Minimum Design Standard – Electrical Services

1. Minimum Design Standard – Electrical Services

1.1 General

The purpose of this Minimum Design Standard is to set out Northern Territory Government (NTG) minimum requirements for the design of Electrical Services for non-residential building projects[1]. All statements made in this document shall be understood to be a minimum requirement, unless specifically noted as otherwise. Guidelines for best-practice are provided over and above the minimum requirements for some design elements and these are clearly described as such, as well as specifying what is required from the design development process with respect to addressing those guidelines (for example a cost-benefit analysis may be required to assess the best-practice guideline, or a qualitative discussion provided in the design development report etc).

1.1.1 Seismic restraint

Seismic restraint to AS 1170.4.

1.1.2 Technical Specification

Construction Technical Specifications are DIPL's Master Specification for Major Building Works available via the DIPL Project Manager for the contract. Read this section in conjunction with all other sections of this Minimum Design Standard and the relevant sections in the Master Specification for Major Building Works.

1.1.3 Co-ordination of designs across disciplines

The Mechanical Services designer is the lead designer in respect to co-ordination of designs for metering and monitoring, and Building Management Systems, across all 3 disciplines, Mechanical, Electrical, and Hydraulic. Provide design information to the Mechanical Services designer.

1.1.4 Designer Submissions – Plant and Equipment Schedules

As a minimum provide schedules giving information about all proposed items of plant and equipment.

For each item proposed the information provided must include, but not be limited to:

- Make
- Model name, designation, and number
- Size, including required clearances for installation
- Capacity of all system elements
- Performance characteristics related to all inputs, all outputs, and all the functions of the item
- Energy efficiency characteristics of proposed item and/or system
- Proposed location
- Country of origin and manufacture
- Materials used in the construction
- Certification of conformance to the applicable code or standard

[1] The functional requirements of residential buildings significantly differ to those of non-residential buildings.

- Assumptions
- Calculations
- Technical data schedules
- Manufacturers' technical literature
- Type-test reports
- Other information listed in this Minimum Design Standard as being required

1.1.5 Design and Installation

The purpose of this Minimum Design Standard is to set out Northern Territory Government (NTG) minimum requirements for the design of Electrical Services for projects.

Any design aspects not specifically addressed by this minimum design standard shall be identified by the designer and brought to the attention of the Department 'Project Manager Electrical' or Superintendent's representative for resolution during the design process.

It is expected that the design and installation of electrical services and equipment in buildings will comply with all current statutory requirements and current applicable Australian Standards. These are not all specifically referenced as part of this document.

For the purpose of this Minimum Design Standard, whenever reference is made to NTG or DIPL it means the nominated DIPL Superintendent, or their representative, for the project.

In all instances the Electrical Services shall be designed in consultation with the designated DIPL representative and the client.

For designs associated with existing assets, the design engineer and the drafter must visit the site and determine the available ceiling space, switchboard capacity (inspection by authorised personnel only), existing equipment/system capacity, etc. prior to submitting the fee offer.

1.1.6 Relevant Sections of this Brief

Read this clause in conjunction with all other clauses of this minimum design standard and the relevant electrical work sections in the Master Specification for Major Building Works.

1.1.7 Design Development

In all instances the Electrical Services shall be designed and documented in accordance with below design development process.

Design development process:

Design the Electrical Services in full consultation with DIPL to ensure compliance with policy guidelines on system components and for their ongoing operation and maintenance. This shall be achieved by means of a written brief by the Project Manager which must be documented by the designer in a return brief to DIPL for verification and acceptance.

Concept design report and drawings include high level load calculations for approval by the Superintendent. Approval must be obtained to proceed to detailed design development documentation phase.

1. Design documentation including concept drawings and technical reports at 25% completion. Approval must be obtained to proceed to 50% documentation stage.
2. Design documentation including drawings, technical reports, concept estimates, etc. at 50% completion. Approval must be obtained to proceed to 75% documentation stage.

3. Design documentation including drawings and technical reports at 75% completion. Approval must be obtained to proceed to 98% documentation stage.
4. Design documentation including drawings, refined budget estimates, draft electrical scope for RFT edited to be project specific and any technical reports at 98% completion. Final maximum demands are to be completed at this stage. Approval must be obtained to proceed to 100% or Construction Issue documentation stage.

Safety in design is to be considered throughout all design stages and is to be submitted for review starting at 75% design submission, or as designated in the project specific scope.

Where these design stages (25%, 50%, 75%, 98% and 100%) differ to the design stages of the project specific scope, the same review principle applies as above for the project specific stages.

On completion of design works, along with all required documentation for tender, submit all CAD files, supporting calculation reports, program data files and safety in design (SID) reports.

1.1.8 Design Compliance

The design and installation of electrical systems must comply with the following:

- All relevant work sections of the Department's Master Specification for Major Building Works. Copies of these work sections must be requested through the DIPL Project Manager
- The Department's Solar Power Design Brief and Layout Criteria. A copy of this must be requested through the DIPL Project Manager
- The Department's typical vapour barrier details and vapour barrier specification, available via https://dipl.nt.gov.au/industry/technical-standards-guidelines-and-specifications/technical-specifications/buildings .
- Department of Corporate and Digital Development (DCDD) - Data and voice cabling standards – Latest Version, available via https://dcdd.nt.gov.au/office-of-digital-government/ict-policies-standards-procedures
- Current applicable Australian Standards
- National Construction Code (NCC)
- Local Council requirements
- Northern Territory and/or Federal requirements
- Power and Water Corporation requirements
- NT WorkSafe Health and Safety requirements
- Environment Protection Authority requirements
- Work Health and Safety (National Uniform Legislation) Act 2011 and its Regulations
- Relevant Work Health and Safety Codes of Practice
- The Department's Standard Specification for Environmental Management, available via https://dipl.nt.gov.au/industry/technical-standards-guidelines-and-specifications/technical-specifications/environmental-management , and
- any other relevant Acts, Regulations, Standards, Codes, and Guides.

1.1.9 Liaison and Coordination

Liaise and co-ordinate all electrical services with all other disciplines on the project including but not limited to the following:

- Power and Water Corporation (PWC), and other required authorities, and gain all required approvals. **Note** The Designer and Liaison person **Must** be a PWC accredited Engineer,
- The civil designer and PWC for site infrastructure,
- Co-ordinate with all other disciplines for the provision of power supplies, communications and data services, and interfaces with the FIP etc, and
- Co-ordination of all control and monitoring functions with other disciplines etc.

Ensure clashes are resolved before the design is finalised.

Co-ordinate to ensure no clashing of services and building elements.

