters that includes meter codes, application, locations, grouped by end use, etc shall be prepared and issued to the THC Energy Team for review. The schedule shall be accompanied by a schematic 'metering strategy' that demonstrates an integrated design.

5 Metering Schedule

5.1 Upon completion of the metering strategy, a schedule of meters that includes meter codes, application, locations, grouped by end use, etc shall be prepared and issued to THC for review. The schedule shall be accompanied by a schematic 'metering strategy' that demonstrates an integrated design.

5.2 Suggested formats of the schedule and schematic strategy are contained in Appendix 1 and 2. The schedule and strategy must include annual estimates of consumption for each meter.

5.3 Separate schedules shall be provided for each utility and can be broken down to individual buildings if appropriate.

5.4 The Utility Meter Naming Convention is as detailed below:

- Label Name
- Site Name
- Utility
- Coverage
- Data Frequency
- BMS Device Type

As per examples shown below:

Label Name	CA-E-Main-30m-S		HQ-H-DHW-30m-S	
Site Name	CA	Culloden Academy	HQ	Headquarters
Utility	E	Electricity	H	Heat
Coverage	Main	Main Supply	DHW	DHW
Data Frequency	30m	30-minute data recording	30m	30-minute data recording
BMS Device Type	S	Sensor	S	Sensor

5.5 Engagement with THC is required to define Site Names and building block reference letters, as appropriate to the project. Note that Buildings are a definition of Highland Council's function and not necessarily physical form, a single supply can feed multiple buildings.

Utilities are to be annotated as follows:

- E Electricity
- G Gas
- H Heat
- W Water

Coverage shall be dependent upon application, however the following are indicative:

- Main - Main supply feeding whole building / site
- MCP - Elec supply to Motor Control Panel
- MCP2 - Elec supply to second Motor Control Panel
- Cater - Catering gas supply.

All associated plots shall follow the same convention, with the suffix "S" replaced by a "P".

Schedules shall be created for all 30min plots, for all utility meters, to automatically record data to the BMS database.

6 Information Communication, Provision, and Interrogation

6.1 For all remote monitoring through a Building Management System (BMS), meters are to be connected via the Modbus communication protocol providing intelligent data rather than simple meter advances or pulse counters.

6.2 The contractor shall provide a schedule indicating meter references and Modbus addresses and issued to the Contract Administrator. The contractor shall arrange for addresses to be pre-programmed off site prior to delivery with the meter tag reference clearly identified on each meter.

6.3 Actual meter advances must correlate with the advances on the BMS, and this shall be demonstrated at the commissioning stage and detailed on the meter commissioning sheet.

6.4 Metering information shall be logically arranged and accessed with respect to buildings and site services provision. (Refer to Appendix 3)

6.5 Selection of metering information on the BMS shall be graphically based where possible with use made of interactive floor or site plans. Colour coding shall be added to floor plans allowing ease of reference, e.g. to electrical circuits. Correlation to technical schematic referencing numbers shall be displayed for each meter. (Refer to Appendix 3)

6.6 Selection of an area / meter shall open up a new pop-up window displaying all metered parameters, which shall all be plottable. (Refer to Appendix 3)

6.7 Through the BMS, all utility meters shall be interrogatable, and the following shall be available for viewing and plotting.

Electricity – Main LV Switchroom (Primary Building Meters)

Parameter	Unit of Measurement	Frequency
Meter Reading	kWh	
Consumption	kWh/day	Daily
Active Energy Consumption	kWh	30min
Reactive Energy Consumption	kVArh	30min
Apparent Energy Consumption	kVAh	30min
Total Active Energy Demand	kW	30min
Total Reactive Energy Demand	kVAr	30min
Total Apparent Energy Demand	kVA	30min
Active Power Demand per Phase	kW	30min
Reactive Power Demand per Phase	kVAr	30min
Apparent Power Demand per Phase	kVA	30min
Total Power Factor	pf	30min
Individual Line Voltages	V	30min
Individual Phase Voltages	V	30min
Individual Phase Currents	I	30min

Electricity – Other Areas (Sub-Distribution Boards)

Parameter	Unit of measurement	Frequency
Meter Reading	kWh	
Consumption or Demand	kWh or kW	30min
Consumption	kWh/day	Daily

Gas

Parameter	Unit of measurement	Frequency
Meter Reading	m^3	
Consumption	kWh or m^3	30min
Consumption	kWh/day	Daily

Water

Parameter	Unit of measurement	Frequency
Meter Reading	litres or m^3	
Consumption	litres	30min
Consumption	litres or m^3/day	Daily

Heat

Parameter	Unit of measurement	Frequency
Meter Reading	kWh	
Consumption	kWh	30min
Consumption	kWh/day	Daily
Flow Rate	litres or m^3/hr	30min

6.8 Numbering format for electrical demands, voltages, currents, frequencies and power factors shall utilise the 1,000-comma separator and have one decimal point.

