THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA

The University of Newcastle

Infrastructure and Facilities Services

Project Briefing Document

Supply and Installation of Photo Voltaic Array

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Version 1.1

UON-ESS-109

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Contents

1. Scope

This Specification covers the general requirements applicable to the design, manufacture, performance and delivery of Photo Voltatic installations at the UON (University of Newcastle).

It is not the intention to specify details of design and construction except where necessary to establish performance requirements, nor is it the intention to set forth those performance requirements which are adequately specified by the applicable Standards.

This specification shall be read in conjunction with Standard Specification UON-ESS-101 Electrical Design Criteria.

2. Standards, Specifications and Statutory Obligations

All aspects of design, manufacture, testing, supply, plant, equipment, accessories, materials, construction, erection, installation, operation and performance shall comply with this Specification and the current issue of the relevant Australian Standards, the relevant International Standards, the UON Standard Specifications and Preferred Equipment List, as well as all Statutory Acts, Codes, Regulations and Requirements of the relevant Authorities having jurisdiction over them unless specified otherwise within this Specification.

These shall include but not be limited to:

Australian/International Standards

AS 3000	Wiring Rules
AS 5033	Installation of photovoltaic (PV) arrays
AS 4509	Stand-alone power systems, Parts 1,2,3
AS 2184	Low voltage switchgear and control gear
AS 2373	Electric Cables
AS 2374	Power Transformers
AS 3010	Electrical Installations
AS 1768	Lightning Protection
AS 1170.2	Wind Loads
AS 4777	Grid Connections of Energy Systems via Inverters
AS 4086	Secondary batteries for SPS
AS1939	Enclosure IP ratings
AS 4509	Stand-alone power systems, Parts 1,2,3
AS 3008	Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV
AS 60038	Standard Voltages
AS 3100:2009	Approval and test specification - General requirements for electrical equipment.

University of Newcastle Standards

UON-ESS-101 General Electrical Specification.
UON Preferred Equipment List.

Authorities and Statutory Acts, Codes, Regulations and Requirements

NS194 Protection Requirements of Embedded Generators >30kw
National Construction Code
Worksafe NSW

NSW Electrical Licencing & Regulation
NSW Service and Installation rules.
Clean Energy Council

Where the stipulations of this Specification, the data sheets and the drawings do not comply with the minimum requirements of the Australian Standards or Statutory Regulations, the latter shall prevail.

Where the stipulations of this Specification, the data sheets and the drawings are more exacting than the minimum requirements of the Australian Standards and Statutory Regulations, the former shall prevail in the following order:

a) Data sheets and detail drawings
b) Specification and standard drawings

3. Introduction

This specification is intended to give a supplier or installer of PV (Photovoltaic) panels for UON guidance when designing or installing a PV installation at UON. This is not a comprehensive specification, this specification covers the supply/installation preferences and the unique requirements that are associated with an installation at the University of Newcastle.

Areas not covered by this specification should be completed as per Australian Standard, to industry best practice and in a 'tradesman like manner'. Only contractors holding Clean Energy Council Certification shall be permitted to supply and/or install solar PV systems for UON.

4. UON's High Voltage Network

The UON is different to most other power consumers. Apart from the larger quantities of power used by the university, the power supplied to the UON is High Voltage (11000V). The UON also owns and operates its own High Voltage Network to distribute the power around campus.

The UON high voltage network is made up of 22 substations connected by approximately 4km of underground cable over around 350 acres. The network is divided into four separate sections, NIER, East Campus, West Campus and accommodation. Each section has a separate Ausgrid supply. West Campus also has a redundant supply. The Ausgrid supply enters the campus at Substation 1, Substation 10, Substation 18 and Substation 19. Ausgrid's Authority and responsibilities end at the above four substations.

There are additional considerations when designing a PV installation for a HV customer. Some of these considerations are addressed in Ausgrid document NS194.

5. PV Protection Network

When a business or premises has more than one solar installation to a customer side of a 'point of supply', there are additional design and functionality requirements. One of the major considerations when designing a solar installation for UON is the need for all solar installations to be integrated into the existing site wide PV Network Controller.