Carefully check space requirements for cabinets, switchboards, distribution boards, items of equipment, fixtures, plant, etc, space requirements for installation of those items, including space for future installation of extra circuits, equipment, and items, and space requirements for routine servicing, maintenance, and repairs to those items. Liaise with other disciplines and ensure that the switchboard, equipment, etc, can be installed in the spaces allotted, and that minimum maintenance access space requirements are met or exceeded.

1.1.10 Electrical Services Minimum Capacities and Guarantees

The electrical services design consultant must design electrical services for the facilities which must be:

- Reliable;
- Easy to maintain and repair;
- Energy efficient and incorporating sustainable design initiatives; and
- Optimised for minimum life cycle cost over a 25 year life cycle.

1.2 Standards

Use Standards, and their amendments, current 3 months before the date for the close of tenders except where different editions and/or amendments are specified or are required by statutory authorities, including, but not limited to, NATA and the National Construction Code which includes the Building Code of Australia and the Plumbing Code of Australia.

Table – Referenced Australian Standards – Minimum Design Standard – Electrical Services	
AS 1170.4	Structural design actions – Earthquake actions in Australia
AS 1627.4	Metal finishing - Preparation and pretreatment of surfaces - Abrasive blast cleaning of steel
AS 1657	Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 1670 (set)	Fire detection, warning control and intercom systems - System, design, installation and commissioning
AS/NZS 1680 (set)	Interior and workplace lighting
AS/NZS 1768	Lightning protection
AS 1891 (set)	Personal equipment for work at height
AS/NZS 2293 (set)	Emergency lighting and exit signs for buildings

Table – Referenced Australian Standards – Minimum Design Standard – Electrical Services	
AS 2344	Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 MHz to 3000 MHz
AS/NZS 3000	Electrical installations – (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3003	Electrical installations - Patient areas
AS/NZS 3008 (set)	Electrical installations – Selection of cables
AS/NZS 3010	Electrical installations – Generating sets
AS/NZS 4777 (set)	Grid connection of energy systems via inverters
AS/NZS 5033	Installation and safety requirements for photovoltaic (PV) arrays
AS/NZS 5532	Manufacturing requirements for single-point anchor device used for harness-based work at height
AS 60038	Standard voltages
AS/NZS 61000 (set)	Electromagnetic compatibility (EMC)
AS/NZS 61439.1 (set)	Low-voltage switchgear and controlgear assemblies (Supersedes AS/NZS 3439. Transition period ends 2021)
AS 62040	Uninterruptible power systems (UPS)

1.3 Definitions and Acronyms

Table – Definitions and Acronyms – Minimum Design Standard – Electrical Services	
A	Ampere – a measure of electrical current
ac, a.c.	Alternating current
ATS	Automatic transfer switch
BACnet	Building automation and control network
BCA	Building Code of Australia - Volumes 1 and 2 of the NCC
BMS	Building management system
CAD	Computer assisted/aided design/drafting
CCTV	Closed circuit television
CEC	Certificate of electrical compliance
Client	The department for which the project is undertaken by DIPL
Day	Working days, not including Saturdays, Sundays and public holidays
DC. dc, d.c.	Direct current
Department, The	The Department of Infrastructure, Planning and Logistics (DIPL)
DIPL	The Department of Infrastructure, Planning and Logistics
DOE	Department of Education
ELV	Extra low voltage
FOBOTS	Fibre optic breakout terminal
GPO	General purpose/power outlet

Table – Definitions and Acronyms – Minimum Design Standard – Electrical Services	
HV	High voltage
HVAC	Heating, ventilation and air conditioning
ICT	Information communication technology
IP	Internet protocol
ka, kA	Kilo Amperes
kVA, KVA	Kilo Volt Amperes
LAN	Local area network
LED	Light emitting diode
lm/w, lm/W	Lumens per Watt
LV	Low voltage
MCB	Multiple circuit breaker
Mwh, MWh	Mega Watt hour
NBN	National Broadband Network
NCC	National Construction Code of Australia - includes the BCA and the PCA
NVR	No volt relay
PCA	Plumbing Code of Australia – Volume 3 of the NCC
PFC	Power factor correction
Provide	Means give to the Superintendent where it refers to documentation. Generally PROVIDE means, supply, transport, install, connect, test, commission and leave ready for use unless the context clearly indicates otherwise. In the context of this design standard this sense of PROVIDE means to incorporate these requirements in the design and specification documentation.
PV	Photo voltaic
PWC	Power and Water Corporation
RCD	Residual current device
RFT/RFQ	Request for Tender / Request for Quotation - requirements applicable to one are equally applicable to the other
Shall	Is indicative of a mandatory requirement which must be incorporated in the design unless the context clearly indicates otherwise.
SMC	Security monitoring centre
Superintendent	As defined in the contract. A reference to the Superintendent includes a reference to the Superintendent's Representative and to any person, or person occupying a position, nominated by the Superintendent, or by the Superintendent's Representative, to act on their behalf in procuring the works under the contract
U/FTP	Unshielded foiled twisted pair
UPS	Uninterruptible power supply
UTP	Unshielded twisted pair
V	Volts – a measure of electrical potential difference

Table – Definitions and Acronyms – Minimum Design Standard – Electrical Services	
wi-fi	Wireless fidelity – wireless network capability
Will	Is indicative of a mandatory requirement which must be incorporated in the design unless the context clearly indicates otherwise.
Wire-To-Water Pump Efficiency	The hydraulic power (W) imparted by a pump (pressure (kPa) x flow (l/s)) divided by the power consumed by the motor (W). This can be calculated by multiplying the pump efficiency (%) by the motor efficiency (%) at the dominant operating points of each
3g, 3G, 4G, 5G	Generational iterations of the cellular telephone network

1.4 Key Design Objectives

The following key electrical services design objectives are the minimum design requirements for any project and must be used in developing design solutions for the project.

1.4.1 General

The Documentation shall be quantitative, prescriptive and completed to 100% design, correlated to a full site investigation undertaken by the consultant. Designs shall be carried out to a level of detail with minimal ambiguity which can be accurately priced by construction tenderers with minimal assumptions.

For designs associated with existing assets, all existing site infrastructure must be fully investigated for cable access and capacity to take additional equipment and circuits where necessary. Allow for data logging of all relevant distribution boards and switchboards to determine existing maximum demand and electrical capacity. Allow for physical investigation of electrical reticulation spaces to determine physical capacity. Exact scope of works to be fully documented. Provide photographic detail where possible. This includes, but is not limited to, switchboards, fire panels, communication racks, P.A. systems, security and CCTV systems, and all overhead and underground cabling systems.

Design to best practice, with economic priorities and whole of life design to be considered. It is not acceptable to indicate that services shall be designed and installed to the requirements of a particular Australian Standard. Generic statements, such as information for design intent only, is not acceptable.

