



AUSTRALIAN RAIL TRACK CORPORATION LTD

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General

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Electrical Technical Maintenance Coding System

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The technical content of this document has been approved by the relevant ARTC engineering authority and has also been endorsed by the ARTC Safety Committee.

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About This Standard

This publication specifies the Technical Maintenance Codes (TMC) as used by the Australian Rail Track Corporation (ARTC) in the Technical Maintenance Plan (TMP) for the classification of their electrical infrastructure equipment in use for electrical reticulation, electrical distribution, electrical system control, system operation and system protection. The TMP specifies the maintenance policy for the Electrical Power (EP) infrastructure as used by ARTC.

This specification provides a description of equipment and configuration to the third level of the five levels of the TMP. The fourth and fifth levels break down the equipment to manufacturer and component levels and are fully shown in the TMP.

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1 General

The Electric Power infrastructure owned by ARTC is defined within the Technical Maintenance Plan (TMP) by the Technical Maintenance Codes (TMC). The TMC also forms the basis of the numbering system for technical documents (ARTC type 2), refer to page 2–3, ARTC 'Publications Management Manual AM 0001 MM'. The TMC defines the system down to five levels which includes sub-systems, assemblies and items that make up the complete system. For the control, costing and specification production there is normally no requirement to go below the third level. Therefore this specification defines the sub-systems to the third level and does not define the fourth (except Transmission lines EP 10) and fifth levels.

2 Definition of sub-systems

The sub-systems are listed below:

2.1 EP 00 General

Contains documentation that applies to the ARTC Electric Power infrastructure of a general nature that is not dependent on an electrical characteristic. (EP 90 provides for Electric Power infrastructure that incorporates electrical characteristics.)

The following subject matter is classified within EP 00:

- Corrosion protection
- Asset management - issues that do not involve electrical requirements, some examples:
 - Maintainability
 - life cycle cost modeling
 - introduction of new equipment
 - system assurance
 - electric power backbone TMP
 - electric power configuration management plan
- Noise
- Environmental (e.g. PCB, asbestos)
- Organisational interfaces
- Historical details (e.g. dates of major electrification projects)
- System dimensions
- System planning - reliability, redundancy, network connectivity

2.2 EP 01 High Voltage AC Switchgear

To provide the distribution and control of the 132 kV, 66 kV, 33 kV, 11 kV and 2 kV power systems. The equipment from EP 01 01 to EP 01 16 is located in System Substations whilst the equipment from EP 01 50 to EP 01 70 is located in Distribution Substations.

TMC codes of EP 01 are:

- EP 01 00 High Voltage AC Switchgear, General
- EP 01 01 HV ACCB, Bulk Oil Interrupted, Outdoor
- EP 01 02 HV ACCB, Minimum Oil Interrupted, Outdoor
- EP 01 03 HV ACCB, Gas Interrupted, Indoor
- EP 01 04 HV ACCB, Vacuum Interrupted, Outdoor
- EP 01 05 HV ACCB, Air Interrupted, Indoor
- EP 01 06 HV ACCB, Bulk Oil Interrupted, Indoor
- EP 01 07 HV ACCB, Minimum Oil Interrupted, Indoor
- EP 01 08 HV ACCB, Vacuum Interrupted, Indoor
- EP 01 09 HV Air Break Switch, Manual operation
- EP 01 10 HV Air Break Switch, Air Operated
- EP 01 11 HV Air Break Switch, Electric Operated
- EP 01 12 HV Busbar, Outdoor (with Voltage Transformer's)
- EP 01 13 HV Busbar, Indoor (encased with Voltage Transformer's)
- EP 01 16 HV Air Break Switch, Electric Operated, Air Blast
- EP 01 50 HV Air Break Switch, Distribution Location
- EP 01 55 HV AC Links, Distribution Location
- EP 01 60 Ring Main Switch, (air interrupted) – metal enclosed
- EP 01 61 Ring Main Switch, (oil interrupted) – metal enclosed
- EP 01 62 Ring Main Switch, (SF6 gas interrupted) – metal enclosed
- EP 01 70 Ring Main Switch, (air interrupted) – resin enclosed

2.3 EP 02 Power Transformers & Regulators

To transform and control the system voltage where all windings are 2 kV and above.

