Interior Engineering

Electrical Services Specification

for

Replacement of Existing Building Main Switchboard

at

Rail Centre 1
305 Edward Street
Brisbane Qld 4000

on behalf of

QueenslandRail

Project No	9208.2
Specification No	11400.2
Revision	A

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Table of Contents

1 Record of Issue 4
2 General 4
2.1 Interpretation of Terms 4
2.2 Form of Contract 5
2.3 Tender / Contract Documents 5
2.4 Documents Provided by the Engineer 5
2.5 Alternatives 5
3 The Scope of Work 6
3.1 By the Contractor 6
3.2 By Others 7
4 Pre and Post Tender Requirements 7
4.1 Application 7
4.2 Familiarisation 7
4.3 Programme 7
4.4 Hold Points 8
4.4.1 Requirement 8
4.4.2 Written Notification 8
4.5 Documentation to be Submitted Prior to Commencement 8
4.6 Continuity of Existing Services 9
4.7 Site Access 9
4.8 Inspection of the Works 9
4.9 Defects Liability 9
4.10 Maintenance 10
4.10.1 Generally 10
4.10.2 Routine Testing and Maintenance 10
4.10.3 Call-out Service 11
5 General Installation Requirements 11
5.1 Materials and Workmanship 11
5.2 Existing Installation 12
5.3 Temporary Work 12
5.4 Cutting and Chasing 12
5.5 Fire Stopping 12
5.6 Interference and Segregation of Services 12
5.7 Finishes 13
5.8 Colours of Equipment and Accessories 13
5.9 General Cabling and Wiring Practices 13
5.10 Cable Support Systems 13
5.10.1 Generally 13
5.10.2 Cable Tray 14
5.11 Hoisting and Scaffolding 14
5.12 Explosive Fixing Devices 14
5.13 Cleaning Up and Removal of Rubbish 14
5.14 Record Documents 14
5.15 Maintenance Logbooks 15
5.16 Reports 16
6 Alterations & Additions Works 16
6.1 Supply 16
6.2 Utility Metering 16
6.3 Co-generation Agreement 16
6.4 Main Switchboard (MSB) 17
6.4.1 General 17
6.4.2 Construction 19
6.4.3 Manufacturer's Information Label 20
6.4.4 Installation 21

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6.5 Existing Automatic Transfer Switch Panel 21
6.6 Existing Generator Control Panel 21
6.7 Surge Protection 22
6.8 Active Power Regulator (APR) 22
6.8.1 APR System 22
6.8.2 Performance Requirements 23
6.8.3 Control & Monitoring 23
6.8.4 APR Construction 24
6.8.5 APR Installation 24
6.9 Switchgear and Control Gear 24
6.9.1 Lockable Main Isolator ACB's 24
6.9.2 Automatic Transfer Switches 25
6.9.3 Power Management Meters 27
6.9.4 Main Switchboard Sub-main Control & Other MCCB's 27
6.9.5 Fuse Carriers and Fuse Bases 28
6.9.6 BMS Control & Monitoring Terminals 28
6.9.7 Current Transformers 28
6.10 Electrical Cables and Wiring 29
6.10.1 Generally 29
6.10.2 "Normal" Supply Mains Cables 29
6.10.3 Rerouting / Extension of Existing Sub-main Cables 29
6.10.4 Existing "Emergency" Supply Mains Cables 30
6.10.5 New "Emergency" Supply Mains Cables 30
6.10.6 Temporary MSB Interconnecting Cabling 30
6.10.7 240V Control Wiring 30
6.10.8 BMS Monitoring ELV Control Wiring 30
6.10.9 BMS Communications Wiring 30
6.11 Prospective Fault Levels and Discrimination 30
6.12 Labelling 31
6.12.1 Switchboards, Control Panels & the Like 31
6.12.2 Cables 31
6.12.3 Warning Notices 31
6.12.4 Informative Notices 31
6.12.5 BMS System Upgrading / Programming 31
6.13 Preliminary Testing & Commissioning of Installation 38
7 Final Acceptance 39
8 Practical Completion 40
8.1 Generally 40
8.2 APR Performance Verification 40
9 Appendix A 41
10 Tender Form 44

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1 Record of Issue

Revision	Details	Author	Checked	Date
A	Tender Issue	RAH	DW	20/09/16
2	Revised Approval Issue	RAH	DW	1/08/16
1	Approval Issue	RAH	DW	4/04/16

2 General

2.1 Interpretation of Terms

The terms used in this specification shall be interpreted in accordance with the following:

Building Proprietor	Means the building owner or any person duly nominated and authorised for the time being or from time to time to act for and on behalf of the building owner as their representative.
Principal	Means Queensland Rail or any person duly nominated and authorised for the time being or from time to time to act for and on their behalf as their representative.
Engineer	Means Interior Engineering or any person duly nominated and authorised for the time being or from time to time to act for and on behalf of Interior Engineering as their representative.
Contractor	Means the Principal Contractor pursuant to the Work Health and Safety Act engaged by the Principal for the execution of the whole of the Works.
Contract	Means the agreement between the Principal and the Contractor for the execution of the Works irrespective of the form of agreement and includes all documents associated with such agreement to which reference may properly be made in order to ascertain the rights and obligations of the parties.
The Works	Means the whole of the Works to be executed in accordance with the Contract.
Supply	Means supply and delivery to Site ready for installation. Warranties, defects liability and maintenance as specified shall apply only to the materials being supplied (i.e. the installation component is excluded).
Install	Means install, test and commission ready for service and includes the supply and installation of all fixings, supports, accessories and ancillary equipment, etc. obviously necessary for completion of the Works. Warranties, defects liability and maintenance as specified shall only apply to the installation component (i.e. the supply component is excluded).
Date of Acceptance of Tender	Means the date on which written notice of acceptance of tender is issued to the Sub-contractor by the Contractor.
Supply and install / Provide	Means supply, install, test and commission, ready for service. Warranties, defects liability and maintenance shall apply to all work and materials associated therewith.
Shall / Must	Means that the requirement is mandatory.
To approval / Approved	Means to the approval of and as approved in writing by the Superintendent. The onus of obtaining such approval(s) rests with the Sub-contractor.
Equal / Approved Equal	Means deemed by the Superintendent to be an equivalent or acceptable alternative for a particular item of material, a complete system and / or installation method specified and duly approved by the Superintendent, in writing, for use in the execution of the Works.
Ready for service	Means complete in every respect and capable of providing continuous, safe and efficient operation in accordance with the requirements indicated in detail in and implied by the Contract Documents.
Site	The lands and other places to be made available to the Contractor by the Principal for the purposes of the Contract and where the Works are to be executed.
Record	Means document information in detail and submit to the Superintendent or other person or persons as particularly specified.
Report	Means both record the information and submit a summary of same therewith to the Superintendent or other person or persons as particularly specified.
This specification	Means the whole of the Contract Document (refer Clauses “Form of Contract’ and “Tender / Contract Documents".
Month	Means calendar month.

These definitions shall apply only insofar as they do not conflict with the Contract Conditions or any other Conditions as issued by the Principal at the time of tender. Where such conflict occurs, these terms shall be interpreted as appropriate with regard to the Contract Conditions and other Conditions issued in accordance with the directions of the Principal.

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2.2 Form of Contract

The Works shall be carried out under a Contract subject to the Conditions of Contract issued by the Principal with this specification at the time of tender in addition to the Conditions and other requirements indicated in this specification.

2.3 Tender / Contract Documents

The Tender / Contract Documents for the Sub-contract Works shall comprise the Conditions of Contract applicable to the Contract as issued by Queensland Rail and this specification.

Each section of this specification shall be read in conjunction with all other sections and all other Tender / Contract documentation and the requirements of each section and each other Tender / Contract document shall apply equally to all other sections and all other Tender / Contract documents insofar as such requirements are relevant. Failure to observe such requirements may result in rejection of the equipment or reduced payment for non-complying work.

The documents listed below also form part of this specification:

- Drawings as follows:

Drawing No	Drawing Title
9208.2 / E1	Rail Centre 1 New Main Switchboard – Schematic Arrangement
9208.2 / E2	Alterations & Additions to Existing ATS & Generator Control Panels
9208.2 / E3	Floor Plans and Details
9208.1 / E1	Rail Centre 1 New Main Switchboard – Over-Track Cabling Arrangement by Others *

(* Issued for information only)

The services layout provided shall be taken as reasonably accurate for tender purposes only. All final measurements, together with any other information required to carry out each portion of the Works, shall be obtained on Site before commencing the Works. In particular, the exact location of each item of equipment shall be confirmed on Site prior to installation and, provided the final agreed location is not greater than two (2) metres in any direction away from the position indicated in the original tender documents, it shall be installed, as directed, without additional cost to Contract.

Sizes indicated and the spaces allocated for the accommodation of the services specified are minimum only. The Contractor will be deemed to have allowed in tender for any variations to such sizes and any changes to space requirements necessary for the proper completion of the Works and operation of the equipment to meet the guarantees required by the Contract documentation.

2.4 Documents Provided by the Engineer

Where all or any part of this specification (including drawings) is issued electronically in ".dwg" file format or ".pdf" file format to assist the Contractor in the execution of the Works (e.g. the production of Operating and Maintenance Manuals, Shop and / or Record Drawings, etc.), these files shall, under no circumstances, be distributed, sold or disclosed to any third party without the written consent of the Engineer. Where such files are supplied, the Engineer takes no responsibility for the accuracy thereof with regard to architectural backgrounds and / or layout details provided by others.

It shall be the responsibility of the Contractor to ensure the final Operating and Maintenance Manuals, Shop and / or Record Drawings, etc. accurately reflect the Works being described.

2.5 Alternatives

Where trade names have been used in this specification to describe systems and / or materials, these are intended to convey only minimum requirements with regard to appearance, quality and performance. It will, however, be deemed that the particular systems and types, manufacture, models, etc. of materials specified by trade name will be used in the execution of the Contract Works unless alternative systems and / or materials have been specifically offered by the Contractor and formally accepted at the time of tender.

The alternative offer must be accompanied by a statement that describes clearly, and in detail, every proposed departure from the specification and provide sufficient technical information to enable a full and proper assessment of the suitability of the proposed alternative to be made.

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Alternative systems and / or materials offered during the Contract period will only be considered where:

- The specified systems and / or materials or alternative systems and / or materials accepted at the time of tender have been discontinued and / or are otherwise unavailable to meet the Works program through no fault of the Contractor.
- The alternative systems and / or materials being offered are at least equal in performance and construction and of similar aesthetic appearance with regard to size, shape and finish as the specified systems and / or materials they are intended to replace.
- The offer is accompanied by a statement that describes clearly, and in detail, every proposed departure from the specification and sufficient technical information to enable a full and proper assessment of the suitability of the alternative(s) being offered to be made.
- The alternative is submitted to allow minimum three (3) working days for the assessment and approval process without disruption to the Works program.

Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid. Alternate bids must list any deviations from this specification.

Once an alternative has been approved in lieu of specified materials, the Contractor shall not submit any further alternatives for the same type of system and / or materials.

3 The Scope of Work

3.1 By the Contractor

The Contractor shall be responsible for the supply and installation of all appliances, equipment, materials, labour, cartage, cranage, tools, plant, fixings, support systems, etc. necessary for the proper execution of the Works together with all obvious and incidental work. If neither the specification nor drawings contain any mention of minor items that, in the opinion of the Superintendent, are reasonably and obviously necessary for the satisfactory completion of the Works, such items shall be provided by the Contractor without additional cost to the Contract.

Below is a brief description of the work to be executed. This list does not purport to contain all items of work and materials to be provided but is only a general outline of the scope of work that is specified in more detail elsewhere herein.

- Supply and installation of a new building main switchboard.
- Supply and installation of a new active power regulator (APR).
- Alterations to the existing Automatic Transfer Switch (ATS) panel.
- Alterations and additions to the existing generator control panel.
- The staged disconnection and removal of all existing cables entering and leaving the existing main switchboard and re-routing / extending and connecting those cables to the new main switchboard.
- Supply and installation of new ELV BMS monitoring cabling associated with all ELV BMS outputs from the new APR to the existing BMS system.
- Supply and installation of new communications cabling associated with MODBUS RS485 outputs to the existing BMS system from the new main switchboard and the new APR.
- Disconnection and removal of the existing building main switchboard.
- The provision of testing and commissioning of the complete installation alterations and additions ready for service.
- Certification of the Works immediately prior to Practical Completion.
- Payment of all fees, giving all notices, obtaining all permits and filling in all necessary application forms for the Principals signature, as appropriate, in association with the Works.
- Defects Liability for the Works. The Defects Liability period shall be for twelve (12) calendar months from the date of Practical Completion of the Works.
- Testing and maintenance of the Works for the Defects Liability period.
- Provision of documents as particularly specified including; Reports, comprehensive Operating and Maintenance Manuals, Record Drawings, Maintenance Logbooks, etc.

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3.2 By Others

- Supply and installation of new “emergency” (generator) supply mains to the new switchboard. 3m of cabling will be left coiled above the location of the existing generator control panel and 6m will be left coiled above the proposed location of the new main switchboard for final connections ready for service at both ends by this Contractor.
- Supply and installation of new 240V 50Hz control cabling between the new main switchboard and the existing generator control panel. 3m of cabling will be left coiled above the location of the existing generator control panel and 6m will be left coiled above the proposed location of the new main switchboard for final connections ready for service at both ends by this Contractor.
- Arrangement with the appropriate fire services maintenance contractor for the isolation of the FIP during power outages and payment of all costs associated therewith.
- Arrangement for additional Security personnel to attend Site during Works if and as required.