All designs are to comply with:

- The NCC
- Current applicable Australian Standards
- Acts, codes and regulations applicable to the works
- The requirements of the building certifier
- The requirements of the NT Police, Fire and Emergency Services
- The requirements of Power and Water Corporation
- The requirements of other authorities or entities with jurisdiction over the works
- Best practice.

Where there are any conflicting clauses between any of these authorities, standards and regulations, then the more comprehensive requirement takes precedence.

1.4.2 Masterplan and Project Development Plans

Provide an electrical development plan that provides the development or upgrade of electrical supply infrastructure to a site.

It must provide a broad outline addressing the needs of the site in the areas of:

- Electrical supply into the site
- Electrical distribution within the site
- The requirements for standby generation
- The requirements for monitoring and control systems for the electrical systems.

Where future expansion of the site is anticipated, standalone electrical masterplan documentation must be provided. An electrical masterplan differs from an electrical development plan by providing a framework within which future development of electrical supply infrastructure at a site can take place.

The purpose of the masterplan is to:

- Ensure adequate infrastructure capacity is available for new and current developments for a minimum of 15 years;
- Minimise redundant or abortive works;
- Provide a framework for the planning of longer-term projects for the site.

As part of the master planning, in-principle design approval by Power and Water Corporation must be obtained.

1.4.3 Environmental Conditions

Obtain data from an Australian Bureau of Meteorology source applicable to the project location and insert the applicable details where the prompts *[enter value]* appear below, and provide this information in the Project Development Plan provided to DIPL.

Consultants must make themselves aware of the climatic conditions prevailing in the area of the project, especially, but not limited to, severe wind conditions, extreme rainfall events, lightning strikes, flooding, fires, smoke, dust, humidity levels, temperature ranges, and levels of irradiation from the sun.

Temperature range: *[enter value]* °C to + *[enter value]* °C

Isokeraunic/Isoceraunic Level: *[enter value]* days (Refer to “Lightning Protection” below.)

Humidity: *[enter value]* %

The area may be subject to high levels of windborne dust during dry periods. Drifting smoke from fires in the adjacent regions must be considered.

Soil resistivity tests from an area in the immediate vicinity of the site will be made available on request.

1.4.4 Energy Considerations

Design for minimum energy consumption. The Sustainability Minimum Design Standard requires compliance with NCC2019 Section J for buildings that are above the DIPL Section J Compliance Threshold. For electrical services, compliance with NCC2019 Part J6 is required for *all* buildings (without qualification). Consider the following in the design:

- NCC2019 Part J6 compliance is required for all buildings
- Dual technology occupancy sensors to meet client and NCC requirements
- High efficacy LED luminaires

- Use of LED Emergency and Exit lights
- Solar panels in conjunction with PWC supply
- Power factor correction
- NCC Section J8 energy monitoring

Where specific measures are taken to reduce energy consumption, provide lifecycle costing of that design.

Note (1) : For the purposes of this design standard the provisions of Section J in the Northern Territory Appendix in Schedule 1 of the NCC Volume 1, do not apply. Use the provisions in Section J in the main body text of the NCC Volume 1

1.4.5 Design Drawings

General requirements for drawings:

- The floor plan scale must be a minimum1:100 @ A3.
- Use standard symbols and terminology from AS/NZS 3000 on the drawings and in the documents.

As a minimum, drawings must include, but not be limited to the following, as applicable:

- Site plans showing cabling layout and the location of the works;
- HV single line diagram of the relevant portions of the PWC HV system putting the works in the context of the network;
- LV detailed single line diagrams including but not limited to:
    - Cable schedules
    - Circuit identification of LV primary systems showing the detailed configuration of the system
    - Cable sizes
    - Voltage drop
    - Protection ratings
    - Circuit breaker type
- Control topology / network drawings;
- Loop drawings if considered necessary to describe the system;
- Single line diagrams of all ancillary supplies, such as DC systems;
- Details of earthing systems, including layout drawings, schematic drawings and cable sizes. All bonding to be shown on drawings
- Protection Reports and protection coordination
- Layout drawings showing building and all major equipment locations. Dimensions are not required unless these are required for coordination purposes.

Refer to Appendix A of this document for “Minimum Standard Single Line Diagram”.

Design documentation to include a lighting controls functional description, schematics and product list for review and approval by the Principal DIPL. The lighting controls functional description shall document the lighting control infrastructure and control strategies (both manual and automatic) to be employed in each type of space, in sufficient detail so that functional tests can be performed using the description as a reference for intended outcomes.

The Drawings and Specifications must clearly indicate the Scope of Works and must provide details of all the components to be installed. Specification by brand name is acceptable.

The Architectural Design Drawings (internal and external elevations) must include the locations of all the electrical accessories; e.g. switches, socket outlets, light fittings, air conditioning controls, access and security keypads and cards readers, door lock override pushbuttons, etc. including mounting heights and critical dimensions. Electrical drawings to accurately reflect the electrical equipment shown on the room layout sheets and locations.

Provide individual floor plans for each building. No typical drawings for floor plans will be accepted.

1.4.6 Specification

In general, the Design Drawings must include the information for the type, location, number, connection for all the specified equipment.

The Specification must be used where necessary to clarify the design intent and to convey technical requirements which are not appropriate to include on the drawings.

Specification by brand name and catalogue number is acceptable, however, the document must clearly state where equivalents may be offered for the Superintendent's consideration.

Ensure that the specified equipment, fixtures, fittings, cables, conduits etc. are suitable for the intended location within the NT, and that they are readily available for supply and installation in the intended location within the NT.

1.4.7 Cabling

Only copper conductors are permitted complete with nylon jacket termite protection for all mains and sub-main cabling in underground conduits.

Provide 30% redundancy when sizing cables and conduits.

Voltage drop to be shown on drawing single line diagrams or shown in a separate schedule on the drawings

All earths to be sized to suit earth fault loop impedance.

1.4.8 Maximum Demand

Provide the Maximum Demand calculations for the Design Review Meetings. Updated maximum demand calculations as necessary during the design process. Allow 30% redundancy for whole of site, unless otherwise directed by DIPL. Calculated maximum demand to be shown on single line drawings. Show the maximum demand and additional 30% redundancy separately for client consideration.

1.4.9 Emergency Power Supplies

If required, design an Emergency Power Supply for the building in compliance with the following Standards:

- Standby Diesel Generator: To AS/NZS 3000:2018 Section 7.3 and AS/NZS 3010. The generator shall be a reputable brand with a local workshop and service provider with spare parts and service support available 24/7. In remote areas with no local workshop, the service provider must be based in the NT and be available to service remote areas.
- Uninterruptable Power Supply (UPS): To AS 62040.

