

Specification (Measurement)

**Transport and Main Roads Specifications
MRS332 Power Supply and Distribution**

August 2024



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1 Introduction

This Specification applies to the construction of power supply and distribution.

The requirements for overhead line equipment are specified in MRS331 *Overhead Line Equipment* (OHLE).

This Specification shall be read in conjunction with MRS01 *Introduction to Specifications* and other Specifications as appropriate.

This Specification forms part of the Transport and Main Roads Specification Manual.

2 Measurement of work

2.1 Standard Work Items

In accordance with the provisions of Clause 2.1.3 of MRS01 *Introduction to Specifications*, the Standard Work Items incorporated in this Specification are listed in Table 2.1.

Table 2.1 – Standard Work Items

Standard Item No.	Description	Unit of Measurement
Power Supply and Distribution Removal / Demolition		
80551	Removal or demolition of feeder substation, complete, [description]	lump sum
80552	Removal or demolition of track sectioning cabin, complete, [description]	lump sum
80553	Removal or demolition of track coupler unit, complete, [description]	lump sum
80554	Removal or demolition of autotransformer Site, complete, [description]	lump sum
80555	Removal or demolition of autotransformer, [description]	each
80556	Removal or demolition of booster transformer, [description]	each
80557	Removal or demolition of auxiliary supply transformer, [description]	each
Traction Switching Stations and Transformer Sites		
80581	Feeder substation, complete, [description]	lump sum
80582	Track sectioning cabin, complete, [description]	lump sum
80583	Track coupler unit, complete, [description]	lump sum
80584	Autotransformer site, complete, [description]	lump sum
Power Supply and Distribution Equipment Supply		
80591	Supply of autotransformer, [description]	each
80592	Supply of [plinth mast] mounted booster transformer, [description]	each
80593	Supply of [plinth mast] mounted auxiliary supply transformer, [description]	each

Standard Item No.	Description	Unit of Measurement
Power Supply and Distribution Equipment Installation		
80641	Installation of autotransformer, <i>[description]</i>	each
80642	Installation of <i>[plinth mast]</i> mounted booster transformer, <i>[description]</i>	each
80643	Installation of <i>[plinth mast]</i> mounted auxiliary supply transformer, <i>[description]</i>	each
Power Supply and Distribution Equipment Supply / Installation		
80691	Supply and installation of autotransformer, <i>[description]</i>	each
80692	Supply and installation of <i>[plinth mast]</i> mounted booster transformer, <i>[description]</i>	each
80693	Supply and installation of <i>[plinth mast]</i> mounted auxiliary supply transformer, <i>[description]</i>	each
Power Supply and Distribution Miscellaneous		
80741	Testing and commissioning of power supply and distribution, <i>[description]</i>	lump sum

2.2 Work Operations

Work Operations included in the Standard Work Items are specified in the relevant clause adjacent to each Standard Work Item listed in Table 2.1.

2.2.1 Power Supply and Distribution Removal / Demolition

Item 80551 Removal or demolition of feeder substation, complete, *[description]*

Item 80552 Removal or demolition of track sectioning cabin, complete, *[description]*

Item 80553 Removal or demolition of track coupler unit, complete, *[description]*

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) de-energisation and disconnection of cabling to transformers and components
- c) removal of transformers, connections to overhead line equipment and traction rails, control and monitoring instrumentation, external cabling and wiring terminations, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- d) removal of part or all of the traction switching station, including but not limited to switchroom and switchgear, busbars, busbar feeders and connections, marshalling cubicles, steel support structure, masts, and mounting frames and racks, cable containment, trays and supports, marshalling cubicle, conduits and cable pits, slabs, fencing, signage, and make good any remaining part of the Site, as appropriate
- e) dismantling of the above components, as appropriate
- f) demolition of any agreed non-salvageable part of the existing installation
- g) transporting, unloading, and stockpiling of components for re-use at a later stage, where necessary

- h) transport of materials selected for salvage to the nominated storage Site
- i) removing from Site and disposing or reusing of all surplus materials
- j) utilising or disposing of excavated and removed or demolished materials, and
- k) backfill and reinstatement of disturbed areas.