4 Pre and Post Tender Requirements

4.1 Application

These requirements apply only insofar as they do not conflict with any other Conditions issued by the Principal at the time of tender. Where conflict occurs, the Conditions as issued by the Principal shall take precedence.

4.2 Familiarisation

The Contractor will be deemed to have:

- Attended a tender Site inspection arranged to allow tenderers the opportunity to inspect and document all Site specific conditions necessary to complete their tender proposals.
- Carefully examined all of the Contract documents and the Site at the time of tender, to have obtained whatever additional information was considered necessary for a complete and thorough understanding of the Works at that time.
- Made due allowances in tender for the provision of a complete working installation.

Unforeseen difficulties will in no way relieve the Contractor from the full execution of the Works in accordance with the requirements of the Contract documents.

4.3 Programme

The Works shall be carried out to conform to the programme submitted by the Contractor at the time of tender and approved by the Principal with acceptance of tender.

The Works shall be staged so as to minimise interruptions to supply within the building.

The program must clearly define the following key dates:

- The proposed date for the commencement of the Works on Site.
- The proposed date for factory inspection of the new main switchboard by the Superintendent immediately prior to its delivery to Site.
- The proposed date for final delivery of the new main switchboard to Site.
- The proposed date for delivery of the new APR to Site.
- Full details of the staging of the Works.
- Proposed times and dates for all partial and full power shutdowns, preferred shutdown times and durations, etc. as necessary for the completion of the works.
- The proposed date for commencement of Contractor’s final testing of the electrical installation on Site.
- The date for completion of Contractor’s final testing of the electrical installation on Site.
- The proposed date for commencement of final APR Equipment Supplier commissioning and testing on Site.
- The date for completion of final APR Equipment Supplier commissioning and testing on Site.
- Full details, including proposed times and dates, of any building power shutdown requirements, including preferred shutdown times and durations, necessary to complete the works.
- The proposed date for overall Practical Completion of the installation.

Ensure that orders for all necessary materials required to complete the Works by the dates are placed in sufficient time to enable delivery to Site to suit the final accepted Works programme.

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Ensure that the Works programme is constantly kept up to date during the course of the Contract and kept fully co-ordinated with equipment manufacturers' and suppliers delivery schedules, etc. Each new revision of the program must be submitted to the Superintendent within one (1) day of any update made.

4.4 Hold Points

4.4.1 Requirement

The following hold points shall be observed:

1. Upon submission of specified "Documentation to be Submitted Prior to Commencement" (refer clause of same name elsewhere herein).
2. Upon submission of notice that the new main switchboard is ready for inspection at its place of manufacture as specified elsewhere herein.
3. Upon completion of the mechanical installation of the new main switchboard on Site and prior to the connection of any supply thereto to allow inspection and acceptance of switchboard mechanical installation.
4. Upon completion of all new cable support system works prior to installing any cables to allow inspection and acceptance of cable support system.
5. Upon completion of cabling installation prior to terminating cables to allow inspection and acceptance of cabling installation.
6. Upon termination of cable terminations prior to "closing-in" to allow inspection and acceptance of cabling terminations.
7. Upon completion of the installation after the submission of full written details and results of all testing and commissioning undertaken by the Contractor and preliminary record documents as specified elsewhere herein and the issue of written advice that the installation is ready for final acceptance and immediately prior to the commencement of the final acceptance inspection.
8. Upon submission of notice of any power shutdown necessary to complete the Works.

4.4.2 Written Notification

Provide minimum seven (7) days' written notice for all hold points. Should any work that is deemed to be unacceptable proceed beyond any specified hold point, all such work shall be completely removed and replaced by the Contractor without additional cost to the Contract.

4.5 Documentation to be Submitted Prior to Commencement

The Works shall be carried out to conform to the documentation submitted by the Contractor at the time of tender and approved by the Principal with acceptance of tender. This documentation shall include the following as a minimum requirement:

- A statement of compliance with the requirements of this specification.
- Details regarding country of manufacture and the country of origin of the materials that will be used in the construction of:
  - The new main switchboard.
  - The new APR.
- Shop drawings of the proposed new main switchboard including physical layout, dimensional parameters and single line schematics.
- Shop drawings of the proposed APR unit including physical layout, dimensional parameters and single line schematics.
- Description of co-generation facilities sufficient for submission to the supply utility company for approval.
- Quality assurance standards observed in the manufacturer of the proposed switchboard.
- Quality assurance standards observed in the manufacture of the proposed APR.
- Dimensioned drawing of the proposed installation including the proposed locations for the new main switchboard and the new APR including dimensioned clearances, etc. and all new main cable routes, joints, etc.

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4.6 Continuity of Existing Services

Queensland Rail is responsible for providing important and essential transport facilities and continuity of existing services is therefore important and essential.

Accordingly, only Works that could reasonably be expected not to cause interruption to existing services anywhere on Site or within the building, or in any other way interfere with the normal business operation of the Principal or the day to day operation of the building will generally be permitted during the hours of 0500 and 2100 the following day.

All other Works are generally required to be carried out outside of these hours and must be reported to the Superintendent for approval prior to commencement. Such report must clearly state:

- The full details of the Works to be carried out.
- The estimated duration of the Works.
- The time(s) tentatively proposed for the Works to take place in order to maintain the Works program.

No such Works are to be carried out until written approval to proceed is given.

At all times, minimum disruption to existing services must be maintained.

It will be deemed that full allowance for all obvious "Out of Hours" Works necessary to complete the installation ready for service has been made in tender and claims for additional remuneration with regard to such Works will not be entertained.

4.7 Site Access

Make suitable arrangements for access to the Site for the purposes of executing the Works via the Superintendent and use only such entrances and other means of access to the Site as directed and only at the times allocated.

4.8 Inspection of the Works

Comply with the directions of, and execute the Works to the satisfaction of the Superintendent. The Superintendent shall be granted access to the Works at all times and be provided with every reasonable facility necessary to enable full and comprehensive inspection of all materials and workmanship used in the execution of the thereof. This will include the following:

- Inspection of new main switchboard at its place of manufacture immediately prior to shipping it out to Site.
- The inspection of any off-Site preparation work and manufacture of other materials at any place where such preparatory work and / or manufacture is being carried out at the discretion of the Superintendent.

4.9 Defects Liability

The Defects Liability period for the Works shall be twelve (12) months.

During the defects liability period, the Contractor shall:

- Ensure a full manufacturer’s guarantee is in place for the APR unit that covers:
  - Repair and / or replacement, as appropriate, of any part or parts of the APR unit that become broken or damaged or suffer from undue wear unless such damage or wear can be clearly shown to have been caused by carelessness or improper usage by some person other than the manufacturer and / or the manufacturer's employees.
  - Provision of comprehensive technical support and back-up for the Contractor with regards to the APR unit for the defects liability period in accordance with the requirements of the clause “Maintenance” contained elsewhere herein.
- Repair or replace any part or parts of the installation other than the APR unit that become broken or damaged or suffer from undue wear unless such damage or wear can be clearly shown to have been caused by carelessness or improper usage by some person other than the Contractor and / or the Contractor's employees.

All work associated with guarantees and defect rectification needing to be carried out after Practical Completion of the Works shall only be carried out outside of normal working hours.

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4.10 Maintenance

4.10.1 Generally

The maintenance period for the Works shall run concurrently with the defects liability period.

During the maintenance period, the Contractor shall:

- Provide comprehensive technical support and back-up with regards to the operation of the alterations and additions to the existing electrical services installation specified herein.
- Carry out all routine testing and maintenance of the alterations and additions to the existing installation specified herein.
- Provide a 24 hour call-out service with regard to the alterations and additions to the existing installation specified herein.

Minimum one month prior to the expiration of this maintenance period, the Contractor shall provide the Principal with a written quotation for maintenance of the installation in accordance with the requirements of this clause for a further minimum twelve (12) calendar months from the date of expiration of this maintenance period.

4.10.2 Routine Testing and Maintenance

During the maintenance period, the Contractor shall ensure that all routine testing and maintenance of the complete new main switchboard installation is carried out in accordance with the following:

- Six Monthly:
  - Conduct a visual inspection of the installation in accordance with the recommendations of AS / NZS 3019, “Electrical Installations – Periodic Verification”, Section 3, for wiring, equipment, etc. that has obviously failed, is obviously faulty or damaged or is showing obvious signs of imminent failure.
  - Any additional six monthly routine testing and maintenance procedures recommended by the switchboard manufacturer and / or the Contractor as contained in the Record Documents provided by the Contractor at Practical Completion of the Works.
  - Provide a brief maintenance report indicating the exact nature of any equipment failure / fault / damage and repair / replacement details, including cost quotations, associated therewith if appropriate (i.e. where wiring and / or equipment is found to have failed or is found to be faulty or damaged in any way, and where it can be adequately demonstrated that such failure / fault / damage is not covered by defects liability). This report shall include verification certification in compliance with clause 2.9 of AS / NZS 3019 and residual current device test certification.
- Annually:
  - As specified in bullet-point number 1 for six monthly routine testing and maintenance above plus the following:
    - Thorough cleaning out of the main switchboard and, where necessary, touching up of chips and scratches, etc. in paintwork with paint to match the colour of the existing.
    - Provision of verification of the installation at in accordance with the recommendations of AS / NZS 3019 “Electrical Installations – Periodic Verification”, Section 5.
    - Thermograph testing of switchboard.
  - Any additional annual routine testing and maintenance procedures recommended by the switchboard manufacturer and / or the Contractor as contained in the Record Documents provided by the Contractor at Practical Completion of the Works.
  - Provide a comprehensive maintenance report indicating the following:
    - The exact nature of any equipment failure / fault / damage and repair / replacement details, including cost quotations, associated therewith if appropriate (i.e. where wiring and / or equipment is found to have failed or is found to be faulty or damaged in any way, and where it can be adequately demonstrated that such failure / fault / damage is not covered by defects liability).
    - A general assessment of the overall state of the installation highlighting, in particular, any system(s) and item(s) of equipment which, in the opinion of the Sub-contractor, is / are showing signs of excessive wear, intermittent operation and / or immanent failure, etc.
    - Details of any additional preventative maintenance work recommended by the Sub-contractor to ensure continued reliability and good operating condition of the installation including cost quotations associated therewith.

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- Verification certification in compliance with clause 2.9 of AS / NZS 3019, residual current device test certification and thermograph test report.

Where wiring and / or equipment is found to have failed or is found to be faulty or damaged in any way, and where it can be adequately demonstrated that such failure / fault / damage is covered by defects liability, the Sub-contractor shall promptly repair or replace such equipment without cost.

Where wiring and / or equipment is found to have failed or is found to be faulty or damaged in any way, and where it can be adequately demonstrated that such failure / fault / damage is not covered by defects liability, the Sub-contractor shall, upon receipt of an official order, promptly repair or replace such equipment and invoice the Principal accordingly.

During the maintenance period, the Contractor shall also ensure that all routine testing and maintenance of the complete APR installation is carried out in accordance with the recommendations of the APR Equipment Supplier and the Record Documents provided by the Contractor at Practical Completion of the Works.

It will be deemed that the Contractor has allowed in tender for all costs associated with the provision of all routine testing and maintenance procedures specified herein.

4.10.3 Call-out Service

During the maintenance period, the Contractor shall provide a 24 hour call out service to promptly attend to all service calls associated with the installation.

Where wiring and / or equipment is found to have failed or is found to be faulty or damaged in any way, and where it can be adequately demonstrated that such failure / fault / damage is covered by defects liability, the Contractor shall promptly repair or replace such equipment without cost.

Where wiring and / or equipment is found to have failed or is found to be faulty or damaged in any way, and where it can be adequately demonstrated that such failure / fault / damage is not covered by defects liability, the Contractor shall:

- In the case of an "urgent" call-out, immediately repair or replace such equipment and submit a comprehensive written report to the Principal regarding such failure / fault / damage together with a detailed invoice indicating all labour and materials costs associated with rectification works.
- In the case of a "non-urgent" call-out, submit a written report to the Principal regarding such failure / fault / damage together with a detailed quotation for rectification works and, upon receipt of an official order, promptly repair or replace such equipment and invoice the Principal accordingly.

An “urgent” call out shall be taken to mean one that is associated with any system or equipment failure that may pose a threat to the safety of persons and / or property or create operational problems with regard to the normal business operations of the Principal resulting in financial loss. Should the Contractor fail to attend to an "urgent" call out, for any reason, the Principal reserves the right to engage the services of an alternative organisation to rectify the immediate problem(s) at the Contractor's expense.

5 General Installation Requirements

5.1 Materials and Workmanship

All works executed and all materials supplied shall be the best of their respective kinds and shall comply with:

- The rules and regulations of all Statutory Authorities having jurisdiction over the works current at the time of submission of tender;
- All codes, specifications and standards promulgated by the Standards Association of Australia current at the time of submission of tender;
- The requirements of this specification;

to the satisfaction of the Superintendent.

All new materials shall be suitable for their intended purpose having due regard to their installed location(s) within the Works. Where similar materials already exist within the installation, new materials shall match the existing in type, manufacture, finish, etc. as far as possible. Samples of all new materials to be used in the execution of the work shall be submitted to the Superintendent for approval before being installed.

Exercise due care and diligence in carrying out the Works. The Contractor will be held responsible for all damage done to the building by the Contractor, the Contractor's employees and any of the Contractor's sub-contractors whether such damage is done during the due performance of the Works or accidentally and shall make good all such damage without additional cost to the Contract.