6.9 All values shall be displayed on the BMS with the units of measurement defined above in Section 5.7.

7 Meter Types and Requirements

7.1 All meters shall be located within buildings and plantrooms and easily accessible for periodic maintenance and recalibration. Meters, and associated display units where applicable, shall not be located underground, nor higher than 1.6m from floor level, unless approved by THC Project Manager/Energy Team.

7.2 A Modbus communication link must be specified and installed for all utilities. Pulse meters are only permitted for gas and water and an appropriate Modbus conversion module shall be specified and installed as required.

7.3 A commissioning certificate shall be issued identifying each meter by serial number and location and confirming its correct installation and function.

7.4 Electricity Meters

Fiscal Meters	Fiscal Meters are to be supplied and installed by the appointed Meter Operator. All meters shall be capable of measuring and recording exported electricity, e.g. from onsite generation. Associated service provision shall align with THC service contracts and early liaison with the THC Energy Team is required (energy.management@highland.gov.uk)
Low Voltage (LV) Electricity Sub-Meters	LV sub-meters shall be panel mounted electronic electricity meters, with an LCD-type display with integrated Modbus communication. The meter shall conform to the following standards: • IEC 61557-12:2018 • IEC 62053-22 class 0.5S • IEC 62053-23 class 2
IoT Sub-Metering	This system of sub-metering may be considered for existing sites. Aspects to be considered, include but are not limited to: • Presence of existing IoT equipment • Electrical installation arrangements, • Ease of separation of areas/ functions.
Renewable Energy Generation	All renewable energy installations require a dedicated generation meter, installed as per current MCS & BS7671 Guidance The Generation Meter will require to have either: • An RJ45 network connection outlet – this being dependant on the availability of a LAN Network being present, or • A Modem Unit – supplied with a multi comms provider SIM Card Where a site has a LAN Network, an RJ45 Data point will require to be installed, in close proximity to the Meter. Reference is to be made to the Council's Solar PV Technical Specification.

	For Solar PV installations it is permissible to alternatively measure electricity generation via the invertor, as long as the information if available free of charge from manufacturers websites, including the ability to automatically download for analysis purposes.

7.5 Natural Gas Meters

Fiscal Meters	Fiscal meter(s), with associated AMR devices, shall be specified and installed by the appropriate Network Operator. AMR service provision shall align with THC service contracts and early liaison with the THC Energy Team is required (energy.management@highland.gov.uk)
Sub-meters – Turbine meters	Turbine meters shall consist of two components, a pipe adapter and a metering head. The metering head shall be removable leaving the pipe adapter in situ. An overflow cap shall be supplied for continued safe operation. The gas sub-meter shall be suitable for either horizontal or vertical mounting and typically requires a minimum of 3 pipe diameters upstream and downstream. This requirement shall be checked with the proposed meter manufacturer. In-line filters shall be provided to protect the meter from particles in the gas stream. Range and Accuracy The range of the meter shall be assessed relative to the volume being measured, particularly if periods of low flow can occur. The range shall be specified indicating • Maximum continuous flow - m^3/h • Minimum flow - m^3/h Meters shall comply with the following: • Manufactured to ISO EN 8859-2 • Accuracy +/-0.25%
Sub-meters – Diaphragm Gas Meters	For applications with low minimum gas flow (<0.1 m^3/h), a diaphragm positive displacement gas sub-meter shall be used. This type of meter has a very wide measuring range designed for low pressure and low to medium flow ranges. Range and Accuracy • Accuracy +/- 1.5%

7.6 Water Meters

(Covering Mains Water, Cold Water, DHW Cold Feed and Recycled Water supplies)

