

TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION R154

TUNNEL AND UNDERPASS ELECTRICAL SERVICES WORKS

NOTICE

This document is a Transport for NSW QA Specification. It has been developed for use with roadworks and bridgeworks contracts let by Transport for NSW or by local councils in NSW. It is not suitable for any other purpose and must not be used for any other purpose or in any other context.

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REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		First Issue	GM, IC Bernie Chellingworth	14.07.08
Ed 1/Rev 1	Guide Notes	<i>Notes to Tender Documenter</i> moved from Clauses 1.1, 4 and 6.3 to Guide Notes.	GM, IC M Andrew	16.10.09
Ed 1/Rev 2	Global	References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW” respectively.	DCS	22.06.20

<p style="text-align: center;">GUIDE NOTES (Not Part of Contract Document)</p>

This document is not to be used for traffic signals or the associated electrical works.

The reader should refer to the applicable traffic signals specifications for traffic signals.

This document is intended to be used for projects involving works for low voltage systems up to 415 volts.

This document will need to be customised by the TENDER DOCUMENTER for each specific project. Customisation requires the insertion of additional information that is project specific or supplementary to the project works.

Existing Services

The Tender Documenter should give consideration to the suitability of existing services and equipment. Supplementary technical specifications may be required to cover related areas of the Project Works.

Depending on the nature of the project, consideration should be given to carrying out a condition assessment of the existing electrical service mains supply. If the findings of the assessment concluded that the electrical service mains supply will need to be upgraded, then such works may be included as part of the Contract.

Clause 4 Switchboards, Distribution Boards and Control Panels

Depending on the project requirements, the Tender Documenter should refer to Specification TfNSW R153 which has been developed for Road Tunnel and Underpass Lighting projects and which requires the design and supply of low voltage switchgear and control gear.

Clause 6.3 Conduit

Where conduits may be subject to mechanical impact, consideration should be given to using galvanized steel in lieu of UPVC conduits.

For under-road boring, checks should be made for location of utilities or other services.

Checks should also be made for site specific requirements as in some instances the minimum depth may need to be increased, e.g. conduits beneath Freeways.



Transport
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QA SPECIFICATION R154

TUNNEL AND UNDERPASS ELECTRICAL SERVICES WORKS

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VERSION FOR: DATE:

CONTENTS

CLAUSE	PAGE
FOREWORD	ii
TfNSW Copyright and Use of this Document	ii
Revisions to Previous Version	ii
Project Specific Changes	ii
1 GENERAL	1
1.1 Scope	1
1.2 Structure of the Specification	1
1.3 Environment	2
2 MATERIALS	2
2.1 Equipment Enclosures	2
2.2 Identification of Equipment Safety Risks.....	3
2.3 Equipment and Materials Approvals	3
2.4 Equipment and Materials Supplied by the TfNSW	3
3 EXISTING SERVICES	4
4 SWITCHBOARDS, DISTRIBUTION BOARDS AND CONTROL PANELS	4
5 ELECTRICAL CABLE	4
5.1 General	4
5.2 Fire Resistant Cables	5
5.3 Cable Colours	5
5.4 Cable Identification	5
6 CABLE INSTALLATION	5
6.1 General	5
6.2 Cable Routing	6
6.3 Conduit	6
6.4 Cable Supports.....	6
6.5 Cable Joints	7
6.6 Arrangement of Cable Tails	7
6.7 Earthing	7
6.8 Cable Sizing, Sub-circuit Arrangements	7
6.9 Junction Boxes.....	7
6.10 Identification of the Contents of Pipes, Conduits and Ducts.....	7
7 TESTING	7
7.1 General	7
7.2 Electrical Panels	8
7.3 Cables	8
7.4 Controls	8
7.5 Earthing	8
8 COMMISSIONING	8
9 DESIGNS FOR APPROVAL	9
9.1 Design Drawings	9
9.2 Design Drawing Format	9
9.3 Work-As-Executed Drawings	9

9.4	Technical Manuals.....	9
	ANNEXURE R154/A – PROJECT SPECIFIC REQUIREMENTS.....	10
	ANNEXURE R154/B – MEASUREMENT AND PAYMENT	11
	ANNEXURE R154/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS	12
C1	Schedule Of Hold Points.....	12
C2	Schedule Of Identified Records.....	12
	ANNEXURES R154/D TO R154/L – (NOT USED).....	12
	ANNEXURE R154/M – REFERENCED DOCUMENTS.....	13
	LAST PAGE OF THIS DOCUMENT IS	13

FOREWORD

TfNSW COPYRIGHT AND USE OF THIS DOCUMENT

Copyright in this document belongs to Transport for NSW.