The onus of ascertaining that all work and materials meet the requirements of this clause rests with the Contractor.

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5.2 Existing Installation

Carry out all demolition work necessary for the completion of the installation specified herein in accordance with the following:

- Disconnect and remove, at such times as appropriate any existing materials that will obviously become redundant with the new or altered construction whether particularly specified or not.
- Care shall be exercised to ensure that existing materials to be reused in association with the Works are not damaged in any way.

Thoroughly inspect, test and clean all existing materials being reused in the Works and ensure that such materials are adequately protected from damage for the duration of the Works until returned to service.

5.3 Temporary Work

All temporary work shall:

- Be supplied, installed, fully tested and commissioned ready for service, maintained and, after it is no longer required, completely disconnected and removed at such times as appropriate to suit the overall Works programme.
- Include the following:
  - Major temporary work (if any) as indicated elsewhere herein.
  - All minor temporary work necessary to enable the completion of the Works including the temporary disconnection of existing services that are to be retained for alterations and additions thereto, etc., as appropriate.

5.4 Cutting and Chasing

Cut all chases and penetrations necessary for the completion of the Works unless particularly indicated otherwise.

Before cutting any portion of the building, obtain the permission of the Building Proprietor. Allow in the tender for all costs associated with obtaining Structural Engineering surveys and X-ray reports on slab areas to be penetrated (if any) prior to cutting and all other approvals with regard to openings and penetrations cut in structural walls, floors, etc. if and as required and / or considered necessary by the Building Proprietor.

Making good all chases and penetrations other than penetrations through fire rated walls, floors, etc. (refer clause “Fire Stopping” below) will be by Contractor.

Ensure that all building penetrations associated with the Works specified herein are:

- Left sealed in accordance with all applicable regulatory and safety requirements to prevent the ingress of moisture and vermin.
- Are made airtight to ensure no degradation to the integrity of air conditioning systems.

5.5 Fire Stopping

All existing building penetrations through fire rated walls, floors, etc. becoming redundant, all new building penetrations through fire rated walls, floors, etc. and all existing building penetrations through fire rated walls, floors, etc. being retained and reused shall be backfilled and fire rated in accordance with the requirements of the Building Code of Australia.

All fire-stopping products are to be installed to the manufacturer’s specifications and certification of the integrity of the fire sealing methods and materials used for fire stopping shall be provided prior to Practical Completion.

5.6 Interference and Segregation of Services

Plan the installation prior to commencing the Works to ensure that, at the completion of the Works:

- Adequate segregation is maintained from all other services. Note that equipment associated with these Works shall not be supported from other services.
- Proper access to the new installation for maintenance purposes is provided.
- Proper access for maintenance purposes to all parts of the existing installation being retained is maintained.
- The installation will not interfere with the normal operation and maintenance of any other services on Site. This includes ensuring that the installation will not cause any radio frequency or electromagnetic interference with radio, television, communications, computer services, and the like throughout the installation.
- The entire installation will not be adversely affected by any other services on Site.

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In particular, the segregation of all electrical services cabling from cabling associated with all other services (communications, fire services, etc.) shall be maintained in accordance with the recommendations of all appropriate standards, rules and regulations and best industry practice.

5.7 Finishes

All plant, equipment, brackets etc. shall be protected from corrosion either by the inherent properties of the materials used or by the application of a suitable approved protective coating.

Ferrous metalwork installed in dry situations and protected from the weather within buildings and the like shall be finished in the following manner:

- Clean all surfaces removing rust, grease and scale to approval.
- Apply one (1) coat of rust inhibiting self-etching primer.
- Apply one (1) coat of zinc enriched primer.
- Stop all holes, imperfections, marks and blemishes with an approved filler and rub back to a smooth finish with wet and dry abrasive paper.
- Apply one (1) coat of all-purpose undercoat.
- Apply two (2) coats of synthetic enamel.

Non-ferrous metalwork shall be finished as follows:

- Stop all holes, imperfections, marks and blemishes with an approved filler and rub back to a smooth finish with wet and dry abrasive paper.
- Apply one (1) coat of all-purpose undercoat.
- Apply two (2) coats of synthetic enamel.

The protective coatings and all paintwork on all new materials shall be left in perfect condition at the completion of the Works. Blemishes shall be repaired and, if necessary, the equipment re-coated and / or re-painted or replaced to the satisfaction of the Superintendent.

Proprietary finishes not complying with the foregoing may be acceptable but shall only be used where prior approval has been obtained from the Superintendent.

5.8 Colours of Equipment and Accessories

Final colours for new materials exposed to normal view shall generally be selected to match the colour of the surface on which the materials are installed or, elsewhere, in accordance with AS 1345 but the final colours of all such equipment and accessories shall be as indicated on architectural drawings or as directed by the Superintendent on Site irrespective of any indications of colour given in this specification. It will be deemed that the Contractor has allowed in tender for the most expensive colour listed in the manufacturer's range for the type and manufacture of each individual item to be supplied in every case.

The onus of ascertaining final colour requirements for all new materials exposed to normal view rests with the Contractor.

5.9 General Cabling and Wiring Practices

Plan cabling and wiring systems and routing prior to installing any cables to ensure their integrity and performance.

All cables shall be run in straight lines, parallel to walls and other structural members where possible, and shall not traverse ceilings, walls, etc.

Support all cables in appropriate steel cable tray / basket fixed by approved methods to structural building elements.

5.10 Cable Support Systems

5.10.1 Generally

Cables shall not be supported from other services or ceiling support rods.

Existing cable support systems complying with the requirements of this clause may be reused wherever possible. New cable support systems shall be provided as required to complete the installation.

Before cables are installed, and after installation, ensure that all cable tray / basket and the like is thoroughly clean of any extraneous material such as cable scraps, dust, dirt and construction debris.

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If necessary, cable tray / basket and the like shall be protectively earthed by connecting to a protective earth wire originating from the electrical switchboard that serves the space in which such cable tray / basket is installed.

Co-ordinate all cable support systems with one another and with other services on Site as necessary.

5.10.2 Cable Tray

Cable tray shall be Unistrut Fastrak hot dipped galvanised type or approved equal and shall:

- Be assembled using only purpose-made cable tray bends, cross-overs, tees, risers and splices as supplied by the cable tray manufacturer.
- Be supplied and installed with all necessary support hangers, brackets, etc. necessary to adequately support the load associated with the cables being supported with the tray loaded to its maximum capacity (weight). Under no circumstances will sagging of any cable tray, new or existing being reused, be tolerated.
- Be secured to and supported only from the building structure by approved fixing methods using purpose made suspension brackets.

5.11 Hoisting and Scaffolding

Provide all scaffolds, ladders, scissor lifts, etc. as necessary to complete the Works specified herein.

5.12 Explosive Fixing Devices

Explosive fixing devices shall not be used under any circumstances.

5.13 Cleaning Up and Removal of Rubbish

Keep working areas clean and tidy and periodically remove rubbish and other debris created by the performance of the Works. At the completion of the Works, clear away and remove from the Site all rubbish and debris for which the Contractor is responsible and leave the complete installation in a thoroughly clean and efficiently operating condition.

5.14 Record Documents

On completion of the Works and prior to final acceptance, Record Documentation for the whole of the new main switchboard installation shall be provided. Such documentation, as a minimum requirement, shall be an accurate record of the Works carried out and shall be in the form of an Operating and Maintenance Manual comprising the following:

- Full business name and contact details for the Principal, Engineer and Contractor together with the date of Practical Completion of the Works.
- A comprehensive index.
- A section giving a detailed description of the complete installation including detailed user operating instructions for all equipment and systems provided.
- A section containing a copy of this specification.
- A section giving full details of all manufacturer's guarantees and warranties with regard to materials, equipment and systems used in the execution of the Works associated with the installation.
- A section containing:
  - A statement of compliance confirming that the new main switchboard installation satisfies the requirements contained in this specification.
  - A copy of the switchboard manufacturer’s quality assurance standards.
- A section containing:
  - Detailed performance specification for the APR unit installed.
  - A statement of compliance confirming that the APR with satisfies the requirements contained in the clause “Active Power Regulator” contained elsewhere in this specification.
  - A copy of the APR unit manufacturer’s quality assurance standards.
- A section containing comprehensive equipment schedules and a list of names and contact telephone numbers for future reference for all other manufacturers and suppliers whose materials have been used in the execution of the Works.
- A section containing copies of all test sheets and commissioning data, including a full record of all system settings and programming defaults (e.g. appropriate settings for electrical installation protective devices to achieve proper discrimination and grading between each level of protection and the next highest level, etc.)

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as they were left at the completion of testing and commissioning for the installation. This shall also include copies of all test sheets and commissioning data associated with APR testing and commissioning carried out by the APR Equipment Supplier.

- A section containing one (1) complete set of all Record Drawings associated with the installation including:
  - As built drawings of the new main switchboard including physical layout, dimensional parameters, single line schematic and equipment ratings.
  - Drawings of the APR unit system layout including the APR physical parameters and single line schematics.
  - A plan showing:
    - The layout of the new main switchboard installation including the location of the switchboard and APR and dimensioned clearances around the switchboard and APR.
    - All main cable routes, joints, etc.
- A comprehensive maintenance section for the whole of the Works that provides:
  - Complete equipment schedules.
  - Details of all routine testing and maintenance of equipment and systems as required by regulation (if any).
  - Details of the switchboard manufacturer's recommendations for routine testing and maintenance procedures associated with the new main switchboard.
  - Details of all APR Manufacturer / supplier recommendations for routine testing and maintenance procedures associated with the APR unit.
  - Details of the protective maintenance agreement between the Contractor and the APR Manufacturer / supplier.
  - All routine testing and maintenance of other equipment and systems as required by regulation (if any).
  - Additional routine testing and preventative maintenance procedures as recommended by the Contractor to ensure on-going safe, efficient operation of the installation and to minimise the risks of installation failures.
  - Step by step procedures for basic troubleshooting and repairing basic problems associated with the installation for use by suitably qualified and competent tradesmen in testing and maintaining the installation.

  A detailed maintenance procedures and checklist similar to that indicated in Appendix A to this specification shall be included in this section.

One (1) copy of preliminary Record Documents in approved .pdf file format shall be submitted to the Superintendent for approval within two (2) weeks of the completion of all commissioning and testing of the complete installation.

Any modifications to the preliminary Record Documents that may be required by the Superintendent shall be incorporated in final Record Documents, which shall then be provided as follows:

- Two (2) separate compact discs containing files in approved .pdf file format.
- One hard copy to be left installed in the record documents section of the new main switchboard.

5.15 Maintenance Logbooks

On completion of the Works and prior to final acceptance, provide an approved new maintenance logbook for the alterations and additions to the existing installation specified herein for the purposes of keeping full and comprehensive details of all routine testing and maintenance and all service calls associated therewith.

Details to be recorded in this logbook, in simple table format, shall include the following:

- Time and date of commencement and completion of each routine testing and maintenance visit together with a brief list of all testing and maintenance carried out, test results obtained, etc. as appropriate.
- Time and date of each received call-out service request, the time and date of attendance to such request, the nature of the reason(s) for such call-out, a brief description of all rectification works carried out and the test results obtained from testing carried out prior to returning the installation to normal service.

The logbook shall have sequentially numbered pages in triplicate with provision for the signatures of the Building Proprietor, the Tenant and the service person. The required distribution shall be clearly indicated on each page as follows:

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- Original – The Principal.
- Duplicate – Service Person.
- Triplicate – Retain in Book.

The maintenance logbook shall be left on Site in installed in the record documents section of the new main switchboard.

5.16 Reports

Where reports are required by this specification, each such report shall:

- Have each page clearly numbered and identified with regard to the subject matter of the report and the date and revision number of the report.
- Include the following information:
  - The name of the building (if appropriate), the Site address and the date of completion of the report.
  - The name of the Principal.
  - The name and signature of the author of the report.
- In the case of defect reports and condition reports associated with the maintenance of fire protection systems and equipment, comply with the requirements of AS 1851.
- In the case of general reports required during the construction period, be submitted to the Superintendent in sufficient time to enable a minimum of one (1) working day for the Superintendent, upon receipt of such report, to review and comment upon the information / recommendations contained therein and issue appropriate instructions with regard to any actions arising therefrom without delaying the Works.

6 Alterations & Additions Works

6.1 Supply

400V / 230V, 50Hz, three phase, 4 wire power supply, originating from the local Supply Provider's supply system currently exists at the existing building main switchboard serving the building. This supply shall be rerouted and / or extended, as necessary, and reused to serve the new main switchboard.

New 400V / 230V, 50Hz, three phase, 4 wire "emergency" (generator) supply mains will be provided to the new main switchboard by others. This Contractor shall connect these cables at both the existing generator control panel and within the new main switchboard ready for service.

6.2 Utility Metering

Rearrange and carry out alterations and additions to existing building utility metering as necessary for the completion of the Works in accordance with the following:

- New utility metering current transformers shall be supplied and installed within the new main switchboard.
- The existing utility metering panel and meters shall be retained and reused.
- Provide appropriate labelling / re-labelling for all utility metering and metering equipment as necessary at the completion of works.

Liaise with the appropriate electricity supply retailer or on-seller to ensure that all necessary energy metering alterations and additions comply with their requirements.

6.3 Co-generation Agreement

The Contractor shall liaise with and assist the Superintendent with regard to negotiations between the Principal and the local supply provider for a suitable co-generation agreement by:

- Obtaining and filling in all necessary application forms as far as practicable (i.e. with all technical and other information excluding the personal details of the Principal) and submitting such forms to the Principal for completion.
- Making submission of the necessary forms to the appropriate supply provider for processing.
- Providing all additional technical advice and information necessary to support the application on behalf of the Principal if and as required.