Fiscal Meters	The meter(s) shall be installed in a position permitting access by external parties without a requirement to cross the secure perimeter. The meter(s), with associated AMR devices, shall be specified and installed by the appropriate Network Operator. AMR service provision shall align with THC service contracts and early liaison with the THC Energy Team is required (energy.management@highland.gov.uk)
Sub-meters	All water meters shall be approved for potable mains cold water. Volumetric rotary piston type meters shall be used for all measurement of potable water. Meters shall be suitable for installation in horizontal, vertical or inclined pipelines without any loss of accuracy. The counter mechanism shall be provided in a water-tight casing. The mechanism shall be designed to keep the counter free from damp and dirt. The meter dial shall be capable of rotating to any position without breaking the calibration seal. Measuring elements shall be interchangeable, allowing the measuring element to be removed from the housing for maintenance and cleaning purposes with the meter housing remaining in line. A removable filter element (strainer) shall be installed before the meter to protect the mechanism from debris and foreign matter. The meter registration shall be m^3 or litres with a resolution suitable for the expected application. • Accuracy - Normal flow operating range +/- 2% The consumption display of the meter shall be assessed relative to the predicted flowrate and specified in a manner that provides an appropriate level of detail. It shall be the default that all meter's display and record in litres or m3 with a minimum resolution of 1 pulse per 10 litres unless written approval is received from the THC Project Manager/Energy Team. Sub-meters shall comply with the following: • Manufactured to ISO EN 4064 Class B • WRAS Approved • Cold and drinking water meters, max temperature 40^{o}C • System water pressure 10 bar.
IoT Sub Metering	This system of sub-metering may be appropriate for certain sites and buildings. Consideration and evaluation should be made of: • Presence of existing IoT equipment • Water installation arrangements • Ease of separation and definition of areas/functions. Liaison with the THC Energy Team at an early stage is essential. (energy.engineering@highland.gov.uk)

7.7 LTHW and Renewable Heat Source Heat Meters

Ultrasonic Heat Meters (up to 100mm)	Heat meter packages shall include an ultrasonic flow meter, together with a Mains powered calculator and two temperature sensors. The flow meter shall be located in the return line.
Electromagnetic Heat Meters (above 100mm)	Heat meter packages shall include a blind electromagnetic flow meter, together with an F4 mains powered integrator and temperature sensors. The flow meter shall have a polypropylene lined flow tube. The flow meter shall be fitted in the return line.
IoT Sub Metering	This system of sub-metering may be appropriate for certain sites and buildings. Consideration and evaluation should be made of: • Presence of existing IoT equipment • Heat generation and provision installation arrangements • Ease of separation and definition of areas/functions. Liaison with the THC Energy Team at an early stage is essential. (energy.engineering@highland.gov.uk)
All meters	The following variables shall be readable at the calculator or F4 integrator, as applicable: - • Flow rate (m^3/h) • Flow temperature (^oC) • Return temperature (^oC) • Energy Demand (kW) • Energy Consumption (kWh) The energy consumption display of the meter shall be assessed relative to the predicted heat flowrate and specified in a manner that provides an appropriate level of detail. It shall be the default that all meter's display and record in kWh with a resolution of **1 pulse per kWh** unless written approval is received from the THC Project Manager. A commissioning certificate shall be issued identifying each meter by serial number and location and confirming its correct installation and function. Heat Meter Sensors shall comply with the following: • Sensors manufactured to ISO EN 1434 Class 1 • Accuracy +/- 1% • Operating temperature range of 0^oC t0 120^oC
Fiscal Metering	For projects that involve the provision and/or charging of heating, cooling or hot water to a third party or final customer, the legal requirements of the latest version of the Heat Network (Metering and Billing) Regulations must be met. Guidance on the regulations can be found here: https://www.gov.uk/guidance/heat-networks.