The controller monitors all solar installation across campus and has the ability to limit the output of an installation or physically disconnect an installation if required. The is a central controller for each of the four Ausgrid incoming supply. Substations 1, 10, 18 and 19 contain a centralised controller that controls all PV installations that are connected to the grid via that substations.

Each individual PV installation across campus reports to the central controller. Based on the information provided by the individual PV installations, the central control may ramp inverters down or disconnect the local PV system entirely using the Disconnect Contactor at the local PV installation. The PV protection network and Central Controller allows the combined campus PV installations to work as one unit and reduces the likelihood of the PV installation causing disruption to the DNSP network.

The Disconnect Contactor shall be mounted in a controlled area not exposed to the elements. The Disconnect Contactor can be mounted local to the Inverter and Solar DB or located in the building switch room housing the building Main Switchboard. The local controller that interfaces with the PV Protection Network shall be located adjacent to the Disconnect Contactor it controls. A motorised Circuit Breaker cannot be used in place of a contactor for the purposes of disconnecting from the network.

Any new solar installation at UON shall include all hardware/equipment, software, programming and configuration required to integrate the new PV installation into the existing control network. Configuration/Programming shall be completed by a UON approved programmers.

Figure 1 below illustrates the PV Protection Network configuration and how it fits into the UON electrical network.

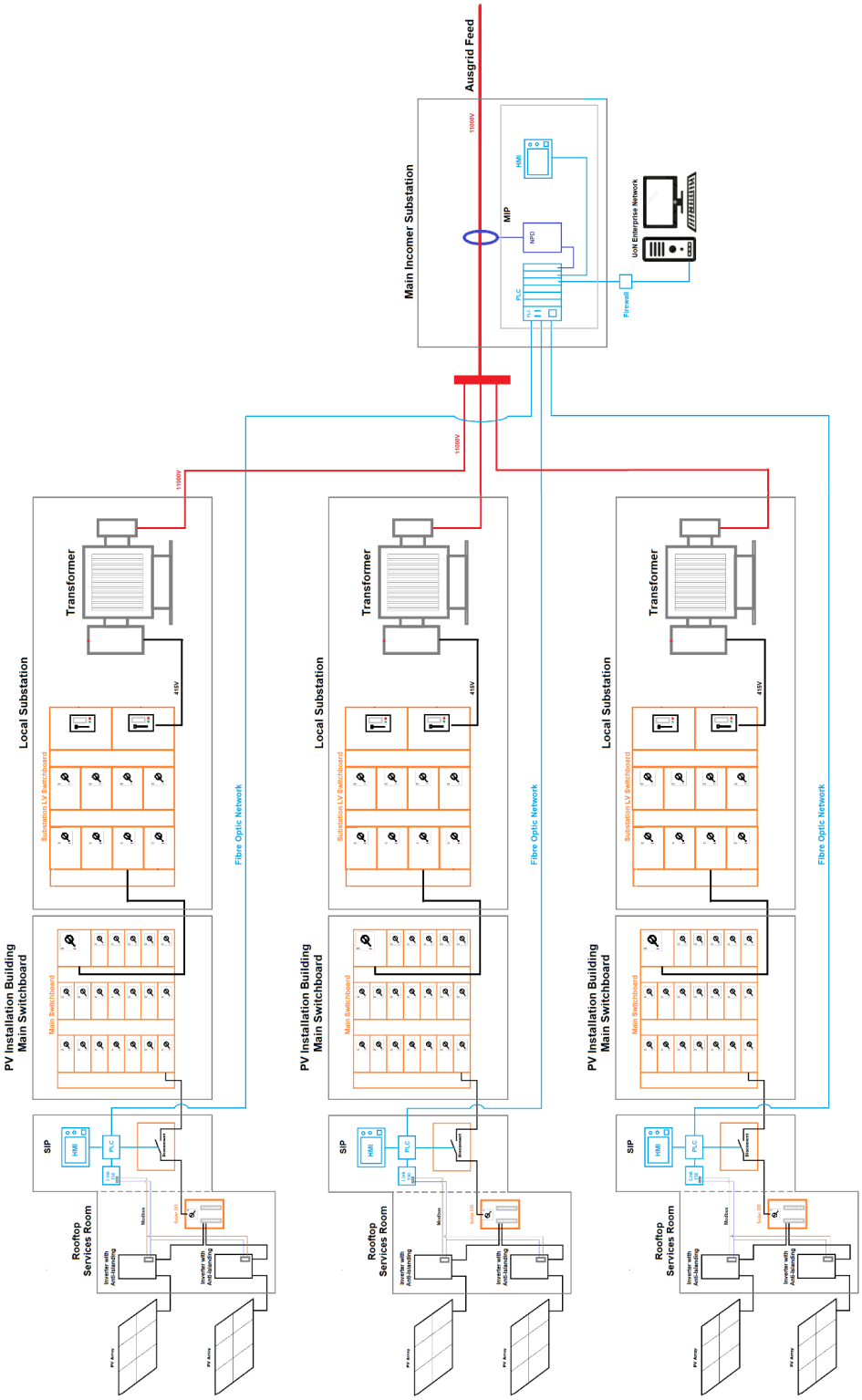
Ausgrid Feed
Main Incomer Substation
11000V
HMI
MIP
NPD
PLC
UON Enterprise Network
Firewall
Transformer
Local Substation
415V
Substation LV Switchboard
Fibre Optic Network
PV Installation Building
Main Switchboard
SIP
HMI
PLC
Rooftop
Services Room
Inverter with
Anti-Islanding
PV Array

