

Specification (Measurement)

**Transport and Main Roads Specifications
MRS333 Signalling and Communications**

March 2024



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1 Introduction

This Specification applies to the construction of rail signalling and communications.

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
Signalling and Communications Removal / Demolition		
80801	Removal of [<i>location cases equipment rooms</i>], [<i>description</i>]	each
80802	Removal of [<i>track circuits axle counters balise groups Lineside Electronic Units (LEU)</i>], [<i>description</i>]	each
80803	Removal of signal [<i>post gantry post ladder and landing head Junction Route Indicator (JRI) speed indicator telephones</i>], [<i>description</i>]	each
80804	Removal of train protection system equipment, [<i>description</i>]	each
80805	Removal of [<i>manual electric pneumatic</i>] points, [<i>description</i>]	each
80806	Removal of [<i>condition monitoring level crossing</i>] equipment, [<i>description</i>]	each
80807	Removal of conduits, [<i>description</i>]	m
80808	Removal of Ground Level Trough (GLT), [<i>description</i>]	m
80809	Removal of Galvanised Steel Trough (GST), [<i>description</i>]	m
80810	Removal of cable pits, [<i>description</i>]	each
80811	Removal of cabling, [<i>description</i>]	m
80812	Removal of pneumatic route, [<i>description</i>]	m
80813	Removal of pneumatic equipment, [<i>description</i>]	each
80814	Removal of signal signs, [<i>description</i>]	each
80815	Removal of rail bonds, [<i>description</i>]	each
Train Control and Interlocking Systems		
80831	Train control and interlocking systems, [<i>description</i>]	lump sum

Standard Item No.	Description	Unit of Measurement
Equipment Housings		
80851	Supply of location cases, [<i>single double</i>] width, [<i>description</i>]	each
80852	Supply of equipment rooms, [<i>SER CER SCER PER RBC SSI OCC PBI LX compressor building</i>], [<i>description</i>]	each
80853	Supply of communications tower, [<i>description</i>]	each
80854	Installation of location cases, [<i>single double</i>] width, [<i>description</i>]	each
80855	Installation of equipment rooms, [<i>SER CER SCER PER RBC SSI OCC PBI LX compressor building</i>], [<i>description</i>]	each
80856	Installation of communications tower, [<i>description</i>]	each
80857	Supply and installation of location cases, [<i>single double</i>] width, [<i>description</i>]	each
80858	Supply and installation of equipment rooms, [<i>SER CER SCER PER RBC SSI OCC PBI LX compressor building</i>], [<i>description</i>]	each
80859	Supply and installation of communications tower, [<i>description</i>]	each
80860	Modification of existing [<i>location cases equipment rooms</i>], [<i>description</i>]	each
Train Detection System – Track Circuits		
80881	Supply of track circuits, [<i>description</i>]	each
80882	Supply of impedance bonds, [<i>description</i>]	each
80883	Installation of track circuits, [<i>description</i>]	each
80884	Installation of impedance bonds, [<i>description</i>]	each
80885	Supply and installation of track circuits, [<i>description</i>]	each
80886	Supply and installation of impedance bonds, [<i>description</i>]	each
Train Detection System – Axle counters		
80911	Supply of enclosure box for [<i>description</i>]	each
80912	Supply of axle counter [<i>heads evaluator</i>], [<i>description</i>]	each
80913	Installation of enclosure box for [<i>description</i>]	each
80914	Installation of axle counter [<i>heads evaluator</i>], [<i>description</i>]	each
80915	Supply and installation of enclosure box for [<i>description</i>]	each
80916	Supply and installation of axle counter [<i>heads evaluator</i>], [<i>description</i>]	each
Track Detection System - Balises		
80931	Supply of balise groups, [<i>description</i>]	each
80932	Supply of trackside junction box, [<i>description</i>]	each
80933	Installation of balise groups, [<i>description</i>]	each
80934	Installation of trackside junction box, [<i>description</i>]	each
80935	Supply and installation of balise groups, [<i>description</i>]	each
80936	Supply and installation of trackside junction box, [<i>description</i>]	each

Standard Item No.	Description	Unit of Measurement
Train Detection System – Lineside Electronic Unit (LEU)		
80951	Supply of Lineside Electronic Units (LEU), [description]	each
80952	Installation of Lineside Electronic Units (LEU), [description]	each
80953	Supply and installation of Lineside Electronic Units (LEU), [description]	each
Movement Control System – Signal Head, Speed Indicator and Signal Sign		
80971	Supply of signal post, [length] metres long, [description]	each
80972	Supply of signal gantry, [description]	each
80973	Supply of signal head, [incandescent LED], [number of aspects] aspects, [description]	each
80974	Supply of [Junction Route Indicator (JRI) speed indicator], [description]	each
80975	Installation of signal post, [length] metres long, [description]	each
80976	Installation of signal gantry, [description]	each
80977	Installation of signal head, [incandescent LED], [number of aspects] aspects, [description]	each
80978	Installation of [Junction Route Indicator (JRI) speed indicator], [description]	each
80979	Supply and installation of signal post, [length] metres long, [description]	each
80980	Supply and installation of signal gantry, [description]	each
80981	Supply and installation of signal head, [incandescent LED], [number of aspects] aspects, [description]	each
80982	Supply and installation of [Junction Route Indicator (JRI) speed indicator], [description]	each
80983	Signal foundation, [description]	each
Movement Control System – Signal Telephones		
81001	Supply of signal telephones, [description]	each
81002	Installation of signal telephones, [description]	each
81003	Supply and installation of signal telephones, [description]	each
81004	Signal telephones foundation, [description]	each
Movement Control System – Train Protection Systems		
81021	Supply of Automated Warning System (AWS) equipment, [uni bi-directional line], [short long ramp], [description]	each
81022	Supply of Train Protection and Warning System (TPWS) equipment, [uni bi-directional], [description]	each
81023	Supply of train stops, [description]	each
81024	Installation of Automated Warning System (AWS) equipment, [uni bi-directional line], [short long ramp], [description]	each
81025	Installation of Train Protection and Warning System (TPWS) equipment, [uni bi-directional], [description]	each

Standard Item No.	Description	Unit of Measurement
81026	Installation of train stops, <i>[description]</i>	each
81027	Supply and installation of Automated Warning System (AWS) equipment, <i>[uni bi-directional line]</i> , <i>[short long ramp]</i> , <i>[description]</i>	each
81028	Supply and installation of Train Protection and Warning System (TPWS) equipment, <i>[uni bi-directional]</i> , <i>[description]</i>	each
81029	Supply and installation of train stops, <i>[description]</i>	each
Movement Control System – Points Equipment		
81051	Supply of manual points, <i>[description]</i>	each
81052	Supply of electric points machines, <i>[description]</i>	each
81053	Supply of pneumatic points, <i>[description]</i>	each
81054	Supply of points detector, <i>[description]</i>	each
81055	Supply of electric points power supplies, <i>[description]</i>	each
81056	Installation of manual points, <i>[description]</i>	each
81057	Installation of electric points machines, <i>[description]</i>	each
81058	Installation of pneumatic points, <i>[description]</i>	each
81059	Installation of points detector, <i>[description]</i>	each
81060	Installation of electric points power supplies, <i>[description]</i>	each
81061	Supply and installation of manual points, <i>[description]</i>	each
81062	Supply and installation of electric points machines, <i>[description]</i>	each
81063	Supply and installation of pneumatic points, <i>[description]</i>	each
81064	Supply and installation of points detectors, <i>[description]</i>	each
81065	Supply and installation of electric points power supplies, <i>[description]</i>	each
81066	Modification of manual points equipment, <i>[description]</i>	each
81067	Modification of electric points equipment, <i>[description]</i>	each
81068	Modification of pneumatic points equipment, <i>[description]</i>	each
Condition Monitoring System		
81081	Supply of Dragging Equipment Detector (DED), <i>[description]</i>	each
81082	Supply of Hot Bearing Detector (HBD), <i>[description]</i>	each
81083	Installation of Dragging Equipment Detector (DED), <i>[description]</i>	each
81084	Installation of Hot Bearing Detector (HBD), <i>[description]</i>	each
81085	Supply and installation of Dragging Equipment Detector (DED), <i>[description]</i>	each
81086	Supply and installation of Hot Bearing Detector (HBD), <i>[description]</i>	each