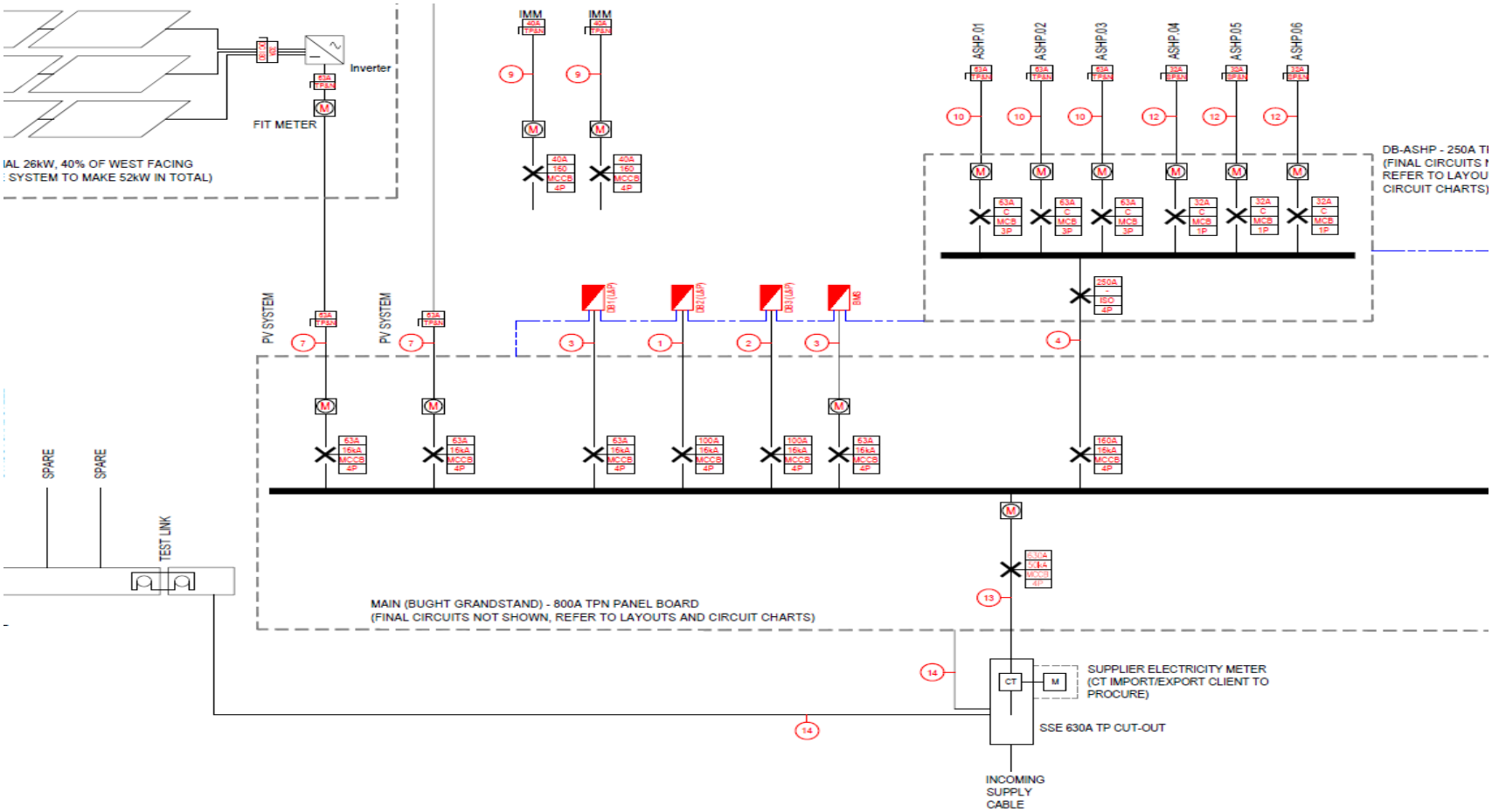
Appendix 1 – Example Metering Schedule

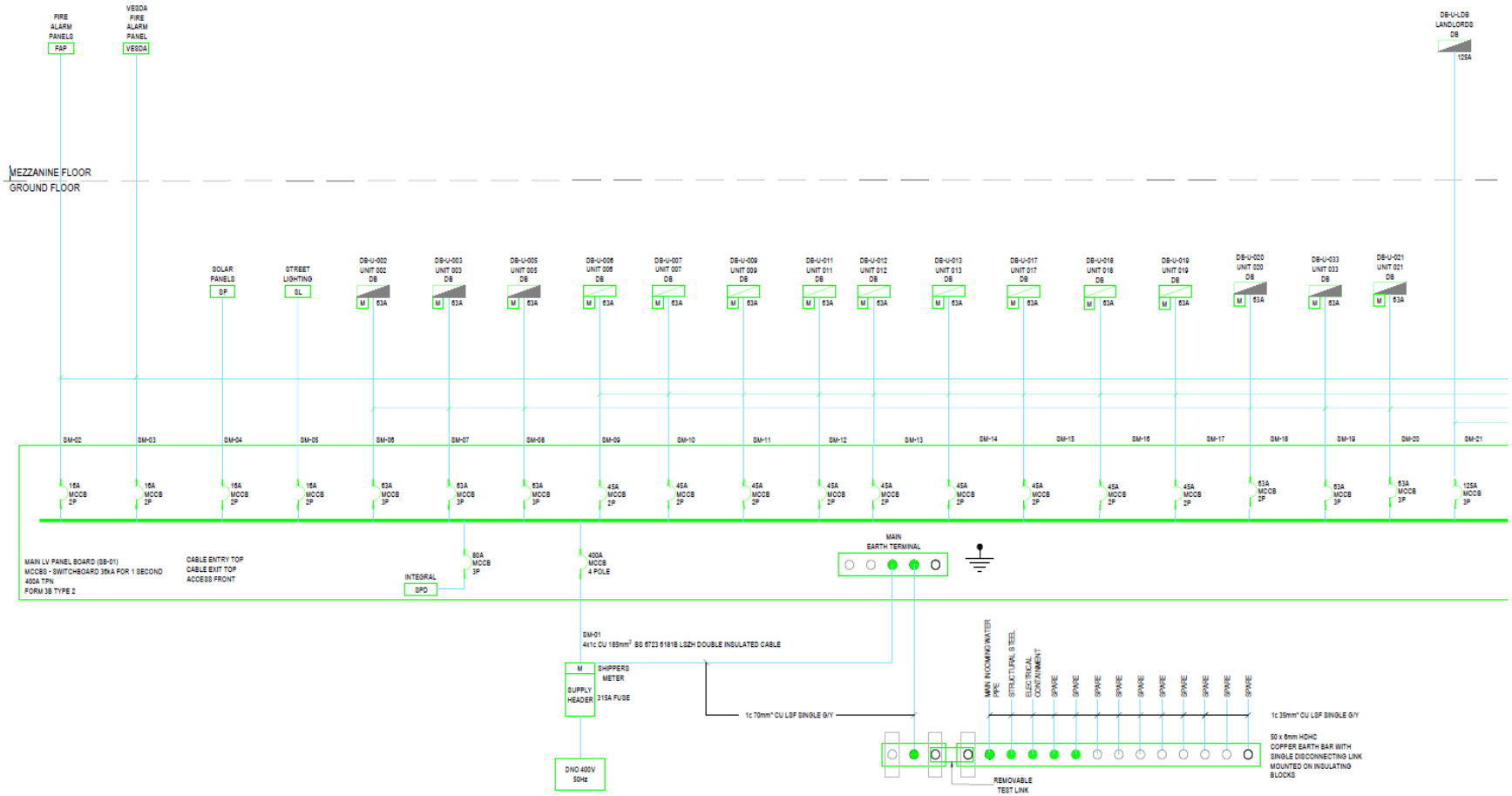
Energy			Meters		Method		Meter Location		
Incoming Energy	Main end - use	Estimated end-use consumption (kW-h/yr)	Meter code	End-use / area / system / circuit or tenancy to be measured	Measurement method and calculation (where appropriate)	Estimated consumption through each meter (kW-h/yr)	List of physical meters	Location	Type of data system if any)
Electricity									
	Incoming	684 000	EM01				Electricity Meter 01		
	Lighting	180 000	EM02	Open plan lighting	Directly metered	157 000	Electricity Meter 02	Main Distribution Room	aM&T
			EM05	Atrium Lighting	Directly metered	8 000	Electricity Meter 05	Main Distribution Room	aM&T
			EM06	External and Car Park	Directly metered	n/a	Electricity Meter 06	External Sub Room	aM&T
			EM08	External Lighting		6 000			
			EM07	Car Park Lighting	Directly metered	9 000	Electricity Meter 07	Main Distribution Room	aM&T
	Fans	162 00	EM09	Fans AHU 1 & 2		87 000	Hours run 1	Plantroom 2	aM&T
			EM10	Fans AHU 3 & 4		75 000	Hours run 2	Plantroom 3	aM&T
	Pumps	27 000	EM04	Pumps	Directly metered	27 000	Electricity Meter 04	Boilerhouse	aM&T
	Office Equip	112 500	EM11	Office Equipment		112 500			
	Cooling	90 000	EM03	Cooling (Screw Chillers)	Directly metered	90 000	Electricity Meter 03	Chiller Room	aM&T
	Server Room	76 500	EM12	Server Room	Directly metered	76 500	Electricity Meter 12	Computer Ventilation Room	aM&T
	Total Electricity Metered					**648 000**			
					% metered	648/684 = 95%			

Appendix 2 – Example Metering Schematics (Electrical & Water)

