Railway

Master Specification

RW-EE-D1 Electrical Systems and Traction Power
Document Amendment Record

<table>
<thead>
<tr>
<th>Version</th>
<th>Change Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Initial issue</td>
<td>30/04/2020</td>
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Document Management

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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 DPTI 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


j) PTS-MS-05-AM-PRS-00000091 Asset Management Technical Data Requirements for Project.


l) FR-AM-GE-806 Identification and Numbering of Technical Documents and Drawings.

m) PR-AM-GE-1013 Rail Drawings Acceptance Procedure.


o) AM4-DOC-000936 Naming and Numbering Conventions for DPTI 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.

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.
   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) obsolesce 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 DPTI 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:

<table>
<thead>
<tr>
<th>Hold point</th>
<th>Frequency</th>
<th>Acceptance criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirm – location, conduit run, supply connection.</td>
<td>During civil works commencement</td>
<td>Witnessed and accepted by DPTI Electrical engineering representative</td>
</tr>
<tr>
<td>Confirm – footings for substation.</td>
<td>Before Erecting switch room</td>
<td>Witnessed and Reviewed QA report and accepted by DPTI Electrical engineering representative</td>
</tr>
<tr>
<td>Confirm – Switch room construction/ final assembly offsite.</td>
<td>Before transport to site</td>
<td>Witnessed and accepted by DPTI Electrical engineering representative</td>
</tr>
</tbody>
</table>
Hold point | Frequency | Acceptance criteria
--- | --- | ---
Confirm – incoming supply, intermittent cable terminations | Before terminating onto switchgear | Witnessed and accepted by DPTI Electrical engineering representative
Confirm – Earthing grid connection | Before concrete pouring | Inspection and accepted by DPTI Electrical engineering representative
Confirm – Transformer erection | After bund area is completed | Inspection and accepted by DPTI Electrical engineering representative
Confirm – Switch room erection on site | After footing readiness | Inspection and accepted by DPTI Electrical engineering representative
Confirm – OHW terminations (return conductor), SVC if any | After switchgear assembly | Inspection and accepted by DPTI Electrical engineering representative
Confirm – SCADA server installation | Server room readiness | Inspection and accepted by DPTI 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 DPTI 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 DPTI Electrical engineering representative
Switchgear Functional test (interlocking) | During commissioning | Witnessed and accepted by DPTI Electrical engineering representative
Incoming and outgoing cable Insulation tests | During commissioning | Witnessed and accepted by DPTI Electrical engineering representative
Primary and secondary injection tests on switchgear (CT, VT and relays) | During commissioning | Witnessed and accepted by DPTI Electrical engineering representative
Transformer soaking | During commissioning | Witnessed and accepted by DPTI Electrical engineering representative
SCADA signal simulation test on site with correspondence to switchgear | During commissioning | Witnessed and accepted by DPTI Electrical engineering representative
Communication testing WAN and LAN substation network | During commissioning | Witnessed and accepted by DPTI Electrical engineering representative
SCADA software testing (Redundancy primary to backup and traction sites) | During commissioning | Witnessed and accepted by DPTI Electrical engineering representative
End to end SCADA signal exchange list testing | During commissioning | Witnessed and accepted by DPTI Electrical engineering representative
Energisation plan (Switching program) | Post commissioning/ readiness | Witnessed and accepted by DPTI Electrical engineering representative
Handover certificate (CoC, NCR’s, defects list, redlines) | Prior to energisation | Witnessed and accepted by DPTI Electrical engineering representative
Section proving | Before short circuit test | Witnessed and accepted by DPTI Electrical engineering representative
Short circuit test | Post energisation | Witnessed and accepted by DPTI Electrical engineering representative
## 9 Hold Points

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

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