Provide the proposed design to the Superintendent for approval. Include:

- The design philosophy,
- Essential load Maximum Demand figures and a schedule of the equipment requiring Essential Supply.

- Maximum Demand figures and design calculations for the UPS together with a schedule of the equipment to be connected. Equipment to be confirmed in conjunction with the Superintendent.
- Generators 750KVA and above to be V-form construction.
- Fuel polishing units to be provided for all tanks with capacity of 5000L or above.
- Local test switch at generator to be provided for actual load test of site and ATS function.
- DIPL representative to view 6 hour load test requirements at local Darwin or regional urban workshop.

Designed with an average radiator ambient temperature of 50 degrees or less for all generators rated above 200 kVA.

1.4.10 General Electrical Services

Provide the design calculations for maximum demand, voltage drop, fault levels, cable sizing and fault loop impedances, including 30% redundancy allowance.

Determine all the circuit breaker sizes and protection settings. Ensure selectivity between circuit breakers, including 30% redundancy allowance.

Generally allow to run cables on cable trays above the ceiling of the corridors and public access areas. Size trays and their suspension systems to facilitate the installation of 30% additional cable during the design life of the building and whilst the building is in full use.

In smaller buildings, stainless steel or coated galvanised catenary wiring may be utilised for cable support. Provide minimum 100mm segregation between LV and ELV services run in parallel and 50 mm at crossovers.

Design the cable locations in the walls to the specific requirements of AS/NZS 3000. Ensure all conduits external to the building have a minimum of 50% spare capacity.

Seal all enclosures, including Distribution boards, junction boxes, and cabling racks, against the entry of vermin.

Seal all conduit ends to prevent the entry vermin. Seal all external luminaires against entry of insects.

Seal all building penetrations against wind driven rain, vermin and insects.

Where cables pass from an air-conditioned space in to an unconditioned space, seal the penetration against ingress of water vapour. Vapour barrier to be continuous.

Sealant must be fire rated if through a fire rated wall.

Electrical floor plans must have circuit identification relevant to the switchboard single line drawings.

No proprietary equipment or programs to be nominated for BMS, fire security, generation, or mechanical control systems.

Lighting and GPO circuit loads must not exceed 75% of circuit breaker capacity.

Outlets to be Clipsal Pro Series or a DIPL approved equivalent

Provide nylon jacket for all underground mains cables.

Nominate hydrovacing to expose any existing underground services.

All excavations through roadways not in a road reserve and carparks to be backfilled with stabilized sand, and all bitumen repairs to be compacted hotmix/asphalt, to the Civil Works work section of the Master Specification for Major Building Works.

Routing of services under roadways in road reserves must be via thrust boring.

Minimum of 300mm clearance between cable support systems and ceiling grid.

1.4.11 Main Switchboard Room

Provide an environment controlled system to ensure the room temperature does not exceed 27 degrees Celsius.

The doors of the main switchboard room shall be sized appropriately to accommodate switchboard size for installation and removal.

Space in the main switchboard room to be allowed for a power factor correction unit.

1.4.12 Switchboards

No custom made enclosures are allowed without the approval of the Superintendent.

Boards must be full metal boards (stainless steel when near marine environments) with lockable doors and hinged escutcheons.

Ensure that there are a minimum of 30% spare poles in each Board.

All boards to be Form 3b or 4a if rated at 800A or greater.

RCD protection must be by individual, single pole width RCD/MCBs.

Proprietary Distribution Boards, type tested modular enclosures must be used.

Determine, and indicate on drawings, circuit breaker type for fault loop impedance satisfaction - electronic or magnetic.

All switchboards to meet the requirements of AS/NZS 61439.1:2016, AS 1627.4:2005 and all other relevant standards.

All Legends must be supplied in “Microsoft Word” format.

Provide a single line diagram for each switchboard inclusive of circuit identification, all cable sizes, calculated maximum demand and fault rating, form rating and surge protection. Include within design sufficient room for cable terminations.

For all switchboards greater than 800A, include space in design and label drawings for solar and PFC circuit breakers and CTs. Design process to consider type of static VAR generation (open- or closed- loop) to be installed if found to be required (refer Section 1.4.15).

1.4.13 Software Ownership and Access

General

It is a fundamental requirement of the project that all controls and associated software systems are provided without any restrictions to cause the Department to be committed to specific manufacturers or controls system integrators / suppliers. All passwords and access rights / responsibilities, inclusive of access / change rights to the base controls programming, shall be passed in full to the Department prior to completion of the project.

Ownership

All ownership of access accounts, passwords, programming logic used, and intellectual property in the control system, must be transferred to the Northern Territory Government. All licenses for proprietary software used in conjunction with the development and/or operation of the control system must be transferrable to the Northern Territory Government.

At the date of practical completion, transfer ownership of all software, all licences, and all supporting documentation produced under this contract to the Superintendent.

Rights to Modify

Assign to the Superintendent unrestricted rights to employ any person or organisation to operate, modify or replace the software. Include in these rights all login details, software and documentation (e.g. development and testing packages) necessary to achieve this.

Software Upgrades

Supply and install all software upgrades, revisions, and the like, issued by the manufacturers up to the end of the Defects Liability Period.

1.4.14 Fire Rated Cables

Fire rated cables shall be fixed to cable support systems with stainless steel cable ties.

Cable support systems for fire rated cables, including fixings to structural elements, shall be certified for performance in fire conditions.

Cable support systems for fire rated cables shall be fixed to fire rated structural elements. Otherwise use conduits with concrete encasement to provide the required fire rating.

1.4.15 Power Factor Correction (PFC)

For existing sites, a load profile must be recorded to determine the required PFC arrangement and determination of PFC unit size (kVAr).

Design to meet Power and Water Corporation (PWC) Network Technical Code power quality requirements. This includes reviewing the impact of new equipment installations on existing buildings' power quality (eg. power factor and harmonics).

Target minimum power factors at the peak load of each calendar month are:

- For buildings forecast to use under 750 MWh per annum (that do not have a peak demand kVA component in their tariff): between 0.9 lagging to 0.9 leading as per PWC Network Technical Code requirements
- For other buildings: between 0.98 lagging to 0.98 leading

New building construction Requests For Tender must include a provisional sum for installation of Power Factor Correction equipment to be estimated by the designer and included in documentation.

Designs are to include:

- A designated space, and a Main Switch Board circuit breaker, for Power Factor Correction equipment in the environmentally controlled main switchboard room.
- A note on drawings:
    - Stating the target power factor and requiring;
    - Post construction measurement of power factor at peak load conditions over a 6-month period; and
    - Installation of static VAR generators if power factor rectification is required

1.4.16 Conduits

Ensure that conduits carrying multiple circuits are sized with 30% redundancy.