Item 80554 Removal or demolition of autotransformer Site, complete, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) de-energisation and disconnection of cabling to transformer and components
- c) removal of transformer, connections to overhead line equipment and traction rails, control and monitoring instrumentation, external cabling and wiring terminations, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- d) removal of part or all of the autotransformer Site including mounting frames and racks, cable containment, trays and supports, marshalling cubicle, conduits and cable pits, slabs, fencing, signage, and make good any remaining part of the Site, as appropriate
- e) dismantling of the above components, as appropriate
- f) demolition of any agreed non-salvageable part of the existing installation
- g) transporting, unloading, and stockpiling of components for re-use at a later stage, where necessary
- h) transport of materials selected for salvage to the nominated storage Site
- i) removing from Site and disposing or reusing of all surplus materials
- j) utilising or disposing of excavated and removed or demolished materials, and
- k) backfill and reinstatement of disturbed areas.

Item 80555 Removal or demolition of autotransformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) de-energisation and disconnection of cabling to transformer and components
- c) removal of transformer, connections to overhead line equipment and traction rails, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- d) removal of part or all of the support structure and concrete foundations and make good any remaining part of the structure, as appropriate
- e) dismantling of the above components, as appropriate
- f) demolition of any agreed non-salvageable part of the existing installation
- g) transporting, unloading, and stockpiling of components for re-use at a later stage, where necessary
- h) transport of materials selected for salvage to the nominated storage Site

- i) removing from Site and disposing or reusing of all surplus materials
- j) utilising or disposing of excavated and removed or demolished materials, and
- k) backfill and reinstatement of disturbed areas.

Item 80556 Removal or demolition of booster transformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) de-energisation and disconnection of cabling to transformer and components
- c) removal of transformer, connections to overhead line equipment and return conductors, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- d) removal of part or all of the support structure and make good any remaining part of the structure, as appropriate
- e) dismantling of the above components, as appropriate
- f) demolition of any agreed non-salvageable part of the existing installation
- g) transporting, unloading, and stockpiling of components for re-use at a later stage, where necessary
- h) transport of materials selected for salvage to the nominated storage Site
- i) removing from Site and disposing or reusing of all surplus materials
- j) utilising or disposing of excavated and removed or demolished materials, and
- k) backfill and reinstatement of disturbed areas.

Item 80557 Removal or demolition of auxiliary supply transformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) de-energisation and disconnection of cabling to transformer and components
- c) removal of transformer, connections to traction equipment and trackside equipment, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- d) removal of part or all of the support structure and make good any remaining part of the structure, as appropriate
- e) demolition of any agreed non-salvageable part of the existing installation
- f) transporting, unloading, and stockpiling of components for re-use at a later stage, where necessary
- g) transport of materials selected for salvage to the nominated storage Site
- h) removing from Site and disposing or reusing of all surplus materials
- i) utilising or disposing of excavated and removed or demolished materials, and
- j) backfill and reinstatement of disturbed areas.

2.2.2 Traction Switching Stations and Transformer Sites

Item 80581 Feeder substation, complete, [description]

Item 80582 Track sectioning cabin, complete, [description]

Item 80583 Track coupler unit, complete, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) localised civil works to prepare the Site, where necessary, including but not limited to:
 - i. clear the Site
 - ii. provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
 - iii. carry out excavations, where required
 - iv. compacting material at bottom of excavations, where required
 - v. placement and compaction of appropriate Fill Material, where required
 - vi. sampling and testing of Fill Material, where required
 - vii. utilising or disposing of material, where required
 - viii. supply, transport, and delivery of road base material
 - ix. spreading and placement of road base material, supply and incorporation of water, compacting and trimming, and
 - x. sampling and testing.
- c) construction of plinth, pads and bases, where necessary, including but not limited to:
 - i. compacting and trimming base, allow correct finished levels and falls for concrete slabs
 - ii. construct concrete foundation pad including all concrete, formwork, reinforcement and finishing for equipment installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply and installation of precast plinth base, where required
 - v. supply and place underlay and waterproof membrane, where required
 - vi. provision of formwork for concrete base and apron surrounding base, where required
 - vii. supply and installation of all fixing bolts, embedded conduit, pits and cable containment and draw strings to concrete foundation pad, where necessary
 - viii. supply, fabrication and placing steel reinforcement, incorporating equipment base frame, where required
 - ix. supply, place, compact, finish and cure concrete
 - x. sealing of gap between enclosure and plinth, where necessary
 - xi. supply and installation of joints

