



# ENGINEERING STANDARD

## Prefabricated Electrical Switchrooms

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**GRC-ES003**

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**2**

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## 1 PURPOSE

The purpose of this Engineering Standard is to describe the requirements for the design, manufacture, supply, testing and delivery to site of Prefabricated Electrical Switchroom buildings for Gladstone Regional Council. This Engineering Standard shall be read in conjunction with the separate project specific scope of work document.

## 2 SCOPE

This Engineering Standard is applicable to all Gladstone Regional Council projects where prefabricated electrical switchroom buildings have been specified in the project documents to contain switchboards and motor control centres.

## 3 RESPONSIBILITIES

All persons involved in the purchasing, design, fabrication and supply of prefabricated electrical switchroom buildings for use on any GRC site shall comply with this Engineering Standard.

Any variations proposed that are contrary to the requirements of this Engineering Standard shall be specifically identified and referred to GRC, in writing, for approval.

## 4 DEFINITIONS

<i>Term</i>	<i>Definition</i>
<b>Council</b>	Gladstone Regional Council or its nominated representative or agent.
<b>GRC</b>	Gladstone Regional Council or its nominated representative or agent.
<b>LV</b>	Low Voltage, Exceeding 32VAC or 115VDC but not exceeding 1000VAC or 1500VDC.
<b>Manufacturer</b>	The corporation or business that manufactures and/or assembles the equipment described by this Engineering Standard.
<b>MCC</b>	Motor Control Centre
<b>Purchaser</b>	The individual or corporation responsible for purchasing the equipment described by this Engineering Standard on behalf of GRC.
<b>Specifier</b>	Any individual specifying equipment for use in electrical installations on a GRC site.
<b>Substation</b>	Installations that convert high voltage to lower voltages to supply local equipment. The installation may include a fenced yard, buildings, transformers and switchboards.
<b>Superintendent</b>	Person authorised to act on behalf of GRC with respect to the Contract works.
<b>Supplier</b>	The individual or corporation with whom GRC enters an agreement to purchase the equipment described by this Engineering Standard. Note that in some instances, the Supplier may also be the Manufacturer.
<b>Switchroom</b>	Building that houses switchboards, motor control centres and other ancillary equipment.
<b>QA</b>	Quality Assurance

## 5 REFERENCE DOCUMENTS

All equipment shall be designed, manufactured and tested in accordance with the latest edition of the following GRC Engineering Standards, Australian Standards, Acts and Regulations.

### 5.1 GRC Engineering Standards

<i>Standard</i>	<i>Title</i>
GRC-ES001	Electrical Work
GRC-ES002	Preferred Electrical Components
GRC-ES004	Motor Control Centres
GRC-ES005	Light & Power Distribution Boards
GRC-ES008	Equipment Identification
GRC-ES015	Standard Provisions for Construction

### 5.2 Australian Standards

<i>Standard</i>	<i>Title</i>
AS/NZS 1163	Cold-formed Structural Steel Hollow Sections
AS/NZS 1214	Hot-dip Galvanized Coatings of Threaded Fasteners
AS/NZS 1252	High Strength Steel Bolts With Associated Nuts and Washers for Structural Engineering
AS/NZS 1554	Structural Steel Welding – Welding of Steel Structures
AS 1657	Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation
AS 1670	Fire Detection, Warning, Control and Intercom Systems.
AS 2293	Emergency Escape Lighting and Exit Signs for Buildings – System Design, Installation and Operation
AS/NZS 2312	Guide to the Protection of Structural Steel Against Atmospheric Corrosion by the Use of Protective Coatings – Hot Dip Galvanizing
AS/NZS 3000	Electrical Installations (Australian/New Zealand Wiring Rules)
AS/NZS 3008	Electrical Installation – Selection of Cables
AS/NZS 3017	Electrical Installations – Testing and Inspection Guidelines
AS/NZS 3500	Plumbing and Drainage
AS 3566	Self-drilling Screws for the Building and Construction Industries
AS/NZS 3679	Structural Steel – Hot-rolled Bars and Sections
AS 4100	Steel Structures
AS/NZS 4600	Cold-formed Steel Structures

### 5.3 Acts and Regulations

<i>Title</i>
Electrical Safety Act 2002
Electrical Safety Regulation 2002
Professional Engineers Act 2002
Professional Engineers Regulation 2003
Work Health and Safety Act 2011
Work Health and Safety Regulation 2011

## 6 TECHNICAL REQUIREMENTS

### 6.1 General

#### 6.1.1 Quality Assurance

The Manufacturer shall have an integrated quality assurance system in place at the locations where the prefabricated switchroom buildings are designed, manufactured and assembled. The system shall be 'third party accredited' to AS/NZS ISO 9001:2000 and frequently audited for compliance. The Manufacturer shall provide documentation proving any claims made with respect to the above if requested by the Purchaser.