In this regard, it will be deemed that the Contractor has allowed in tender to engage the services of the ATS supplier to provide detailed technical and other information regarding the operation of the installed ATS units if and as necessary and pay all costs associated therewith.

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6.4 Main Switchboard (MSB)

6.4.1 General

The new MSB is to be an approved, totally enclosed, flush metal fronted, floor standing cubicle type complying with the requirements of AS / NZS 61439 and the following:

Characteristics	User Requirement
Earthing system	TN-C-S
Nominal voltage (V)	415V
Transient over-voltages	Category IV at switchboard
Rated frequency f_n Hz	50Hz
Additional on-Site testing requirements – wiring, operational performance & function	As indicated on the drawings and specified elsewhere herein
Prospective short-circuit current at supply terminals I_{cp} (kA)	Minimum 43kA
SCPD in the incoming functional unit requirement	An SCPD is required in each incoming functional unit
Co-ordination of short-circuit protective devices including external short-circuit protective device details	Required – exact details to be determined on Site
Data associated with loads likely to contribute to the short circuit current	It should be noted that the both the utility and generator supplies may be connected in parallel to the main switchboard for short periods during “no-break” changeover. The 43kA prospective short-circuit current at supply terminals specified above allows for this situation
Protection against internal arcing fault currents	AS / NZS 3000 & Appendix ZC of AS / NZS 61439.1
Location type	Located indoors
Protection against ingress of solid foreign bodies and ingress of water	Min. IP54
Maximum overall dimensions and weight	Must be able to be accommodated within the space provided with due regard to the existing building structure and all clearances required by AS / NZS 3000.
External conductor type(s)	Various cables (exact sizes / types to be determined on Site)
Direction(s) of external conductors	As indicated on the drawings
External conductor material	Generally all copper
External phase conductor, cross sections & terminations	Exact details to be determined on Site
External PE, N, PEN conductors cross sections & terminations	Exact details to be determined on Site
Access to manually operated devices	Switchboard will be accessible only to “authorised” persons (i.e. installed in a secure, lockable space)
Isolation of load installation equipment items	Refer drawings and confirm on Site
Requirements related to accessibility in service by ordinary persons – requirement to operate devices or change components while the ASSEMBLY is energised	Minimum level of accessibility as indicated on the drawings and as specified elsewhere herein
Requirements related to accessibility for inspection and similar operations	Minimum level of accessibility as indicated on the drawings and as specified elsewhere herein

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Requirements related to accessibility for maintenance in service by authorised persons	Minimum level of accessibility as indicated on the drawings and as specified elsewhere herein
Requirements related to accessibility for extension in service by authorised persons	Minimum level of accessibility as indicated on the drawings and as specified elsewhere herein
Protection against direct contact with hazardous live internal parts during maintenance or upgrade (e.g. functional units, main busbars, distribution busbars)	Minimum levels of protection as indicated on the drawings and as specified elsewhere herein
Rated current of the ASSEMBLY I_{nA} (amps)	2,500A / phase
Ratio of cross section of the neutral conductor to phase conductors – phase conductors above 16mm^2	100%

Standard default arrangements shall be adopted where not varied in the above table.

The MSB shall be supplied and installed, ready for service, complete with:

- A lockable main isolator air circuit breaker in the main incoming utility supply to the switchboard.
- Supply distributor's metering current transformers, potential fuses, test block, etc. as required by the Supply distributor in the incoming utility supply in accordance with the supply retailer's / on-seller's requirements.
- Private multi-function metering in the main incoming utility supply to the switchboard.
- An appropriately rated moulded case circuit breaker (MCCB) for connection of the external APR being supplied and installed by this Contractor.
- Surge protection on the main incoming utility supply and appropriately rated moulded case circuit breaker (MCCB) associated therewith.
- A lockable main isolator air circuit breaker in the main incoming generator supply to the switchboard.
- Private multi-function metering in the main incoming generator supply to the switchboard.
- Main three phase "normal" (utility) supply and "emergency" (generator) supply busbar systems as particularly indicated on the drawings.
- ASCO automatic load transfer switches (ATS's) for main control and changeover of supply from "normal" to "emergency" and *vice versa* for moulded case circuit breaker (MCCB) sections of the main switchboard and sub-mains leaving the switchboard as follows:
  - Safety services MCCB section.
  - Lifts 1, 2, 4 & 5 sub-mains.
  - Lift 3 sub-mains.
  - Mechanical services section.
  - Low level light & power rising sub-mains.
  - High level light & power rising sub-mains.
  - UPS services sub-mains.
  - Miscellaneous services MCCB section.
- Moulded case sub-main control circuit breakers (MCCB's) for the following safety services:
  - The smoke control system.
  - Hydrant booster pump.
  - Essential services distribution board.
  - Fire indicator panel.
- Moulded case sub-main control circuit breakers (MCCB's) for the following miscellaneous services:
  - Submersible pump.
  - Pump room hydraulic control panel.
  - Platform level lighting and power.
  - Minor UPS.
- All other controls and switchgear obviously necessary for the satisfactory operation of the installation including relays, fuses, etc.
- Full length neutral and earth bars.

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- All necessary miscellaneous internal wiring, connections and terminations, wiring support systems for internal wiring and all cables and wiring entering and leaving the switchboard, etc.
- Blank spaces for future equipment as particularly indicated on the drawings. Provide appropriate busbar connections, mounting and fixing facilities, etc. for all such future equipment. All blank spaces on escutcheon panels and the like shall be fitted with blank covers or appropriate filler pieces to approval.
- Labelling in accordance with the requirements of clause “Labelling” contained elsewhere herein.

The switchboard shall be sized to fit within the space indicated on the drawings and shall be back-to-back front connected.

As this switchboard will form a very important part of Queensland Rail’s critical railways system infrastructure, however, it must be designed for maximum reliability and, very importantly, maximum serviceability, and comply with the following:

- The incoming “normal” and “emergency” supplies must be totally mechanically and electrically segregated from each other such that one incoming supply section can be shut down and accessed without the need to shut down the other incoming supply section.
- The “normal” supply busbars and “emergency” supply busbars must be totally mechanically and electrically segregated from each other such that one busbar section can be accessed without the need to shut down supply to the other section.
- All switchgear sections of the switchboard as indicated on the drawings must also be mechanically and electrically segregated from each other such that any section can be shut down and accessed without the need to shut down the entire switchboard or any other section.
- A separate mechanically and electrically segregated section containing 240V 50Hz field wiring terminals for the connection of all 240V 50Hz control cables leaving and entering the switchboard.
- A separate mechanically and electrically segregated section containing field wiring terminals for the connection of all extra low voltage dry contact output and communications cabling for the purposes of remote BMS control and monitoring.
- A separate mechanically and electrically segregated section to hold a complete set of full-sized hard copy "Record Documents” and the maintenance logbook for the switchboard.

6.4.2 Construction

All work and materials used in the manufacture of new MSB shall comply with the clause “Standards and Authorities” and the requirements specified elsewhere herein with regard to form of construction, fault withstand and IP rating.

The external surface of the switchboard shall be filled, rubbed down and painted in accordance with the clause "Finishes" contained elsewhere herein. Other proprietary finishes of equal or better quality may be acceptable but only with the express approval of the Superintendent. The switchboard shall be finished white internally.

The final design of the switchboard, including all control circuits associated therewith, shall be the responsibility of the Contractor and detailed general arrangement, schematic arrangement and control drawings shall be submitted to the Superintendent for approval prior to commencing construction.

Provide suitable louvered vents fitted with fine bronze mesh welded to the inside of switchboard cabinets at the top and bottom of each cubicle for ventilation.

Removable hinged escutcheon panels shall:

- Be fitted, where appropriate, to neatly exposed only the toggles of circuit breakers, operating mechanisms of switchgear, instrumentation, indicating lights, etc., and to conceal busbar, terminals, wiring, etc. and prevent accidental contact with live parts. No escutcheon shall be larger than 750mm wide or 0.85m² in overall area.
- Be fitted with approved lift-off type hinges and lift-off handles.

Escutcheon fixings shall be approved knurled head type metal thread screws, held captive in the escutcheon plate, screwed into nut inserts or captive type nuts securely fixed to the switchboard case.

Lockable hinged doors shall be fitted to switchboard where particularly indicated and elsewhere where obviously appropriate such as the following:

- The section containing the field wiring terminals for the connection of 240V control field cabling.
- The section containing the field wiring terminals for the connection of cabling to the BMS system for BMS monitoring and control purposes.

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- The section containing the hard copy "Record Documents" and the maintenance logbook for the switchboard.

No switchboard door shall be larger than 1000mm wide without prior approval of the Superintendent. Each door shall be fitted with an approved robust door operating handle and keyed locking mechanism. All locks provided for the switchboard shall be identical and keyed the same and three (3) keys shall be supplied and handed over to the Principal on Site at Practical Completion of the Works.

Circuit breakers, switches, etc., shall be neatly flush mounted into the front of the switchboard to approval.

Busbars shall be used for all connections rated at 100A or more.

All busbars shall be high conductivity hard drawn copper with radius edges of sufficient cross-sectional area to carry not less than 150% of the current rating of the last protection device installed on the line side of the busbars and, in any case, shall not be less than 12mm x 3mm.

All busbars rated up to and including 200A shall be fully insulated and colour coded by means of PVC dipping. All busbars rated above 200A shall be fully insulated and colour coded, with the exception of joints, with approved heat-shrink PVC sleeving.

Readily accessible and removable busbar links shall be provided for the mounting of all current transformers.

Busbars shall be arranged and adequately supported on approved synthetic resin moulded type insulators, panels and cleats to safely withstand, without damage, the stresses consistent with the specified minimum fault withstand capacity.

Neutral and earth bars and links shall be:

- Installed in an approved location that will enable them to be readily viewed and accessed at all times during normal operation without the need to move or in any way interfere with other busbars, wiring or equipment contained within the switchboard enclosure.
- Brass or copper rectangular section.
- Fitted with tunnel type terminals for the termination of cables up to and including 6 mm2 and stud type terminals for the termination of cables larger than 6mm^2.
- Supplied and installed over the full length of multi-compartmented switchboards.

Neutral bars shall be of the same current rating as the phase busbars with which they are associated.

Provide adequate cable entries for all incoming and outgoing cables. Gland plates, fixed by means of approved metal thread screws screwed into nut inserts or captive type nuts securely fixed to the switchboard case, shall be provided for all cables larger than 10mm^2. Suitable knockouts / cut-outs shall be provided for all other cables.

Proprietary switchboards not complying strictly with the foregoing, including modular type switchboards, may be acceptable but shall only be used where prior approval has been obtained from the Superintendent at time of tender.

6.4.3 Manufacturer's Information Label

The switchboard shall be provided with a permanently affixed labelling in accordance with the requirements of Clause 6.1 of AS / NZS 61439.1 and the following:

- The information shown must include the following information as a minimum requirement:
  - Manufacturer's name or trade mark.
  - Date of manufacture.
  - Type designation or identification number or any other means of identification making it possible to obtain relevant information from manufacturer.
  - Short circuit withstand strength.
  - Degree of protection (IP rating).
  - Earthing system types for which the switchboard is designed. Where direct earthing is nominated, refer Queensland Rail Standard MD-10-192 for separate identification sticker also to be installed.
  - Form of internal separation for each zone.
  - Arc fault classification and personnel protection zone similar to the following "Australian Compliant" Arc Flash Label Single Location:

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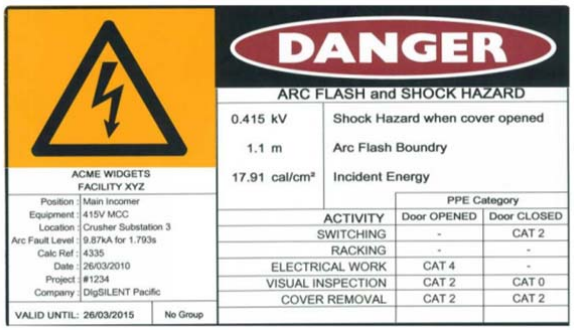

- IEC 61439-"X" (the specific part "X" to be identified).

All specified information labelling shall be kept together in a single prominent location that is readily accessible and open to view.

6.4.4 Installation

The new switchboard shall be mounted on an approved purpose-made minimum 100mm high plinth manufactured from mild steel channel and painted and finished to match the switchboard. The plinth shall be firmly and rigidly fixed in position to the structural floor slab by means of approved masonry anchors and galvanised screws or bolts fitted with galvanised flat washers and spring washers. The switchboard shall be firmly and rigidly fixed to its plinth by means of galvanised bolts fitted with galvanised flat washers and spring washers.

Galvanised shims shall be supplied and installed at fixing points where necessary to ensure that the switchboard is not distorted as the fixings are tightened.