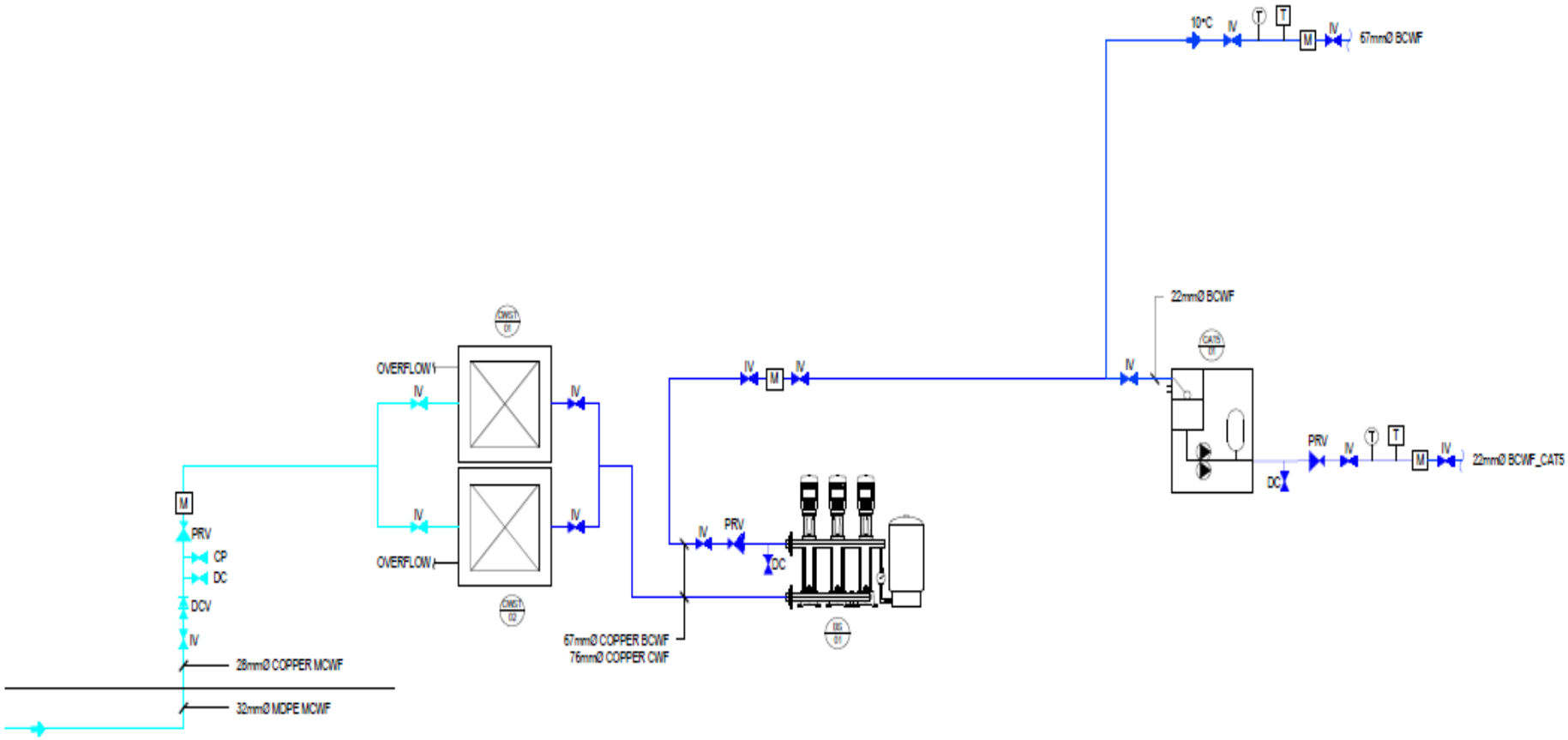
Electrical Schematics

Note – all meters require to have unique identifier noted on schematic drawings

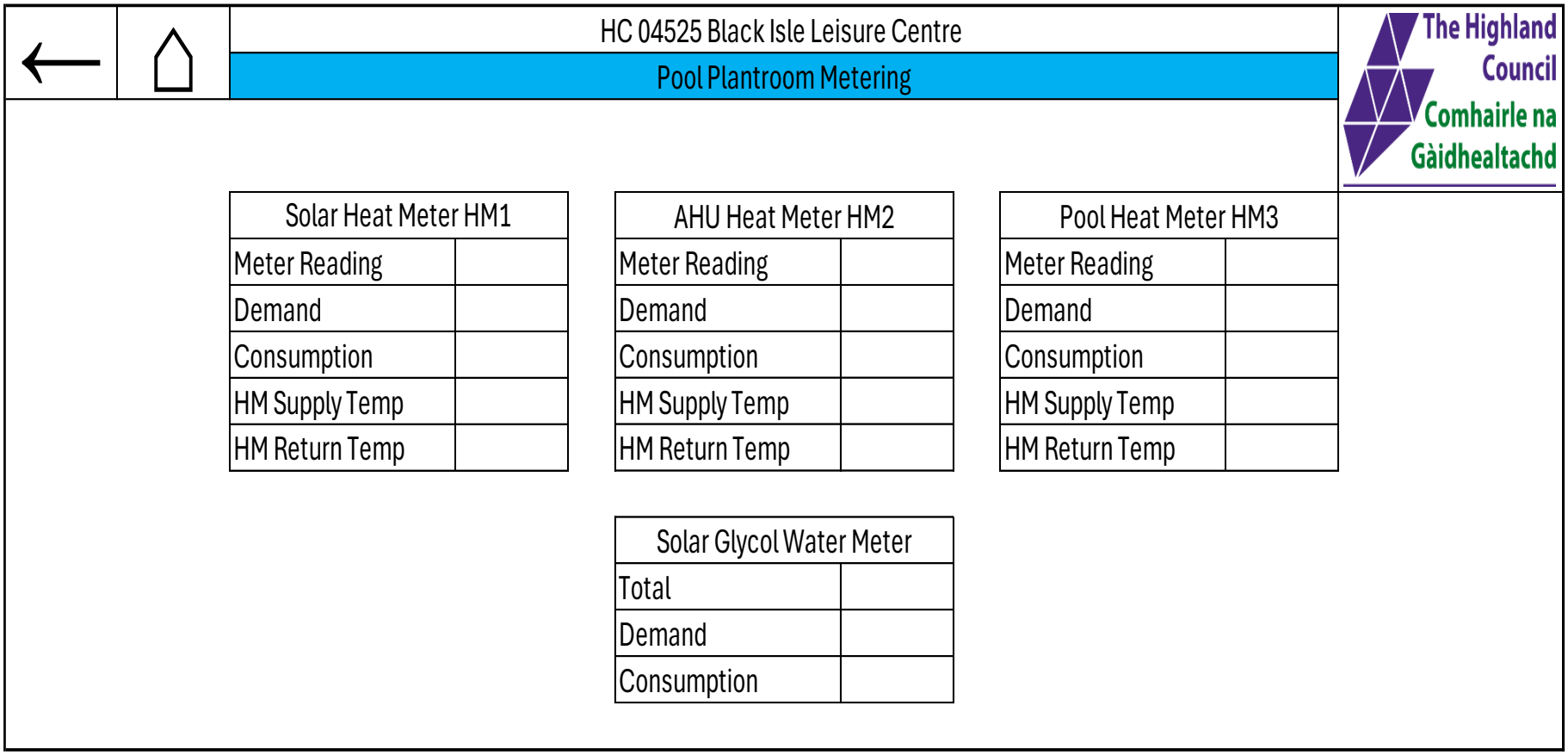



FIRE ALARM PANELS
FAP
VESDA FIRE ALARM PANEL
VESDA
DB-U-LDB LANDLORDS DB
125A
MEZZANINE FLOOR
GROUND FLOOR
SOLAR PANELS
SP
STREET LIGHTING
SL
DB-U-002 UNIT 002 DB
DB-U-003 UNIT 003 DB
DB-U-005 UNIT 005 DB
DB-U-006 UNIT 006 DB
DB-U-007 UNIT 007 DB
DB-U-009 UNIT 009 DB
DB-U-011 UNIT 011 DB
DB-U-012 UNIT 012 DB
DB-U-013 UNIT 013 DB
DB-U-017 UNIT 017 DB
DB-U-018 UNIT 018 DB
DB-U-019 UNIT 019 DB
DB-U-020 UNIT 020 DB
DB-U-033 UNIT 033 DB
DB-U-021 UNIT 021 DB
63A
SM-02
SM-03
SM-04
SM-05
SM-06
SM-07