#### 6.1.2 Prohibited Materials

Components that contain asbestos, mercury, cadmium, PCB's, silica gel containing the indicating agent cobalt chloride or any other products either known to or suspected of having carcinogenic or other detrimental long or short term effects on the health of personnel if they are inhaled, ingested or otherwise contacted during normal and reasonable use are not permitted in electrical equipment to be used on the Purchaser's site.

This requirement shall apply to all fabrication tools and equipment used that could leave dust particles or other residues inside the assemblies as well as components used in the construction of the MCC's and associated components covered by this Standard.

#### 6.1.3 Standardisation of Parts and Equipment

The Supplier shall select all components, parts and equipment used in the construction and fabrication of the switchboard from the Preferred Electrical Components List GRC-ES002.

If the Supplier wishes to utilise items not included in the preferred components list, approval shall be obtained from GRC in accordance with the requirements of GRC-ES002.

### 6.2 Service Conditions

The ambient conditions in the Gladstone Region are:

<b>Temperature:</b>	Maximum	40°C
	Daily average maximum hottest month	30°C
	Mean daily average maximum hottest month	26°C
	Mean yearly average	22°C
	Minimum	3°C
<b>Humidity:</b>	Maximum	100%
	Mean yearly average	73%
<b>Altitude:</b>	Essentially sea level	
<b>Atmosphere:</b>	Coastal marine with heavy salt and dust (sand, dirt, coal)	

### 6.3 Design Basis

The Switchroom building shall be designed to be transported to site while fitted out to minimize installation time on site. The equipment and switchgear to be installed and tested prior to dispatch to site is detailed in this Engineering Standard.

The Switchroom building shall be a weatherproof, prefabricated construction mounted on steel support columns in conjunction with a structural steel frame, and fitted with landing areas and access facilities.

The Switchroom building shall be provided with sufficient space to allow for future extensions of the switchgear and switchboards. Allowance shall be made for an extra tier at each end of switchgear and switchboards.

The building shall be air-conditioned and have lighting, power, communications and fire services installed as detailed in this Engineering Standard.

The building shall be as compact as practicable, to facilitate easy transportation around the site, whilst still providing space for future equipment as indicated in this document.

The Supplier shall size the building in accordance with the equipment installed, ensuring that all requirements of AS/NS 3000 and applicable Regulations are met. Specifically, clearances and exit space requirements shall be maintained around the equipment, especially with equipment doors opened to 90 degrees or switchgear withdrawn. Doors with pintle hinges that allow the door to be removed shall be considered as a hinged door (clearances should be measured with the door open to 90 degrees), as this is the normal method of operation.

The Supplier shall provide a suitable footing design to meet the individual site requirements. The Switchroom building shall be designed to achieve an operational life of 30 years. The design of the building, structural supports and concrete footings shall be carried out by, or under the direct supervision of a Registered Professional Engineer in accordance with the requirements of the Professional Engineers Act 2002.

Unless specified otherwise, the Switchroom building shall be designed for the following conditions:

- a) The building floor and associated access platforms shall be designed for the actual loads imposed by the equipment, including provision for additional future panels. As a minimum, the building floors shall be designed for a live load of 5kPa.
- b) The building floor shall be designed to withstand the dynamic forces associated with transport.
- c) The building shall be designed for a wind loading to suit Region C, Terrain Category 2 in accordance with AS/NZS 1170.
- d) The building shall be classified as having an Importance Level of 4 in accordance with the National Construction Code corresponding to an Annual Probability of Exceedance of 1:1500.
- e) The building shall be classified as a Class 10a structure in accordance with the National Construction Code.
- f) Earthquake design forces shall be determined based upon AS1170.4 (Earthquake load): Hazard factor of 0.15.