6.5 Existing Automatic Transfer Switch Panel

Provide alterations and additions to the existing automatic transfer switch (ATS) panel as indicated on the drawings and in accordance with the following:

- Disconnect and remove the existing ATS units becoming redundant. The ATS units shall be disconnected and removed one by one only and only outside of normal hours at specific times to be agreed with the Principal. Each existing ATS shall only be disconnected after it has been verified that the new ATS in the new switchboard for the same service operates satisfactorily.
- Connect the existing incoming sub-mains cables from the existing main switchboard for each service straight-through to the appropriate existing outgoing sub-mains cables within the ATS Panel for that service. The incoming and outgoing cables shall be joined to approval immediately the redundant ATS unit for that sub-main has been disconnected and removed.
- The existing incoming "emergency" (generator) supply mains cables are to be retained and reused to maintain "emergency" supply to the existing UPS DB.
- All existing ATS auto / off / manual switches, circuit breaker manual open / close pushbuttons and circuit breaker open / close indicating lights, etc. made redundant by the disconnection and removal of the existing ATS units are to be completely disconnected and labelled as being no longer in use.
- The existing programmable logic controller (PLC) within the existing ATS Panel for ATS control shall be completely disconnected and labelled as being no longer in use.
- Supply and install suitable blank covers or filler pieces to blank off any openings left in escutcheon panels by the disconnection and removal of any existing equipment.

The existing incoming "emergency" (generator) supply input and ATS Panel busbar / wiring is to be retained and reused to maintain "emergency" supply capability to the existing UPS switchboard, "Sub-board UPS 1".

Provide appropriate labelling / re-labelling of the existing ATS Panel to accurately reflect the alterations and additions made in accordance with the requirements of clause "Labelling" contained elsewhere herein.

6.6 Existing Generator Control Panel

The existing Generator Control Panel which shall be retained and reused with the following alterations and additions:

- Supply and install a new 2000A TP circuit breaker for the control and protection of new "essential" mains to the new main switchboard.
- Disconnect the existing main switchboard "normal" / "emergency" supply availability sensing control cabling from the existing generator programmable logic controller (PLC) and connect the new "normal" /

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"emergency" supply availability sensing control cabling from the mains / phase failure relays within the new main switchboard.

Provide appropriate labelling / re-labelling of the existing Generator Control Panel to accurately reflect the alterations and additions made in accordance with the requirements of clause "Labelling" contained elsewhere herein.

6.7 Surge Protection

Surge protection for the incoming "normal" supply shall be provided UL 1449 type 1 installed within the new Site MSB in the form of an NHP CPTCPSBLOCKPLUS200, 3 phase, 200kA surge diverter or approved equivalent.

The unit shall be mounted within the switchboard such that the front of the unit can be readily viewed without opening switchboard doors or removing any switchboard panels.

Remote monitoring contacts within the surge diverter shall be wired out to extra low voltage terminals within the main switchboard for interfacing with the BMS. Supply and install appropriate control cabling from the BMS terminals to the nearest BMS interface terminal strip and make final connections at both ends, ready for service, to approval.

6.8 Active Power Regulator (APR)

6.8.1 APR System

The APR system shall be designed to provide high quality, automatic, seamless VAr control to maintain a displacement power factor of 1.0 ± 0.01pf or client selected power factor ± 0.01pf, within system stated rating and shall generally comprise a cabinet housing the following:

- A fully controlled thyristor bridge converter.
- A suitable capacitor bank.
- Suitable Input inductors.
- Suitable cabinet ventilation fans.
- Instrumentation, monitoring and system control.

The APR shall:

- Provide instantaneous, seamless, transient free response to variable VAr demand utilising a thyristor bridge converter. It shall be capable of correcting for lagging power factor.
- Be designed to prevent resonance and interaction with other equipment on the same supply. The APR shall not require detuning to prevent this resonance. The APR shall not generate transients or cause distortion to the voltage waveform.
- Be capable of operation with other switched capacitor power factor correction systems on the same supply.
- Be capable of stable operation with mains supply or standby diesel generator.

Converter switching devices shall be suitably rated to permit use of circuit breakers for protection. Fast acting semiconductor fuses will not be used. Converters shall be capable of withstanding a short circuit and tripping the output circuit breaker without damage.

The APR converter shall instantly block output from the source on loss of input supply. Stored energy shall be dissipated internally.

The existing incoming supply is from a single 1500kVA Supply Provider transformer with 100% in-house generator back-up.

An analysis of existing supply characteristics logged on Site over the period 01/03/2014 to 13/06/2015 at 30 minute intervals reveals the following information:

- Real Power:
  - Maximum indicated over the period: 926.894kW.
  - Minimum indicated over the period: 174.536kW.
- Power Factor:
  - Best indicated over the period: 0.725 lagging.
  - Worst indicated over the period: 0.541 lagging.

It should be noted that the existing harmonic characteristics of the supply are currently being determined and precise information regarding harmonic voltages and currents will be made available as soon as it comes to hand.

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6.8.2 Performance Requirements

The APR shall be designed to meet the performance requirements indicated based on the supply characteristics given.

Electrical:

- Power factor correction — 0.99 lagging
- Input voltage range — 415Vac +/- 10%
- Frequency range — 50 Hz +/- 5 Hz
- Regulation — to 0.01pf of set point
- Regulation time constant — Sub-cycle

NOTE:

PF compensation calculation based on highest recorded load and worst recorded PF:

kVA_1 (existing PF)	=	*Real Power (kW)/Current PF*	=	*926.894/0.541*	=	*1,713.298kVA*
kVAr @ existing PF	=	*$\sqrt{kVA_1^2-kW2}$*	=	*$\sqrt{1,713.298^2-926.894^2}$*	=	*1,440.922kVAr*
Proposed new PF	=	*0.99*				
kVA_2 (new PF)	=	*Real Power (kW)/New PF*	=	*926.894/0.99*	=	*936.257*
kVAr for new PF		*$\sqrt{kVA_2^2-kW^2}$*	=	*$\sqrt{936.257^2-926.894^2}$*	=	*132.075kVAr*
Compensation kVAr	=	*1,440.922 – 132.075*			=	*1,308.847kVAr*

- Harmonic Correction — To be tuneable

NOTE:

As also noted above, the harmonic characteristics of the existing supply on Site are currently being explored and more precise information will be provided prior to the commencement of manufacture of the APR equipment.

Environmental:

- Operating ambient temperature range: — 0 to 40 Degrees Centigrade
- Operating relative humidity range: — 15 to 95% non-condensing
- Enclosure rating: — IP20 indoor
- Cooling: — Forced air
- Audible noise: — < 80dBA
- Heat loss — <1kw per 100kVAr for lag correction

Interface Facilities:

- Modbus: — RS485 to APR Power Monitor
- Voltage free contacts: — 1

Other Facilities:

- Top cable entry required.
- Modbus output required for remote monitoring.

6.8.3 Control & Monitoring

The APR control shall be automatic and continuous for fast transient free response.

The APR shall be supplied with status indication lamps, individual control pushbuttons for start and stop functions and a power quality meter displaying source data on the front surface of the enclosure.

The APR power quality display shall be an LCD panel with easy to navigate menus. The following power monitoring (source) shall be accessible at the local panel:

- 3 phase and single phase real power (kW).
- 3 phase and single phase apparent power (kVA).
- 3 phase and single phase reactive power (kVAr).
- 3 phase and single phase real power factor (PF).
- 3 X single phase current (A).
- 3 X phase to phase voltage (V).
- 3 X single phase voltage (V).

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- Frequency (Hz).
- 3 phase and single phase harmonic distortion (THDV & THDi).
- Accumulated power (kWh, kVAh).

The control panel shall include the following:

- Start pushbutton
- Stop pushbutton
- Online lamp indication
- Offline / Fault lamp indication.

6.8.4 APR Construction

All work and materials used in the manufacture of APR shall comply with the clause “Standards and Authorities” and the fault withstand and the following IP rating requirements:

- A minimum fault withstand capacity of not less than the prospective fault current level at its installed location (refer clause "Prospective Fault Levels and Discrimination" contained elsewhere herein).
- Minimum IP54 degree of protection in accordance with the requirements of AS 1939.

The external surface of the cabinet shall be filled, rubbed down and painted in accordance with the clause "Finishes" contained elsewhere herein. Other proprietary finishes of equal or better quality may be acceptable but only with the express approval of the Superintendent.

The final design of the APR, including the layout of equipment and all control circuits associated therewith, shall be the responsibility of the Contractor and shall be in accordance with the documentation provided at the time of tender as required under the clause “Documentation to be Submitted” contained elsewhere herein unless specifically approved otherwise.

Provide suitable fan(s) and vent(s) for cubicle for ventilation.

Provide adequate cable entries for all incoming and outgoing cables. Gland plates, fixed by means of approved metal thread screws screwed into nut inserts or captive type nuts securely fixed to the switchboard case, shall be provided for all cables larger than 10mm². Suitable knockouts / cut-outs shall be provided for all other cables.

6.8.5 APR Installation

The APR shall be designed to be mounted on an approved purpose-made plinth to be supplied by the APR equipment manufacturer / supplier painted and finished to match the APR cabinet with the APR unit.

The Contractor shall:

- Install the APR unit in its final position within the installation in accordance with the following:
  - The unit shall be firmly and rigidly fixed in position to the structural floor slab by means of approved masonry anchors and galvanised screws or bolts fitted with galvanised flat washers and spring washers.
  - Galvanised shims shall be supplied and installed at fixing points where necessary to ensure that the unit is not distorted as the fixings are tightened.

6.9 Switchgear and Control Gear

6.9.1 Lockable Main Isolator ACB’s

Each lockable main isolator ACB shall:

- Be a 3 pole NHP Terasaki TemPower 2 double break type 2500A 50kA withdrawable air circuit breaker fitted with TemPro Premier OCR or approved equal. The OCR shall provide MODBUS output to the appropriate BMS monitoring output terminals within the new main switchboard to enable remote display of the following:
  - Real time energy measurement:

    I, V, kW, MWh, PF, Hz, harmonics (3rd to 19th minimum).
  - Intelligent fault analysis:

    Status, fault type, fault size, tripping time, fault history.
  - Maintenance information:

    Trip circuit supervision, protection relay supervision, contact temperature alarm.
- Incorporate an integral LCD on the front to display all of the real time energy measurement, intelligent fault analysis and maintenance information indicated above.

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- Have an interrupting capacity of not less than 43kA.
- Have a short term time withstand rating (I_{cw}) of not less than 50kA 1 second).
- Have the brand name, type / model number and rated current clearly visible when installed from the front without the need to remove escutcheon panels. Alternatively, labelling may be provided on the front of switchboard escutcheon panel adjacent to the isolator to indicate this information.
- Be adjustable electronic overcurrent relay type.
- Be flush escutcheon panel mounted in a manner that enables the LCD display to be readily read and operated.

6.9.2 Automatic Transfer Switches

Each automatic transfer switch (ATS) shall:

- Be an ASCO 7000 series unless particularly approved otherwise (refer clause “Alternatives” contained elsewhere herein regarding offers based on alternative equipment).
- Include auto / manual switching for load transfer and isolation facilities as follows:
  - In auto mode the ATS shall operate as follows:
    - Load will be automatically transferred from normal supply to emergency supply upon normal supply failure as soon as availability of acceptable emergency supply is sensed. In the event of normal supply failure being sensed and no acceptable emergency supply being available, no load transfer shall occur.
    - Load will be automatically transferred from emergency supply to normal supply upon sensing that the normal supply has been returned to normal. Whenever both an acceptable normal supply and acceptable emergency supply are sensed as being available, the load shall always be transferred / left connected to the normal supply.
  - In manual mode the ATS shall operate as follows:
    - Automatic control will be locked out.
    - The load will be able to be manually disconnected from both the normal and emergency supplies (i.e. completely isolated).
    - The load will be able to be manually connected to the normal supply irrespective of the status of the emergency supply.
    - The load will be able to be manually connected to the emergency supply irrespective of the status of the normal supply.
- Transfer the load without interruption (closed transition 4 pole to 4 pole with overlapping neutral) by momentarily connecting both sources of power when both sources are present and acceptable except for the ATS associated with supply to the UPS switchboard. The maximum interconnection time shall be not more than 100 milliseconds.
- Transfer the load with slight interruption (open transition 4 pole to 4 pole with overlapping neutral) in the case of the ATS associated with supply to the UPS switchboard
- Operate as a conventional break-before-make (open transition) switch when the power source serving the load fails and an acceptable alternative supply is sensed as being available in all cases.
- Have main electrical contacts that are electrically operated by momentarily energized solenoid mechanisms and positively lock and are mechanically held in position such that contact pressure is maintained at a constant value minimising contact temperature rise and guarding against short-term momentary outages.
- Have facilities for testing the entire emergency power system, including the automatic transfer switch, with no interruption of power to the load. When in the "Test" mode, automatic operation of the ATS shall be locked out but it shall still be capable of being used as a manual transfer switch.
- Be completely withdrawable when isolated for inspection or maintenance without removal of power conductors or the use of any tools in accordance with appropriate regulatory requirements.
- Be microprocessor controlled using a Group 5 controller supplied with a suitable integral display keypad for viewing all available data and setting desired operational parameters associated with the unit. All instructions and controller settings shall be easily accessible, readable and able to be accomplished without the use of codes, calculations, or instruction manuals.
- The following parameters shall be adjustable via DIP switches on the controller:
  - Nominal line voltage and frequency.
  - Single or three phase sensing.

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- Operating parameter protection.
- Transfer operating mode configuration (Open transition, Closed transition or Delayed transition).

Each ATS controller display keypad must be capable of continuously monitoring and displaying the following for both the normal and emergency supply inputs both locally with the display and keypad and remotely via serial communications port access:

- Voltage and frequency
- Phase rotation.
- All programmed operational parameter settings.