When this document forms part of a contract

This document should be read with all the documents forming the Contract.

When this document does not form part of a contract

This copy is not a controlled document. Observe the Notice that appears on the first page of the copy controlled by TfNSW. A full copy of the latest version of the document is available on the TfNSW Internet website: <http://www.rms.nsw.gov.au/business-industry/partners-suppliers/specifications/index.html>

REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R154 Edition 1 Revision 1.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

- Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.
- Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION R154

TUNNEL AND UNDERPASS ELECTRICAL SERVICES WORKS

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for tunnel and underpass electrical services works.

Personnel undertaking the Contracted Works must be qualified licensed electrical tradesmen and be experienced in this field of work.

The works must comply with either the Contracted Works design requirements or the relevant standards, regulatory or guidelines applicable to the works. The Contracted Works include where applicable:

- (a) Supply, installation and connection of Electrical Services Mains Supply (i.e. Consumer Mains) to the main switchboard.
- (b) Connection from the distributor's mains, switchboard or stand alone power supply to appliances and electrical equipment.
- (c) Supply, installation and connection of all sub-mains to the distribution boards.
- (d) Supply (where applicable) and installation of all cable ladders and junction boxes.
- (e) Supply, installation and connection of all cabling and auxiliaries from distribution boards to junction boxes and all luminaires.
- (f) Supply, installation and connection of lighting level control cabling and lighting sensors.
- (g) Supply of all control and safety devices.
- (h) Supply of all mounting hardware.
- (i) Completion of all installation and connection work to ensure the safe and correct operation of the Contracted Works.
- (j) Supply and installation of all decals, labels and signage required for identification and safety purposes as required by this specification, relevant standards, regulations or guidelines.
- (k) Testing and commissioning of the completed installation, and arrangement for the necessary Energy Supply Authority approval.

Complete all necessary notices, pay all fees and charges and arrange for all inspections and tests by the local Energy Supply Authority.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 Project Specific Requirements

Project specific details of work are shown in Annexure R154/A.

1.2.2 Measurement and Payment

The method of measurement and payment must comply with Annexure R154/B.

1.2.3 Schedules of HOLD POINTS and Identified Records

The schedules in Annexure R154/C list the **HOLD POINTS** that must be observed. Refer to Specification TfNSW Q for the definition of **HOLD POINTS**.

The records listed in Annexure R154/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.2.4 Referenced Documents and Definitions

Inform yourself of and comply with all current Legislation, Codes, Regulations, Standards and Directives issued by the governing regulatory bodies.

Unless specified otherwise or is specifically supplied by the Principal, the applicable issue of a referenced document, including any standards and codes, is the issue current at the date one week before the closing date for tenders, or if no issue is current at that date, the most recent issue.

Standards, specifications and codes used in this Specification are referred to in abbreviated form (e.g. AS 1023). For convenience, the full titles are given in Annexure R154/M.

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

1.3 ENVIRONMENT

All electrical equipment supplied must be suitable for withstanding the local environment. They must be fire resistant, non-flammable, low smoke and halogen free.

All equipment must be rated for 0 to 40 degrees Celsius ambient and test certificates will be required for a 40 degree Celsius rating.

The electrical installation must be protected against damage from the operation of fire protection systems, by spillage, by cleaning, or from any form of water ingress or mechanical damage.

Care is to be taken with the electrical installation to ensure that no cable, conduits, switchboards, panels or luminaires are located within the trafficable sections, including the sway of traffic impacting with the side barriers.

2 MATERIALS

2.1 EQUIPMENT ENCLOSURES

All equipment enclosures must have IP65 Degree of Protection in accordance with AS 60529, unless stated otherwise.

HOLD POINT

Process Held: Supply of equipment enclosures.

Submission Details: Degree of Protection test certificates.

Release of Hold Point: The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

2.2 IDENTIFICATION OF EQUIPMENT SAFETY RISKS

The use of colours for all equipment and components must be in accordance with AS 1318.

You are responsible for identification of all risks and hazards associated with the equipment or installations and the supply and fitting of safety signs in accordance with AS 1216 and AS 1319.

2.3 EQUIPMENT AND MATERIALS APPROVALS

Submit for review and acceptance by the Principal complete data on all equipment which are proposed for use in the works prior to their supply and/or installation. The submission must list the manufacturer, model number and all other information necessary for the Principal to identify the items and determine their acceptance or otherwise. The cost of providing any samples required will be at your own expense.

The list must include materials which are specified in the contract documents by manufacturer name, model or trade name, as well as materials proposed by you.