TMC codes of EP 02 are:

- EP 02 00 Power Transformers & Regulators, General
- EP 02 01 to 02 08 Power Transformers 132 kV and 66 kV primary voltage and includes 11/2 kV multiple secondary transformers
- EP 02 11 to 02 29 Transformers 33/11 kV rated from 2 to 12.5 MVA
- EP 02 30 to 02 43 Transformers 33/11 kV rated below 2 MVA
- EP 02 45 to 02 49 Regulator 11 kV
- EP 02 51 to 02 59 Transformer 33/2 kV rated to 0.5 MVA
- EP 02 61 to 02 64 Regulator 2 kV
- EP 02 65 to 02 80 Transformer 11/2 kV rated to 1 MVA (may be utilised in Distribution Substations)

2.4 EP 03 Rectification

To transform and rectify 66 kV and 33 kV ac power to 1500 V dc traction power.

TMC codes of EP 03 are:

- EP 03 00 Rectification, General
- EP 03 01 Rectifier Transformer
- EP 03 02 Silicon Rectifiers
- EP 03 03 Harmonic Filter
- EP 03 04 Anode Reactor
- EP 03 05 Negative Reactor

2.5 EP 04 DC Switchgear

To provide locally and remotely controlled switching and fault clearing of the 1500 V dc system.

TMC codes of EP 04 are:

- EP 04 00 DC Switchgear, General
- EP 04 01 DC circuit breaker - Feeder
- EP 04 02 DC circuit breaker – Rectifier
- EP 04 03 1500 V DC Bus Assembly
- EP 04 04 1500 V (positive) Link Assembly – Manual operation
- EP 04 05 Rail Connecting Link – Manual operation
- EP 04 06 1500 V (positive) Isolating Switch Manual operation
- EP 04 07 1500 V Isolating and Rail Connecting Switch Pairs
- EP 04 09 1500 V Negative (Rectifier) Link – Manual
- EP 04 10 1500 V (positive) Link Assembly – Motor operated

2.6 EP 05 AC Auxiliary Power Supplies

To provide the transformation of 33 kV, 11 kV, 2 kV and 600 V ac power into low voltage for use by Auxiliary Services within supervisory controlled substations.

TMC codes of EP 05 are:

- EP 05 00 AC Auxiliary Power Supplies, General

Other TMC codes of EP 05 have not yet been allocated.

2.7 EP 06 Auxiliary Services

To provide lighting, low voltage power, dc power supplies, ventilation and compressed air within system substations.

TMC codes of EP 06 are:

- EP 06 00 Auxiliary Services, General
- EP 06 01 Battery Chargers
- EP 06 02 Battery
- EP 06 03 DC Distribution Equipment
- EP 06 04 Staff Alarm
- EP 06 05 Light & Power
- EP 06 06 Substation – Compressed Air System

2.8 EP 07 Electric Braking

To provide the off-train electric braking equipment for electric trains and limit the voltage rise in the dc system to acceptable limits.

TMC codes of EP 07 are:

- EP 07 00 Electric Braking, General

Other TMC codes of EP 07 have not yet been allocated.

2.9 EP 08 1500 V Overhead Wiring

To transmit 1500 V dc power to and from electric trains. Providing a continuous overhead collection path for pantographs under specified operating and climatic conditions. This includes insulated aerial feeders from 1500 V dc sources.

