

Railway

Master Specification

RW-EE-D1 Electrical Systems and Traction Power

Document Information

K Net Number:	14047284
Document Version:	1
Document Date:	August 2020

DEPARTMENT FOR
INFRASTRUCTURE
AND TRANSPORT



Government of South Australia

Department for Infrastructure
and Transport

Document Amendment Record

Version	Change Description	Date
1	Initial issue	August 2020

Document Management

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Contents

Contents	2
RW-EE-D1 Electrical Systems and Traction Power	4
1 General	4
2 Design Reports	5
3 Requirements Definition (Notionally 15% Design Complete) Stage	5
4 Preliminary Design (Notionally 30% Design Complete) Stage	5
5 Detailed Design (Notionally 70% Design Complete) Stage	6
6 Final Design (Notionally 100% Design Complete) Stage	7
7 Construction and Installation	7
8 Inspection, Testing and Commissioning	8
9 Hold Points	9
10 Asset Handover	9

RW-EE-D1 Electrical Systems and Traction Power

1 General

1.1 This Part specifies the Requirements for the design of the Railway Electrical Engineering systems that comprises of

- Traction Power
- Station Electrical & Lighting
- Earthing & Bonding
- Traction SCADA systems

1.2 The Contractor must comply with the following DIT Standards:

- | | |
|--|--|
| a) AR-EL-STD-0102 | Guidelines for the Protective Provisions Related to Electrical Earthing and Bonding for the Adelaide Metro Electrified Rail Network. |
| b) TP2-DOC-002020 | Guideline for low voltage electrical earthing and bonding for the Adelaide metro Tram Network. |
| c) TP1-DOC-001097 | Traction Power Principles & Practices - Train system |
| d) TP2-DOC-002253 | Traction Power SCADA Functional & performance specification. |
| e) AM4-DOC-000364 | Drafting Standard for AutoCAD Drawings. |
| f) AM4-DOC-000466 | Type Approval for Railway Products. |
| g) AR-PW-SPE-00129002 | Design – Stations – Earthing and Bonding – D part 061 |
| h) AR-PW-PM-SPE- 00129014 | Design – Stations – Electrical Infrastructure – D part 074 |
| i) PTS-AR-10-PM-GUD-00000098 | Guidelines for Inspections, Testing and Commissioning of Assets for Rail Projects. |
| j) PTS-MS-05-AM-PRS-00000091 | Asset Management Technical Data Requirements for Project. |
| k) PTS-MU-1O-EG-PRC-00000016 | Design Decision Records Procedure. |
| l) FR-AM-GE-806 | Identification and Numbering of Technical Documents and Drawings. |
| m) PR-AM-GE-1013 | Rail Drawings Acceptance Procedure. |
| n) PR-AM-GE-762 | Punchlist Management Procedure for Public Transport Projects. |
| o) AM4-DOC-000936 | Naming and Numbering Conventions for DIT Rail Assets & Infrastructure. |
| p) AM4-DOC-000940 | Asset Management Handover Requirements Standard. |
| q) PR-RC-MC-009 | Management of Change. |
| r) AS 3000 | Electrical Installations (also referred to as the "Wiring Rules"). |
| s) AS 2067:2016 | Substations and high voltage installations exceeding kV a.c. |
| t) AS 2053 | Conduits and Fittings for Electrical Installations. |
| u) Plumbers, Gas Fitters and Electricians Act 1995 (SA). | |

- v) Electricity Act 1996 Section 12 “Licensed Contractor’s work to be carried out by registered worker” and Section 13 “Obligation of workers to be registered”.
 - w) Works incorporating conduits for communications cabling shall comply with the applicable Australian Communications Authority standards.
- 1.3 The Contractor must comply with:
- a) EN50121 Railway Applications - Electromagnetic Compatibility.
 - b) EN50122-1 Railway Applications - Fixed Installation. Electrical Safety, Earthing and the Return Circuit. Protective provisions against electric shock.
 - c) EN 50122-2:2010 Railway Applications - Fixed installations - Electrical Safety, Earthing and the return circuit - Part 2: Provisions against the effects of stray currents caused by D.C. traction systems.
 - d) EN 50123 – 1 Railway Applications - Fixed Installations - D.C. Switchgear – General
- 1.4 The Contractor must comply with Rail Commissioner Management of Change Procedure PR-RC-MC-009 for the types of changes specified in it.
- 1.5 An advice must be sought from the Principal’s or Rail Electrical Engineering representative for any clarification or conflict regarding the standards listed in the above clauses.

2 Design Reports

- 2.1 At a minimum, the Design Reports listed in this Part for the Electrical Engineering Systems must be provided at the following stages (15% design complete, 30% design complete, 70% design complete, 100% design complete) unless otherwise specified by the Principal.