Standard Item No.	Description	Unit of Measurement
Level Crossings		
81101	Supply of <i>[flashing light signals boom barriers pedestrian tone alarms walk signals pedestrian barriers pedestrian automatic gates personal call lights]</i> , <i>[description]</i>	each
81102	Installation of <i>[flashing light signals boom barriers pedestrian tone alarms walk signals pedestrian barriers pedestrian automatic gates personal call lights]</i> , <i>[description]</i>	each
81103	Supply and installation of <i>[flashing light signals boom barriers pedestrian tone alarms walk signals pedestrian barriers pedestrian automatic gates personal call lights]</i> , <i>[description]</i>	each
81104	Modification of <i>[flashing light signals boom barriers pedestrian tone alarms walk signals pedestrian barriers pedestrian automatic gates personal call lights]</i> , <i>[description]</i>	each
Cable Route System – Trenching, Conduits and Troughs		
81121	Supply of conduits, <i>[description]</i>	m
81122	Supply of Ground Level Trough (GLT), <i>[description]</i>	m
81123	Supply of Galvanised Steel Trough (GST), <i>[description]</i>	m
81124	Supply of cable <i>[hangers ladders trays]</i> , <i>[description]</i>	m
81125	Supply of cable route fixed to bridge, <i>[description]</i>	m
81126	Installation of conduits in trench, <i>[description]</i>	m
81127	Installation of conduits in under track crossing, <i>[description]</i>	m
81128	Installation of conduits in existing conduit, <i>[description]</i>	m
81129	Installation of Ground Level Trough (GLT), <i>[description]</i>	m
81130	Installation of Galvanised Steel Trough (GST), <i>[description]</i>	m
81131	Installation of cable <i>[hangers ladders trays]</i> , <i>[description]</i>	m
81132	Installation of cable route fixed to bridge, <i>[description]</i>	m
81133	Supply and installation of conduits in trench, <i>[description]</i>	m
81134	Supply and installation of conduits in under track crossing, <i>[description]</i>	m
81135	Supply and installation of conduits in existing conduit, <i>[description]</i>	m
81136	Supply and installation of Ground Level Trough (GLT), <i>[description]</i>	m
81137	Supply and installation of Galvanised Steel Trough (GST), <i>[description]</i>	m
81138	Supply and installation of cable <i>[hangers ladders trays]</i> , <i>[description]</i>	m
81139	Supply and installation of cable route fixed to bridge, <i>[description]</i>	m
Cable Route System – Pits and Manholes		
81161	Supply of cable pits, <i>[description]</i>	each
81162	Installation of cable pits, <i>[description]</i>	each

Standard Item No.	Description	Unit of Measurement
81163	Supply and installation of cable pits, <i>[description]</i>	each
81164	Supply and installation of cable route marker, <i>[description]</i>	each
Cable Route System - Cables		
81181	Supply of cable, <i>[description]</i>	m
81182	Installation of cable in direct buried cable route, <i>[description]</i>	m
81183	Installation of cable in conduit, <i>[description]</i>	m
81184	Supply and installation of cable in direct buried cable route, <i>[description]</i>	m
81185	Supply and installation of cable in conduit, <i>[description]</i>	m
81186	Cable route connection to existing pit, <i>[description]</i>	each
Pneumatic Route System		
81201	Supply of pneumatic route, <i>[description]</i>	m
81202	Supply of pneumatic route equipment, <i>[description]</i>	each
81203	Installation of pneumatic route, <i>[description]</i>	m
81204	Installation of pneumatic route equipment, <i>[description]</i>	each
81205	Supply and installation of pneumatic route, <i>[description]</i>	m
81206	Supply and installation of pneumatic route equipment, <i>[description]</i>	each
Signalling and Communications Miscellaneous		
81221	Testing and commissioning of signalling and communications, <i>[description]</i>	lump sum
81222	Supply of signal signs, <i>[description]</i>	each
81223	Supply of signal to rail bonds, <i>[description]</i>	each
81224	Installation of signal signs, <i>[description]</i>	each
81225	Installation of signal to rail bonds, <i>[description]</i>	each
81226	Supply and installation of signal signs, <i>[description]</i>	each
81227	Supply and installation of signal to rail bonds, <i>[description]</i>	each

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 Signalling and Communications Removal / Demolition

- Item 80801** Removal of *[location cases | equipment rooms]*, *[description]*
- Item 80802** Removal of *[track circuits | axle counters | balise groups | Lineside Electronic Units (LEU)]*, *[description]*
- Item 80803** Removal of signal *[post | gantry | post ladder and landing | head | Junction Route Indicator (JRI) | speed indicator | telephones]*, *[description]*
- Item 80804** Removal of train protection system equipment, *[description]*

- Item 80805** **Removal of [*manual* | *electric* | *pneumatic*] points, [*description*]**
- Item 80806** **Removal of [*condition monitoring* | *level crossing*] equipment, [*description*]**
- Item 80807** **Removal of conduits, [*description*]**
- Item 80808** **Removal of Ground Level Trough (GLT), [*description*]**
- Item 80809** **Removal of Galvanised Steel Trough (GST), [*description*]**
- Item 80810** **Removal of cable pits, [*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 the signalling equipment
- c) removal of the signalling equipment and all internal cabling and associated components, as appropriate
- d) dismantling of the signalling equipment, 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 the 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.

Item 80811 **Removal of cabling, [*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 of circuit
- c) removal of cable
- d) transport of materials selected for salvage to the nominated storage Site
- e) removing from the Site and disposing or reusing of all surplus materials
- f) utilising or disposing of excavated and removed or demolished materials, and
- g) backfill and reinstatement of disturbed areas.

Item 80812 **Removal of pneumatic route, [*description*]**

Item 80813 **Removal of pneumatic equipment, [*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) removal of components

- c) transporting, unloading, and stockpiling of components for re-use at a later stage, where necessary
- d) transport of materials selected for salvage to the nominated storage Site
- e) removing from the Site and disposing or reusing of all surplus materials
- f) utilising or disposing of excavated and removed or demolished materials, and
- g) backfill and reinstatement of disturbed areas.

Item 80814 Removal of signal signs, [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) removal of components
- c) transporting, unloading, and stockpiling of components for re-use at a later stage, where necessary
- d) transport of materials selected for salvage to the nominated storage Site
- e) removing from the Site and disposing or reusing of all surplus materials
- f) utilising or disposing of excavated and removed or demolished materials, and
- g) backfill and reinstatement of disturbed areas.

Item 80815 Removal of rail bonds, [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) removal of all bonding components
- c) make good structure and rail, where necessary, and
- d) removing from the Site and disposing or reusing of all surplus materials.

2.2.2 Train Control and Interlocking Systems

Item 80831 Train control and interlocking systems, [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) design and development of the train control and interlocking systems, including but not limited to:
 - i. the traffic management sub-system
 - ii. the interlocking sub-system
 - iii. movement authority management sub-system
 - iv. secondary train protection sub-system
 - v. fixed data network sub-system
 - vi. configuration sub-system

- vii. diagnostic sub-system
 - viii. track vacancy sensors
 - ix. line-side signals and signs
 - x. track to train (mobile) data communications
 - xi. Train Control to Train (UHF) data communications (DTC)
 - xii. points operating mechanisms and associated sensors, and
 - xiii. at-grade active crossing warning and control mechanisms and associated sensors.
- c) design and development of the train control and interlocking systems interfaces, including but not limited to:
- i. the track
 - ii. the track formation and structures
 - iii. the train
 - iv. the overhead line traction system
 - v. the telecommunication network
 - vi. external power supply providers including public electricity network
 - vii. all above rail operators
 - viii. other railways e.g. cane railway at-grade crossings, private sidings
 - ix. other transport modes e.g. road crossings, road traffic signals
 - x. the train (network) controller
 - xi. the train driver
 - xii. passenger information sub-system
 - xiii. public information sub-system; Tunnel ventilation
 - xiv. fire alarm systems
 - xv. track workers
 - xvi. network operations management
 - xvii. enterprise fixed data network
 - xviii. enterprise mobile data network, and
 - xix. asset management.
- d) supply and installation of the hardware required by the train control and interlocking systems within operations control centres, including but not limited to:
- i. electronic and electrical equipment
 - ii. cable containment and cabling
 - iii. racks and supports
 - iv. power supply

- v. communications equipment, and
 - vi. operating consoles and workstations.
- e) supply, installation, configuration, testing of software required by the train control and interlocking systems including but not limited to:
- i. integration with the UTC/TMS
 - ii. integration with sub-systems, and
 - iii. integration with all other interfacing networks, systems, equipment.
- f) all modifications required to be made to the Universal Train Controls (UTC) operating systems
- g) supply, fabrication, construction and/or modification of any buildings and/or rooms to accommodate the train control and interlocking systems
- h) all other works to provide successful integration and satisfactory performance of a complete system
- i) factory assembly, as appropriate
 - j) handling, transport to the Site, and storage on the Site
 - k) rehandling and transport on the Site, where necessary, and
 - l) on Site assembly.

2.2.3 Equipment Housings

Item 80851 Supply of location cases, [*single* | *double*] width, [*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 location case
- c) supply of fire and smoke stopping to cable penetrations
- d) supply of air conditioning, temperature and humidity control equipment
- e) supply of ventilation equipment and vent fans
- f) supply of equipment mounting frames and racks, cable containment, trays or support
- g) supply of signalling and communication equipment and components including all internal wiring, connections and terminations
- h) supply of primary power supply for signalling and communication equipment
- i) supply of Uninterruptible Power Supply (UPS) including batteries
- j) supply of earth mats and earthing and bonding to the case, racks, mounting frames and equipment
- k) supply of lightning and surge protection
- l) factory assembly, as appropriate, and
- m) handling, transport to the Site, and storage on the Site.