- xii. supply and installation of all fixing bolts, nuts and washers as appropriate, and
- xiii. supply and installation of required structure earthing and bonding including earthing mats and tags to foundation.
- d) construction of all associated civil works, including but not limited to security fencing and gates, signage, pads and access paths, as appropriate
- e) supply and installation of area lighting, including conduits, pits, poles, luminaires, cabling, terminations and connections
- f) supply and installation of underground conduits, cable pits, and earth grids, as appropriate
- g) supply and installation of security CCTV, including but not limited to:
 - i. cameras and mounting
 - ii. conduits, pits, poles, cabling, terminations and connections
 - iii. field cabinet, complete with CCTV equipment and SCADA, and
 - iv. CCTV power supply.
- h) supply and installation of steel support structure, masts, and mounting frames, including all fixing bolts, nuts, and washes, earthing and bonding, and mortar grouting, where necessary, for all power equipment components, including but not limited to:
 - i. busbar feeders, connectors and bushing supports
 - ii. isolators
 - iii. circuit breakers
 - iv. transformers
 - v. interrupters
 - vi. power factor correction units, and
 - vii. lighting arrestors.
- i) supply and installation of switchroom, as appropriate, including but not limited to:
 - i. prefabricated switchroom including floors, windows, doors, internal partitions, linings and finishes, electrical, lighting, and fire protection
 - ii. fire and smoke stopping to cable penetrations
 - iii. air conditioning, temperature and humidity control equipment
 - iv. ventilation equipment and vent fans
 - v. equipment enclosures, mounting frames and racks, cable containment, trays or support
 - vi. communication equipment and components including all internal wiring, connections and terminations
 - vii. earth mats and earthing and bonding to the case, racks, mounting frames and equipment
 - viii. lightning and surge protection
 - ix. communications compartment

- x. automatic line telephones
 - xi. DC battery and charger system
 - xii. isolation transformers
 - xiii. SCADA RTU and cubicle
 - xiv. Return Circuit Bus Cabinet
 - xv. Earth Bar Cabinet
 - xvi. Queensland Rail Fault Locator Marshalling Cubicles
 - xvii. LV Power, ELV Control Circuit and analogue Instrument Cable
 - xviii. furniture and fixings
 - xix. structure bonding and termination of cables
 - xx. cabling, connect electrical and communications services
 - xxi. earthing including supply of earthing materials
 - xxii. handrails, bollards, security fencing and gates as required, and
 - xxiii. anti-graffiti finish, as appropriate.
- j) supply and installation of switchgear, as appropriate, including but not limited to:
- i. equipment mounting frames and racks, cable containment, trays or support
 - ii. busbars and connections
 - iii. current and voltage transformers
 - iv. static frequency convertors
 - v. harmonic filters
 - vi. circuit breakers
 - vii. LV Power, ELV Control Circuit and monitoring equipment and cabling
 - viii. external cabling and wiring terminations
 - ix. lightning and surge protection
 - x. earth mats, earthing and bonding to the case, racks, mounting frames, equipment and make connections
 - xi. external cabling and wiring terminations
 - xii. lightning and surge protection
 - xiii. structure bonding and termination of cables, and
 - xiv. rating and identification plates.
- k) supply and installation of busbars, including but not limited to rigid bars or tubes, wires, terminations, joint and splice materials, fixtures and fittings, insulators, connection and termination, and labelling
- l) supply and installation of busbar feeders and connections