SM-08
SM-09
SM-10
SM-11
SM-12
SM-13
SM-14
SM-15
SM-16
SM-17
SM-18
SM-19
SM-20
SM-21
16A MCCB 2P
63A MCCB 3P
45A MCCB 2P
125A MCCB 3P
MAIN LV PANEL BOARD (SB-01)
MCCBS - SWITCHBOARD 36kA FOR 1 SECOND
400A TPN
FORM 3B TYPE 2
CABLE ENTRY TOP
CABLE EXIT TOP
ACCESS FRONT
INTEGRAL
SPD
80A MCCB 3P
400A MCCB 4 POLE
MAIN EARTH TERMINAL
SM-01
4x1c CU 185mm² BS 6723 6181B LSZH DOUBLE INSULATED CABLE
M
SHIPPERS METER
SUPPLY HEADER
315A FUSE
1c 70mm² CU LSF SINGLE G/Y
DNO 400V 50Hz
MAIN INCOMING WATER PIPE
STRUCTURAL STEEL
ELECTRICAL CONTAINMENT
SPARE
1c 35mm² CU LSF SINGLE G/Y
50 x 6mm HDHC COPPER EARTH BAR WITH SINGLE DISCONNECTING LINK MOUNTED ON INSULATING BLOCKS
REMOVABLE TEST LINK