Item 80852 Supply of equipment rooms, [SER | CER | SCER | PER | RBC | SSI | OCC | PBI | LX | compressor building], [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 prefabricated equipment room including windows, doors, internal partitions, linings and finishes, electrical, lighting, and fire protection
- c) supply of equipment room within a structure including windows, doors, internal partitions, linings and finishes, electrical and lighting, and fire protection
- d) supply of separate power supply room
- e) supply of separate air compressor air room
- f) supply of fire and smoke stopping to cable penetrations
- g) supply of air conditioning, temperature and humidity control equipment
- h) supply of ventilation equipment and vent fans
- i) supply of equipment mounting frames and racks, cable containment, trays or support
- j) supply of signalling and communication equipment and components including all internal wiring, connections and terminations
- k) supply of handle primary power supply for signalling and communication equipment
- l) supply of uninterruptible power supply (UPS) including batteries
- m) supply of earth mats and earthing and bonding to the case, racks, mounting frames and equipment
- n) supply of lightning and surge protection
- o) supply of communications compartment
- p) supply of automatic line telephones
- q) factory assembly, as appropriate, and
- r) handling, transport to the Site, and storage on the Site.

Item 80853 Supply of communications tower, [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 steel grillage, concrete spread footings, concrete auger, piled, rock, or raft foundations
- c) supply of all fixing bolts, embedded conduit, pits and cable containment to foundation or concrete foundation pile cap or pad
- d) supply of required structure earthing and bonding including earthing mats and tags to foundation
- e) supply of rigid or folding concrete or steel monopole, lattice, or guyed mast complete with ladders, footplates and equipment mounting brackets

- f) supply of aircraft warning lights and/or marking
- g) supply of communication transmission and receiving antennae equipment
- h) supply of cabling and cable trays and make connections to the antennae equipment
- i) supply of earthing and bonding to the mast and equipment and make connections to the foundation earthing
- j) supply of lightning and surge protection
- k) supply of security fencing and gates, and
- l) handling, transport to the Site, and storage on the Site.

Item 80854 Installation of location cases, [single | double] width, [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, 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 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) construct the base, 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 location case installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply 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 location 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 required structure earthing and bonding including earthing mats and tags to foundation.
- d) Install the location case, including but limited to:
- i. on Site assembly, as appropriate
 - ii. rehandling and transport on the Site, where necessary
 - iii. installation of location case
 - iv. installation of fire and smoke stopping to cable penetrations
 - v. installation of air conditioning, temperature and humidity control equipment
 - vi. installation of ventilation equipment and vent fans
 - vii. installation of equipment mounting frames and racks, cable containment, trays or support
 - viii. installation of signalling and communication equipment and components including all internal wiring, connections and terminations
 - ix. installation of primary power supply for signalling and communication equipment
 - x. installation of Uninterruptible Power Supply (UPS) including batteries
 - xi. installation of earth mats and earthing and bonding to the case, racks, mounting frames and equipment and make connections to the foundation earthing
 - xii. installation of lightning and surge protection, and
 - xiii. anti-graffiti finish, as appropriate.

Item 80855 Installation of equipment rooms, [SER | CER | SCER | PER | RBC | SSI | OCC | PBI | LX | compressor building], [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, including but 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 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) construct the base, 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 location case installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply 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 location 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 required structure earthing and bonding including earthing mats and tags to foundation.
- d) Install the equipment room, including but not limited to:
- i. on Site assembly, as appropriate
 - ii. rehandling and transport on the Site, where necessary
 - iii. construct free standing equipment room including structure, roof cladding, windows, doors, internal partitions, linings and finishes, electrical and lighting, fire protection
 - iv. rehandling and transport on the Site, where necessary
 - v. installation or construct free standing prefabricated equipment room including windows, doors, internal partitions, linings and finishes, electrical and lighting, fire protection
 - vi. installation or construct separate power supply room
 - vii. installation or construct separate air compressor air room
 - viii. installation of fire and smoke stopping to cable penetrations

- ix. installation of air conditioning, temperature and humidity control equipment
- x. installation of ventilation equipment and vent fans
- xi. installation of equipment mounting frames and racks, cable containment, trays or support
- xii. installation of signalling and communication equipment and components including all internal wiring, connections and terminations
- xiii. installation of primary power supply for signalling and communication equipment
- xiv. installation of Uninterruptible Power Supply (UPS) including batteries
- xv. installation of earth mats and earthing and bonding to the case, racks, mounting frames and equipment and make connections to the foundation earthing
- xvi. installation of lightning and surge protection
- xvii. installation of communications compartment
- xviii. installation of automatic line telephones
- xix. pre-testing and bell testing on installed signalling, communication and ancillary equipment
- xx. structure bonding and termination of cables
- xxi. supply and installation of cabling, connect electrical and communications services
- xxii. earthing including supply of earthing materials
- xxiii. supply and installation of handrails, bollards, security fencing and gates as required, and
- xxiv. anti-graffiti finish, as appropriate.

Item 80856 Installation of communications tower, [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) clear the Site
- c) rehandling and transport on the Site, where necessary
- d) installation of steel grillage, concrete spread footings, concrete auger, piled, rock, or raft foundations
- e) construct concrete foundation pad, pile cap and ground beams including all concrete, formwork, reinforcement and finishing
- f) installation of all fixing bolts, embedded conduit, pits and cable containment to foundation or concrete foundation pile cap or pad
- g) installation of required structure earthing and bonding including earthing mats and tags to foundation
- h) carry out all sampling and testing of materials
- i) installation of rigid or folding concrete or steel monopole, lattice, or guyed mast complete with ladders, footplates and equipment mounting brackets

- j) installation of aircraft warning lights and/or marking
- k) installation of communication transmission and receiving antennae equipment
- l) installation of cabling and cable trays and make connections to the antennae equipment
- m) installation of earthing and bonding to the mast and equipment and make connections to the foundation earthing
- n) installation of lightning and surge protection, and
- o) installation of security fencing and gates.

Item 80857 Supply and installation of location cases, [*single* | *double*] width, [*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, 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 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) construct the base, 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 location case installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply 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 location 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 required structure earthing and bonding including earthing mats and tags to foundation.
- d) supply and install the location case, including but not limited to:
- i. supply of location case
 - ii. supply of fire and smoke stopping to cable penetrations
 - iii. supply of air conditioning, temperature and humidity control equipment
 - iv. supply of ventilation equipment and vent fans
 - v. supply of equipment mounting frames and racks, cable containment, trays or support
 - vi. supply of signalling and communication equipment and components including all internal wiring, connections and terminations
 - vii. supply of primary power supply for signalling and communication equipment
 - viii. supply of Uninterruptible Power Supply (UPS) including batteries
 - ix. supply of earth mats and earthing and bonding to the case, racks, mounting frames and equipment
 - x. supply of lightning and surge protection
 - xi. factory assembly, as appropriate
 - xii. handling, transport to the Site, and storage on the Site
 - xiii. on Site assembly, as appropriate
 - xiv. rehandling and transport on the Site, where necessary
 - xv. installation of location case
 - xvi. installation of fire and smoke stopping to cable penetrations
 - xvii. installation of air conditioning, temperature and humidity control equipment
 - xviii. installation of ventilation equipment and vent fans
 - xix. installation of equipment mounting frames and racks, cable containment, trays or support
 - xx. installation of signalling and communication equipment and components including all internal wiring, connections and terminations
 - xxi. installation of primary power supply for signalling and communication equipment
 - xxii. installation of Uninterruptible Power Supply (UPS) including batteries
 - xxiii. installation of earth mats and earthing and bonding to the case, racks, mounting frames and equipment and make connections to the foundation earthing

- xxiv. installation of lightning and surge protection, and
- xxv. anti-graffiti finish, as appropriate.

Item 80858 Supply and installation of equipment rooms, [SER | CER | SCER | PER | RBC | SSI | OCC | PBI | LX | compressor building], [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, 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 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) construct the base, 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 location case installation
 - iii. steel platforms, access stairs, handrails, piled foundations and protection bollards
 - iv. supply 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 location 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 required structure earthing and bonding including earthing mats and tags to foundation.
- d) supply and install the equipment room, including but not limited to:
 - i. supply of prefabricated equipment room including windows, doors, internal partitions, linings and finishes, electrical, lighting, and fire protection
 - ii. supply of equipment room within a structure including windows, doors, internal partitions, linings and finishes, electrical and lighting, and fire protection
 - iii. supply of separate power supply room
 - iv. supply of separate air compressor air room
 - v. supply of fire and smoke stopping to cable penetrations
 - vi. supply of air conditioning, temperature and humidity control equipment
 - vii. supply of ventilation equipment and vent fans
 - viii. supply of equipment mounting frames and racks, cable containment, trays or support
 - ix. supply of signalling and communication equipment and components including all internal wiring, connections and terminations
 - x. supply of handle primary power supply for signalling and communication equipment
 - xi. supply of uninterruptible power supply (UPS) including batteries
 - xii. supply of earth mats and earthing and bonding to the case, racks, mounting frames and equipment
 - xiii. supply of lightning and surge protection
 - xiv. supply of communications compartment
 - xv. supply of automatic line telephones
 - xvi. factory assembly, as appropriate
 - xvii. handling, transport to the Site, and storage on the Site
 - xviii. on Site assembly, as appropriate
 - xix. rehandling and transport on the Site, where necessary
 - xx. construct free standing equipment room including structure, roof cladding, windows, doors, internal partitions, linings and finishes, electrical and lighting, fire protection
 - xxi. rehandling and transport on the Site, where necessary
 - xxii. installation or construct free standing prefabricated equipment room including windows, doors, internal partitions, linings and finishes, electrical and lighting, fire protection
 - xxiii. installation or construct separate power supply room
 - xxiv. installation or construct separate air compressor air room
 - xxv. installation of fire and smoke stopping to cable penetrations
 - xxvi. installation of air conditioning, temperature and humidity control equipment