HOLD POINT

Process Held: Supply and/or installation of equipment and materials.

Submission Details: Equipment and materials data.

Release of Hold Point: The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

2.4 EQUIPMENT AND MATERIALS SUPPLIED BY THE TFNSW

Collect any equipment and materials provided by the Principal from a storage depot within the Sydney Metropolitan area. The location of this storage depot is stated in Annexure R154/A.

Where applicable, unpack and uncrate the equipment immediately after taking delivery. Check the contents against the packing list accompanying the equipment and report any discrepancy or damage to the Principal.

From the date of receipt of the supplied equipment from the Principal until the Date of Completion, you are wholly responsible for the safe keeping of this equipment. Any loss or damage incurred during this period to this supplied equipment, must be made good to the Principal's satisfaction at your expense.

3 EXISTING SERVICES

Before commencing site works, make all necessary enquiries and inspections as necessary to confirm the types and locations of surface and underground utility services. All necessary precautions must be implemented to avoid damage to such services.

4 SWITCHBOARDS, DISTRIBUTION BOARDS AND CONTROL PANELS

Where applicable, you are responsible for the design and supply of the main switchboard, distribution boards and control panels.

You are responsible for the installation, connection, testing and commissioning of the main switchboard, distribution boards and control panels.

The main switchboard must comprise circuit breakers, isolators, contactors and relays, metering and other accessories as necessary.

You must design the boards and panels to suit the equipment offered, making due allowance for spare space for expansion. The drawings must show all necessary fault limiting and/or protective devices.

All switchboards must be constructed in accordance with AS 3439 and installed in accordance with AS/NZS 3000.

All switchboards must be readily accessible and positioned in a dry and well ventilated environment.

5 ELECTRICAL CABLE

5.1 GENERAL

Supply all new electrical cable necessary to perform the work. You are responsible for cable selection (unless indicated to the contrary in the Specification or on the Drawings) and testing to appropriate Australian and IEC Standards. Cables must be suitable for the intended purpose.

Supply all cables necessary to complete the installation. All cable supplied must be for use on an effectively earthed system. All cables must have stranded copper conductors.

Remove all disused cables (including conduits and fittings) from the Site.

HOLD POINT

Process Held:	Submission of electrical installation design information.
Submission Details:	Preliminary electrical schematic wiring details.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

5.2 FIRE RESISTANT CABLES

All cables providing electrical services must be fire resistant, non-flammable, low smoke and halogen free.

5.3 CABLE COLOURS

In accordance with AS/NZS 3000 and as shown below, all electrical cable cores must be colour identified according to their intended function.

(a)	A Phase	Red
(b)	B Phase	White
(c)	C Phase	Blue
(d)	Neutral	Black
(e)	Earth	Green/Yellow
(f)	240V AC Control Active	Grey
(g)	240V AC Control Neutral	Black
(h)	D.C. Control Positive	Orange
(i)	D.C. Control Common	Brown
(j)	4-20mA Positive	White
(k)	4-20mA Negative	Black

Additional colours may be used as necessary to provide logical circuit identification. Any additional or alternative colours must be used only with the approval of the Principal.

Alternative colour coding will be acceptable for the flexible connection to individual tunnel luminaires with the approval of the Principal. Such alternative must be logical and consistent throughout the installation.

5.4 CABLE IDENTIFICATION

Label all new cables near the cable origin and destination terminations. The labels must be permanent straight cut type (minimum 5 mm black legend on yellow background). Hand written labels are unacceptable and legends must be either preprinted or generated on a hand-held label printer.

The marker holders or method of attachment to the cable must be permanent and must provide protection to the label. The marker holders must be securely attached to the cable and not be an adhesive-type attachment.

Submit details of the cable identification system to the Principal for approval prior to use.

6 CABLE INSTALLATION

6.1 GENERAL

The incoming supply cables must be buried underground and must be enclosed in heavy duty rigid UPVC conduit.

All trenches must be backfilled and consolidated and made good to the original ground level with allowance for settlement.

Allen-type marking tape “Buried Electric Line Below” or similar material must be placed in a straight line, approximately 200 mm above the conduit for the whole of the cable run.

Lay, terminate and label all cables necessary to complete the installation.

Cables must be accessible. Cable runs must be as straight as possible.

Cables, cable enclosures and supports must be so located that they do not obstruct doorways, passages, or any other space required for access.

Where cables enter conduits or ducts, arrange the entry to prevent entry of water and dirt. Provide drainage openings at the closest practical locations.