The Supplier shall provide documentation indicating compliance with the above conditions as specified in Section 10.

## **6.4 Construction Requirements**

### **6.4.1 Structural Steel Work**

The building shall be a steel framed skeletal structure with cladding and linings to suit the external environment and the internal function of the room.

- a) The roof framing shall consist of Lysaght or Stramit purlin sections with flat sheet internally.
- b) The structure shall provide a reasonable level of protection against malicious attack (i.e. vandal proof).
- c) No external parts including cladding and fasteners shall be made of aluminium.
- d) All stainless steel components shall be electrically insulated from galvanised or plain steel to avoid galvanic corrosion.
- e) Removable lifting brackets that extend beyond the line of the wall to minimise damage during crantage shall be located to provide a balanced lift with all equipment assembled within the building.
- f) Floor deflection during lifting shall be limited to the allowances specified for the installed switchboard.
- g) Square hollow section (SHS) galvanised columns and cross bracing shall be provided to support the switchroom at a height of 900mm to the underside of the building chassis, unless otherwise specified.
- h) The switchroom shall have a bolted connection to the stubs allowing convenient bolt fitment at building installation.
- i) All wall and floor penetrations for the access of cable trays and bus ducts shall be reinforced to ensure building structural integrity is maintained.
- j) Steel framing and joists shall not restrict any part of gland plates, cable tray or bus duct entry points to equipment to be installed or marked for future installation.
- k) All structural steelwork and fixings shall be hot dipped galvanised to AS/NZS 2312.

### **6.4.2 Stairways and Platforms**

Stairways and platforms shall be provided where shown on the drawings at the specified external door locations.

These shall be of normal structural construction, using prefabricated steel components, suitable for bolted assembly at site and designed to comply with AS1657 – Fixed Platforms, Walkways and Ladders – Design Construction and Installation.

- a) Stairways and platforms shall use Webforge or an approved equivalent grating. Removable guardrails shall be provided.
- b) The platform for external equipment access doors shall be designed to withstand switchgear loads, and shall incorporate removable guardrails to facilitate the movement of equipment.
- c) Gratings shall be banded at openings in platforms and around removable panels.
- d) Gratings shall be neatly cut and fitted around columns, support legs, machinery, piping, ducts and other similar installations.
- e) Gratings shall be fixed using multi-purpose clips, clamped or screwed to the support structure as per the manufacturers specification.
- f) Guardrails, steps, handrails and platforms to be hot dipped galvanised after fabrication.
- g) All stair treads shall be provided with a yellow visual abrasive nosing similar to Webforge “Webgrit”.



### 6.4.3 Roof, Walls and Ceilings

- a) Walls and roof shall have a Fire Resistance Level of 120/120/120.
- b) Walls and roof shall be a minimum of 75mm thick either in sandwich panel or framed construction. All materials used shall be non-combustible.
- c) Walls and ceilings shall have a minimum 75 mm, R2.5 foil faced fibreglass blanket, non-flammable core.
- d) All roof and wall cladding shall be Trimdek Hi-Ten Colorbond (Ultra Steel) cladding 0.48BMT fixed with cyclone washers screwed at every crest.
- e) The colour of the roof sheeting shall match the colour of the external wall sheeting, unless otherwise specified.
- f) External walls shall achieve a minimum total R-value of 1.9.
- g) Internal walls and ceilings shall be finished with pre-painted flat steel sheet (painted both sides). Internal colour shall be "Off White".
- h) Unless otherwise specified, exterior wall colour shall be "Surfmist".
- i) The minimum ceiling height above floor level shall be the greater of:
  - o 2800mm
  - o 300mm higher than the switchgear height
  - o Minimum height recommended by the switchgear manufacturer
- j) Adequate clearance shall be provided for the installed equipment and any overhead items such as cable tray, cabling, air-conditioning ducting etc.
- k) The roof shall be sloped and fitted with a suitable barge capping to provide a neat clean roof line. All joints shall be fully sealed using a flexible durable sealant to ensure a completely weatherproof enclosure.
- l) All cladding, flashing and capping shall have an "XSE" heavy duty protective coating system.
- m) Guttering, complete with downpipes, shall be provided around the complete building. A rain canopy shall be installed over the personnel access door using the same sheeting type as the roof.