- xxvii. installation of ventilation equipment and vent fans
- xxviii. installation of equipment mounting frames and racks, cable containment, trays or support
- xxix. installation of signalling and communication equipment and components including all internal wiring, connections and terminations
- xxx. installation of primary power supply for signalling and communication equipment
- xxxi. installation of Uninterruptible Power Supply (UPS) including batteries
- xxxii. installation of earth mats and earthing and bonding to the case, racks, mounting frames and equipment and make connections to the foundation earthing
- xxxiii. installation of lightning and surge protection
- xxxiv. installation of communications compartment
- xxxv. installation of automatic line telephones
- xxxvi. pre-testing and bell testing on installed signalling, communication and ancillary equipment
- xxxvii. structure bonding and termination of cables
- xxxviii. supply and installation of cabling, connect electrical and communications services
- xxxix. earthing including supply of earthing materials
- xl. supply and installation of handrails, bollards, security fencing and gates as required, and
- xli. anti-graffiti finish, as appropriate.

Item 80859 Supply and installation of communications tower, [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) clear the Site
- c) construct concrete foundation pad, pile cap and ground beams including all concrete, formwork, reinforcement and finishing
- d) carry out all sampling and testing of materials
- e) supply and installation of steel grillage, concrete spread footings, concrete auger, piled, rock, or raft foundations
- f) supply and installation of all fixing bolts, embedded conduit, pits and cable containment to foundation or concrete foundation pile cap or pad
- g) supply and installation of required structure earthing and bonding including earthing mats and tags to foundation
- h) supply and installation of rigid or folding concrete or steel monopole, lattice, or guyed mast complete with ladders, footplates and equipment mounting brackets
- i) supply and installation of aircraft warning lights and/or marking
- j) supply and installation of communication transmission and receiving antennae equipment

- k) supply and installation of cabling and cable trays and make connections to the antennae equipment
- l) supply and installation of earthing and bonding to the mast and equipment and make connections to the foundation earthing
- m) supply and installation of lightning and surge protection
- n) supply and installation of security fencing and gates
- o) handling, transport to the Site, and storage on the Site, and
- p) rehandling and transport on the Site, where necessary.

Item 80860 Modification of existing [*location cases* | *equipment rooms*], [*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 of the signalling and communications equipment
- c) disconnect and remove redundant equipment
- d) supply all necessary signalling equipment and internal wiring
- e) factory assembly, as appropriate
- f) handling, transport to the Site, and storage on the Site
- g) on Site assembly, as appropriate
- h) rehandling and transport on the Site, where necessary, and
- i) installation and reconfiguration of signalling and communications equipment.

2.2.4 Train Detection System – Track circuits

Item 80881 Supply of track circuits, [*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 track circuit trackside equipment, including but not limited to transmitters, receivers, power supplies, collector, tuning/matching units, transformers and air core inductors, cabling, fixtures, fittings and enclosures, and
- c) handling, transport to the Site, and storage on the Site.

Item 80882 Supply of impedance bonds, [*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 impedance bonds and all necessary components, and
- c) handling, transport to the Site, and storage on the Site.

Item 80883 Installation of track circuits, [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) installation of track circuit trackside equipment, including but not limited to transmitters, receivers, power supplies, collector, tuning/matching units, transformers and air core inductors, cabling, fixtures, fittings and enclosures
- c) clear existing track circuit connections where an existing signalling system is being renewed, including old feed and relay connections, impedance bonds, air-core inductors and spark-gap connections
- d) rehandling and transport on the Site, where necessary
- e) installation of track circuit trackside equipment on mounting posts
- f) drill and clean sleepers and rail, install track circuit equipment to rail
- g) installation of power supply to track circuit equipment
- h) installation of cables from transmitter to receiver, enclosures and relays, and
- i) connect to interlocking sub-system.

Item 80884 Installation of impedance bonds, [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) rehandling and transport on the Site, where necessary
- c) installation of impedance bond with all necessary components, and
- d) include for all drilling, cleaning, fixtures and fittings.

Item 80885 Supply and installation of track circuits, [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 and delivery of track circuit trackside equipment, including but not limited to transmitters, receivers, power supplies, collector, tuning/matching units, transformers and air core inductors, cabling, fixtures, fittings and enclosures
- c) handling, transport to the Site, and storage on the Site
- d) installation of track circuit trackside equipment, including but not limited to transmitters, receivers, power supplies, collector, tuning/matching units, transformers and air core inductors, cabling, fixtures, fittings and enclosures
- e) clear existing track circuit connections where an existing signalling system is being renewed, including old feed and relay connections, impedance bonds, air-core inductors and spark-gap connections
- f) rehandling and transport on the Site, where necessary
- g) installation of track circuit trackside equipment on mounting posts

- h) drill and clean sleepers and rail, install track circuit equipment to rail
- i) installation of power supply to track circuit equipment
- j) installation of cables from transmitter to receiver, enclosures and relays, and
- k) connect to interlocking sub-system.

Item 80886 Supply and installation of impedance bonds, [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 and installation of impedance bond with all necessary components
- c) include for all drilling, cleaning, fixtures and fittings
- d) handling, transport to the Site, and storage on the Site, and
- e) rehandling and transport on the Site, where necessary.

2.2.5 Train Detection System – Axle Counters

Item 80911 Supply of enclosure box for [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 enclosure box, complete with racks, mounting frames, fixtures, and fittings, and
- c) handling, transport to the Site, and storage on the Site.

Item 80912 Supply of axle counter [heads | evaluator], [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 axle counter heads, axle counter evaluator, power transformer, ethernet switch, router, enclosure box
- c) supply of cabling and cable containment, and
- d) handling, transport to the Site, and storage on the Site.

Item 80913 Installation of enclosure box for [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) installation of foundation pad
- c) rehandling and transport on the Site, where necessary, and
- d) installation of enclosure box, complete with racks, mounting frames, fixtures, and fittings.

Item 80914 Installation of axle counter [heads | evaluator], [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) rehandling and transport on the Site, where necessary
- c) installation of axle counter heads, axle counter evaluator, power transformer, ethernet switch, router, enclosure box, and
- d) installation of cabling and cable containment.

Item 80915 Supply and installation of enclosure box for [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) installation of foundation pad
- c) supply and installation of enclosure box, complete with racks, mounting frames, fixtures, and fittings
- d) handling, transport to the Site, and storage on the Site, and
- e) rehandling and transport on the Site, where necessary.

Item 80916 Supply and installation of axle counter [heads | evaluator], [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 and installation of axle counter heads, axle counter evaluator, power transformer, ethernet switch, router, enclosure box
- c) supply and installation of cabling and cable containment
- d) handling, transport to the Site, and storage on the Site, and
- e) rehandling and transport on the Site, where necessary.

2.2.6 Train Detection System – Balises

Item 80931 Supply of balise groups, [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 balise groups, including but not limited to:
 - i. controlled or fixed balises
 - ii. spreader beams, on- sleeper or between beams
 - iii. balise identification plate
 - iv. balise location identification plate
 - v. balise tail cable to junction box
 - vi. cable connections, fixtures and fittings, and
 - vii. calibration balise marker plaque.
- c) data design for balise group

- d) programming of balises, and
- e) handling, transport to Site, and storage on the Site.

Item 80932 Supply of trackside junction box, [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 junction box, cable tails, cable termination, surge arrestor, fixtures and fittings, and
- c) handling, transport to Site, and storage on the Site.

Item 80933 Installation of balise groups, [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) rehandling and transport on the Site, where necessary, and
- c) installation of balise groups, including but not limited to:
 - i. controlled or fixed balises
 - ii. spreader beams, on- sleeper or between beams
 - iii. balise identification plate
 - iv. balise location identification plate
 - v. balise tail cable to junction box
 - vi. cable connections, fixtures and fittings, and
 - vii. calibration balise marker plaque.

Item 80934 Installation of trackside junction box, [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) rehandling and transport on the Site, where necessary, and
- c) installation of junction box, cable tails, cable termination, surge arrestor, fixtures and fittings.

Item 80935 Supply and installation of balise groups, [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 and installation of balise groups, including but not limited to:
 - i. controlled or fixed balises
 - ii. spreader beams, on- sleeper or between beams
 - iii. balise identification plate
 - iv. balise location identification plate
 - v. balise tail cable to junction box

- vi. cable connections, fixtures and fittings, and
- vii. calibration balise marker plaque.
- c) data design for balise group
- d) programming of balises
- e) handling, transport to the Site, and storage on the Site, and
- f) rehandling and transport on the Site, where necessary.

Item 80936 Supply and installation of trackside junction box, [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 and installation of junction box, cable tails, cable termination, surge arrestor, fixtures and fittings
- c) handling, transport to the Site, and storage on the Site, and
- d) rehandling and transport on the Site, where necessary.