6.2 CABLE ROUTING

You are responsible for the selection of cable routes, supports and protection, glands, lugs, ducts, conduits, indelible markers, fixtures and fasteners, and any other material required for the installation of cables, unless nominated otherwise in the Specification.

6.3 CONDUIT

Conduits must comply with AS 2053.

Conduits must be heavy duty UPVC. The size of conduit must not exceed a space factor of 0.5, the space factor being the ratio of the sum of the cross sectional areas of the installed cables to the internal cross sectional area of the conduit.

Provide polypropylene draw cord in conduits not in use.

Erect all conduits and fittings completely before the cables are drawn in.

All elbows and tees must be inspection type.

Provide adequate pull in boxes to ensure that cabling can be drawn in without recourse to dismantling any sections of the runs.

Seal all conduit ends to stop the ingress of dirt and moisture with a pliable non-setting waterproof compound.

Where above ground, conduits must be fixed at intervals not exceeding 900 mm and must follow the building and structure lines.

6.4 CABLE SUPPORTS

Provide cable support systems for cable runs of groups of cable considered too large for individual conduits. The support system must consist of cable trays, ladders, connectors, bends and other support hardware necessary to provide an adequate support and must be in accordance with the manufacturer's recommendations.

Cable support systems must be hot dipped galvanized steel. Slots or ladder rails must be suitable for fixing cable ties or strapping. An additional 10% capacity must be provided on cable trays or ladders.

6.5 CABLE JOINTS

All cables must be run in one continuous length between equipment terminals. Intermediate joints must not be employed unless authorised by the Principal.

"BP" connectors or other connecting devices must not be used under any circumstances for looping of control wiring which must be carried out at equipment terminals.

6.6 ARRANGEMENT OF CABLE TAILS

Within equipment cabling spaces, cables and cable tails must be neatly arranged and laced or cleated where necessary until they are finished off at their respective terminals.

At all supports, ensure that no mechanical strain is imposed upon the conductor termination under either normal or fault conditions.

6.7 EARTHING

Supply and install all materials necessary to complete the plant earthing system.

6.8 CABLE SIZING, SUB-CIRCUIT ARRANGEMENTS

Sub-mains must be sized by you to meet the voltage drop and current carrying requirements of the installation.

Arrange sub-circuit cabling such that the phases are evenly balanced.

Sub-circuit cabling from the distribution board to the individual equipment components must be terminated in a junction box and then connected to the equipment component.

6.9 JUNCTION BOXES

Install junction boxes at the locations and of the type and size shown on the design drawings.

6.10 IDENTIFICATION OF THE CONTENTS OF PIPES, CONDUITS AND DUCTS

Identify all pipes, conduits and ducts in accordance with the requirements of AS 1345 and AS/NZS 3000.

7 TESTING

7.1 GENERAL

Carry out the following tests on the equipment supplied and/or installed and supply all necessary testing equipment.

Type testing certificates from a recognised testing authority must be provided by the supplier and submitted to the Principal for all main switchboards to substantiate that all equipment, which is identical in essential details to that being supplied, has passed all necessary type tests.

7.2 ELECTRICAL PANELS

Carry out the following tests on all electrical panels:

With cable tails disconnected, check the insulation resistance between phases and between phases to earth, using a 1000 volt megger. Insulation resistance readings of less than 10 megohms will not be accepted.

7.3 CABLES

Carry out the following tests on all cables:

Measure the insulation resistance between cores and between all cores and earth, using a 1000 volt megger. Resistance values of less than 10 megohms for 415 volt cables per cable run will not be accepted. Care must be taken during these tests to ensure that no equipment likely to be damaged by the test voltages is connected to the cables.

On power cables, check correct phase rotation with numbers or colours. On control cabling, check correct core numbering.

7.4 CONTROLS

Carry out sequence testing on control circuits.

Interlocking must be proven to be effective by manual operation of the interlocks.

All protective and stop devices are to be operated to prove their effectiveness.

7.5 EARTHING

Check the earth continuity to all equipment.

8 COMMISSIONING

At the completion of installation, carry out all necessary tests to prove that the equipment and systems operate in accordance with the Specification and in a manner in which they were intended to operate.

Carry out testing in a progressive manner such that each section of the system is satisfactorily tested and pre-commissioned prior to integration with other sections of the system.

At the time of satisfactory completion of testing and pre-commissioning, all of the equipment and systems must be commissioned to ensure complete integration of all elements and operations meet the Contract requirements.

Employ commissioning engineers and sub-professionals who are experienced in the commissioning of each part of the work.

In the event of the equipment or systems failing a particular test, rectify the fault or deficiency and repeat all tests on the equipment or systems.