TMC codes of EP 08 are:

- EP 08 00 1500 V Overhead Wiring, General
- EP 08 01 Regulated - Single Contact OHW
- EP 08 02 Regulated - Twin Contact OHW
- EP 08 03 Regulated - Contact Only OHW
- EP 08 04 Regulated -Twin Catenary, Twin Contact OHW
- EP 08 06 Fixed Anchor - Single Contact
- EP 08 07 Fixed Anchor - Twin Contact
- EP 08 08 Fixed Anchor - Contact Wire Only
- EP 08 09 Fixed Anchor - Compound System OHW
- EP 08 10 Fixed Anchor - Auxiliary Feeder Wire
- EP 08 11 Regulated OHW Support Registration Arrangements
- EP 08 12 Fixed Anchor OHW Support Registration Arrangements
- EP 08 14 Auxiliary Feeder - Support Arrangements
- EP 08 16 OHW Support Structure
- EP 08 21 Anchor Arrangements
- EP 08 26 Airgap Arrangements
- EP 08 31 Section Insulator Arrangements
- EP 08 36 1500 V Switch Arrangement
- EP 08 41 Feeding Arrangements
- EP 08 43 Surge Diverter Arrangements
- EP 08 46 Over-run Protection Arrangements
- EP 08 51 Signs

2.10 EP 09 Traction Return

To provide a trackside connection facility for traction return currents between the running rails and signalling equipment (e.g. impedance bonds, cables) and the 1500 V negative cables.

TMC codes of EP 09 are:

- EP 09 00 Traction Return, General

Other TMC codes of EP 09 have not yet been allocated.

2.11 EP 10 HV Transmission Lines

To provide the aerial reticulation of high voltage ac power to substations and the distribution of low voltage power to points of attachment on buildings and installations. This includes Aerial Bundled Conductors (ABC).

TMC codes of EP 10 are:

- EP 10 01 00 Aerial Transmission Lines, General
- EP 10 01 01 Access and Right of Way
- EP 10 01 05 Wood Pole Support
- EP 10 01 06 Steel Support Structure
- EP 10 01 11 Pole Top
- EP 10 01 21 Conductors
- EP 10 01 25 Conductor Connections
- EP 10 01 28 Conductor Accessories
- EP 10 01 30 Guy Arrangements

NOTE: This sub-system is taken to the 4th level.

2.12 EP 11 SCADA

To provide Supervisory Control And Data Acquisition from appropriate equipment.

TMC codes of EP 11 are:

- EP 11 00 Scada, General

Other TMC codes of EP 11 have not yet been allocated.

2.13 EP 12 Protective Earthing, Bonding and Electrolysis Mitigation

To provide a low impedance path for fault current and lightning to the general mass of earth or to rail (in the case of the 1500 V traction system), and to ensure step and touch voltages do not exceed statutory limits. To control and monitor the level of stray 1500 V dc current. To control and monitor rail earth potentials. Includes spark gaps for the unearthed 220 V auxiliary supply and 1500 V dc system spark gaps.

TMC codes of EP 12 are:

- EP 12 00 Protective Earthing, Bonding and Electrolysis Mitigation, General
- EP 12 10 Protective Earthing
- EP 12 20 Structure Bonding
- EP 12 30 Electrolysis Mitigation
- EP 12 40 Rail Earth Contactor

2.14 EP 13 Structures

To provide mechanical support for various Electric Power system components, including 1500 V structures, substation busbar supports.

TMC codes of EP 13 are:

- EP 13 00 Structures, General

Other TMC codes of EP 13 have not yet been allocated.

2.15 EP 14 Enclosures

To provide appropriate enclosures for power system equipment that are safe, clean and environmentally acceptable to employees and the public.

TMC codes of EP 14 are:

- EP 14 00 Enclosures, General

Other TMC codes of EP 14 have not yet been allocated.

2.16 EP 15 Test and Support Equipment

To provide appropriate equipment for testing, operating and maintaining the power system equipment.

TMC codes of EP 15 are:

- EP 15 00 Test and Support Equipment, General

Other TMC codes of EP 15 have not yet been allocated.

2.17 EP 16 Distribution Transformers

To transform and control the system voltages to a secondary voltage system of nominally 415 V, 240 V or 120 V ac.