- m) supply and installation of power and current transformers, including but not limited to:
 - i. rating and identification plates
 - ii. heater breathers
 - iii. conservator
 - iv. anti-condensation heater
 - v. protection and monitoring equipment instrumentation, earthing terminals and connections
 - vi. terminal bushings and surge arrestor mounting brackets
 - vii. terminal palms
 - viii. tank
 - ix. oils and consumables
 - x. all cable connections to transformer terminals, and
 - xi. earthing cables and connections to transformer earthing points and structure earth.
- n) supply and installation of autotransformer including connections to overhead line equipment and traction rails, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- o) supply and installation of auxiliary supply transformer including connections to traction equipment and trackside equipment, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- p) supply and installation of marshalling cubicle, including but not limited to:
 - i. marshalling cubicle
 - ii. equipment mounting frames and racks, cable containment, trays or support
 - iii. earth mats and earthing and bonding to the case, racks, mounting frames and equipment
 - iv. external cabling and wiring terminations to marshalling cubicle terminals
 - v. lightning and surge protection, and
 - vi. structure bonding and termination of cables.
- q) carry out any necessary modifications to the overhead line structures, overhead line equipment, traction equipment, feeder conductors, trackside equipment, and traction rails
- r) factory assembly, as appropriate
- s) handling, transport to the Site, and storage on the Site
- t) on Site assembly, as appropriate, and
- u) rehandling and transport on the Site, where necessary.

Item 80584 Autotransformer Site, complete, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) localised civil works to prepare the Site, where necessary, including but not limited to:
 - i. clear the Site
 - ii. provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
 - iii. carry out excavations, where required
 - iv. compacting material at bottom of excavations, where required
 - v. placement and compaction of appropriate Fill Material, where required
 - vi. sampling and testing of Fill Material, where required
 - vii. utilising or disposing of material, where required
 - viii. supply, transport and delivery of road base material
 - ix. spreading and placement of road base material, supply and incorporation of water, compacting and trimming, and
 - x. sampling and testing.
- c) construction of plinth, where necessary, including but not limited to:
 - i. compacting and trimming base, allow correct finished levels and falls for concrete slabs
 - ii. construct concrete foundation pad including all concrete, formwork, reinforcement and finishing for transformer installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply and installation of precast plinth base, where required
 - v. supply and place underlay and waterproof membrane, where required
 - vi. provision of formwork for concrete base and apron surrounding base, where required
 - vii. supply and installation of all fixing bolts, embedded conduit, pits and cable containment and draw strings to concrete foundation pad, where necessary
 - viii. supply, fabrication and placing steel reinforcement, incorporating transformer base frame, where required
 - ix. supply, place, compact, finish and cure concrete
 - x. sealing of gap between enclosure and plinth, where necessary
 - xi. supply and installation of joints
 - xii. supply and installation of all fixing bolts, nuts and washers as appropriate, and
 - xiii. supply and installation of required structure earthing and bonding including earthing mats and tags to foundation.

- d) supply and installation of autotransformer including connections to overhead line equipment and traction rails, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- e) carry out any necessary modifications to the overhead line structures, overhead line equipment, feeder conductors, and traction rails
- f) supply and installation of steel support structure, masts, and mounting frames, including all fixing bolts, nuts, and washes, earthing and bonding, and mortar grouting, where necessary
- g) supply and installation of all associated power supply and distribution equipment, including but not limited to feeder isolators and terminations, insulators, bushings and connections, busbars and wire connections
- h) supply and installation of underground conduits, cable pits, and earth grids, as appropriate
- i) construction of all associated civil works, including but not limited to security fencing and gates, signage, pads and access paths, as appropriate
- j) supply and installation of marshalling cubicle, including but not limited to:
 - i. marshalling cubicle
 - ii. equipment mounting frames and racks, cable containment, trays or support
 - iii. earth mats and earthing and bonding to the case, racks, mounting frames and equipment
 - iv. external cabling and wiring terminations to marshalling cubicle terminals
 - v. lightning and surge protection, and
 - vi. structure bonding and termination of cables.
- k) factory assembly, as appropriate
- l) handling, transport to the Site, and storage on the Site
- m) on Site assembly, as appropriate, and
- n) rehandling and transport on the Site, where necessary.

2.2.3 Power Supply and Distribution Equipment Supply

Item 80591 Supply of autotransformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) supply of autotransformer including connections to overhead line equipment and traction rails, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- c) factory assembly, as appropriate, and
- d) handling, transport to the Site, and storage on the Site.

Item 80592 Supply of [plinth | masf] mounted booster transformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) supply of booster transformer including connections to overhead line equipment and return conductors, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- c) factory assembly, as appropriate, and
- d) handling, transport to the Site, and storage on the Site.