Figure 1

6. Electrical Installation

Solar installation at UON shall be connected to building Main Switchboards or Low Voltage substation switchboards only. Connections shall not be made to Distribution Boards or any other distribution equipment that is a 'child to building' Main Switchboard.

When designing the solar installation, the existing electrical infrastructure needs to be considered to ensure it is capable of delivering the power produced by the installation to the public grid without disruption to the electrical supply local to the solar installation. This includes at a minumum:

- Physically space the Switchboard to house the solar installation circuit breaker
- The Switchboard is rated to carry the produced power
- Any Mains or Submains between the Solar array and area distribution transformer are sized to carry the power produced by the array
- Any Mains or Submains between the Solar array and area distribution transformer are sized to keep voltage rise below 1%

PV Installation Cluster controllers are to be supplied by a designated circuit no other items shall be supplied from that circuit. Cluster controllers shall have a factory default password when handed over to UON upon completion of the installation. All cable exposed to weather shall have protective covers to prevent UV degradation of cables over time.

Cables shall not be run on the exterior of the building without the 'express permission' of UON. All cables shall be fully enclosed and mechanically protected with UV resistant materials. All cable routes shall be approved by UON.

Each solar installation shall include a PMU (Power Monitoring Unit) to UON Specifications, at the point of connection to the UON electrical infrustrastructure. This power monitoring is in addition to any power monitoring functionality provided by the Inverters.

Each inverter shall have AC and DC isolators adjacent, allowing the isolation of all AC and DC voltages to facilititate the removal of the inverter. The isolator shall have an intergrated locking system to allow it to be locked without the use of a taglock clamp or similar additional equipment.

DC strings inputs to the inverter shall be evenly distrubuted across the inverter input terminals.

Each solar installation shall verify that the existing site connection revenue metering complies with the DNSP requirements and allows to undertake meter replacement if required.

The installer shall ensure that the installations anti islanding functionality is not comprimised by site back-up generation equipment. Speciffically, when power is lost from the DNSP, the aplication of electrical power to reticulation infrustructure by the site backup generators shall not initiate the solar installation to resume normal operation and return to an On-Line state.

A motorised Circuit Breaker cannot be used in place of a contactor for the purposes of disconnecting from the network.

7. Equipment Installation

Solar Panels shall be arranged in such a way as to facilitate access for cleaning and removal. There should be no more than two rows of panels without an access row in between, access rows shall be a minimum 600mm wide. Access beneath the panel also needs to be considered. Panels shall not be installed with less than a 200mm gap between the roof and panel with UON approval. Panels shall not be installed within 2.6 meters of an edge of a roof or raised area if no fall prevention is in place.

Panels shall be placed to eliminate shading from existing infrastructure or other solar panels and orientated to maximise power output. Panels shall be mounted at a minimum angle of 10 degrees to minimise cleaning requirements.

Inverters shall be numerically labelled and PV strings shall be labelled with reference to the associated inverter. Example I2S3 would be the third string on inverter number two. Engraved labels shall be attached to each inverter and stainless steel, engraved labels shall be mechanically attached directly adjacent to the string isolator. Isolation IP rating shall not be compromised to the attached label.