TMC codes of EP 16 are:

- EP 16 00 Distribution Transformer, General
- EP 16 01 Transformer oil, silica gel breather, cable, ground type
- EP 16 02 Transformer oil, silica gel breather, bushing, ground type
- EP 16 05 Transformer oil, ventilated, cable, ground type
- EP 16 06 Transformer oil, ventilated, bushing, ground type
- EP 16 07 Transformer oil, sealed, bushing, pole type
- EP 16 08 Transformer oil, ventilated, bushing, pole type
- EP 16 40 Transformer air, cable, ground type
- EP 16 50 Transformer, primary voltage 2 kV

2.18 EP 17 Low Voltage Distribution

To provide the low voltage (650 volts or less) distribution and the metering of power up to the consumers terminals.

TMC codes of EP 17 are:

- EP 17 00 Low Voltage Distribution, General

Other TMC codes of EP 17 have not yet been allocated.

2.19 EP 18 Signal Air Compressors

To provide compressed air for signalling purposes.

TMC codes of EP 18 are:

- EP 18 00 Signal Air Compressors, General

Other TMC codes of EP 18 have not yet been allocated

2.20 EP 19 Fault Protection

To provide a reliable, economical and graded system of safeguarding the electrical infrastructure, whilst allowing operation at optimum output with minimal risk of unintentional interruption. Excludes low voltage protection within installations.

TMC codes of EP 19 are:

- EP 19 00 Fault Protection, General
- EP 19 01 Pilot Wire Relays
- EP 19 02 Transformer Differential Relays
- EP 19 03 Bus Zone Relays
- EP 19 04 Inverse Definite Minimum Time (Non Directional) Relay
- EP 19 05 Inverse Definite Minimum Time (Directional) Relay
- EP 19 06 Directional Relays
- EP 19 07 Instantaneous Relays
- EP 19 08 Auxiliary Relays
- EP 19 09 Multi-Function Relay
- EP 19 40 Communications
- EP 19 60 Protection Relay Wiring
- EP 19 70 DCCB Delta I Protection
- EP 19 80 DCCB Frame Leakage System

2.21 EP 20 High Voltage AC and Traction Cables

To provide high voltage ac cable reticulation of power to substations, and to provide the insulated 1500 V positive and negative cable distribution of dc power, and ac power connections to rectifiers.

TMC codes of EP 20 are:

- EP 20 00 High Voltage AC and Traction Cables, General
- EP 20 10 Positive 1500 V DC Cables
- EP 20 20 Negative 1500 V DC Cables
- EP 20 30 AC Rectifier Transformer – Rectifier Cables
- EP 20 40 2.2 kV AC Cables
- EP 20 50 11 kV AC Cables
- EP 20 60 25 kV AC Cables
- EP 20 70 33 kV AC Cables
- EP 20 80 66 kV AC Cables
- EP 20 90 Protection Pilot Cables

2.22 EP 21 Surge Protection

To provide protection from lightning surges and other overvoltages that affect the system.

TMC codes of EP 21 are:

- EP 21 00 Surge Protection, General

Other TMC codes of EP 21 have not yet been allocated

2.23 EP 22 Voltage Transformers and Current Transformers

To provide transformation of system voltages and currents for use with electrical measuring instruments and/or electrical protection devices.

TMC codes of EP 22 are:

- EP 22 00 Voltage Transformers and Current Transformers, General

Other TMC codes of EP 22 have not yet been allocated

2.24 EP 90 Electrical System Requirements

Provides a structured hierarchy for ARTC Electric Power system documentation, which contains details of an electrical characteristic. This characteristic being a common requirement applied across a range of equipment types (two or more sub-systems). However, where a common requirement is only applicable to substation equipment this documentation is to be included within the category EP 97 or EP 99 as applicable.