### 6.4.4 Doors and Door Frames

- a) The switchroom shall be provided with at least one single door for personnel access and one double door for equipment access.
- b) All personal access doors shall be a minimum of 2040 mm x 1000 mm x 50 mm. Double doors should be at a minimum 2800mm high x 1600mm x 50 mm.
- c) Doors shall be flush panel heavy duty external type, clad in 'Colorbond' sheeting. They shall be dust tight and fit for purpose in operation within the sites environmental conditions.
- d) External access doors shall open outwards from the switchroom.
- e) Unless specified otherwise, doors and door frames shall be fitted with the following hardware:
  - o **Hinges:** Three heavy duty stainless steel butt hinges (per door)
  - o **Latches:** Lever type, heavy duty:
    - External: Kaba 601C-25SCP
    - Internal: Crash bar door latch
  - o **Locksets:** Satin Chrome finish, Kaba MS2SCP

- **Flush Bolts:** Stainless steel, heavy duty, 25 mm shoot
  - **Closers:** Kaba 9026SIL mounted on the internal side of the door
  - **Kick-plate:** 1.2 mm stainless steel kick plate screw fixed to both sides. Kick plate shall be 400 mm high and width shall be 50 mm less than door width
  - **Sealing:** Rubber sealing around full perimeter of each leaf
- f) On double doors, the door hardware shall be supplied as follows:
- On the active leaf (left door when entering the Switchroom):
    - Install crash bar door latch
    - No latch or lock outside
  - On the inactive leaf:
    - Install flush bolts top and bottom on the inside, top flush bolt long enough to access from the floor
    - No latch or lock outside
- g) If the building is required to be locked, GRC will provide lock barrels for installation prior to despatch.

#### 6.4.5 Floors and Penetrations

- a) The floor shall consist of compressed fibre cement flooring (minimum thickness of 18mm) fixed to RHS steel joists and shall include penetrations as required for cable entry.
- b) All interior floor surfaces shall be covered with 2.5 mm flexible sheet vinyl complying with AS 2055, glued to flooring in accordance with manufacturer's recommendations. All joints shall be fully welded to form a waterproof seal. A 100 mm PVC skirting shall be glued to the floor-wall joint after the vinyl is laid. The floor covering shall be a hard wearing surface designed to resist scratching and gouging from equipment and personnel traffic. The floor covering shall be grey in colour.
- c) A layer of 3mm plywood shall be installed over the vinyl flooring temporarily to protect the flooring during installation.
- d) Switchroom floors shall have a minimum tolerance of  $\pm 1$  mm in any one metre circular area and a tolerance of  $\pm 3$  mm over the entire switchboard length.
- e) The switchroom floors shall have a tighter tolerance if this is required to meet the switchboard requirements.
- f) Reinforced floor or wall penetrations shall be positioned as dictated by the switchboard manufacturer and as required by all other equipment to be installed within the switchroom to facilitate connection of external cabling and cable trays.
- g) 5mm brass gland plates shall be provided when appropriate by the switchboard manufacturer.

#### 6.5 Heating, Ventilation and Air Conditioning (HVAC) Services

The Switchroom building shall be fitted with an air conditioning system with a capacity capable of maintaining the temperature at 25°C dry bulb with normal electrical equipment loadings and for the specified external ambient temperature range service conditions.

- a) The air conditioning system shall incorporate a minimum of two split-system air conditioning units based on Mitsubishi inverter type units.
- b) The air conditioning equipment shall control the temperature within the range specified taking into account the inside heat generated, outside ambient conditions and solar radiation. Where a building is air conditioned by more than one unit, the size of the plant shall be

selected such that with one unit out of service, the room temperature shall be no more than 40°C all year round.