The following voltage and frequency pickup, dropout and trip settings shall be continuously programmable in 1% increments either locally with the display and keypad or remotely via serial communications port access:

Parameter	Source	Dropout / Trip	Pickup / Reset
Undervoltage	N&E, 3 phase	70% to 98%	85% to 100%
Overvoltage	N&E, 3 phase	102% to 115%	2% below trip
Underfrequency	N&E	85% to 98%	90% to 100%
Overfrequency	N&E	102% to 110%	2% below trip
Voltage unbalance	N&E	5% to 20%	1% below dropout

Preferred phase rotation shall also be programmable (ABC or CBA).

The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

Each ATS shall incorporate appropriate time features:

- An adjustable time delay of 0 to 6 seconds to override momentary normal source outages and delay all transfer and engine starting signals.
- An adjustable time delay 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
- An adjustable time delay of 0 to 6 seconds to override momentary emergency source outage to delay all retransfer signals during initial loading of engine generator set.
- Two time delay modes (to be independently adjustable) for re-transfer of the load to normal supply. One time delay shall be for return to normal supply following an actual normal supply power failures and the other shall be for return to normal supply after using the test mode function. Both time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal supply is acceptable.
- A time delay adjustable from 0 to 60 minutes for generator run-on cool down period upon shut down of the diesel generator.
- The controller shall also include the following built-in time delays for Closed Transition Transfer with Bypass-Isolation operation:
  - 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
  - 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation.

All time parameters shall be adjustable in 1 second increments except for the extended parallel operation timer, which shall be adjustable in .01 second increments.

All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port. The time delay value displayed on the LCD or remote device shall be the remaining time until the next event occurs.

Each controller shall be supplied and installed complete with an ASCO 72EE2 Quad-Ethernet Module (QEM) communications module for the provision of the following network remote monitoring and control options:

- Remote monitoring:

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  - Status of normal supply, emergency supply.
  - Transfer switch status.
  - Transfer switch in “Auto” mode.
  - Transfer switch in “Manual” mode.
  - Transfer switch in “Test” mode.
  - Email Notification.
  - Statistics and Activity.
  - Event Log (with Print function).
  - Controller set-points.
- Remote control:
  - ATS transfer / re-transfer.
  - Generator test.
  - Bypass timer delays.
  - Generator start / stop.

The QEM communications module shall provide the following connectivity options:

- Modbus.
- SNMP.
- SMTP.
- Advanced Encryption Standard.
- Four Port Ethernet Switch.
- RS485 Port.

It should be noted that the following will not be accepted:

- ATS designs utilising circuit breakers, contactors, or the like not intended for continuous duty, repetitive switching or transfer between two active power sources.
- ATS designs that include overcurrent disconnect devices, linear motors or gears.

6.9.3 Power Management Meters

Supply and install an Emerson 5220 power management meter in association with each ATS to provide real time energy measurements and other system data for each individual MCCB section of the main switchboard and each individual set of sub-mains leaving the switchboard shall be provided as follows:

- System voltage (phase to neutral and phase to phase).
- Load amps (A).
- Power (kW).
- Reactive power (kVAr).

Remote reading of the following via MODBUS protocol by the existing BMS system shall also be provided for each individual MCCB section of the main switchboard and each individual set of sub-mains leaving the switchboard:

- Energy consumption (kWh, cumulative).
- Historical KW Demand.

6.9.4 Main Switchboard Sub-main Control & Other MCCB’s

Sub-main control other MCCB’s shall:

- Have an interrupting capacity of not less than 43kA.
- Have the brand name, type / model number and rated current clearly visible when installed from the front without the need to remove escutcheon panels. Alternatively, labelling may be provided on the front of switchboard escutcheon panel adjacent to the isolator to indicate this information.
- Be adjustable electronic overcurrent relay type for all circuit breakers with a rating of greater than 40A.
- Be flush escutcheon panel mounted.

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6.9.5 Fuse Carriers and Fuse Bases

Fuse carriers and fuse links shall comply with the requirements of AS 2005, class Q1 Type certified for category of duty 550 C80 and shall be high rupturing capacity type. Each fuse carrier shall be permanently marked to indicate the maximum fuse cartridge size it will accommodate and fitted with a marker that clearly indicates the size of the fuse cartridge fitted.

6.9.6 BMS Control & Monitoring Terminals

Main Switchboard:

Appropriate N/O auxiliary contacts within each main ACB shall be wired to suitable ELV output terminals within the new main switchboard for BMS monitoring status (open / closed).

Appropriate N/O dry contacts within each ATS shall be connected in series and wired to suitable ELV output terminals within the new main switchboard for new generator “start / stop” signal.

Appropriate N/O dry contacts within each ATS shall be wired to suitable ELV output terminals within the new main switchboard for BMS monitoring of the following in addition to the network monitoring specified:

- Status of supply at each ATS (normal supply available / emergency supply available).
- Status of each ATS (load connected to normal supply / load connected to emergency supply / supply to load isolated).
- ATS in “Auto” mode (for each individual ATS).
- ATS in “Manual” mode (for each individual ATS).
- ATS in “Test” mode (for each individual ATS).

All ELV terminals shall:

- Be grouped together in a common communications terminal block.
- Be provided for the termination of all communications field wiring associated with equipment provided within the main switchboard.

A minimum of 30% spare ELV terminals shall also be provided for future use.

Data / communications output terminals shall be provided within the new main switchboard for the connection of communications cables leaving the switchboard for remote control and monitoring of main control ACB OCR’s, each ATS and all switchboard instrumentation via MODBUS protocol.

All data / communications terminals shall:

- Be grouped together in a common communications terminal block.
- Be provided for the termination of all communications field wiring associated with equipment provided within the main switchboard.

A minimum of 30% spare communications terminals shall also be provided for future use.

New APR:

A set of dry contacts wired to suitable ELV output terminals shall be provided within the APR for remote monitoring of APR fault / failure.

Data / communications output terminals shall also be provided within the APR for data / communications cables leaving the APR for remote monitoring of the APR instrumentation via MODBUS RS485 protocol.

All ELV terminals shall:

- Be grouped together in a common ELV terminal block separate from the communications terminal block.
- Be provided for the termination of all ELV BMS field wiring associated with equipment provided within the APR.

A minimum of 30% spare terminals shall also be provided for future use.

All data / communications terminals shall:

- Be grouped together in a common communications terminal block separate from the ELV terminal block.
- Be provided for the termination of all communications field wiring associated with equipment provided within the switchboard as specified elsewhere herein.

A minimum of 30% spare terminals shall also be provided for future use.

6.9.7 Current Transformers

All current transformers shall:

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- Have primary current rating of not less than 120% of the maximum possible current that could be normally expected to flow in the primary circuit.
- Have secondary windings capable of operating at up to 5A (integral adjustment facilities enabling the output to be continuously adjusted shall be provided) set to match the equipment to which they are to be connected.
- Be capable of withstanding the prospective short circuit current at their installed locations.

Measurement current transformers shall:

- In each case be selected to specifically suit the instrument with which they are to be associated such that the accuracy of the instrument reading will not be compromised by the accuracy of the current transformer.
- Be mounted within switchboards on removable busbar sections.

6.10 Electrical Cables and Wiring

6.10.1 Generally

Supply and install all new, and all alterations and additions to existing cables and wiring systems necessary for the completion of the installation ready for service.

All cables used to extend existing mains / sub-mains needing to be extended shall match the existing cables they are extending with regard to type, stranding, insulation grade and external sheathing (including sheath colour) unless particularly approved otherwise.

Unless particularly indicated or approved otherwise, all new electrical cables, including new control cables, shall be stranded copper conductor insulated and sheathed type in accordance with the following as a minimum requirement:

- For working voltages up to 0.6 / 1 (1.2) kV, V90 Polymetric insulated type complying with the requirements of AS / NZS 5000.1.
- For working voltages up to 450 / 750V and for cables with conductors up to and including 16mm2, V90 Polymetric insulated type complying with the requirements of AS / NZS 5000.2 may be used.

All BMS monitoring control wiring between the new main switchboard and the BMS system shall be carried out using appropriate multicore cable with minimum 2.5mm^2 stranded copper conductors.

Unless particularly indicated or approved otherwise, all new MODBUS communications cables between the new main switchboard and the BMS system shall be 4 pair high performance unshielded twisted pair (UTP) Category 6 type with bare solid copper conductors, high density insulation and a PVC sheath coloured to match any existing BMS communications cables or as approved by the Superintendent.

6.10.2 “Normal” Supply Mains Cables

The existing incoming “normal” (utility) consumer’s mains cables from the existing substation will become redundant and shall be disconnected and removed. Supply and install new “normal” (utility) consumer’s mains cables from the substation to the new main switchboard. Connect as follows:

- Connect the cables within the new main switchboard ready for service prior to connecting the cables within the substation.
- Disconnect the existing cables within the substation and connect the new cables ready for service. This shall be done:
  - As soon as possible after the physical installation of the new “normal” (utility) consumer’s mains cables and the new main switchboard.
  - Only after temporary sub-mains have been installed between the existing main switchboard and the new main switchboard for the purposes of maintaining temporary supply to the existing main switchboard until all of the existing sub-mains can be rerouted / extended and connected to the new main switchboard.
  - Outside of normal hours at a specific time to be agreed with the Principal.

6.10.3 Rerouting / Extension of Existing Sub-main Cables

Disconnect and remove all existing sub-mains cables from the existing main switchboard and reroute and / or extend them as appropriate and reconnect them to the appropriate new ATS’ on the new main switchboard. Each set of sub-mains shall be rerouted and / or extended one by one and only outside of normal hours at a specific time to be agreed with the Principal. The re-outing / extension of each set of sub-mains for each service shall be done:

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- Only after the new main switchboard has been installed with both “normal” and “emergency” supply connected and it has been confirmed that the new ATS for that particular service in the new main switchboard operates satisfactorily.
- At the same time as the existing ATS for that service in the existing ATS Panel is disconnected and removed and the sub-mains entering and leaving the existing ATS Panel for that service are joined straight through within the ATS Panel.

6.10.4 Existing “Emergency” Supply Mains Cables

The existing incoming “emergency” (generator) supply mains cabling to the existing ATS Panel is to be retained and reused to maintain “emergency” supply capability to the existing UPS switchboard, “Sub-board UPS 1”.

6.10.5 New “Emergency” Supply Mains Cables

New three phase, 4 wire “emergency” (generator) mains cables from the existing generator switchboard to the new main switchboard will be supplied and installed by others. Make all final connections ready for service of these cables at both ends. The new mains will be fire rated (“Firestop” or equal) type with an installed capacity of not less than 2,000A / phase.

The new “emergency” mains cables must be installed prior to commencing disconnection and removal of any existing ATS units and /or the making of any straight-through joints in the existing sub-mains within the ATS Panel.

6.10.6 Temporary MSB Interconnecting Cabling

Supply and install temporary interconnecting cabling between the new main switchboard and the existing main switchboard for the purposes of maintaining temporary supply to the existing main switchboard after the existing consumer’s mains have been rerouted / extended and reconnected to the new main switchboard. Such cables shall:

- Be installed ready for service prior to re-routing and / or extending the existing “normal” consumer’s mains cables to the new main switchboard.
- Remain in place until such time as all existing sub-mains currently connected to the existing main switchboard have been rerouted / extended and reconnected to the new main switchboard at which stage the temporary cables shall be disconnected and removed.

6.10.7 240V Control Wiring

A 20 core multicore control cable between the new main switchboard and the existing generator control PLC in the existing Generator Control Panel for the generator start / stop signal from the ATS units will be supplied and installed by others. Make all final connections ready for service at both ends of this multicore cable to ensure correct operation of the emergency supply and supply changeover system.

6.10.8 BMS Monitoring ELV Control Wiring

Supply and install an appropriate multicore ELV BMS monitoring control cable capable of providing interface between all specified alarm and monitoring dry contacts, plus minimum 30% future alarm and monitoring dry contacts, and the existing BMS from the ELV BMS monitoring terminals within the new main switchboard and new APR to the closest appropriate BMS marshalling station in each case. Make final connections ready for service at both ends.

6.10.9 BMS Communications Wiring

Supply and install minimum category 6 4 pair shielded UTP BMS monitoring communications cabling from the MODBUS communications BMS monitoring terminals within the new main switchboard to the closest appropriate BMS marshalling station. Make final connections ready for service at both ends.

Supply and install minimum category 6 4 pair shielded UTP BMS monitoring communications cabling from the MODBUS communications BMS monitoring terminals within the new APR to the closest appropriate BMS marshalling station. Make final connections ready for service at both ends.

6.11 Prospective Fault Levels and Discrimination

Every item of equipment installed by the Sub-contractor shall be suitable for the maximum prospective fault level at its installed location and shall be designed to withstand such level and continue to operate without damage for the maximum time that such current could be flowing.

All protective devices shall be selected and left adjusted at the time of Practical Completion to achieve proper discrimination and grading between each level of protection and the next highest level.

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6.12 Labelling

6.12.1 Switchboards, Control Panels & the Like

Every section of every new and altered switchboard, control panel and the like, and every item contained therein, shall be left clearly and permanently labelled with regard to its purpose and function. Labelling shall be by means of engraved laminated labels or other approved means. Each label shall be screw fixed to the front of the enclosure, escutcheon panel, or particular item to which it refers or to the mounting panel / rail associated therewith as appropriate. Each label shall be installed so as to ensure that there can be no confusion as what it applies to or what it means. Hand written labelling on or within switchboards, control panels and the like will not be accepted.

Where important manufacturer's details (e.g. circuit breaker maximum rating / setting, isolator rating, fuse holder / fuse cartridge size, etc.) are obscured by flush escutcheon mounting of the equipment, such details are to be provided on a label mounted on the front of the escutcheon panel adjacent to the item of equipment in a readily viewable location.