2.2.7 Train Detection System – Lineside Electronic Unit (LEU)

Item 80951 Supply of Lineside Electronic Units (LEU), [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 Lineside Equipment Unit (LEU) enclosure
- c) supply of racks for LEU
- d) supply of power supply, cabling, cable containment
- e) supply of electrical and electronic equipment, and
- f) handling, transport to the Site, and storage on the Site.

Item 80952 Installation of Lineside Electronic Units (LEU), [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) provide LEU enclosure foundation pad or mounting structure
- c) provide space in LOC or equipment room for LEU
- d) rehandling and transport on the Site, where necessary
- e) installation of Lineside Equipment Unit (LEU) enclosure
- f) installation of racks for LEU
- g) installation of power supply, cabling, cable containment
- h) installation of electrical and electronic equipment, and
- i) connections to input cable tails and interlocking sub-system.

Item 80953 Supply and installation of Lineside Electronic Units (LEU), [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*
- c) provide LEU enclosure foundation pad or mounting structure
- d) provide space in LOC or equipment room for LEU
- e) supply and installation of Lineside Equipment Unit (LEU) enclosure
- f) supply and installation of racks for LEU
- g) supply and installation of power supply, cabling, cable containment
- h) supply and installation of electrical and electronic equipment
- i) connections to input cable tails and interlocking sub-system
- l) handling, transport to the Site, and storage on the Site, and
- m) rehandling and transport on the Site, where necessary.

2.2.8 Movement Control System – Signal Head, Speed Indicator and Signal Sign

Item 80971 Supply of signal post, [length] metres long, [description]

Item 80972 Supply of signal gantry, [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 and fabrication of signal post, gantry, ladders, platforms, outside signal module, in signal module, mounting brackets, rung ladder, gallery ring and handrails including all fixing bolts, nuts and washers
- c) supply of earthing mats, earthing and bonding cabling, and
- d) handling, transport to the Site, and storage on the Site.

Item 80973 Supply of signal head, [incandescent | LED], [number of aspects] aspects, [description]

Item 80974 Supply of [Junction Route Indicator (JRI) | speed indicator], [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 signal equipment including fixtures and fittings
- c) supply of power and control cabling, and
- d) handling, transport to the Site, and storage on the Site.

Item 80975 Installation of signal post, [length] metres long, [description]

Item 80976 Installation of signal gantry, [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) rehandling and transport on the Site, where necessary
- c) installation of signal post, gantry, ladders, platforms, outside signal module, in signal module, mounting brackets, rung ladder, gallery ring and handrails including all fixing bolts, nuts and washers, and
- d) installation of earthing mats, earthing and bonding cabling.

Item 80977 Installation of signal head, [*incandescent* | *LED*], [*number of aspects*] aspects, [*description*]

Item 80978 Installation of [*Junction Route Indicator (JRI)* | *speed indicator*], [*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) rehandling and transport on the Site, where necessary
- c) installation of signal equipment including fixtures and fittings, and
- d) installation of power and control cabling.

Item 80979 Supply and installation of signal post, [*length*] metres long, [*description*]

Item 80980 Supply and installation of signal gantry, [*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, fabrication, and installation of signal post, gantry, ladders, platforms, outside signal module, in signal module, mounting brackets, rung ladder, gallery ring and handrails including all fixing bolts, nuts and washers
- c) supply and installation of earthing mats, earthing and bonding cabling
- d) handling, transport to the Site, and storage on the Site, and
- e) rehandling and transport on the Site, where necessary.

Item 80981 Supply and installation of signal head, [*incandescent* | *LED*], [*number of aspects*] aspects, [*description*]

Item 80982 Supply and installation of [*Junction Route Indicator (JRI)* | *speed indicator*], [*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 and installation of signal equipment including fixtures and fittings
- c) supply and installation of power and control cabling
- d) handling, transport to the Site, and storage on the Site, and
- e) rehandling and transport on the Site, where necessary.

Item 80983 Signal foundation, [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) setting out of the signal and footing including confirmation of vertical clearance and lateral offset
- c) clear the Site, where necessary
- d) geotechnical Site investigation to confirm minimum foundation capacity, where necessary
- e) provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
- f) piled foundation, where necessary
- g) excavate and compact material at bottom of excavations, where necessary
- h) utilising or disposing of excavated and removed or demolished materials
- i) backfill and reinstatement of disturbed areas
- j) supply and installation of blinding concrete, where necessary
- k) provision of formwork, where necessary
- l) supply and installation of reinforcing, anchor cage or ragbolt assembly, as appropriate
- m) supply of and installation of holding down bolts, as appropriate
- n) supply place, cure and finish concrete
- o) stripping formwork, and
- p) placing and compacting backfill material.

2.2.9 Movement Control System – Signal Telephones

Item 81001 Supply of signal telephones, [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 signal telephone enclosure, mounting, fixtures and fittings
- c) supply of power supply, cabling, cable containment
- d) supply of electrical and electronic equipment, and
- e) handling, transport to the Site, and storage on the Site.

Item 81002 Installation of signal telephones, [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) rehandling and transport on the Site, where necessary
- c) provide space in LOC or equipment room for signal telephone
- d) installation of signal telephone enclosure, mounting, fixtures and fittings

- e) installation of power supply, cabling, cable containment
- f) installation of electrical and electronic equipment, and
- g) connections to telephone equipment and interlocking sub-system.

Item 81003 Supply and installation of signal telephones, [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) provide space in LOC or equipment room for signal telephone
- c) supply and installation of signal telephone enclosure, mounting, fixtures and fittings
- d) supply and installation of power supply, cabling, cable containment
- e) supply and installation of electrical and electronic equipment, and
- f) connections to telephone equipment and interlocking sub-system
- g) handling, transport to the Site, and storage on the Site, and
- h) rehandling and transport on the Site, where necessary.

Item 81004 Signal telephones foundation, [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) clear the Site, where necessary
- c) provide temporary and/or permanent Site stabilisation including but not limited to piling, retaining structures, where necessary
- d) excavate and compact material at bottom of excavations, where necessary
- e) utilising or disposing of excavated and removed or demolished materials
- f) backfill and reinstatement of disturbed areas
- g) provide, place and compact fill material from all sources, where necessary
- h) sample and test of fill material, where necessary
- i) supply, transport, delivery spread, compact and trim road base material, where necessary
- j) construct concrete foundation pad including all concrete, formwork, reinforcement and finishing
- k) supply of installation all holding down bolts, embedded conduit, pits and cable containment sand draw strings to concrete foundation pad, as appropriate
- l) supply of installation structure earthing and bonding including earthing mats and tags to foundation, if required
- m) supply place, cure and finish concrete
- n) stripping formwork, and
- o) placing and compacting backfill material.

2.2.10 Movement Control System – Train Protection Systems

Item 81021 **Supply of Automated Warning System (AWS) equipment, [uni | bi-directional line], [short | long ramp], [description]**

Item 81022 **Supply of Train Protection and Warning System (TPWS) equipment, [uni | bi-directional], [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 Automated Warning System (AWS) or Train Protection and Warning System (TPWS) equipment and associated components including power supply and ramps, and
- c) handling, transport to the Site, and storage on the Site.

Item 81023 **Supply of train stops, [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 train stop equipment including trip arm mechanism, fixtures and fittings, and
- c) handling, transport to the Site, and storage on the Site.

Item 81024 **Installation of Automated Warning System (AWS) equipment, [uni | bi-directional line], [short | long ramp], [description]**

Item 81025 **Installation of Train Protection and Warning System (TPWS) equipment, [uni | bi-directional], [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) rehandling and transport on the Site, where necessary
- c) preparation of Automated Warning System (AWS) or Train Protection and Warning System (TPWS) equipment and associated components, and
- d) installation of Automated Warning System (AWS) or Train Protection and Warning System (TPWS) equipment and associated components including power supply and ramps.

Item 81026 **Installation of train stops, [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) rehandling and transport on the Site, where necessary
- c) provide train stop equipment foundation pad or mounting structure, and
- d) installation of train stop equipment including trip arm mechanism, fixtures and fittings.

Item 81027 Supply and installation of Automated Warning System (AWS) equipment, [uni | bi-directional line], [short | long ramp], [description]

Item 81028 Supply and installation of Train Protection and Warning System (TPWS) equipment, [uni | bi-directional], [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) preparation of Automated Warning System (AWS) or Train Protection and Warning System (TPWS) equipment and associated components
- c) supply and installation of Automated Warning System (AWS) or Train Protection and Warning System (TPWS) equipment and associated components including power supply and ramps
- d) handling, transport to the Site, and storage on the Site, and
- e) rehandling and transport on the Site, where necessary.

Item 81029 Supply and installation of train stops, [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) provide train stop equipment foundation pad or mounting structure
- c) supply and installation of train stop equipment including trip arm mechanism, fixtures and fittings
- d) handling, transport to the Site, and storage on the Site, and
- e) rehandling and transport on the Site, where necessary.

2.2.11 Movement Control System – Points Equipment

Item 81051 Supply of manual points, [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 manual points including fittings and fixtures
- c) supply of power cables and cable containment
- d) supply of power supply including cabling, and
- e) handling, transport to the Site, and storage on the Site.