Item 80593 Supply of [plinth | masf] mounted auxiliary supply transformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) supply of auxiliary supply transformer including connections to traction equipment and trackside equipment, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- c) factory assembly, as appropriate, and
- d) handling, transport to the Site, and storage on the Site.

2.2.4 Power Supply and Distribution Equipment Installation

Item 80641 Installation of autotransformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) localised civil works to prepare the Site, where necessary, including but not limited to:
 - i. clear the Site
 - ii. provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
 - iii. carry out excavations, where required
 - iv. compacting material at bottom of excavations, where required
 - v. placement and compaction of appropriate Fill Material, where required
 - vi. sampling and testing of Fill Material, where required
 - vii. utilising or disposing of material, where required
 - viii. supply, transport and delivery of road base material
 - ix. spreading and placement of road base material, supply and incorporation of water, compacting and trimming, and
 - x. sampling and testing.

- c) construction of plinth, where necessary, including but not limited to:
 - i. compacting and trimming base, allow correct finished levels and falls for concrete slabs
 - ii. construct concrete foundation pad including all concrete, formwork, reinforcement and finishing for transformer installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply and installation of precast plinth base, where required
 - v. supply and place underlay and waterproof membrane, where required
 - vi. provision of formwork for concrete base and apron surrounding base, where required
 - vii. supply and installation of all fixing bolts, embedded conduit, pits and cable containment and draw strings to concrete foundation pad, where necessary
 - viii. supply, fabrication and placing steel reinforcement, incorporating transformer base frame, where required
 - ix. supply, place, compact, finish and cure concrete
 - x. sealing of gap between enclosure and plinth, where necessary
 - xi. supply and installation of joints
 - xii. supply and installation of all fixing bolts, nuts and washers as appropriate, and
 - xiii. supply and installation of required structure earthing and bonding including earthing mats and tags to foundation.
- d) installation of autotransformer including connections to overhead line equipment and traction rails, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- e) carry out any necessary modifications to the overhead line structures, overhead line equipment, feeder conductors, and traction rails
- f) on Site assembly, as appropriate, and
- g) rehandling and transport on the Site, where necessary.

Item 80642 Installation of [plinth | masf] mounted booster transformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) localised civil works to prepare the Site, where necessary, including but not limited to:
 - i. clear the Site
 - ii. provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
 - iii. carry out excavations, where required
 - iv. compacting material at bottom of excavations, where required
 - v. placement and compaction of appropriate Fill Material, where required

- vi. sampling and testing of Fill Material, where required
 - vii. utilising or disposing of material, where required
 - viii. supply, transport and delivery of road base material
 - ix. spreading and placement of road base material, supply and incorporation of water, compacting and trimming, and
 - x. sampling and testing.
- c) construction of plinth, where necessary, including but not limited to:
- i. compacting and trimming base, allow correct finished levels and falls for concrete slabs
 - ii. construct concrete foundation pad including all concrete, formwork, reinforcement and finishing for transformer installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply and installation of precast plinth base, where required
 - v. supply and place underlay and waterproof membrane, where required
 - vi. provision of formwork for concrete base and apron surrounding base, where required
 - vii. supply and installation of all fixing bolts, embedded conduit, pits and cable containment and draw strings to concrete foundation pad, where necessary
 - viii. supply, fabrication and placing steel reinforcement, incorporating transformer base frame, where required
 - ix. supply, place, compact, finish and cure concrete
 - x. sealing of gap between enclosure and plinth, where necessary
 - xi. supply and installation of joints
 - xii. supply and installation of all fixing bolts, nuts and washers as appropriate, and
 - xiii. supply and installation of required structure earthing and bonding including earthing mats and tags to foundation.
- d) supply and installation of booster transformer support structure including all fixing bolts, nuts and washers, where necessary
- e) installation of booster transformer including connections to overhead line equipment and return conductors, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- f) carry out any necessary modifications to the mast, overhead line equipment, and return conductors
- g) on Site assembly, as appropriate, and
- h) rehandling and transport on the Site, where necessary.