The final wording used and the final size, type and colouring of lettering used for all labelling shall be as indicated below and / or to the approval of the Superintendent.

6.12.2 Cables

Each 240V and ELV control cable shall be left labelled at both ends adjacent to every connection point using to approval using slip-on ferules or by other approved means.

6.12.3 Warning Notices

Existing warning notices on the existing ATS Panel and Generator Control Panel will remain relevant and shall generally be retained as existing.

Provide new warning notices as follows:

- All busbar zones in the new main switchboard shall be labelled "Danger – live busbars behind".
- A warning sign shall be provided at every new and altered switchboard, control panel and the like indicating "Dual supplies (normal and emergency) – emergency supply is automatic can be connected at any time without warning unless properly locked out and isolated"

6.12.4 Informative Notices

Provide new informative notices on the front of the existing ATS Panel where each existing ATS has been replaced by a straight through cable joint indicate "CABLES JOINED BEHIND PANEL".

Existing warning notices on the existing ATS Panel and Generator Control Panel will remain relevant and shall generally be retained as existing.

6.12.5 BMS System Upgrading / Programming

The Contractor shall arrange with Honeywell for the upgrading / programming of the existing BMS for control and monitoring points as indicated in the following points list and pay all costs associated therewith.

Item	No.	Function / Description	Point Type
Normal Supply ACB	1.	• Real-time energy measurement (I, V, kW, MWh, pf, Hz, 3rd-19th harmonics). • Intelligent fault analysis ((status, fault type, fault size, tripping time, fault history). • Maintenance Information (trip circuit supervision, protection relay supervision, contact temperature alarm).	Modbus output.
	2.	• ACB open.	Dry contacts.
	3.	• ACB closed.	Dry contacts.
Emerg. Supply ACB	4.	• Real-time energy measurement (I, V, kW, MWh, pf, Hz, 3rd-19th harmonics).	Modbus output.

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		• Intelligent fault analysis ((status, fault type, fault size, tripping time, fault history). • Maintenance Information (trip circuit supervision, protection relay supervision, contact temperature alarm).	
	5.	• ACB open.	Dry contacts.
	6.	• ACB closed.	Dry contacts.
Item	**No.**	**Function / Description**	**Point Type**
Surge Diverter	7.	Alarm	Dry contacts.
ATS 1 controller & Quad Ethernet Module	8.	• Real-time energy measurement (V, Hz, phase rotation). • Programmed parameter settings (status of all settings). • Parameter programming (setting / changing program parameters including all time delays). • ATS mode selection (set ATS to auto, manual or test mode). • ATS control (manually set ATS to normal supply, emerg. Supply or supply isolate position). • Supply status (normal supply and emerg. Supply available / unavailable at line side of ATS). • ATS status (ATS in normal / emerg. Supply position, ATS in auto mode, manual mode, test mode). • Other general ATS data (statistics and activity, event log, controller set-points).	Modbus output.
	9.	• Normal supply available at ATS input.	Dry contacts.
	10.	• Emerg. Supply available at ATS input.	Dry contacts.
	11.	• Load connected to normal supply.	Dry contacts.
	12.	• Load connected to emerg. Supply.	Dry contacts.
	13.	• All supply to load isolated.	Dry contacts.
	14.	• ATS in auto mode.	Dry contacts.
	15.	• ATS in manual mode.	Dry contacts.
	16.	• ATS in test mode.	Dry contacts.
ATS 1 Power Management Meter	17.	• Real-time energy measurement (I, V, kW, kVAr) • Cumulative data (kWh, historical kW demand)	Modbus output.
ATS 2 controller & Quad Ethernet Module	18.	• Real-time energy measurement (V, Hz, phase rotation). • Programmed parameter settings (status of all settings). • Parameter programming (setting / changing program parameters including	Modbus output.

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		all time delays). • ATS mode selection (set ATS to auto, manual or test mode). • ATS control (manually set ATS to normal supply, emerg. Supply or supply isolate position). • Supply status (normal supply and emerg. Supply available / unavailable at line side of ATS).	
Item	**No.**	**Function / Description**	**Point Type**
		• ATS status (ATS in normal / emerg. Supply position, ATS in auto mode, manual mode, test mode). • Other general ATS data (statistics and activity, event log, controller set-points).	
	19.	• Normal supply available at ATS input.	Dry contacts.
	20.	• Emerg. Supply available at ATS input.	Dry contacts.
	21.	• Load connected to normal supply.	Dry contacts.
	22.	• Load connected to emerg. Supply.	Dry contacts.
	23.	• All supply to load isolated.	Dry contacts.
	24.	• ATS in auto mode.	Dry contacts.
	25.	• ATS in manual mode.	Dry contacts.
	26.	• ATS in test mode.	Dry contacts.
ATS 2 Power Management Meter	27.	• Real-time energy measurement (I, V, kW, kVAr) • Cumulative data (kWh, historical kW demand)	Modbus output.
ATS 3 controller & Quad Ethernet Module	28.	• Real-time energy measurement (V, Hz, phase rotation). • Programmed parameter settings (status of all settings). • Parameter programming (setting / changing program parameters including all time delays). • ATS mode selection (set ATS to auto, manual or test mode). • ATS control (manually set ATS to normal supply, emerg. Supply or supply isolate position). • Supply status (normal supply and emerg. Supply available / unavailable at line side of ATS). • ATS status (ATS in normal / emerg. Supply position, ATS in auto mode, manual mode, test mode). • Other general ATS data (statistics and activity, event log, controller set-points).	Modbus output.
	29.	• Normal supply available at ATS input.	Dry contacts.
	30.	• Emerg. Supply available at ATS input.	Dry contacts.

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	31. 32. 33. 34. 35. 36.	• Load connected to normal supply. • Load connected to emerg. Supply. • All supply to load isolated. • ATS in auto mode. • ATS in manual mode. • ATS in test mode.	Dry contacts. Dry contacts. Dry contacts. Dry contacts. Dry contacts. Dry contacts.
Item	**No.**	**Function / Description**	**Point Type**
ATS 3 Power Management Meter	37.	• Real-time energy measurement (I, V, kW, kVAr) • Cumulative data (kWh, historical kW demand)	Modbus output.
ATS 4 controller & Quad Ethernet Module	38.	• Real-time energy measurement (V, Hz, phase rotation). • Programmed parameter settings (status of all settings). • Parameter programming (setting / changing program parameters including all time delays). • ATS mode selection (set ATS to auto, manual or test mode). • ATS control (manually set ATS to normal supply, emerg. Supply or supply isolate position). • Supply status (normal supply and emerg. Supply available / unavailable at line side of ATS). • ATS status (ATS in normal / emerg. Supply position, ATS in auto mode, manual mode, test mode). • Other general ATS data (statistics and activity, event log, controller set-points).	Modbus output.
	39. 40. 41. 42. 43. 44. 45. 46.	• Normal supply available at ATS input. • Emerg. Supply available at ATS input. • Load connected to normal supply. • Load connected to emerg. Supply. • All supply to load isolated. • ATS in auto mode. • ATS in manual mode. • ATS in test mode.	Dry contacts. Dry contacts. Dry contacts. Dry contacts. Dry contacts. Dry contacts. Dry contacts. Dry contacts.
ATS 4 Power Management Meter	47.	• Real-time energy measurement (I, V, kW, kVAr) • Cumulative data (kWh, historical kW demand)	Modbus output.
ATS 5 controller & Quad Ethernet Module	48.	• Real-time energy measurement (V, Hz, phase rotation). • Programmed parameter settings (status	Modbus output.

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		of all settings). • Parameter programming (setting / changing program parameters including all time delays). • ATS mode selection (set ATS to auto, manual or test mode). • ATS control (manually set ATS to normal supply, emerg. Supply or supply isolate position).	
Item	**No.**	**Function / Description**	**Point Type**
		• Supply status (normal supply and emerg. Supply available / unavailable at line side of ATS). • ATS status (ATS in normal / emerg. Supply position, ATS in auto mode, manual mode, test mode). • Other general ATS data (statistics and activity, event log, controller set-points).	
	49.	• Normal supply available at ATS input.	Dry contacts.
	50.	• Emerg. Supply available at ATS input.	Dry contacts.
	51.	• Load connected to normal supply.	Dry contacts.
	52.	• Load connected to emerg. Supply.	Dry contacts.
	53.	• All supply to load isolated.	Dry contacts.
	54.	• ATS in auto mode.	Dry contacts.
	55.	• ATS in manual mode.	Dry contacts.
	56.	• ATS in test mode.	Dry contacts.
ATS 5 Power Management Meter	57.	• Real-time energy measurement (I, V, kW, kVAr) • Cumulative data (kWh, historical kW demand)	Modbus output.
ATS 6 controller & Quad Ethernet Module	58.	• Real-time energy measurement (V, Hz, phase rotation). • Programmed parameter settings (status of all settings). • Parameter programming (setting / changing program parameters including all time delays). • ATS mode selection (set ATS to auto, manual or test mode). • ATS control (manually set ATS to normal supply, emerg. Supply or supply isolate position). • Supply status (normal supply and emerg. Supply available / unavailable at line side of ATS). • ATS status (ATS in normal / emerg. Supply position, ATS in auto mode, manual mode, test mode). • Other general ATS data (statistics and activity, event log, controller set-points).	Modbus output.

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	59.	• Normal supply available at ATS input.	Dry contacts.
	60.	• Emerg. Supply available at ATS input.	Dry contacts.
	61.	• Load connected to normal supply.	Dry contacts.
	62.	• Load connected to emerg. Supply.	Dry contacts.
	63.	• All supply to load isolated.	Dry contacts.
	64.	• ATS in auto mode.	Dry contacts.
	65.	• ATS in manual mode.	Dry contacts.
Item	**No.**	**Function / Description**	**Point Type**
	66.	• ATS in test mode.	Dry contacts.
ATS 6 Power Management Meter	67.	• Real-time energy measurement (I, V, kW, kVAr) • Cumulative data (kWh, historical kW demand)	Modbus output.
ATS 7 controller & Quad Ethernet Module	68.	• Real-time energy measurement (V, Hz, phase rotation). • Programmed parameter settings (status of all settings). • Parameter programming (setting / changing program parameters including all time delays). • ATS mode selection (set ATS to auto, manual or test mode). • ATS control (manually set ATS to normal supply, emerg. Supply or supply isolate position). • Supply status (normal supply and emerg. Supply available / unavailable at line side of ATS). • ATS status (ATS in normal / emerg. Supply position, ATS in auto mode, manual mode, test mode). • Other general ATS data (statistics and activity, event log, controller set-points).	Modbus output.
	69.	• Normal supply available at ATS input.	Dry contacts.
	70.	• Emerg. Supply available at ATS input.	Dry contacts.
	71.	• Load connected to normal supply.	Dry contacts.
	72.	• Load connected to emerg. Supply.	Dry contacts.
	73.	• All supply to load isolated.	Dry contacts.
	74.	• ATS in auto mode.	Dry contacts.
	75.	• ATS in manual mode.	Dry contacts.
	76.	• ATS in test mode.	Dry contacts.
ATS 7 Power Management Meter	77.	• Real-time energy measurement (I, V, kW, kVAr) • Cumulative data (kWh, historical kW demand)	Modbus output.
ATS 8 controller & Quad Ethernet Module	78.	• Real-time energy measurement (V, Hz, phase rotation). • Programmed parameter settings (status	Modbus output.

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		of all settings). • Parameter programming (setting / changing program parameters including all time delays). • ATS mode selection (set ATS to auto, manual or test mode).	
Item	**No.**	**Function / Description**	**Point Type**
		• ATS control (manually set ATS to normal supply, emerg. Supply or supply isolate position). • Supply status (normal supply and emerg. Supply available / unavailable at line side of ATS). • ATS status (ATS in normal / emerg. Supply position, ATS in auto mode, manual mode, test mode). • Other general ATS data (statistics and activity, event log, controller set-points).	
	79.	• Normal supply available at ATS input.	Dry contacts.
	80.	• Emerg. Supply available at ATS input.	Dry contacts.
	81.	• Load connected to normal supply.	Dry contacts.
	82.	• Load connected to emerg. Supply.	Dry contacts.
	83.	• All supply to load isolated.	Dry contacts.
	84.	• ATS in auto mode.	Dry contacts.
	85.	• ATS in manual mode.	Dry contacts.
	86.	• ATS in test mode.	Dry contacts.
ATS 8 Power Management Meter	87.	• Real-time energy measurement (I, V, kW, kVAr) • Cumulative data (kWh, historical kW demand)	Modbus output.
APR	88	Instrumentation. General fault alarm.	Modbus output. Dry contacts.

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Where necessary and / or appropriate, the Contractor shall supply and install appropriate Modbus to BACnet converters as required by Honeywell to enable:

- Information transfer between Modbus outputs and the BMS for all of the measurement and status parameters to be read remotely via the BMS as specified in the above points table.
- Transfer of set-up and control signals from the BMS to appropriate Modbus control inputs to enable all of the remote set-up and control functions specified in the above points table to be effectively carried out.

All remote monitoring and control functions indicated as being required to be carried out by the BMS shall be left fully operative ready for services at the completion of the Works.

6.13 Preliminary Testing & Commissioning of Installation

The whole of the Works specified herein shall be subjected to preliminary testing in accordance with the requirements and recommendations of the following (including all amendments thereto):

- The current issue of AS 3000 ""Electrical Installations".
- The current issue of AS 3017 "Electrical Installations - Verification Guidelines".
- The current issue of AS 3760 "In-service Safety Inspection and Testing of Electrical Equipment".
- Current Workplace Health and Safety and Electrical Safety Regulations.