3 Requirements Definition (Notionally 15% Design Complete) Stage

- 3.1 The following shall constitute **Hold Points** for this stage:
- a) concept general arrangement (GA) plan for Traction sites [Feeder Station (FS), Track Sectioning Cabin (TSC), Track Coupling Unit (TCU), Converter Station (CS)];
 - b) single Line drawings for electrical systems,
 - c) confirmation of existing Electrical System Design drawings and standards,
 - d) departures and / or proposed System Design drawings,
 - e) type approval and manufacturer, of any proposed equipment (switchgear/ system components) requirements;
 - f) Compatibility concept to existing system architecture for Electrical SCADA systems,
 - g) Design Basis Report for all Electrical Engineering systems,
 - h) Load flow study and system modelling concept,
 - i) Proposed traction site locations including incoming distribution supply requirements,
 - j) Earthing and Bonding concept report for traction sites,
 - k) Station supply concept schematic and lighting requirements, and
 - l) Any third party assets assessment and interface management (Electrolysis, Utility companies, other Rail operator assets).

4 Preliminary Design (Notionally 30% Design Complete) Stage

- 4.1 The following shall constitute **Hold Points** for this stage:

- a) Layout for Equipment (switchgear/ components) fitout plans,
- b) Bill of Materials,
- c) Design Development Report (including any Engineering Waivers),
- d) Preliminary Design Report for all Electrical Engineering systems,
- e) Preliminary protection philosophy report,
- f) AC immunisation requirements (if any) to protect other rail electrical infrastructure,
- g) Preliminary design report on Substation load flow and systems modelling,
- h) Preliminary Earthing and Bonding report for traction sites,
- i) Preliminary design report for Station electrical,
- j) Preliminary design report for Electrical SCADA systems,
- k) updated System Design drawings; including type approval and manufacturer, of any proposed materials/ components and switchgear, and
- l) Preliminary independent (third party) assessment report.

5 Detailed Design (Notionally 70% Design Complete) Stage

5.1 The following shall constitute **Hold Points** for this stage:

- a) detailed System Design drawings; including approval and manufacturer, of any proposed materials/ components, switchgear and SCADA systems software compatibility;
- b) final approved Single line drawings, general arrangement of switchgear and protection scheme;
- c) detailed Design Report for all Electrical Engineering systems,
- d) detailed numbering on switchgear,
- e) detailed load flow study and system modelling,
- f) detailed protection philosophy and interlocking requirements,
- g) earth grid detailed design report of traction sites,
- h) detailed Bill of Materials,
- i) detailed Bill of Quantities,
- j) final Isolation procedures and instructions,
- k) list of spare parts,
- l) obsolescence management plan,
- m) quality management plan for all Electrical Engineering systems,
- n) RAM and HAZOP report on Electrical Engineering systems,
- o) independent validation and verification of Electrical system design,
- p) detailed hardware and software SCADA system report,
- q) detailed HMI design report,
- r) detailed Substation Automation design report,
- s) gap analysis of system standards to the specifications, departures and justification as of the relevant or equivalent standard;
- t) Operator and Maintenance manuals;
- u) detailed training plans and manuals,
- v) FAT (Factory Acceptance Test) and SAT (Site Acceptance Test) preliminary requirements,

- w) detailed station electrical design report including lighting and maximum demand calculations for future expansion/ provision, and
- x) detailed station electrical E & B design report.

6 Final Design (Notionally 100% Design Complete) Stage

6.1 The following shall constitute **Hold Points** for this stage:

- a) final System Design drawings (IFC); including approval and manufacturer, of any proposed materials;
- b) final approved SLD's, General Arrangement (GA) and interconnection with OHW and Incoming supply connection points;
- c) Network connection agreement and Joint operating protocol between the Department and electrical supply provider (SAPN),
- d) final Design Report for all Electrical Engineering systems,
- e) final protection relay coordination study report,
- f) final interlocking arrangement,
- g) final report on system load flow and modelling,
- h) final earth grid design and interconnections (CDEGS modelling report),
- i) final E & B plans for station electrical systems,
- j) final signal exchange list for SCADA systems,
- k) final design report on HMI software design,
- l) final independent verification report on all Electrical Engineering systems,
- m) detailed Bill of Materials,
- n) detailed Bill of Quantities,
- o) index sheets,
- p) final inter panel drawings and cable schedule (IFC),
- q) final Isolation procedures, system switching requirements and instructions,
- r) final FAT reports,
- s) final ITP's and commissioning plan,
- t) final SAT requirements report,
- u) final spare list,
- v) final Operator and Maintenance Manuals,
- w) final Training manuals,