**Item 80643 Installation of [plinth | mast] mounted auxiliary supply transformer,
[description]**

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) localised civil works to prepare the Site, where necessary, including but not limited to:
 - i. clear the Site
 - ii. provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
 - iii. carry out excavations, where required
 - iv. compacting material at bottom of excavations, where required
 - v. placement and compaction of appropriate Fill Material, where required
 - vi. sampling and testing of Fill Material, where required
 - vii. utilising or disposing of material, where required
 - viii. supply, transport and delivery of road base material
 - ix. spreading and placement of road base material, supply and incorporation of water, compacting and trimming, and
 - x. sampling and testing.
- c) construction of plinth, where necessary, including but not limited to:
 - i. compacting and trimming base, allow correct finished levels and falls for concrete slabs
 - ii. construct concrete foundation pad including all concrete, formwork, reinforcement and finishing for transformer installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply and installation of precast plinth base, where required
 - v. supply and place underlay and waterproof membrane, where required
 - vi. provision of formwork for concrete base and apron surrounding base, where required
 - vii. supply and installation of all fixing bolts, embedded conduit, pits and cable containment and draw strings to concrete foundation pad, where necessary
 - viii. supply, fabrication and placing steel reinforcement, incorporating transformer base frame, where required
 - ix. supply, place, compact, finish and cure concrete
 - x. sealing of gap between enclosure and plinth, where necessary
 - xi. supply and installation of joints
 - xii. supply and installation of all fixing bolts, nuts and washers as appropriate, and
 - xiii. supply and installation of required structure earthing and bonding including earthing mats and tags to foundation.

- d) supply and installation of auxiliary supply transformer support structure including all fixing bolts, nuts and washers, where necessary
- e) installation of auxiliary supply transformer including connections to traction equipment and trackside equipment, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- f) carry out any necessary modifications to the mast, traction equipment, and trackside equipment
- g) on Site assembly, as appropriate, and
- h) rehandling and transport on the Site, where necessary.

2.2.5 Power Supply and Distribution Equipment Supply / Installation

Item 80691 Supply and installation of autotransformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) localised civil works to prepare the Site, where necessary, including but not limited to:
 - i. clear the Site
 - ii. provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
 - iii. carry out excavations, where required
 - iv. compacting material at bottom of excavations, where required
 - v. placement and compaction of appropriate Fill Material, where required
 - vi. sampling and testing of Fill Material, where required
 - vii. utilising or disposing of material, where required
 - viii. supply, transport and delivery of road base material
 - ix. spreading and placement of road base material, supply and incorporation of water, compacting and trimming, and
 - x. sampling and testing.
- c) construction of plinth, where necessary, including but not limited to:
 - i. compacting and trimming base, allow correct finished levels and falls for concrete slabs
 - ii. construct concrete foundation pad including all concrete, formwork, reinforcement and finishing for transformer installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply and installation of precast plinth base, where required
 - v. supply and place underlay and waterproof membrane, where required
 - vi. provision of formwork for concrete base and apron surrounding base, where required

- vii. supply and installation of all fixing bolts, embedded conduit, pits and cable containment and draw strings to concrete foundation pad, where necessary
 - viii. supply, fabrication and placing steel reinforcement, incorporating transformer base frame, where required
 - ix. supply, place, compact, finish and cure concrete
 - x. sealing of gap between enclosure and plinth, where necessary
 - xi. supply and installation of joints
 - xii. supply and installation of all fixing bolts, nuts and washers as appropriate, and
 - xiii. supply and installation of required structure earthing and bonding including earthing mats and tags to foundation.
- d) supply and installation of autotransformer including connections to overhead line equipment and traction rails, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
 - e) carry out any necessary modifications to the overhead line structures, overhead line equipment, feeder conductors, and traction rails
 - f) factory assembly, as appropriate
 - g) handling, transport to the Site, and storage on the Site
 - h) on Site assembly, as appropriate, and
 - i) rehandling and transport on the Site, where necessary.

Item 80692 Supply and installation of [plinth | mast] mounted booster transformer, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) localised civil works to prepare the Site, where necessary, including but not limited to:
 - i. clear the Site
 - ii. provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
 - iii. carry out excavations, where required
 - iv. compacting material at bottom of excavations, where required
 - v. placement and compaction of appropriate Fill Material, where required
 - vi. sampling and testing of Fill Material, where required
 - vii. utilising or disposing of material, where required
 - viii. supply, transport and delivery of road base material
 - ix. spreading and placement of road base material, supply and incorporation of water, compacting and trimming, and
 - x. sampling and testing.