Item 81052 Supply of electric points machines, [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 electric point machines and accessories
- c) supply of mechanical and electrical accessories
- d) supply of power cables and cable containment
- e) supply of control cables and cable containment

- f) supply of power supply including cabling, and
- g) handling, transport to the Site, and storage on the Site.

Item 81053 Supply of pneumatic points, [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 pneumatic machines and accessories
- c) supply of mechanical and electrical connections
- d) supply of power cables and cable containment
- e) supply of control cables and cable containment
- f) supply of power supply including cabling and connections, and
- g) handling, transport to the Site, and storage on the Site.

Item 81054 Supply of points detector, [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 point detectors and accessories
- c) supply of power cables and cable containment
- d) supply of control cables and cable containment
- e) supply of power supply including cabling and connections, and
- f) handling, transport to the Site, and storage on the Site.

Item 81055 Supply of electric points power supplies, [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 electric points power supplies, and
- c) handling, transport to the Site, and storage at the Site.

Item 81056 Installation of manual points, [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) preparation of mounting surfaces to accommodate manual points
- c) rehandling and transport on the Site, where necessary
- d) installation of manual points including fittings and fixtures
- e) installation of power cables and cable containment
- f) installation of power supply including cabling

- g) make connections to interlocking sub-systems, and
- h) integration with rail systems.

Item 81057 Installation of electric points machines, [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) preparation of mounting surfaces to accommodate electric points machines
- c) construction of pit to house electric point machines
- d) rehandling and transport on the Site, where necessary
- e) installation of electric point machines and accessories
- f) installation of mechanical and electrical accessories
- g) installation of power cables and cable containment
- h) installation of control cables and cable containment
- i) installation of power supply including cabling
- j) make connection to interlocking sub-systems, and
- k) integration with rail systems.

Item 81058 Installation of pneumatic points, [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) preparation of mounting surfaces to accommodate pneumatic points machines
- c) construction of pit to house pneumatic point machines
- d) rehandling and transport on the Site, where necessary
- e) installation of pneumatic machines and accessories
- f) installation of mechanical and electrical connections
- g) installation of power cables and cable containment
- h) installation of control cables and cable containment
- i) installation of power supply including cabling and connections
- j) connections to compressed air supply line
- k) make connection to interlocking sub-systems, and
- l) integration with rail systems.

Item 81059 Installation of points detector, [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) preparation of mounting surfaces to accommodate point detectors

- c) rehandling and transport on the Site, where necessary
- d) installation of point detectors and accessories
- e) installation of mechanical and electrical connections
- f) installation of power cables and cable containment
- g) installation of control cables and cable containment
- h) installation of power supply including cabling and connections
- i) make connection to interlocking sub-systems, and
- j) integration with rail systems.

Item 81060 Installation of electric points power supplies, [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) rehandling and transport on the Site, where necessary, and
- c) installation of electronic points power supplies.

Item 81061 Supply and installation of manual points, [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) preparation of mounting surfaces to accommodate manual points
- c) supply and installation of manual points including fittings and fixtures
- d) supply and installation of power cables and cable containment
- e) supply and installation of power supply including cabling
- f) make connections to interlocking sub-systems
- g) handling, transport to the Site, and storage on the Site
- h) rehandling and transport on the Site, where necessary, and
- i) integration with rail systems.

Item 81062 Supply and installation of electric points machines, [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) preparation of mounting surfaces to accommodate electric points machines
- c) construction of pit to house electric point machines
- d) supply and installation of electric point machines and accessories
- e) supply and installation of mechanical and electrical accessories
- f) supply and installation of power cables and cable containment
- g) supply and installation of control cables and cable containment

- h) supply and installation of power supply including cabling
- i) make connection to interlocking sub-systems
- j) handling, transport to the Site, and storage on the Site
- k) rehandling and transport on the Site, where necessary, and
- l) integration with rail systems.

Item 81063 Supply and installation of pneumatic points, [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) preparation of mounting surfaces to accommodate pneumatic points machines
- c) construction of pit to house pneumatic point machines
- d) supply and installation of pneumatic machines and accessories
- e) supply and installation of mechanical and electrical connections
- f) supply and installation of power cables and cable containment
- g) supply and installation of control cables and cable containment
- h) supply and installation of power supply including cabling and connections
- i) connections to compressed air supply line
- j) make connection to interlocking sub-systems
- k) handling, transport to the Site, and storage on the Site
- l) rehandling and transport on the Site, where necessary, and
- m) integration with rail systems.

Item 81064 Supply and installation of points detectors, [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) preparation of mounting surfaces to accommodate point detectors
- c) supply and installation of point detectors and accessories
- d) supply and installation of mechanical and electrical connections
- e) supply and installation of power cables and cable containment
- f) supply and installation of control cables and cable containment
- g) supply and installation of power supply including cabling and connections
- h) make connection to interlocking sub-systems
- i) handling, transport to the Site, and storage on the Site
- j) rehandling and transport on the Site, where necessary, and
- k) integration with rail systems.

Item 81065 Supply and installation of electric points power supplies, [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 and installation of electric points power supplies
- c) handling, transport to the Site, and storage on the Site, and
- d) rehandling and transport on the Site, where necessary.

Item 81066 Modification of manual points equipment, [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) removal of equipment to be modified for disposal or salvage
- c) supply and installation of equipment, fixtures, fittings as required
- d) supply and installation of equipment or materials for replacement or repair of rail, sleepers or points where affected by points equipment modification
- e) make connections to interlocking sub-systems
- f) reconfigure interlocking sub-systems if required
- g) handling, transport to the Site, and storage on the Site
- h) rehandling and transport on the Site, where necessary, and
- i) integration with rail systems.

Item 81067 Modification of electric points equipment, [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-energise and isolate electric points equipment
- c) removal of equipment to be modified for disposal or salvage
- d) supply and installation of equipment, cables, cable containment, fixtures, fittings as required
- e) supply and installation of equipment or materials for replacement or repair of rail, sleepers or points where affected by points equipment modification
- f) make connections to interlocking sub-systems
- g) reconfigure interlocking sub-systems if required
- h) handling, transport to the Site, and storage on the Site
- i) rehandling and transport on the Site, where necessary, and
- j) integration with rail systems.

Item 81068 Modification of pneumatic points equipment, [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-energise, disconnect and isolate pneumatic points equipment
- c) removal of equipment to be modified for disposal or salvage
- d) supply and installation of equipment, cables, cable containment, fixtures, fittings as required
- e) supply and installation of equipment or materials for replacement or repair of rail, sleepers or points where affected by points equipment modification
- f) make connections to interlocking sub-systems
- g) reconfigure interlocking sub-systems if required
- h) handling, transport to the Site, and storage on the Site
- i) rehandling and transport on the Site, where necessary, and
- j) integration with rail systems.

2.2.12 Condition Monitoring System

Item 81081 Supply of Dragging Equipment Detector (DED), [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 dragging equipment detectors, fixtures and fittings
- c) supply of dragging equipment detector trackside enclosure and mounting post
- d) supply of power cables and cable containment
- e) supply of control cables and cable containment
- f) supply of power supply including cabling and connections, and
- g) handling, transport to the Site, and storage on the Site.

Item 81082 Supply of Hot Bearing Detector (HBD), [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 hollow steel sleeper
- c) supply of hot bearing detectors, fixtures and fittings
- d) supply of power cables and cable containment
- e) supply of control cables and cable containment
- f) supply of including cabling and connections
- g) make connection to interlocking sub-systems, and
- h) handling, transport to the Site, and storage on the Site.

Item 81083 Installation of Dragging Equipment Detector (DED), [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) preparation of mounting surfaces to accommodate dragging equipment detector
- c) rehandling and transport on the Site, where necessary
- d) installation of dragging equipment detectors, fixtures and fittings
- e) installation of dragging equipment detector trackside enclosure and mounting post
- f) installation of power cables and cable containment
- g) installation of control cables and cable containment
- h) installation of power supply including cabling and connections, and
- i) make connection to interlocking sub-systems.

Item 81084 Installation of Hot Bearing Detector (HBD), [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) preparation of mounting surfaces to accommodate hot bearing detector
- c) rehandling and transport on the Site, where necessary
- d) installation of hollow steel sleeper
- e) installation of hot bearing detectors, fixtures and fittings
- f) installation of power cables and cable containment
- g) installation of control cables and cable containment
- h) installation of supply including cabling and connections
- i) handling and installation of power supply including cabling and connections, and
- j) make connection to interlocking sub-systems.

Item 81085 Supply and installation of Dragging Equipment Detector (DED), [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) preparation of mounting surfaces to accommodate dragging equipment detector
- c) supply and installation of dragging equipment detectors, fixtures and fittings
- d) supply and installation of dragging equipment detector trackside enclosure and mounting post
- e) supply and installation of power cables and cable containment
- f) supply and installation of control cables and cable containment
- g) supply and installation of power supply including cabling and connections
- h) make connection to interlocking sub-systems
- i) handling, transport to the Site, and storage on the Site, and
- j) rehandling and transport on the Site, where necessary.