Long runs of dedicated conduits shall be appropriately sized to reduce the risk of damaging the cables during installation.

1.4.17 Lighting

Provide a schedule of any specific lamps to be used. Luminaires which require specific lamps shall be permanently labelled on a surface, clearly visible to the Maintenance Personnel, indicating specific lamp requirements and the lamp description.

If requested by the Superintendent, provide copies of all lighting calculations and isolux diagrams for all artificially illuminated areas, both internal and external to the building. LED light fittings are preferred over discharge light fittings on all external lighting including carpark lighting, area lighting, and high use sporting arenas.

All lighting designs shall comply with the maximum illumination power density limits prescribed in NCC2019 Part J6.2.

Artificial lighting systems shall be designed to achieve the minimum illuminance levels specified in AS/NZS 1680 and must not exceed the minimum illuminance requirement by more than 20% at Project Completion (except where it can be demonstrated that lamp depreciation requires a greater initial illuminance to ensure sufficient illuminance at the end of lamp life).

Lighting design documentation is to be provided verifying that the following AS/NZS 1680 glare index and uniformity requirements are met as evidenced by inclusion of a table on drawings detailing the classification categories used for different areas.

Provide the maintenance factors and lamp depreciation factors used in the calculations.

When selecting suitable light fittings the following needs to be considered: fit for purpose, whole of life, value for money, and replacements must be readily available.

Internal LED fittings to be a minimum low glare L80 50,000 hour life expectancy and minimum luminaire efficacy of 100 lm/W.

All fittings to be plug type. Lighting sockets to be hard wired with looping terminal. Piercing type connectors are not acceptable.

Dual technology occupancy sensors to be utilised for all hands-free light switching.

Lighting control shall be compliant with NCC Part J6.3 and lighting control devices shall be compliant with NCC Specification J6, with the following clarifications and additions:

- Dual technology motion sensors shall be employed wherever automated control is required (specific exceptions will be considered by DIPL where the designer can provide a justification for an alternative control device)
- Irrespective of building/storey size, automated lighting controls shall be employed for all intermittently occupied spaces such as bathrooms, meeting rooms, break-out spaces, classrooms, lift lobbies, thoroughfares etc.
- Motion sensor controls in sensor-integrated luminaires shall be provided for all underground and/or undercover car parks with the capability for auto-dimming to a standby illuminance level. The designer shall undertake a risk assessment to determine a safe standby illuminance level for the specific application.
- Fire-stair lighting control must comply with NCC Part 6.3(f) and Specification J6.4(d). The preferred best-practice option for doing so is with sensor-integrated luminaires with internal controls for auto-dimming to a standby illuminance level. If electing not to employ this technology the designer shall provide justification to DIPL for approval prior to final design.

1.4.18 Exit and Emergency Lighting

Provide exit and emergency lighting in accordance with the requirements of the NCC and AS/NZS 2293.

Consider providing additional emergency lighting in critical areas (to assist the facility occupiers/users during any period of loss of normal power supply.

Zoneworks monitoring to be considered for larger sites.

1.4.19 Lightning and Surge Protection

Provide calculations and lightning protection proposal (if required under SID report), incorporating a Faraday cage configuration with roof/tower mounted finials (lightning rods) compliant with AS/NZS 1768 appropriate for the Isokeraunic/Isoceraunic levels of the site, for approval by the Superintendent prior to inclusion in the Design. Include surge diverters and other lightning protection measures on the internal electrical infrastructure.

Main switchboards must have 200ka and distribution boards to have 50ka surge protection devices. Surge protection devices selected must have clearly distinguishable fail indicators that can be seen without removing covers and exposing other live components.

1.4.20 Metering

The electrical design shall include provision of meters to cover:

- Incoming check meter(s)
- Artificial lighting
- Appliance power
- Lifts and other internal transport devices
- Diesel generator electricity production
- Solar PV electricity generation

Where the installation incorporates a new or existing BMS system, connect the meters into the BMS system to facilitate the monitoring of the magnitude and pattern of energy consumption

For all buildings irrespective of NCC2019 Part J8 requirements the electrical design shall include provision of electronic “smart” meters in each Distribution Board.

Electrical design documentation shall include documentation of the metering systems provided under the scope of the electrical design and shall be coordinated with the mechanical design to ensure a consistent approach to metering documentation with a consistent naming convention.

Generally - The requirements of NCC2019 Part J8 shall apply. The lead responsibility for the metering system shall be under the mechanical design. The electrical design shall be coordinated with the mechanical design to ensure the following requirements are met using standardised BACnet or BACnet over IP compatible equipment.

Minimum metering requirements are:

Table – Minimum Design Standard – Electrical Services – Minimum metering requirements	
Incomer check meters	15 minute (minimum) interval data, meter specifications equivalent to Power and Water Corporation smart billing meter requirements (at minimum, must record kWh, kVA, kW, kVAr and power factor and retain data for at least 12 months)
Sub-system meters	15 minute (minimum) data kWh or MJ, smart meter (same specification as incomer check meters preferred)

For buildings that require a sub-metering system under NCC J8.3(b), and for any building with a central plant HVAC configuration, the sub-metering system must have remote access capability and independently capture the following end use categories:

- Incomer check meter(s)
- Chillers
- Chilled water plant ancillaries (i.e. pumps and cooling towers)
- Heating hot water generators
- Heating hot water system pumps and ancillary loads
- Fan coil units and air handler fans
- Artificial lighting
- Appliance power
- Central hot water supply (domestic)
- Lifts and other internal transport devices
- Diesel generator electricity production
- Solar PV electricity generation
- Other ancillary plant

Note that metering requirements for the above categories are to be understood as a requirement to capture the aggregate of all units within the category. It is not the intention to individual sub-meter each individual unit in each category.

1.4.21 Space for Equipment and for Maintenance Access

Ensure sufficient space allowed for the installation and maintenance of all the electrical services infrastructure including, but not limited to, communications racks, distribution boards, mechanical services control panels, nurse call equipment, fire indicator panels, emergency lighting monitoring equipment etc.

1.4.22 Fire Detection and Protection

Design fire detection and alarm systems, including occupancy warning systems, in accordance with the NCC, AS 1670, and all other relevant Australian Standards. During the design process consider any/all special circumstances of the building, its structure, and its location.

Indicate on the drawings the location, type, and number of all detectors and alarm devices including concealed detectors where applicable. Fire services shall be shown on drawings independently from other services.

1.4.23 Earthing

To be designed to meet AS/NZS 3000 Section 5.
Wet areas to have reinforcement steel bonded and earthed.