- c) construction of plinth, where necessary, including but not limited to:
 - i. compacting and trimming base, allow correct finished levels and falls for concrete slabs
 - ii. construct concrete foundation pad including all concrete, formwork, reinforcement and finishing for transformer installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply and installation of precast plinth base, where required
 - v. supply and place underlay and waterproof membrane, where required
 - vi. provision of formwork for concrete base and apron surrounding base, where required
 - vii. supply and installation of all fixing bolts, embedded conduit, pits and cable containment and draw strings to concrete foundation pad, where necessary
 - viii. supply, fabrication and placing steel reinforcement, incorporating transformer base frame, where required
 - ix. supply, place, compact, finish and cure concrete
 - x. sealing of gap between enclosure and plinth, where necessary
 - xi. supply and installation of joints
 - xii. supply and installation of all fixing bolts, nuts and washers as appropriate, and
 - xiii. supply and installation of required structure earthing and bonding including earthing mats and tags to foundation.
- d) supply and installation of booster transformer support structure including all fixing bolts, nuts and washers, where necessary
- e) supply and installation of booster transformer including connections to overhead line equipment and return conductors, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- f) carry out any necessary modifications to the mast, overhead line equipment, and return conductors
- g) factory assembly, as appropriate
- h) handling, transport to the Site, and storage on the Site
- i) on Site assembly, as appropriate, and
- j) rehandling and transport on the Site, where necessary.

Item 80693 Supply and installation of [*plinth* | *masf*] mounted auxiliary supply transformer, [*description*]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) localised civil works to prepare the Site, where necessary, including but not limited to:
 - i. clear the Site

- ii. provide temporary and/or permanent Site stabilisation including but not limited to piling and retaining structures, where necessary
 - iii. carry out excavations, where required
 - iv. compacting material at bottom of excavations, where required
 - v. placement and compaction of appropriate Fill Material, where required
 - vi. sampling and testing of Fill Material, where required
 - vii. utilising or disposing of material, where required
 - viii. supply, transport and delivery of road base material
 - ix. spreading and placement of road base material, supply and incorporation of water, compacting and trimming, and
 - x. sampling and testing.
- c) construction of plinth, where necessary, including but not limited to:
- i. compacting and trimming base, allow correct finished levels and falls for concrete slabs
 - ii. construct concrete foundation pad including all concrete, formwork, reinforcement and finishing for transformer installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply and installation of precast plinth base, where required
 - v. supply and place underlay and waterproof membrane, where required
 - vi. provision of formwork for concrete base and apron surrounding base, where required
 - vii. supply and installation of all fixing bolts, embedded conduit, pits and cable containment and draw strings to concrete foundation pad, where necessary
 - viii. supply, fabrication and placing steel reinforcement, incorporating transformer base frame, where required
 - ix. supply, place, compact, finish and cure concrete
 - x. sealing of gap between enclosure and plinth, where necessary
 - xi. supply and installation of joints
 - xii. supply and installation of all fixing bolts, nuts and washers as appropriate, and
 - xiii. supply and installation of required structure earthing and bonding including earthing mats and tags to foundation.
- d) supply and installation of auxiliary supply transformer support structure including all fixing bolts, nuts and washers, where necessary
- e) supply and installation of auxiliary supply transformer including connections to traction equipment and trackside equipment, earthing and bonding, and any other associated components, fittings and attachments, as appropriate
- f) carry out any necessary modifications to the mast, traction equipment, and trackside equipment

- g) factory assembly, as appropriate
- h) handling, transport to the Site, and storage on the Site
- i) on Site assembly, as appropriate, and
- j) rehandling and transport on the Site, where necessary.

2.2.6 Power Supply and Distribution Miscellaneous

Item 80741 Testing and commissioning of power supply and distribution, [description]

Work Operations incorporated in the above include the following as appropriate:

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) undertake testing and commissioning activities in accordance with the approved Testing and Commissioning Plan
- c) prepare detailed inspection, test plans and processes covering management and planning of all testing activities
- d) factory acceptance testing
- e) Site acceptance testing
- f) Site integration testing
- g) pre and post energisation testing
- h) coordinate with rail operations
- i) clearance reports
- j) as-built documentation
- k) handover documentation including test documents, and
- l) reporting to client representative.