The following subject matter is classified within EP 90:

- Electromagnetic Compatibility
- Electromagnetic Fields
- Quality of Supply (e.g. harmonics, voltage regulation)
- Voltage levels
- Fault levels
- Phase relationships
- Insulation coordination
- System modelling - normal and emergency rating(s)
- System operation
- Energy
- Feeder Data Bank

TMC codes of EP 90 are:

- EP 90 00 Electrical System Requirements, General
- EP 90 10 HV AC Sub-Transmission
- EP 90 20 1500 V DC Traction
- EP 90 30 LV Distribution

2.25 EP 95 System Safe Operation

Documents the administrative system(s) for the safe operation of the ARTC electric power system. It provides the ARTC implementation of the relevant Acts and Regulations which govern the operation of the ARTC electric power system.

The following aspects classified within EP 95 are:

- operational features of the system which have safety implications
- detailed requirements for staff who operate and maintain the ARTC Electric Power system
- control centre interfaces for isolation and restoration of electrical supply
- access permit system
- detailed safety procedures for operating ARTC equipment
- the safety, operating & other plans required by the Electricity Supply (Safety Plans) Regulation, 1997

TMC codes of EP 95 are:

- EP 95 00 System Safe Operation, General
- EP 95 10 HV AC Sub-Transmission
- EP 95 20 1500V DC Traction
- EP 95 30 LV Distribution

2.26 EP 97 Distribution Substation

This definition applies to all substations (except those defined as System Substations) containing high voltage electrical equipment but not high voltage circuit breakers, but does include reclosers. The EP 97 is derived from a combination of EP 01 and EP 16 equipment that make up the location. The third level TMC defines the category of HV switchgear.

TMC codes of EP 97 are:

- EP 97 00 Distribution Substation, General
- EP 97 01 Transmission line sectioning location
- EP 97 10 Air Break Switch – ground substation
- EP 97 11 Air Break Switch – pole substation
- EP 97 12 Cast Resin Ring Main Switch – pole substation
- EP 97 13 11 kV Link Isolated Transformer – pole substation
- EP 97 15 to 97 20 Air Ring Main Switch substation
- EP 97 30 to 97 35 Oil Ring Main Switch substation
- EP 97 40 to 97 49 SF6 Ring Main Switch substation
- EP 97 50 Cast Resin Ring Main Switch (padmount)
- EP 97 60 to 97 65 Location Primary voltage 2 kV

2.27 EP 99 System Substation

A 'system' substation is defined as:

- traction substations
- sectioning huts, and
- any substation location that has a voltage >2 kV and includes a **HV circuit breaker** as an item of equipment (i.e. has a protection setting).

This sub-system number (EP 99) identifies equipment installed in ARTC high voltage substations and the sub-system EP 09 traction return.

TMC codes of EP 99 are:

- EP 99 00 System Substation, General

For the purpose of publication management, EP 99 is also used to identify the publication manuals containing documents that relate to substation equipment. There are two volumes in the EP 99 manual, the volumes are described below.

Volume 1, contains documents which include the following equipment:

- EP 01 HV AC Switchgear
- EP 02 Power Transformers & Regulators
- EP 03 Rectification
- EP 04 DC Switchgear
- EP 21 Surge Protection
- EP 99 System Substations, General

Volume 2, contains documents which include the following equipment:

- EP 05 AC Auxiliary Power Supplies
- EP 06 Auxiliary Services
- EP 07 Electric Braking
- EP 09 Traction Return
- EP 16 Distribution Transformers
- EP 18 Signal Air Compressors (substations only)
- EP 22 CT's and VT's
- EP 97 Distribution Substation

3 Definitions and Abbreviations

AC	alternating current
ACCB	alternating current circuit breaker
CT's	current transformers
DC	direct current
DCCB	direct current circuit breaker
HV	high voltage
kV	kilovolts
SCADA	Supervisory Control And Data Acquisition
SF6	insulating gas (Sulphur Hexafluoride)
TMC	Technical Maintenance Code
TMP	Technical Maintenance Plan
VT's	voltage transformers