No roof penetration shall be made to secure the panels or for any other reason unless approved by the University of Newcastle. All fastening hardware is to be 316 stainless steel, rooftop isolators will include metal sun covers.

The contractor shall ensure the roof or other support structure to which the PV installation is installed is capable of supporting the proposed equipment.

Inverters shall be installed to manufacturer's recommendations in a location that is well ventilated, not exposed to the weather and can be secured to restrict access.

Prior to the installation of solar panels a structural assessment of the roof or area must be completed to establish the ability to support the proposed installation. Consideration shall also be given to the expected life of the existing roof cladding. Cladding may need to be replaced prior to the installation of solar panels.

8. Equipment Specification

The type and brand of PV panel and inverters shall be approved by the UON Electrical or Mechanical Asset Engineer prior to acceptance of any design or installation.

UON's preffered inverter manufacturer is SMA. Approval needs to be given by UON prior to installing any other brand of inverter.

At a minimum, a solar panel's performance warranty should guarantee 90% production at 10 years and 80% at 25 years. The panels and associated infrastructure should have a minimum 12 year warranty. Warranties shall be 'On Site' and shall include all costs associated with the repair or replacement of system components. This includes the costs of assessing, removing and returning the equipment to its place of installation.

Panels shall be of monocrystalline or approved alternate minimum 15% efficiency. Installations shall not include micro-inverters unless specifically requested by UON.

Structure shall be propriety supplied available in Australia, compliant with present Australian Standards, modular in nature and including stainless steel hardware.

9. Roof Access

Allowance shall be made for safe roof access during the installation. Roof height safety systems may need to be altered to cater for the installation and layout of solar systems. Any solar works shall include allowance to modify the existing roof height safety system and provide certification on completion that the final system is compliant with current requirements. Safe access walkways of Alutread/FRP (or approved equal) shall be supplied and installed with all solar systems to allow safe access to all solar panel modules.

Connection of dissimilar metals shall include rubber isolation to prevent corrosion. All exposed metals shall be corrosion protected during the installation. Roof material is to be protected from drilling/grinding swarf during the installation and protected by the application of paint to re-instate coating after drilling/cutting/grinding.

10. Communications and integration into UON Network

The installation shall include all hardware, software and configuration to allow the Solar Installation to be monitored by the existing UON Cirutor Power Studio Energy Monitoring software. This applies to both data from the inverters and PMU data.

All solar installations shall include a Data Manager.

Data outlets & cabling shall only be installed by UON approved certified installers and as per UON IT networks standards document. UON's network is protected by security firewall and is not accessible externally via the internet by the installation contractor (monitoring of the system will not be possible via remote Sunny Portal type software).

The data listed below shall be displayed and trended on Power studio.

10.1. Inverter Data

- AC Current all phases (A)
- DC Current (A)
- DC Power (W)
- DC Voltage (V)
- Energy Active (kWh)
- Frequency (Hz)
- Power Active all phases (W)
- Power Active combined (W)
- Apparent Power all phases (VA)
- Apparent Power combined (VA)
- Reactive Power all phases (Var)
- Reactive Power combined (Var)
- Status
- AC Voltage all phases (V)
- AC Voltage L-L (V)

10.2. PMU Data

- AC Current all phases (A)
- AC Current Average (A)
- AC Current Neutral (A)
- Energy Active (kWh)
- Frequency (Hz)
- Power Active all phases (W)
- Power Active combined (W)
- Apparent Power all phases (VA)
- Apparent Power combined (VA)
- Power Factor all phases
- Reactive Power all phases (Var)
- Reactive Power combined (Var)
- AC Voltage all phases (V)
- AC Voltage average (V)
- AC Voltage all phases (V)

The Power Studio Export file shall also be updated to export relevant data to Envizi. The configuration of the Power studio interface and export file should be completed by the UON preferred third party contractor – Energy Systems & Services (Sydney). This work is all completed via remote dial into the server.

An interface shall be installed local to the inverters to allow system Voltage, Power, Frequency, Status, and alarms to be monitored. This requirement may be satisfied by a display screen integral to the inverter.