7 Construction and Installation

7.1 The following are **Hold Points** for construction and installation of Electrical Engineering systems :

Hold point	Frequency	Acceptance criteria
Confirm – location, conduit run, supply connection.	During civil works commencement	Witnessed and accepted by the Department's Electrical engineering representative
Confirm – footings for substation.	Before Erecting switch room	Witnessed and Reviewed QA report and accepted by the Department's Electrical engineering representative
Confirm – Switch room construction/ final assembly offsite.	Before transport to site	Witnessed and accepted by the Department's Electrical engineering representative

Hold point	Frequency	Acceptance criteria
Confirm – Incoming supply, intermittent cable terminations	Before terminating onto switchgear	Witnessed and accepted by the Department's Electrical engineering representative
Confirm – Earthing grid connection	Before concrete pouring	Inspection and accepted by the Department's Electrical engineering representative
Confirm – Transformer erection	After bund area is completed	Inspection and accepted by the Department's Electrical engineering representative
Confirm – Switch room erection on site	After footing readiness	Inspection and accepted by the Department's Electrical engineering representative
Confirm – OHW terminations (return conductor), SVC if any	After switchgear assembly	Inspection and accepted by the Department's Electrical engineering representative
Confirm – SCADA server installation	Server room readiness	Inspection and accepted by the Department's Electrical engineering representative
Confirm – Station Earthing and Bonding connections and resistance testing i.e Spark gaps, VLD's and any continuity /insulation tests.	Before concrete pour	Inspection and accepted by the Department's Electrical engineering representative

8 Inspection, Testing and Commissioning

- 8.1 The Contractor must comply with PC-RW50 "Inspection, Testing and Commissioning".
- 8.2 The following are additional **Hold Points**, on top of Hold Points listed in PC-RW50 "Inspection, Testing and Commissioning", for inspection, testing and commissioning of Electrical Engineering systems

Hold point	Frequency	Acceptance criteria
Relay Coordination testing (Interface, Inter tripping)	Before Energisation	Witnessed and accepted by the Department's Electrical engineering representative
Switchgear Functional test (interlocking)	During commissioning	Witnessed and accepted by the Department's Electrical engineering representative
Incoming and outgoing cable Insulation tests	During commissioning	Witnessed and accepted by the Department's Electrical engineering representative
Primary and secondary injection tests on switchgear (CT, VT and relays)	During commissioning	Witnessed and accepted by the Department's Electrical engineering representative
Transformer soaking	During commissioning	Witnessed and accepted by the Department's Electrical engineering representative
SCADA signal simulation test on site with correspondence to switchgear	During commissioning	Witnessed and accepted by the Department's Electrical engineering representative
Communication testing WAN and LAN substation network	During commissioning	Witnessed and accepted by the Department's Electrical engineering representative
SCADA software testing (Redundancy primary to backup and traction sites)	During commissioning	Witnessed and accepted by the Department's Electrical engineering representative
End to end SCADA signal exchange list testing	During commissioning	Witnessed and accepted by the Department's Electrical engineering representative

Hold point	Frequency	Acceptance criteria
Energisation plan (Switching program)	Post commissioning/ readiness	Witnessed and accepted by the Department's Electrical engineering representative
Handover certificate (CoC, NCR's, defects list, redlines)	Prior to energisation	Witnessed and accepted by the Department's Electrical engineering representative
Section proving	Before short circuit test	Witnessed and accepted by the Department's Electrical engineering representative
Short circuit test	Post energisation	Witnessed and accepted by the Department's Electrical engineering representative
Station electrical (Isolation Tx, switchboard energisation, Lighting Control DALI testing and LUX testing)	Commissioning	Witnessed and accepted by the Department's Electrical engineering representative

9 Hold Points

9.1 The following is a summary of Hold Points referenced in this Part:

Document Ref.	Hold Point	Response Time
3.1	Provision of Requirements Definition Documents and Drawings	10 Working days prior 15% design complete stage
4.1	Provision of Preliminary Design Documents and Drawings	10 Working days prior 30% design complete stage
5.1	Provision of Detailed Design Documents and Drawings	10 Working days prior 70% design complete stage
6.1	Provision of Final Design Documents and Drawings	10 Working days prior 100% design complete stage
7.1	Construction and installation of Electrical Engineering systems	Minimum 15 working days for inspection and witnessing
8.2	Inspection, testing and commissioning of Electrical Engineering systems	Minimum 15 working days for inspection and witnessing

10 Asset Handover

10.1 The Contractor must comply with AM4-DOC-000940 Asset Management Handover Requirements Standard and PTS-MS-05-AM-PRS-00000091 Asset Management Technical Data Requirements for Project.