Commissioning must include repeating of all initial and pre-commissioning test and adjustments as necessary to all equipment and systems.

HOLD POINT

Process Held: Acceptance of completed Contract Works.

Submission Details: Commissioning report.

Release of Hold Point: The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

9 DESIGNS FOR APPROVAL

9.1 DESIGN DRAWINGS

Submit for approval the following design drawings.

- (a) Schematic wiring diagram;
- (b) Equipment location drawings;
- (c) Current and volt drop calculations schedules;
- (d) Cable schedules;
- (e) Mounting details for cable and conduit supports.

Do not commence work until the drawings have been approved.

9.2 DESIGN DRAWING FORMAT

All design drawings must preferably be in MicroStation version 8 or alternatively in AutoCAD version 2000 format with standard metric scale.

Paper copies must be produced either full size or on A1 and bound with a covering title page and table of index.

Provide two copies of all documents in both hard and electronic format.

9.3 WORK-AS-EXECUTED DRAWINGS

Prior to acceptance by the TfNSW of the Contracted Works, work-as-executed (WAE) drawings must be provided to the TfNSW for all drawings produced by you.

The WAE drawings must show all information necessary to facilitate future maintenance and operation. They must include accurate cable routes and cable lengths, cable ladder runs etc, underground cable details including depth of laying, enclosure etc, and any modifications carried out to facilitate satisfactory installation or operation, representing departures from the Specification.

9.4 TECHNICAL MANUALS

Prior to acceptance by the TfNSW of the electrical installation, supply four (4) bound hardcopies and two (2) softcopies of Installation, Operating and Maintenance Instructions covering all aspects of the Contracted Works. Prepare the documents using Microsoft Word 2003. Originals of documents are required. Photocopies are unacceptable.

ANNEXURE R154/A – PROJECT SPECIFIC REQUIREMENTS

NOTES TO TENDER DOCUMENTER: (Delete this boxed text after customising Annexure R154/A)

Where “Yes / No” options are shown below, delete whichever is not applicable.

Complete the table below by inserting the address of the storage depot, if applicable.

Clause	Description	Requirement
2.4	Equipment and materials supplied by Principal	Yes / No
2.4	If requirement for above is “Yes”, storage depot is located at:	

ANNEXURE R154/B – MEASUREMENT AND PAYMENT

Payment will be made for all costs associated with completing the work detailed in this Specification in accordance with the following Pay Items.

Where no specific pay items are provided for a particular item of work, the costs associated with that item of work are deemed to be included in the rates and prices generally for the Work Under the Contract.

Pay item R154P1 – Design of Electrical Scheme

This is a Lump Sum item.

The lump sum must include the design of the electrical scheme.

Pay item R154P2 – Design and Supply of Main Switchboard and Distributions Boards and Control Panels

This is a Lump Sum item.

The lump sum must include the design and supply of main switchboard and distribution boards and control panels.

Pay item R154P3 – Electrical Cabling

This is a Lump Sum item.

The lump sum must include the supply, installation, connection, testing and commissioning of all electrical cabling, cable ladders and all mounting hardware. It also covers the removal and disposal of all redundant cabling and mounting hardware.

Progress payments must be made on a pro-rata basis of work done under this item, having due regard to the duration of the Contract.

Pay item R154P4 – Scheme Testing and Commissioning

This is a Lump Sum item.

The lump sum must include the testing and commissioning of the completed scheme and the supply to the Principal of all documentation covering the scheme.

ANNEXURE R154/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS

Clause	Description
2.1	Test certificates - degree of protection for equipment enclosures.
2.3	Equipment and materials data.
5.1	Electrical installation preliminary design.
8	Commissioning report.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
2.1	IP test certificates.
2.3	Equipment and materials information.
5.1	Electrical installation preliminary design.
9	Commissioning report.

ANNEXURES R154/D TO R154/L – (NOT USED)

ANNEXURE R154/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.4.

TfNSW Specifications

TfNSW Q Quality Management System

Australian Standards

AS 1216 Class labels for dangerous goods.
AS 1318 SAA Industrial safety colour codes.
AS 1319 Safety signs for the occupational environment.
AS 1345 Identification of the contents of pipes, conduits and ducts.
AS/NZS 2053 Conduits and fittings for electrical installations.
AS/NZS 3000 Electrical installations.
AS 60529 Degrees of protection provided by enclosures (IP Code)

Other Reference Codes

Local Energy Supply Authority.
NSW Service and Installation Rules.
Building Code of Australia.
TfNSW Road Design Guide