Cables trays, permanently installed steel structures and framing to be bonded and earthed. Equipotential earthing must be maintained on all cable tray/ladder runs, particularly where there are breaks between sections of trays.

Earthing cables to be sized appropriately and fault levels are to be provided to DIPL.

1.4.24 Communications Requirements

Communications requirements to be in conformance with:

- All relevant Australian Standards
- Latest version of NT Government Data and Voice Cabling Standard (available at https://dcdd.nt.gov.au/office-of-digital-government/ict-policies-standards-procedures)

Identify the need for 6A UTP or 6A U/FTP for specific sites at design stage.

On Department of Education (DOE) projects, comply with the latest DOE ICT requirements for schools.

The number of lead-in conduits to be considered at design stage to provide access for NBN and multiple providers.

Outlets to be Clipsal Pro Series or a DIPL approved equivalent – deep wall boxes are required for termination, and to be noted on drawings.

An approved NBN plan for the site must be provided by the design consultant as part of the construction drawings.

1.4.25 Lift Communications

All lift phones to be connected wirelessly via a generic 3g wi-fi. Lift phone to be provided with a minimum 8 hour battery back-up. Sim cards for the phones will be provided by the client.

1.4.26 Electronic Security, Intercom, CCTV and Duress

General

This clause applies to projects with security requirements of any security system incorporating swipe cards, external CCTV and intercom.

An electronic security system is to be provided to include detection via external door status monitoring and access control. An intruder detection system is to comprise the installation of door status monitoring reed switches which are to be provided on all non-public external doors in conjunction with internal dual technology intruder detectors. Electric door locking and access control (proximity card readers) are required to the external non-public entry doors and to internal doors requiring secure access.

CCTV cameras must be provided to monitor the external perimeters of all the buildings. Provide fibre optic LAN network with FOBOTS switches. Provide local power supply including 50% redundancy in each building, with surge protection, in racks. Main building to have a secure rack with server based NVR and switch equipment. CCTV equipment to be Avigilon and Access Control to be Inner Range Integriti or similar and approved by the Superintendent.

Intercom interconnections shall be as nominated on the room data sheets

Existing Systems

Include in design scope/notes: Construction contractor required to engage relevant DIPL period contractor to provide user name, password, and/or PIN, for installer use.

UNDER NO CIRCUMSTANCE SHOULD INSTALLER/MASTER/ADMIN ACCESS BE DEFAULTED TO GAIN SYSTEM ACCESS.

New and Existing Systems

Include in design scope/notes: If new or existing system includes back to base monitoring then installer will be required to request a technician voice code through DIPL Electrical Section in order to liaise with the Security Monitoring Centre (SMC). Commissioning of all monitored devices is to be confirmed by SMC.

New Systems

Include in design scope/notes: INSTALLER, MASTER, ADMIN, USER, PASSWORD, PIN and LOGIN shall be provided to DIPL upon completion of project.

1.4.27 Solar Power

For projects with solar power requirements design in accordance with 'Solar Power Design Brief and Layout Criteria' in the Appendices to this design guideline for details.

1.4.28 Department of Health Specific Requirements

A complete design to be completed for all body and cardiac protected areas to comply with AS/NZS 3003 inclusive of schematic diagrams to detail cardiac earthing systems.

All body and cardiac protected areas to be certified by a Bio-Medical Engineer or qualified trained personnel who have used the correct calibrated equipment.

Areas which are to have Cyanosis lighting requirements must also be identified.

1.5 Scope of Deliverables

1.5.1 General

Provide the electrical services design documentation consistent with the following descriptions.

1.5.2 Preliminary details

Submit preliminary concept documentation for review indicating the design, construction, commissioning, and maintenance characteristics of the works intended to meet the objectives of the specification.

Reviewers' comments must be taken by the Design Consultant as an indication that the design must be amended and resubmitted, where the reviewer considers incorporation of aspects of the Design Consultant's design are considered to be inconsistent with the objectives of the specification.

The Design Consultant may submit a request for variation to the contract where the client's and/or reviewers' comments indicate changes to the scope and/or objectives of the specification.

1.5.3 Review Submissions

If not defined differently in the project scope documentation, submit documentation at 50%, 75% and Final design stage for review.

1.5.4 Workshopping

When requested by any of the Superintendent, client, or consultants, convene a workshop to resolve any issues, queries, concerns, or conflicts.

1.5.5 CAD Drawing Requirements

All Electrical CAD Drawings are to conform to the NTG technical drawings - Part 1 – Requirements for Technical Records Management (available via https://dipl.nt.gov.au/industry/technical-standards-guidelines-and-specifications/technical-records)

1.5.6 Design and Construct – Preliminary Submissions and As-Constructed Submissions

Conform to the requirements in this document and the requirements in the Master Specification for Major Building Works. As-Constructed CAD Drawings must comply with the CAD Drawing Requirements. Conform to the requirements of the Building Certification clauses in the Request for Tender/Request for Quotation for the project.

1.5.7 General

Unless directed by DIPL, the following shall constitute the minimum required details to be described in the design submissions:

- Calculations
- Electrical Services Detail Drawings
- Technical Data
- Control Functional Descriptions