- c) The evaporator shall have plumbing fitted to drain condensate water to an external drain using sewer grade PVC condensate pipe 40 mm NB discharging approximately 100 mm above a hard surface that does not drain under the switchroom. No drip trays or plumbing joints shall be installed above switchgear.
- d) Ducted air conditioning systems are not preferred. Should the design requirements and conditions indicate that ducted air conditioning is the best solution, the Supplier shall provide a written design proposal to the Superintendent for approval.
- e) The switchroom shall be provided with an isolator for each air conditioner mounted externally in a location easily seen from the normal pedestrian approach route to the switchroom. The isolators shall be clearly labelled with the names of the air conditioners.
- f) Air conditioner units must have the facility for being automatically shutdown in the event of a fire in the Switchroom building.
- g) A positive pressure of 15-20Pa shall be maintained within the room and an adjustable pressure relief damper shall be provided to allow regulation of this pressure without loss of cool air.
- h) Openings on wall for inlet and return air ducts shall be provided with one and a half (1.5) hour fire rated dampers which shall be automatically closed if a fire is detected inside the room.
- i) A separate room temperature sensor shall be provided to allow for connection to a local PLC for monitoring of the switchroom internal temperature via the site SCADA system.
- j) Each air conditioning unit shall indicate its alarm status via voltage free contacts for connection to a local PLC for monitoring via the site SCADA system.
- k) The system shall be installed by qualified gas fitters.

## **6.6 Fire Services**

- a) The Switchroom building, including doors, shall have 120/120/120 fire resistance level (FRL) in accordance with the National Construction Code unless otherwise specified.
- b) 4.5kg carbon dioxide fire extinguishers complete with signage and a suitable wall bracket shall be provided inside and outside the building adjacent to each exit. Each fire extinguisher shall be installed in an approved UV stabilised plastic cabinet.
- c) A fire detection and alarm system shall be installed in accordance with the requirements of AS1670.1 and shall include as a minimum:
  - o Tyco Vigilant F3200 Fire Indicating Panel (FDCIE) installed indoors, adjacent to the main access door with 24 hour back up battery and voltage free contacts for remote indication and tripping of HVAC systems.
  - o Tyco Series M614 smoke detectors.
  - o Manual call points installed indoors adjacent to the main access door and externally next to each access door (complete with weatherproof kit).
  - o Weather resistant strobe light and siren installed externally to the building.
  - o Labelling and signage in accordance with AS1670.1.
- d) The system shall be installed by qualified fire system installers.

## **6.7 Electrical Services**

### **6.7.1 Distribution Board**

The Supplier shall provide a 36 pole lighting and power Distribution Board in accordance with Engineering Standard GRC-ES005 – Light and Power Distribution Boards.

- a) All circuits for lighting and small power shall be protected using 30mA RCD type circuit breakers to AS/NZS 3000.
- b) The distribution board and all ancillary equipment shall be of types listed in Engineering Standard GRC-ES002 – Preferred Electrical Components.
- c) All cabling for light and power circuits shall be concealed in ceiling and wall spaces and mechanically protected through penetrations with the use of ridged or flexible electrical conduit.

### **6.7.2 Lighting**

The switchroom shall be provided with internal energy efficient LED lighting to provide a minimum illumination of 240 lux with a uniformity of 0.5.

- a) Luminaires shall be positioned so that their output is not obstructed by overhead cable trays and air conditioning ducts and provides adequate illumination to the front of the switchgear.
- b) Light fittings shall be surface mounted Pierlite PWP 236 or approved equivalent.
- c) Internal lighting shall be controlled by two-way switching located at the main access doors.
- d) An external luminaire shall be installed above each outside door and wired to the daylight controlled section of the Distribution Board.
- e) Emergency and exit lighting shall be provided according to AS/NZS 2293.1.
- f) Each light fitting shall be labelled in accordance with Engineering Standard GRC-ES-008 – Equipment Identification.

### **6.7.3 Small Power**

The Switchroom shall be provided with a minimum of four RCD protected 10A general purpose outlets. These shall be spaced evenly throughout the switchroom. Two separate circuits containing two double GPOs each shall be installed.

## **6.8 Switchroom Earthing**

- a) The Switchroom building shall be provided with a main earth bar of minimum dimensions 40mm x 6mm x 1500mm mounted on stub insulators beneath the building.
- b) The earth bar shall be drilled for M10 bolts every 50mm, for connection of main earth conductors and equipment earthing cables.
- c) Two earth conductors shall be provided between opposite corners of the switchroom structure and the earth bar.
- d) Two earth conductors shall be provided between the MCC earth bar and the switchroom earth bar.