Water Schematic



Appendix 3 – Example Metering Software Screenshots



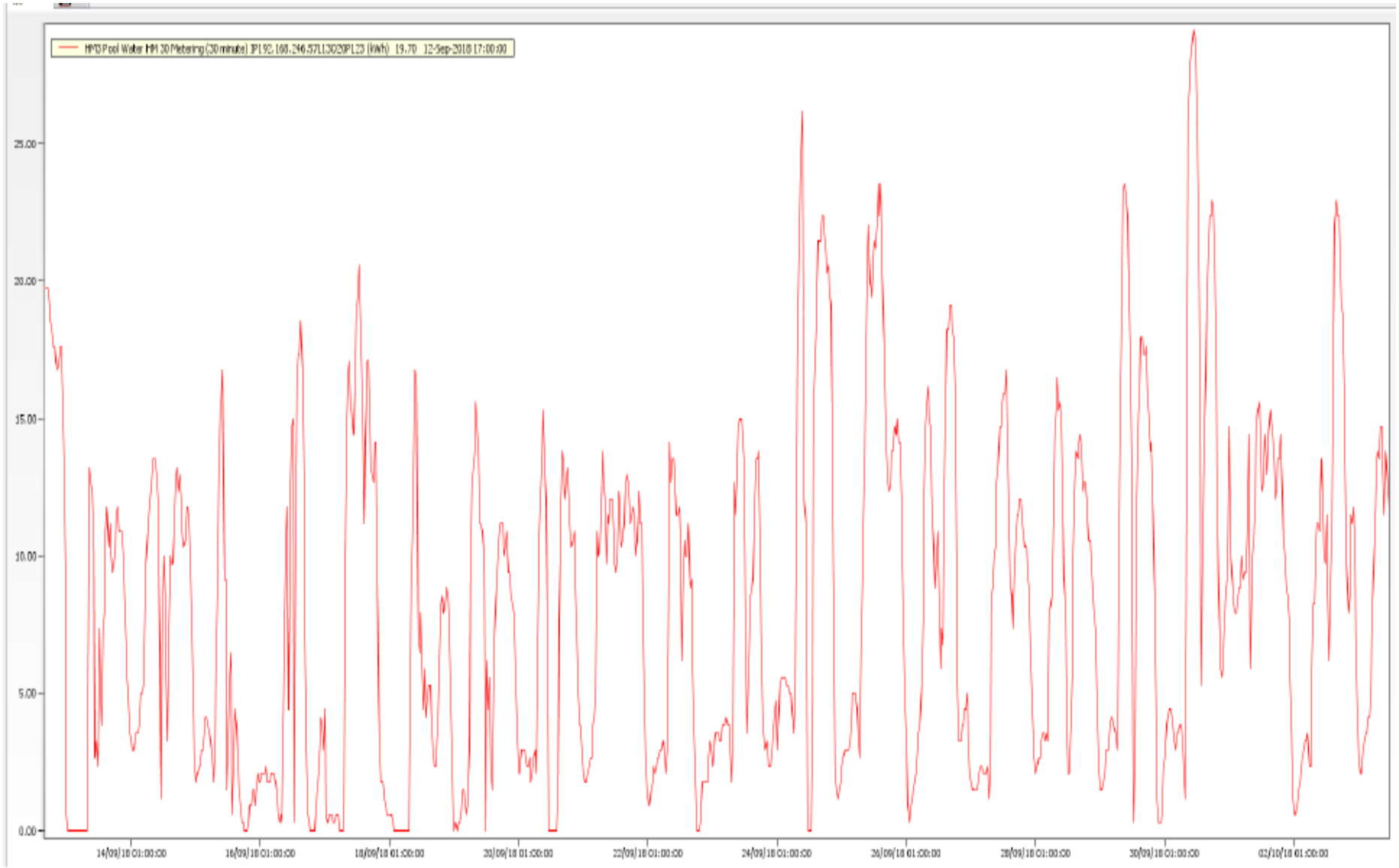
Solar Heat Meter HM1	
Meter Reading	
Demand	
Consumption	
HM Supply Temp	
HM Return Temp	

AHU Heat Meter HM2	
Meter Reading	
Demand	
Consumption	
HM Supply Temp	
HM Return Temp	

Pool Heat Meter HM3	
Meter Reading	
Demand	
Consumption	
HM Supply Temp	
HM Return Temp	

Solar Glycol Water Meter	
Total	
Demand	
Consumption	

30-minute or 60-minute plot profile



Daily Total plot profile