1.5.8 Calculations

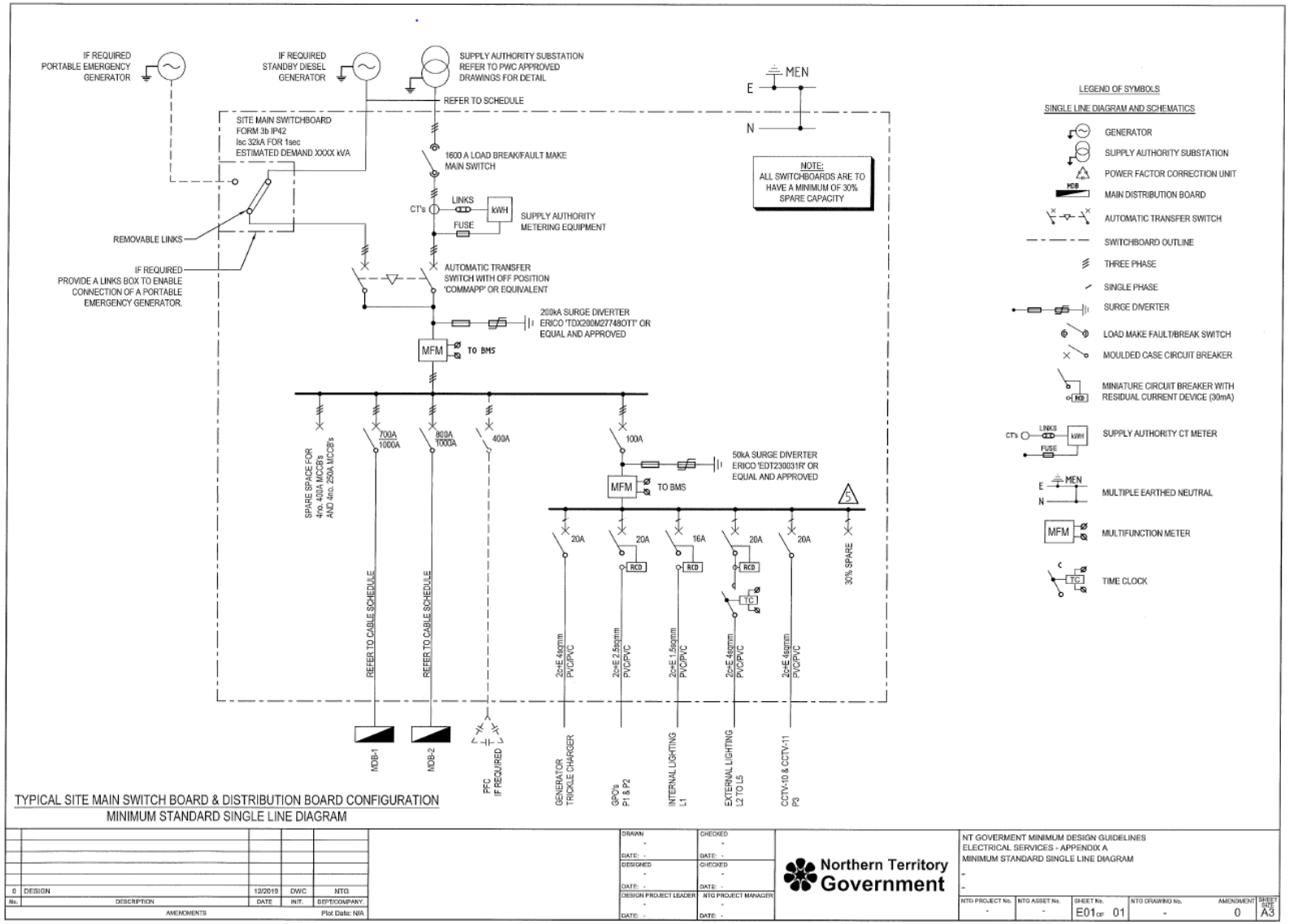
Submit calculations upon request by the Superintendent.

1.5.9 Certification

Submit certification that the proposed equipment meets the statutory and design requirements of the contract documents.

1.6 APPENDIX A

Minimum Standard Single Line Diagram


IF REQUIRED PORTABLE EMERGENCY GENERATOR
IF REQUIRED STANDBY DIESEL GENERATOR
SUPPLY AUTHORITY SUBSTATION REFER TO PWC APPROVED DRAWINGS FOR DETAIL
REFER TO SCHEDULE
MEN
E
N
SITE MAIN SWITCHBOARD FORM 3b IP42 Isc 32kA FOR 1sec ESTIMATED DEMAND XXXX kVA
1600 A LOAD BREAK/FAULT MAKE MAIN SWITCH
NOTE: ALL SWITCHBOARDS ARE TO HAVE A MINIMUM OF 30% SPARE CAPACITY
CT's
LINKS
FUSE
kWH
SUPPLY AUTHORITY METERING EQUIPMENT
REMOVABLE LINKS
IF REQUIRED PROVIDE A LINKS BOX TO ENABLE CONNECTION OF A PORTABLE EMERGENCY GENERATOR.
AUTOMATIC TRANSFER SWITCH WITH OFF POSITION 'COMMAPP' OR EQUIVALENT
200kA SURGE DIVERTER ERICO 'TDX200M27748OTT' OR EQUAL AND APPROVED
MFM
TO BMS
SPARE SPACE FOR 4no. 400A MCCB's AND 4no. 250A MCCB's
700A 1000A
800A 1000A
400A
100A
50kA SURGE DIVERTER ERICO 'EDT230031R' OR EQUAL AND APPROVED
MFM
TO BMS
5
20A
20A
16A
20A
20A
RCD
RCD
RCD
TC
30% SPARE
REFER TO CABLE SCHEDULE
REFER TO CABLE SCHEDULE
2cnE 4sqmm PVC/PVC
2cnE 2.5sqmm PVC/PVC
2cnE 1.5sqmm PVC/PVC
2cnE 4sqmm PVC/PVC
2cnE 4sqmm PVC/PVC
MDB-1
MDB-2
PFC IF REQUIRED
GENERATOR TRICKLE CHARGER
GPO's P1 & P2
INTERNAL LIGHTING L1
EXTERNAL LIGHTING L2 TO L5
CCTV-10 & CCTV-11 P3
LEGEND OF SYMBOLS
SINGLE LINE DIAGRAM AND SCHEMATICS
GENERATOR
SUPPLY AUTHORITY SUBSTATION
POWER FACTOR CORRECTION UNIT
MDB
MAIN DISTRIBUTION BOARD
AUTOMATIC TRANSFER SWITCH
SWITCHBOARD OUTLINE
THREE PHASE
SINGLE PHASE
SURGE DIVERTER
LOAD MAKE FAULT/BREAK SWITCH
MOULDED CASE CIRCUIT BREAKER
RCD
MINIATURE CIRCUIT BREAKER WITH RESIDUAL CURRENT DEVICE (30mA)
SUPPLY AUTHORITY CT METER
MULTIPLE EARTHED NEUTRAL
MFM
MULTIFUNCTION METER
TC
TIME CLOCK
TYPICAL SITE MAIN SWITCH BOARD & DISTRIBUTION BOARD CONFIGURATION
MINIMUM STANDARD SINGLE LINE DIAGRAM
0 DESIGN 12/2019 DWC NTG
No. DESCRIPTION DATE INIT. DEPT/COMPANY
AMENDMENTS
Plot Date: N/A
DRAWN - DATE: -
CHECKED - DATE: -
DESIGNED - DATE: -
CHECKED - DATE: -
DESIGN PROJECT LEADER - DATE: -
NTG PROJECT MANAGER - DATE: -
Northern Territory Government
NT GOVERMENT MINIMUM DESIGN GUIDELINES
ELECTRICAL SERVICES - APPENDIX A
MINIMUM STANDARD SINGLE LINE DIAGRAM
NTG PROJECT No. -
NTG ASSET No. -
SHEET No. E01 OF 01
NTG DRAWING No. -
AMENDMENT 0
SHEET SIZE A3

1.7 APPENDIX B

Solar Power Design Brief and Layout Criteria

Department of Infrastructure, Planning and Logistics – Photovoltaic Design Brief 22 August 2019