## 6.9 Safety Equipment

- a) The Switchroom building shall be supplied with a low voltage rescue kit comprising:
- Insulating Gloves
  - Insulated Torch
  - Rescue Crook
  - Fire Blanket
  - Multi-trauma Dressing
  - Sign for attachment at the main switch reading “Isolate Here”
- b) Storage locations for all these items shall be provided in the switchroom and shall be easily accessible and clearly marked.
- c) An electrical resuscitation board, in compliance with relevant Australian standards shall be provided and mounted in the room.

## 6.10 Signage

As a minimum, the following signs shall be provided for each switchroom building:

- a) Switchroom name, displayed adjacent to each access door. The labels shall be stainless steel 150mm high black lettering on high-visibility yellow background.
- b) “Danger No Unauthorised Entry 415V”
- c) “Doors To Be Locked At All Times”
- d) Other equipment safety warning signs as required by regulations.
- e) Resuscitation signage on the inside leaf of each door.

## 6.11 Other Equipment

Where specified, the following equipment shall be installed according to the appropriate manufacturer’s instructions:

- LV switchboards and MCC’s
- PLC cabinets
- Communications equipment cabinet
- Variable speed drives
- Cable ladder and associated supports
- Other miscellaneous equipment as shown on the layout drawing

## **7 INSPECTION AND TESTING**

### **7.1 Routine Testing**

The switchroom supplier shall carry out all routine tests or any tests required to prove compliance with this specification, the drawings and the relevant standards. The testing shall include the following as a minimum:

- a) Continuity test of earthing systems.
- b) Insulation resistance test of lighting and small power circuits.
- c) Continuity and polarity tests on all circuits.
- d) Functional and operation checks of complete installation including circuit breakers, residual current devices, general purpose outlets and light fittings.
- e) Illumination level measurements.
- f) Checks for installation compliance with drawings and specifications.

### **7.2 Test Certificates**

The supplier shall provide test certificates for all routine testing carried out. These shall be forwarded to the purchaser within 7 days of completion of the tests.

### **7.3 Witnessing**

In addition to the Routing Testing outlined above, the Supplier shall make allowance for factory acceptance testing (FAT). These tests shall be carried out to the satisfaction of, and if necessary, in the presence of the purchaser's representative. The supplier shall provide 7 days' notice to enable the purchaser's representative to witness such tests.

## **8 TRANSPORTATION AND STORAGE**

- a) The switchboards and other equipment items fitted to the building shall be suitably braced and / or wrapped in 'bubble wrap' for protection against damage during loading, transport, unloading and storage.
- b) Care shall be taken to ensure that packing tapes used to hold 'bubble wrap' or any other bracing in place are not secured to paintwork items that will be damaged upon removal of such tape upon the switchroom reaching site.
- c) Where damage occurs in this regard, repairs on site required to be carried out are to be arranged by the Supplier at the Supplier's cost.
- d) Equipment sensitive to damage due to vibration such as plug-in relays and the like shall be removed and separately packed in clearly marked containers.
- e) Heavy items that may dislodge during transportation shall be disconnected and packed separately.
- f) Each container shall be clearly and indelibly labelled and shall contain all assembly fittings, accessories and instructions for refitting.

## **9 PAINTING AND SURFACE PROTECTION**

Steelwork surface preparation, anti-corrosion protection and the surface coating system shall be to Australian Standards. Evidence shall be provided that these items meet Australian Standards.

## 10 DOCUMENTATION AND DRAWINGS

The Supplier shall provide full drawings and documentation for the Switchroom building. This shall include:

- a) General arrangement drawings showing all equipment to be installed prior to construction.
- b) Detailed structural drawings of the switchroom.
- c) Lighting and power layout drawing.
- d) Lighting and power distribution board single line diagram.
- e) Heat loading calculations and HVAC system design.
- f) Fire detection and alarm system design.
- g) All relevant manuals/data sheets pertaining to all of the equipment installed inside the switchroom, including air conditioning and fire protection systems.
- h) Evidence that surface protection and painting meets the requirements of Australian Standards.
- i) Evidence that the design requirements outlined in Section 6.3 (a – f) have been met.

Final copies of all documentation shall be provided within two weeks of Factory Acceptance Testing.

The Supplier shall provide 2 paper copies of all documentation in hardbound folders, plus an electronic copy on CD in a structured folder arrangement.

All drawings shall be provided in AutoCAD electronic file format (.dwg) and in PDF format.