Item 81086 Supply and installation of Hot Bearing Detector (HBD), [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) preparation of mounting surfaces to accommodate hot bearing detector
- c) supply and installation of hollow steel sleeper
- d) supply and installation of hot bearing detectors, fixtures and fittings
- e) supply and installation of power cables and cable containment
- f) supply and installation of control cables and cable containment
- g) supply and installation power supply including cabling and connections
- h) make connection to interlocking sub-systems
- i) handling, transport to the Site, and storage on the Site, and
- j) rehandling and transport on the Site, where necessary.

2.2.13 Level Crossings

Item 81101 Supply of [flashing light signals | boom barriers | pedestrian tone alarms | walk signals | pedestrian barriers | pedestrian automatic gates | personal call lights], [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 level crossing protection, as appropriate, including but not limited to:
 - i. flashing light signals
 - ii. boom barriers
 - iii. pedestrian tone alarms
 - iv. walk signals
 - v. pedestrian barriers
 - vi. pedestrian automatic gates, and
 - vii. personal call lights.
- c) supply of all mounting structures, brackets, fixtures and fittings, connections and electrical equipment, as required
- d) supply of earthing mats and earthing and bonding to all level crossing protection equipment, and
- e) handling, transport to the Site, and storage on the Site.

Item 81102 Installation of [*flashing light signals | boom barriers | pedestrian tone alarms | walk signals | pedestrian barriers | pedestrian automatic gates | personal call lights*], [*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) rehandling and transport on the Site, where necessary
- c) installation of level crossing protection including but not limited to:
 - i. flashing light signals
 - ii. boom barriers
 - iii. pedestrian tone alarms
 - iv. walk signals
 - v. pedestrian barriers
 - vi. pedestrian automatic gates, and
 - vii. personal call lights.
- d) Installation of all mounting structures, brackets, fixtures and fittings, connections and electrical equipment, as required
- e) installation of earthing mats and earthing and bonding to all level crossing protection equipment, and
- f) make all connections to interlocking sub-systems.

Item 81103 Supply and installation of [*flashing light signals | boom barriers | pedestrian tone alarms | walk signals | pedestrian barriers | pedestrian automatic gates | personal call lights*], [*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 and installation of level crossing protection including but not limited to:
 - i. flashing light signals
 - ii. boom barriers
 - iii. pedestrian tone alarms
 - iv. walk signals
 - v. pedestrian barriers
 - vi. pedestrian automatic gates, and
 - vii. personal call lights.
- c) supply and installation of all mounting structures, brackets, fixtures and fittings, connections and electrical equipment, as required

- d) supply and installation of earthing mats and earthing and bonding to all level crossing protection equipment
- e) make all connections to interlocking sub-systems
- f) handling, transport to the Site, and storage on the Site, and
- g) rehandling and transport on the Site, where necessary.

Item 81104 Modification of [*flashing light signals* | *boom barriers* | *pedestrian tone alarms* | *walk signals* | *pedestrian barriers* | *pedestrian automatic gates* | *personal call lights*], [*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 of the level crossing protection equipment, where necessary
- c) disconnect and remove redundant equipment, where necessary
- d) supply all necessary signalling equipment and internal wiring
- e) factory assembly, as appropriate
- f) handling, transport to the Site, and storage on the Site
- g) on Site assembly, as appropriate
- h) rehandling and transport on the Site, where necessary
- i) installation and reconfiguration of level crossing protection equipment, and
- j) make all connections to interlocking sub-systems.

2.2.14 Cable Route System – Trenching, Conduits and Troughs

Item 81121 Supply of conduits, [*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 conduit, conduit bends, draw rope and other fixtures and fittings, and
- c) handling, transport to the Site, and storage on the Site.

Item 81122 Supply of Ground Level Trough (GLT), [*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 ground level trough including covers, fixtures and fittings, and
- c) handling, transport to the Site, and storage on the Site.

Item 81123 Supply of Galvanised Steel Trough (GST), [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 galvanised steel trough including post, covers, fixtures and fittings, and
- c) handling, transport to the Site, and storage on the Site.

Item 81124 Supply of cable [hangers | ladders | trays], [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 and fabrication of cable hangers, ladders, trays including fixtures and fittings, and
- c) handling, transport to the Site, and storage on the Site.

Item 81125 Supply of cable route fixed to bridge, [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 and fabrication of brackets, fixtures and fittings for cable route fixed to bridge, and
- c) handling, transport to the Site, and storage on the Site.

Item 81126 Installation of conduits in trench, [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) excavation of trench
- c) utilising or disposing of surplus excavated material
- d) supply and installation of bedding and backfill materials
- e) supply of primer and adhesive for joining
- f) rehandling and transport on the Site, where necessary
- g) installation of conduit and conduit bends
- h) supply and installation of marker tape
- i) supply and installation of draw rope, and
- j) reinstatement of original surface.

Item 81127 Installation of conduits in under track crossing, [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) provision of boring / jacking equipment
- c) excavation of working spaces
- d) utilising or disposing of surplus excavated material

- e) operation of boring / jacking equipment
- f) supply of primer and adhesive for joining
- g) rehandling and transport on the Site, where necessary
- h) installation of conduit
- i) supply and installation of draw rope, and
- j) reinstatement of working spaces.

Item 81128 Installation of conduits in existing conduit, [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 primer and adhesive for joining
- c) rehandling and transport on the Site, where necessary
- d) installation of conduits in existing conduit installations
- e) supply and installation of expansion joints and cable access points as required, and
- f) supply and installation of draw rope.

Item 81129 Installation of Ground Level Trough (GLT), [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) rehandling and transport on the Site, where necessary, and
- c) installation of ground level trough.

Item 81130 Installation of Galvanised Steel Trough (GST), [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) rehandling and transport on the Site, where necessary, and
- c) installation of galvanised steel trough.

Item 81131 Installation of cable [hangers | ladders | trays], [description]

- a) Work Operations listed in Clause 2.1.5 of MRS01 *Introduction to Specifications*
- b) rehandling and transport on the Site, where necessary, and
- c) installation of cable hangers, ladders, trays.

Item 81132 Installation of cable route fixed to bridge, [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) rehandling and transport on the Site, where necessary, and
- c) installation of cable route fixed to bridge.

Item 81133 Supply and installation of conduits in trench, [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 conduit, conduit bends, and other fixtures and fittings
- c) handling, transport to the Site, and storage on the Site
- d) excavation of trench
- e) utilising or disposing of surplus excavated material
- f) supply of primer and adhesive for joining
- g) rehandling and transport on the Site, where necessary
- h) installation of conduit and conduit bends
- i) supply and installation of bedding and backfill materials
- j) supply and installation of marker tape
- k) supply and installation of polymeric cable protection cover
- l) supply and installation of draw rope, and
- m) reinstatement of original surface.

Item 81134 Supply and installation of conduits in under track crossing, [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 conduit, conduit bends, and other fixtures and fittings
- c) handling, transport to the Site, and storage on the Site
- d) provision of boring / jacking equipment
- e) excavation of working spaces
- f) utilising or disposing of surplus excavated material
- g) operation of boring / jacking equipment
- h) supply of primer and adhesive for joining
- i) rehandling and transport on the Site, where necessary
- j) installation of conduit
- k) supply and installation of draw rope, and
- l) reinstatement of working spaces.

Item 81135 Supply and installation of conduits in existing conduit, [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 conduit, conduit bends, and other fixtures and fittings

- c) handling, transport to the Site, and storage on the Site
- d) supply of primer and adhesive for joining
- e) rehandling and transport on the Site, where necessary
- f) installation of conduits in existing conduit installations
- g) supply and installation of expansion joints and cable access points as required, and
- h) supply and installation of draw rope.

Item 81136 Supply and installation of Ground Level Trough (GLT), [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 ground level trough including fixtures and fittings
- c) handling, transport to the Site, and storage on the Site
- d) rehandling and transport on the Site, where necessary, and
- e) installation of ground level trough.

Item 81137 Supply and installation of Galvanised Steel Trough (GST), [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 ground level trough including fixtures and fittings
- c) handling, transport to the Site, and storage on the Site
- d) rehandling and transport on the Site, where necessary, and
- e) installation of galvanised steel trough.

Item 81138 Supply and installation of cable [*hangers | ladders | trays*], [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 and fabrication of cable hangers including fixtures and fittings
- c) handling, transport to the Site, and storage on the Site
- d) rehandling and transport on the Site, where necessary, and
- e) installation of cable hangers.

Item 81139 Supply and installation of cable route fixed to bridge, [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 and fabrication of brackets, fixtures and fittings for cable route fixed to bridge
- c) handling, transport to the Site, and storage on the Site

- d) rehandling and transport on the Site, where necessary, and
- e) installation of cable route fixed to bridge.

2.2.15 Cable Route System – Pits and Manholes

Item 81161 Supply of cable pits, [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 pit, pit riser (for circular pit), pit collar (for circular pit), sand band (for circular split pit) and pit cover, and
- c) handling, transport to the Site, and storage on the Site.