Table - Photovoltaic Design Brief 22 August 2019		
Item	**Design Criteria**	**Comments**
Solar PV System		
Extreme ambient conditions including rain/hail/cyclonic and other conditions under which the solar panels are expected to operate.	-10° C to +65° C	Equipment shall be suited for full and efficient operations in Northern Territory climatic conditions. Special consideration is required for coastal areas subject to high humidity, high airborne salt levels, and cyclonic conditions.
Extreme ambient conditions for which inverter plant and string monitors are expected to operate.	-10°C to +50°C	Equipment shall be suited for full and efficient operations in Northern Territory climatic conditions. Special consideration is required for coastal areas subject to high humidity, high airborne salt levels, and cyclonic conditions.
Grid Connection	As required. Provide compliant grid protection and zero export devices	Comply with PWC Requirements as per Class 3 approvals.
Solar Panel selection	Panels selected must be current CEC approved PV modules	
Panel module efficiency	>19%	Per manufacturers'/CEC guidelines
Average Power Generation Yield at 25 Years	>86%	Per manufacturers'/CEC guidelines

Table - Photovoltaic Design Brief 22 August 2019		
Item	**Design Criteria**	**Comments**
Solar Panel Orientation	North facing with a panel angle above horizontal as close as possible to: • Darwin, Nhulunbuy (Gove) 12.5° • Katherine 14.5° • Tennant Creek 19.5° • Alice Springs 23.5° • Other areas interpolated from these or as close as possible to angle of latitude of the site	Dimensions and available roof area to be confirmed on site and final system size determined by available roof area.
Mounting Method	• Non-penetrative preferred on low pitch roof. • Example: Clenergy	• Fixings are to have watertight seals if they penetrate the roof sheet. • Penetrative roof mounts are permissible provided they maintain the integrity of the roofing system and if they have watertight seals.
Panel Monitoring	Monitoring each panel and string connection to the inverter.	• Monitoring output performance of individual panels. • Remote monitoring to facility and to the Department. • Panel outage alerts.
System performance monitoring	Provision of system data to third party software to support educational and curriculum outcomes.	Monitoring solution shall be 3G/4G compatible and provide 5 minute interval data feeds.

Table - Photovoltaic Design Brief 22 August 2019		
Item	**Design Criteria**	**Comments**
Mass/Area (kg/m^2) Panel Arrays	15kg/m^2	• PV installer to verify roof strength requirements and structural calculations prior to commencement of PV installation. • The mass per m^2 may be increased upon assessment and approval by the installer's structural Engineer/certifier. • Calculations shall be submitted to the Department prior to ordering any materials and prior to works commencing on site.
Inverters	• 400V (3 Phase) • Compliant with AS/NZS 4777 • Examples: Solar Edge, Fronius, SMA or approved equivalent as appropriate for the design.	• Operating Voltage range in accordance with AS 60038 and AS/NZS 3000 • Inverters must be tested, and certified for use, in Australia. • 20 year product/parts warranty
Supply Metering	Facilitate the provision of 3 Phase import/export revenue meter(s) to the Main Switchboard within each PWC Substation as required	New Type 2 PV Metering (import/export revenue meter) to be supplied and installed by a PWC accredited contractor at the project's cost. Include PWC meter replacement fees and charges within submission.
Power Systems • Harmonics • Fault Current • Over/Under Current • Over/Under Voltage • Frequency • Zero Export • Grid Protection	Compliance with PWC requirements	Final requirements to be in accordance with PWC requirements and assessment

Table - Photovoltaic Design Brief 22 August 2019		
Item	**Design Criteria**	**Comments**
Compliance with Power and Water Corporation Utilities for Small Embedded Generation Equipment and Network Connections	All equipment, including the inverter(s) must comply with: • PWC specification "Technical requirements for Grid Connection of Photovoltaic Systems via Inverters" • AS/NZS 4777 series	• Required for connection to the grid. • PWC documents available for download from PWC web site: https://www.powerwater.com.au/developers/drawings-and-downloads
Electrical Wiring & Electrical Installation	To AS/NZS 3000, AS/NZS 3008, and AS/NZS 5033	
Power Factor	Within 0.90 (Lagging) and 0.90 (Leading)	• At times of the customer's monthly maximum demand. • Refer to site inspection regarding existing PFC equipment at the site. • Refer to respective PWC preliminary assessment for compliance. • The proposed solar installation must not negatively impact the site's power factor.
Surge Protection	Provide surge protection to the solar installation, solar distribution board and site main switchboard.	• Surge protection (DC/Solar) shall be equivalent to Novaris SDPV series. • Surge protection (AC) shall be equivalent to Erico TDX-100 or Novaris SD3 within the site main switchboard. • Surge protection (AC) shall be equivalent to Erico TDS-350 or Novaris within the Solar Distribution Board.
Electromagnetic Interference	In accordance with AS 2344	Any electromagnetic interference caused by the installation or any plant / equipment connected must be less than the limits set out in AS 2344
Disturbing Loads	In accordance with the limits in AS/NZS 61000	Voltage disturbance at the grid connection points for each site to be in accordance with AS/NZS 61000

Table - Photovoltaic Design Brief 22 August 2019		
Item	**Design Criteria**	**Comments**
Photovoltaic Orientation	PV installer to nominate orientations and pitches for PV panel arrays.	North facing with a panel angle above horizontal as close as possible to: • Darwin, Nhulunbuy (Gove) 12.5° • Katherine 14.5° • Tennant Creek 19.5° • Alice Springs 23.5° • Other areas interpolated from these or as close as possible to angle of latitude of the site
Roof Platform, Access and Safety System		
Roof access	• Provide permanent safe roof access and safety attachment points • To be compliant with, and installed to, AS 1657	Walkways to provide access to all panels for cleaning and maintenance purposes.
Roof walkway	• Provide permanent walkway on roof between panel rows to support future maintenance • To be compliant with, and installed to, AS 1657	• Non-slip walkway surface • Penetrative roof mounts are permissible provided they maintain the integrity of the roofing system and if they have watertight seals.
Roof anchor points and static lines	• Provide safety anchor points and static lines on roof • The system must be installed in accordance with AS/NZS 1891 and AS/NZS 5532	• For travel restraint or fall restraint as applicable • Penetrative roof mounts are permissible provided they maintain the integrity of the roofing system and if they have watertight seals.

Table - Photovoltaic Design Brief 22 August 2019		
Item	**Design Criteria**	**Comments**
Warranty		
Photovoltaic Panels	Minimum 20 year product and production warranty	
Inverters	Minimum 20 year product warranty	
Other electrical equipment	Minimum 7 year product warranty	