2.3 Measurement

If any item for which a quantity of work is listed in the Schedule of Rates has not been priced by the Contractor, it will be deemed that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

2.3.1 Measurement of power supply and distribution

This Specification provides Standard Work Items for:

- a) supply only
- b) installation only, and
- c) supply and installation

of power supply and distribution components.

Any combination of Standard Work Items relating to these methods of measurement may be used in the Schedule of Rates. However, where a Standard Work Item for supply and installation of a particular component or group of components is included in the Schedule of Rates, no supply only nor

installation only Standard Work Item shall also apply to that component or group of components, as applicable.

2.3.2 Measurement of complete items

This Specification provides Standard Work Items for:

- a) “complete” traction switching stations and transformer Sites, and
- b) “supply”, “installation”, and “supply and installation” of power supply and distribution equipment.

In addition, other Specifications may include Standard Work Items for various associated components.

Any combination of Standard Work Items relating to these methods of measurement may be used in the Schedule of Rates. However, where a “complete” Standard Work Item for a particular component or group of components is included in the Schedule of Rates, no other Standard Work Item shall also apply to that component or group of components, as applicable.

2.3.3 Measurement of structure earth, earth mats, earthing and bonding

No separate Standard Work Item shall apply to, and no separate payment shall be made for providing or making connections with the structure earth, earth mats, earthing and bonding of any civil or structural work or power supply and distribution equipment or materials on the Site described by this Specification and/or the Drawings. Full payment for such activities shall be deemed to be included in the Work Items included in the Contract.

2.3.4 Measurement of power supply and distribution testing and commissioning

Where Standard Work Item 80741 is not included in the Schedule of Rates for the Contract, the Work Operations associated with that Work Item shall be deemed to be included in the other Work Items included in the Contract.

2.4 Calculation of quantities

2.4.1 General

Unless specified otherwise in Clause 2.4, quantities shall be calculated in accordance with the provisions of Clause 2.1.1 of MRS01 *Introduction to Specifications*.

2.4.2 Supply only

Where power supply and distribution components are supplied only under the Contract (i.e., not installed), the quantity shall be the exact quantity supplied and quantities shall not be rounded in accordance with Clause 2.1.1 of MRS01 *Introduction to Specifications*.

Where power supply and distribution components are installed only or are supplied and installed under the Contract, the quantity shall be measured in accordance with the remainder of this clause and normal rounding of the final quantity shall apply.

2.5 Removal of existing equipment

The Superintendent will inspect the salvaged materials at the storage Site and will reject any materials which, in the opinion of the Superintendent, have been damaged during the salvage operation. The Contractor shall be required to reimburse the Principal for materials damaged during salvage.

2.6 Power supply and distribution materials supplied by the Principal

2.6.1 Supply of power supply and distribution materials

Where listed in the Principal Supplied Material List (Form C7827), power supply and distribution materials shall be supplied by the Principal. Where not so listed, power supply and distribution materials shall be supplied by the Contractor.

2.6.2 Supply location

Power supply and distribution materials supplied by the Principal will be made available at the point of delivery and by the transport mode shown in the Principal Supplied Material List (Form C7827).

2.6.3 Time of delivery

The time of delivery shall generally conform to the construction program supplied by the Contractor with its tender.

Should on-Site construction be delayed, the Contractor may be required to accept delivery of the power supply and distribution materials at any time after the programmed date and to store the power supply and distribution materials at no cost to the Principal.

2.6.4 Acceptance of power supply and distribution materials by the Contractor

The Contractor shall check the power supply and distribution materials for quantity and condition upon taking delivery and shall immediately report to the Administrator any defect or deficiency.

Nonconformance

2.6.5 Damage to power supply and distribution materials

In the event of any power supply and distribution materials sustaining damage after the power supply and distribution materials has been accepted by the Contractor or Principal, the power supply and distribution materials shall be set aside until it has been inspected by the Administrator or Principal.

Nonconformance The cost of repairs to the damaged power supply and distribution materials and the cost of replacing the rejected power supply and distribution materials shall be borne by the Contractor or manufacturer.