11. Approvals, Inspection, testing and commissioning

The contractor shall submit any grid connection application and approval including inspections and any witness testing of the Solar PV installation as required by the DNSP.

The contractor shall pay all fees to authorities in connection with applications, inspections and approvals.

The contractor shall submit test reports from manufacturers or suppliers verifying the performance of safety and control functions of each system prior to energising the array in accordance with the requirements of AS/NZS 5033, AS/NZS4777.1, “CEC Install and Supervise Guidelines” and local distributor’s requirements.

The contractor shall submit written reports including all results for the testing and commissioning of each component of the system including:

(a) Each string voltage
(b) Each string current
(c) Power to the grid
(d) Power produced (Etotal)
(e) Open circuit voltages
(f) Short circuit currents
(g) Integrity of fuses
(h) Verify operation protective devices (CBs)
(i) Verify operation of earth fault protection system
(j) Verify the operation of each isolator.
(k) Perform Anti-Islanding test in according to AS/NZS 4777
(l) Remote system monitoring
(m) System load test
(n) Verify operation of central control system & tripping of local PV system (if required)

The contractor shall complete all commissioning to the Clean Energy Council and local distributor requirements to allow system accreditation and grid connection.

The contractor must submit the Certificate of Compliance – Electrical Work (CCEW), covering all installation work, to the Local Electricity Distributor. As well as supplying the CCEW, the person who conducted all testing must submit test reports certifying the electrical installation.

The same phase rotation shall be used throughout installation. This should generally be RWB clockwise.

11.1. Performance requirements

The Contractor shall offer a Performance Guarantee that outlines the minimum performance and guaranteed minimum energy output of the PV system over the course of the Contract. The guaranteed minimum energy output shall be based on a simulation of the PV system showing the expected monthly and annual energy output for the life of the system. The simulation shall be based on software specifically designed for simulating PV system output, such as Helioscope or PVSyst, and is to be submitted by the Contractor prior to the completion of installation. In addition, the simulation should show the expected monthly and annual energy output over the life of the system.

The Contractor shall conduct annual performance evaluations and compare actual energy output with predicted energy output for each system. If the annual generation over the course of the Contract falls below the performance guarantee offered by the Contractor, compensation shall be paid to the Principal. Compensation shall be equivalent to the cost of the generation shortfall that was supplied by the grid, or otherwise agreed upon between the Contractor and the Principal.

The system output shall also be measured during the peak few weeks of the year (Nov 30 to Jan 30) and demonstrate that the specified peak output of the system achieves -0%-+10% of the nominated value and that the annual energy generation is typically achieving a minimum of 1.5 MWh / kW of system install.

12. Drawings and Data

The contractor shall supply the following drawings for approval before manufacture. This should be done two weeks after award or at such time as stated in the Scope of Works:

- All control wiring including core numbering
- Single line diagram
- GA for all electrical components/equipment and Inverter location
- GA for the Panel Array displaying associated String and Inverter numbers
- Communications Drawing
- DB or MSB drawings as per UON requirements
- Drawings shall be updated for any changes made to existing UON electrical Infrastructure
- Proposed panel module structure-fixing method– panel tech details – inverter tech details and warranty details of major components
- Electrical AC & DC cable pathways & any modifications required for connection point

Upon completion of the works an “As constructed” set above drawing must be submitted to UON.

A full set of operating and maintenance manuals is to be supplied to UON in in hard copy and in electronic format.

All drawings and documentation shall comply with the latest version of the UON Drafting standard “UON-DSS-001 CAD Drafting Standards”.

All Inverters and Solar DB’s shall be labelled with a UON asset number. Upon request, UON will supply the contractor with an Asset label that is to be prominently affixed to the equipment. The contractor shall supply UON asset information in writing for each Inverter and Solar DB. This will include information such as Make, Model, KW rating etc etc. Allow for up to Ten pieces of information on each piece of equipment.

13. Defect Liability Period

The minimum Defect Liability Period for the project shall be twelve months. The installation contractor shall be responsible for managing all warranty replacement of panels/inverters OR defect recalls of any solar PV components not meeting Australian requirements.

14. Miscellaneous

Once the works is complete, the area is to be cleaned of all redundant-loose-spare components, construction debris and packing materials.