Where the requirements and recommendations contained in any one of the above documents differ from the requirements and recommendations contained in any of the other documents, the greater requirement shall be complied with.

The Sub-contractor shall carry out all other commissioning and testing necessary to ensure satisfactory operation of the installation at the completion of the Works in accordance with the following:

- Set trip characteristics of all ACB's and MCCB's throughout as appropriate and record all settings.
- Set up parameters via DIP switches on the controller in each ATS as follows but final parameters must be confirmed on Site prior to set up:
  - Nominal line voltage and frequency.
  - Three phase sensing.
  - Operating parameter protection.
  - Transfer operating mode (open transition or closed transition as appropriate).
- Set up time delays within each ATS as follows but final parameters must be confirmed on Site prior to set up:
  - 5 second time delay upon normal supply failure before transmission of all generator starting and supply changeover signals to guard against unnecessary operation upon very short term voltage dips and momentary outages in the normal supply.
  - Time delays as follows for load transfer from normal supply to emergency supply upon normal supply failure and availability of emergency supply being sensed:
    - ✓ ATS 1 – 0 seconds.
    - ✓ ATS 2 – 5 seconds.
    - ✓ ATS 3 – 0 seconds.
    - ✓ ATS 4 – 15 seconds.
    - ✓ ATS 5 – 10 seconds.
    - ✓ ATS 6 – 10 seconds.
    - ✓ ATS 7 – 0 seconds.
    - ✓ ATS 8 – 10 seconds.

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- Time delays (independently adjustable) for actual normal supply failures and test mode function set as follows:
  - ✓ ATS 1 – 0 seconds and 0 seconds respectively.
  - ✓ ATS 2 – 5 seconds and 0 seconds respectively.
  - ✓ ATS 3 – 0 seconds and 0 seconds respectively.
  - ✓ ATS 4 – 15 seconds and 0 seconds respectively.
  - ✓ ATS 5 – 10 seconds and 0 seconds respectively.
  - ✓ ATS 6 – 10 seconds and 0 seconds respectively.
  - ✓ ATS 7 – 0 seconds and 0 seconds respectively.
  - ✓ ATS 8 – 10 seconds and 0 seconds respectively.
- Time delay for generator run-on time for cool-down set at 30 minutes.
- Set time delays for Closed Transition and Delayed Transition operation as follows:
  - ✓ 1 minute delay on failure to synchronise sources prior to load transfer.
  - ✓ 0.5 seconds parallel operation time with both sources available during closed transition.
  - ✓ 0 seconds delay for load disconnect for delayed transition operation.

- Test the following automatic operations including confirmation of all time delay settings:
  - Auto start-up of generator upon sensing normal supply failure at the input of any ATS.
  - Auto changeover from normal supply to emergency supply upon normal supply failure and sensing of normal supply availability for each ATS.
  - Auto closed transition changeover from emergency supply back to normal supply upon restoration of the normal supply after a normal supply failure for each ATS.
  - Generator cooling down period (run-on time) and auto shut-down following return to normal supply.
- Test the following manual operations including confirmation of all time delay settings:
  - Auto start-up of generator upon manual changeover of any ATS from normal supply to emergency supply..
  - Manual closed transition changeover from normal supply to emergency supply for ATS' 1, 2, 3, 4, 5, 6 & 8 with both supplies available.
  - Manual open transition changeover from normal supply to emergency supply for ATS 7 with both supplies available.
  - Manual closed transition changeover from emergency supply back to normal supply for ATS' 1, 2, 3, 4, 5, 6 & 8 with both supplies available.
  - Manual open transition changeover from emergency supply back to normal supply for ATS 7 with both supplies available.
  - Generator cooling down period run-on time following manual return of all ATS' to normal supply.
- Test correct operation of all ACB OCR's, ATS keypads and power monitoring meters and their ability to accurately display the parameters specified both locally and remotely via the BMS.

It will be deemed that the Contractor has allowed in tender for all testing commissioning procedures requiring open and closed transition supply changeover operations and all procedures that either require or can be at risk of causing any kind of interruption to power supply anywhere within the installation to be carried out outside of normal hours as directed by the Superintendent.

All test results and commissioning details, including all set-up details and setting values shall be recorded in detail and submitted to the Superintendent prior to final acceptance testing.

7 Final Acceptance

The Contractor shall ensure that all testing and commissioning necessary for the satisfactory, compliant completion of the Works ready for service has been completed, documented and submitted prior to final acceptance.

When all testing and commissioning of the installation has been completed in accordance with all of the specified test criteria and the Contractor is satisfied that all systems are complete and operating satisfactorily, the Contractor shall submit to the Superintendent the following:

- Full written details and results of all testing and commissioning undertaken by the Contractor.

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- Preliminary Record Documents as specified elsewhere herein.
- Written advice that the installation is ready for final acceptance.

The final acceptance inspection will not commence until three (3) normal working days after all of the above documentation and written advice has been provided to the satisfaction of the Superintendent.

Immediately prior to the final acceptance inspection, the Contractor shall:

- Carry out final cleaning of the Works.
- Check all finished paintwork associated with and around the area of the Works and touch up all damaged parts to approval.
- Ensure that all labelling required by this specification has been completed.

The final acceptance inspection shall generally comprise the following:

- A preliminary walk-through by the Superintendent and the Contractor to verify the quality of materials and workmanship, the accurately of the installation and the accuracy of the preliminary Record Documentation and Operating and Maintenance Manuals.
- Performance by the Contractor of all tests required by the Superintendent to demonstrate that the installation complies with the requirements of the Contract documentation.

Should any portion of the installation fail to pass the final acceptance inspection, problems associated therewith shall be rectified and such portion re-tested and re-inspected. All such modifications and re-testing shall be accomplished within two (2) normal working days unless specific approval is given for an extension of time beyond that. Final acceptance will also be conditional upon the provision of the final Record Documents specified.

Please note that final acceptance does not relieve the Contractor of responsibility to promptly attend to any defects that subsequently arise and make good any work or replace any materials that may subsequently be found not to comply with the original specified requirements at a later date. The Contractor shall make immediate repairs to same as and when directed.

All costs associated with rectification work and re-testing of the work due to the unsatisfactory operation of any system, item of equipment, etc. and / or unsatisfactory test result(s) shall be borne by the Contractor. Similarly, all costs associated with rectification work and re-testing of work due to making good any work that, in the opinion of the Superintendent, is non-compliant or represents unsatisfactory workmanship shall be borne by the Contractor.

8 Practical Completion

8.1 Generally

Following the granting of final acceptance and prior to `Practical Completion, the Contractor shall:

- Ensure that no faults exist in any part of the installation.
- Carry out all works necessary to ensure that all parts of the services installation have been commissioned, tested and ready for service.
- Obtain the relevant approvals from all authorities having jurisdiction over the Works.
- Provide final Record Documents as specified elsewhere herein.
- Provide final test results and commissioning data as specified elsewhere herein
- Provide certification for all aspects of the services installation, including:
  - Fire sealing methods and materials used for fire stopping (This includes backfilled and sealed services penetrations through fire and/or smoke barriers).
  - Compliance with the Building Code of Australia and Australian Standards.
  - Compliance of the electrical reticulation system with AS / NZS 3000 and AS / NZS 3017.

8.2 APR Performance Verification

Verification that the completed APR installation is performing as intended by properly controlling power factor and harmonics is required as follows:

- Immediately following the granting of Practical Completion of the installation, the Contractor shall provide constant monitoring data for the installation for minimum one (1) week. The monitoring data shall be submitted to the Superintendent for review.
- Maximum four (4) weeks and minimum two (2) weeks prior to the expiration of the defects liability period, the Contractor shall again provide constant monitoring data for the installation for minimum one (1) week.

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The monitoring data shall again be submitted to the Superintendent for review and comparison with the data submitted earlier.

In the event that the installed APR does not meet the specified performance criteria, the Contractor shall add to, alter, modify, recalibrate the APR or otherwise adjust the installation and perform additional verification assessments until such time as those assessments prove compliance to the approval of the Superintendent. Additional performance assessments must be undertaken within four (4) weeks of the date of making any such adjustment.

9 Appendix A

Appendix A to this specification is a sample routine testing and maintenance schedule to be provided as part of the Contractor's Record Documentation. This schedule is intended for:

- Use in calling tenders for ongoing routine testing and maintenance at the end of the Installation Contractor's defects liability and maintenance period in conjunction with the remainder of the Contractor's Record Documentation.
- Use as a check list to confirm that all recommended routine testing and maintenance has been carried out in accordance with the Contractor's recommendations.

The Contractor shall provide a detailed routine testing and maintenance schedule using this or another approved format as part of the Record Documentation to be provided as specified elsewhere herein.

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APPENDIX A

(SAMPLE ONLY) MAINTENANCE PROCEDURES & CHECKLIST

General Instructions: The Principal must always be advised prior to isolating supply to the SiteSite.

The Maintenance Contractor shall provide a completed check-list following each routine maintenance visit and submit this check-list together with a detailed maintenance report.

SITE ADDRESS:	**Rail Centre 1, 305 Edward Street, Brisbane Qld 4000**	**3 Monthly Visit**[1]	☐
PLANT:	**Main Switchboard**	**6 Monthly Visit**[1]	☐
PLANT ID:	**(Show Queensland Rail Plant ID Number)**	**Annual Visit**[1]	☐

[1] Tick appropriate box

Required Frequency of Procedure	Item no.	Description of Required Procedure	Check[2]
3 monthly	1.	Describe procedure.	☐
(if applicable)	2.	Describe procedure.	☐
	3.	Describe procedure.	☐
	4.	Describe procedure.	☐
	5.	Describe procedure.	☐
	6.	Describe procedure.	☐
	7.	Describe procedure.	☐
	8.	Describe procedure.	☐
6 monthly	1.	Describe procedure.	☐
(if applicable)	2.	Describe procedure.	☐
	3.	Describe procedure.	☐
	4.	Describe procedure.	☐
	5.	Describe procedure.	☐
	6.	Describe procedure.	☐
	7.	Describe procedure.	☐
	8.	Describe procedure.	☐
Annually	1.	Describe procedure.	☐
(if applicable)	2.	Describe procedure.	☐
	3.	Describe procedure.	☐
	4.	Describe procedure.	☐
	5.	Describe procedure.	☐
	6.	Describe procedure.	☐
	7.	Describe procedure.	☐
	8.	Describe procedure.	☐

DECLARATION OF TESTING AND MAINTENANCE:

I hereby certify that the plant described in this report has been tested and maintained in accordance with the procedures prescribed herein.			
Name of Person:	Signature:	Licence No:	Date:

([2] Tick off items as they are attended to in the check box provided and submit this schedule with maintenance report. If item is not appropriate for the particular switchboard being maintained, mark "N/A" adjacent to the tick box.)

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APPENDIX A (cont.)

(SAMPLE ONLY) MAINTENANCE PROCEDURES & CHECKLIST

General Instructions: The Principal must always be advised prior to isolating supply to the SiteSite.

The Maintenance Contractor shall provide a completed check-list following each routine maintenance visit and submit this check-list together with a detailed maintenance report.

SITE ADDRESS:	**Rail Centre 1, 305 Edward Street, Brisbane Qld 4000**	**3 Monthly Visit**[1]	☐
PLANT:	**Automatic Power Regulator**	**6 Monthly Visit**[1]	☐
PLANT ID:	**(Show Queensland Rail Plant ID Number)**	**Annual Visit**[1]	☐

[1] Tick appropriate box

Required Frequency of Procedure	Item no.	Description of Required Procedure	Check[2]
3 monthly	1.	Describe procedure.	☐
(if applicable)	2.	Describe procedure.	☐
	3.	Describe procedure.	☐
	4.	Describe procedure.	☐
	5.	Describe procedure.	☐
	6.	Describe procedure.	☐
	7.	Describe procedure.	☐
	8.	Describe procedure.	☐
6 monthly	1.	Describe procedure.	☐
(if applicable)	2.	Describe procedure.	☐
	3.	Describe procedure.	☐
	4.	Describe procedure.	☐
	5.	Describe procedure.	☐
	6.	Describe procedure.	☐
	7.	Describe procedure.	☐
	8.	Describe procedure.	☐
Annually	1.	Describe procedure.	
(if applicable)	2.	Describe procedure.	
	3.	Describe procedure.	
	4.	Describe procedure.	
	5.	Describe procedure.	
	6.	Describe procedure.	
	7.	Describe procedure.	
	8.	Describe procedure.	

DECLARATION OF TESTING AND MAINTENANCE:

I hereby certify that the plant described in this report has been tested and maintained in accordance with the procedures prescribed herein.			
Name of Person:	Signature:	Licence No:	Date:

([2] Tick off items as they are attended to in the check box provided and submit this schedule with maintenance report. If item is not appropriate for the particular switchboard being maintained, mark "N/A" adjacent to the tick box.)

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10 Tender Form

A base tender must be submitted on the Tender Form provided. All pages and sections of the Tender Form must be fully completed, including the Schedule of Rates where applicable, and signed by the tenderer or, in the case of a Company, by the Principal duly authorised to enter into contracts for that Company. The Tender Form comprises pages TF.1 to TF.3 inclusive.

END OF SPECIFICATION

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TF.1

Optional Pricing (if any proposed):

Item No.	Description	Proposed Cost Variation (including GST)	
1.		$	Add / Subtract*
2.		$	Add / Subtract*
3.		$	Add / Subtract*

*** Delete inapplicable alternatives.**

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