Item 81162 Installation of cable pits, [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) excavation for pit
- c) utilising or disposing of surplus excavated material
- d) supply and installation of bedding and backfill materials
- e) rehandling and transport on the Site, where necessary
- f) installation of pit, pit riser (for circular pit), pit collar (for circular pit), sand band (for circular split pit) and pit cover, and
- g) installation of conduit bell mouths and conduits to pit.

Item 81163 Supply and installation of cable pits, [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 pit, pit riser (for circular pit), pit collar (for circular pit), sand band (for circular split pit, pit cover and conduit bell mouths
- c) handling, transport to the Site, and storage on the Site
- d) excavation for pit
- e) utilising or disposing of surplus excavated material
- f) supply and installation of bedding and backfill materials
- g) rehandling and transport on the Site, where necessary
- h) installation of pit and pit cover, and
- i) installation of conduit bell mouths and conduits to pit.

Item 81164 Supply and installation of cable route marker, [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 cable route marker
- c) handling, transport to the Site, and storage on the Site
- d) supply of concrete
- e) local excavation where necessary
- f) utilising or disposing of surplus excavated material
- g) rehandling and transport on the Site, where necessary, and
- h) installation of cable route marker in concrete pad.

2.2.16 Cable Route System – Cables

Item 81181 Supply of cable, [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 all materials, and
- c) handling, transport to the Site, and storage on the Site.

Item 81182 Installation of cable in direct buried cable route, [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) excavation of trench
- c) utilising or disposing of surplus excavated material
- d) supply and installation of bedding and backfill materials
- e) rehandling and transport on the Site, where necessary
- f) installation of cables
- g) protection of cables during installation
- h) connection and termination of cables
- i) labelling of cables
- j) sealing of cable entries
- k) supply and installation of cable protection covers
- l) supply and installation of warning marker tapes, and
- m) reinstatement of original surface.

Item 81183 Installation of cable in conduit, [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) rehandling and transport on the Site, where necessary
- c) installation of cables

- d) protection of cables during installation
- e) connection and termination of cables
- f) replacement of draw ropes in ducting
- g) labelling of cables, and
- h) sealing of cable entries.

Item 81184 Supply and installation of cable in direct buried cable route, [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 all materials
- c) handling, transport to the Site, and storage on the Site
- d) excavation of trench
- e) utilising or disposing of surplus excavated material
- f) supply and installation of bedding and backfill materials
- g) rehandling and transport on the Site, where necessary
- h) installation of cables
- i) protection of cables during installation
- j) connection and termination of cables
- k) labelling of cables
- l) sealing of cable entries
- m) supply and installation of protection cover
- n) supply and installation of warning tape, and
- o) reinstatement of original surface.

Item 81185 Supply and installation of cable in conduit, [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 all materials
- c) handling, transport to the Site, and storage on the Site
- d) rehandling and transport on the Site, where necessary
- e) installation of cables
- f) protection of cables during installation
- g) connection and termination of cables
- h) replacement of draw ropes in ducting

- i) labelling of cables, and
- j) sealing of cable entries.

Item 81186 Cable route connection to existing pit, [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) installation of cables
- c) protection of cables during installation
- d) connection and termination of cables
- e) labelling of cables, and
- f) sealing of cable entries.

2.2.17 Pneumatic Route System

Item 81201 Supply of pneumatic route, [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 pipes, hoses, fittings, manifolds, valves, switches, gauges, filters, drains, lubricator, compressors and associated equipment, and
- c) handling, transport to the Site, and storage on the Site.

Item 81202 Supply of pneumatic route equipment, [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 pneumatic route equipment as per project specifications, and
- c) handling, transport to the Site, and storage on the Site.

Item 81203 Installation of pneumatic route, [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) rehandling and transport on the Site, where necessary
- c) installation of pneumatic route above ground, underground, on structures as required including mounting fixtures, fittings and controls, and
- d) connect to power and communications systems.

Item 81204 Installation of pneumatic route equipment, [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) rehandling and transport on the Site, where necessary

- c) on Site assembly, and
- d) installation of pneumatic route equipment as per project specifications.

Item 81205 Supply and installation of pneumatic route, [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 pipes, hoses, fittings, manifolds, valves, switches, gauges, filters, drains, lubricator, compressors and associated equipment
- c) handling, transport to the Site, and storage on the Site
- d) rehandling and transport on the Site, where necessary
- e) installation of pneumatic route above ground, underground, on structures as required including mounting fixtures, fittings and controls, and
- f) connect to power and communications systems.

Item 81206 Supply and Installation of pneumatic route equipment, [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 pneumatic route equipment as per project specifications
- c) handling, transport to the Site, and storage on the Site
- d) rehandling and transport on the Site, where necessary, and
- e) on Site assembly, and
- f) installation of pneumatic route equipment as per project specifications.

2.2.18 Signalling and Communications Miscellaneous

Item 81221 Testing and commissioning of signalling and communications, [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) commissioning testing
- g) sub-system testing
- h) sub-system integration testing
- i) system Integration testing

- j) testing integration with the UTC/TMS
- k) testing integration with all other interfacing networks, systems, equipment
- l) coordinate with rail operations
- m) clearance reports
- n) as-built documentation
- o) handover documentation including test documents
- p) reporting to client representative, and
- q) visual inspection of communications using an approved method.

Item 81222 Supply of signal signs, [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 all materials
- c) fabrication of the sign panels
- d) attachment of stiffeners, where applicable
- e) application of protective coatings, colour coatings, reflective coatings and messages
- f) reference marking of signs, and
- g) handling, transport to the Site, and storage on the Site.

Item 81223 Supply of signal to rail bonds, [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 bonding cable and crimp lug, where necessary
- c) supply of Cadweld tail, mould, and ancillary welding materials, where necessary
- d) supply of all fixing bolts, nuts, and washers, and
- e) handling, transport to the Site and storage on the Site.

Item 81224 Installation of signal signs, [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 posts
- c) supply of brackets, saddles and fixings
- d) supply and fabrication of sign frames, where applicable
- e) handling, transport to the Site, and storage on the Site
- f) rehandling and transport on the Site, where necessary
- g) installation of the posts

- h) installation of frames, where applicable, and
- i) installation of the sign faces to posts or frames.

Item 81225 Installation of signal to rail bonds, [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) rehandling and transport on the Site, where necessary
- c) grinding of the structure and rail surface, where necessary
- d) drilling of structure and rail, where necessary
- e) fitting of crimp lugs to cable, and
- f) connection to structure and rail by bolting or welding, as appropriate.

Item 81226 Supply and installation of signal signs, [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 all materials
- c) handling, transport to the Site, and storage on the Site
- d) fabrication of the sign panels
- e) attachment of stiffeners, where applicable
- f) application of protective coatings, colour coatings, reflective coatings and messages
- g) reference marking of signs
- h) supply of posts
- i) supply of brackets, saddles and fixings
- j) supply and fabrication of sign frames, where applicable
- k) rehandling and transport on the Site, where necessary
- l) installation of the posts
- m) installation of frames, where applicable, and
- n) installation of the sign faces to posts or frames.

Item 81227 Supply and installation of signal to rail bonds, [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 bonding cable and crimp lug, where necessary
- c) supply of Cadweld tail, mould, and ancillary welding materials, where necessary
- d) supply of all fixing bolts, nuts, and washers
- e) handling, transport to the Site and storage on the Site

- f) rehandling and transport on the Site, where necessary
- g) grinding of the structure and rail surface, where necessary
- h) drilling of structure and rail, where necessary
- i) fitting of crimp lugs to cable, and
- j) connection to structure and rail by bolting or welding, as appropriate.

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 signalling and communications

This Specification provides Standard Work Items for:

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

of signalling and communications 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 signalling and communications testing and commissioning

Where Standard Work Items 81221 are 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.

2.3.3 Measurement of signal to rail bonds

Where Standard Work Items 81223, 81225, and/or 81227 are 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 signalling and communications 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 signalling and communications 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.

2.4.3 Cable route system (conduits, troughs, and pits)

Supply and installation of conduits and troughs shall be measured from pit centre to pit centre or to the termination point of the conduit or trough as shown on the Standard Drawings.

Sections of conduit or trough installed between a backbone or rail crossing pit and an item of equipment installed in the field, including signals, points and other signalling and communications equipment, shall not be measured separately. Such lengths shall be measured as part of the supply and installation of the relevant item of equipment.

Supply and installation of pits shall be measured per each for each type of pit.

2.4.4 Cable route system (cables)

Quantities for the supply and installation of cable shall be the sum of the measured duct length plus 4 m for each pit through which the cable passes.

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 Signalling and communications materials supplied by the Principal

2.6.1 Supply of signalling and communications materials

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

2.6.2 Supply location

Signalling and communications 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 signalling and communications materials at any time after the programmed date and to store the signalling and communications materials at no cost to the Principal.

2.6.4 Acceptance of signalling and communications materials by the Contractor

The Contractor shall check the signalling and communications 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 signalling and communications materials

In the event of any signalling and communications materials sustaining damage after the signalling and communications materials has been accepted by the Contractor or Principal, the signalling and communications materials shall be set aside until it has been inspected by the Administrator or Principal. **Nonconformance** The cost of repairs to the damaged signalling and communications materials and the cost of replacing the rejected signalling and communications materials shall be borne by the Contractor or manufacturer.

