Superseded by T HR EL 16003 SP , 16/09/2016

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Technical Note - TN 082: 2015

Issued date: 09 December 2015

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Subject: Update to EP 16 40 00 01 SP *Dry Type Cast Resin Distribution Transformer for Indoor Substations*

This technical note is issued by the Asset Standards Authority to notify the following updates to EP 16 40 00 01 SP *Dry Type Cast Resin Distribution Transformer for Indoor Substations*, Version 1.0:

- update of Australian standards
- ASA Type approval requirements
- update to testing requirements

All references to AS 2374 *Power transformers* should be replaced with AS 60076 *Power transformers* unless otherwise stated.

All references to RIC should be replaced with RailCorp.

Unless stated otherwise the existing entire content in the identified section should be replaced by the content detailed in this technical note.

Add the following new section after Section 1:

1.1. ASA type approval

Transformers procured to this specification require type approval by ASA prior to being allowed to be connected to the RailCorp electrical network. The current ASA process for type approval at the time of publication of this document is TN 050:2014 *Electrical Type Approvals – Interim process*.

After Section 2 replace the existing Section 2.1, and Section 2.2 with the following:

Australian standards

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AS 1627.4 Metal Finishing – Preparation and pre-treatment of surfaces Part 4: Abrasive blast cleaning of steel

AS 1627.5 Metal finishing – Preparation and pre-treatment of surfaces Part 5: Pickling

AS 2067 Substations and high voltage installations exceeding 1 kV a.c.

AS 2374.1.2 Power transformers Part 1.2: Minimum energy performance standard (MEPS) requirements for distribution transformers

AS/NZS 2344 Limits of electromagnetic interference from overhead a.c. power lines and high voltage equipment installations in the range 0.15 to 1000 MHz

AS 2629 Separable insulated connectors for power distribution systems above 1 kV

AS 2700 Colour standards for general purposes

AS/NZS 4680: Hot-dip galvanised (zinc) coatings on fabricated ferrous articles

AS/NZS 60076.1 Power transformers Part 1: General

AS/NZS 60076.3: Power transformers Part 3: Insulation levels, dielectric tests and external clearances in air

AS 60076.4: Power transformers Part 4: Guide to the lightning impulse and switching impulse testing – Power transformers and reactors

AS/NZS 60076.5: Power transformers Part 5: Ability to withstand short circuit

AS/NZS 60076.10: Power transformers Part 10: Determination of sound levels

AS/NZS 60076.10.1: Power transformers Part 10.1: Determination of sound levels – Application guide

AS/NZS 60076.11: Power transformers Part 11: Dry – type transformers

AS/NZS 60137 Insulated bushings for alternating voltages above 1000 V

AS 60270 High Voltage test techniques – Partial discharge measurements

AS 60529 Degree of Protection provided by enclosures (IP Code)

AS 62271.301 High voltage switchgear and controlgear Part 301: Dimensional standardisation of terminals

Transport for NSW standards

TMD 0001 CAD and Drafting Manual – Electrical Design – Section 4

T MU AM 01002 MA Maintenance Requirements Analysis Manual

T MU HF 00001 ST Human factors Integration – General requirements

T HR EL 00002 PR Electrical Power Equipment – Integrated Support Requirements

EP 00 00 15 SP Common Requirements for Electrical Power Equipment

T HR EL 20001 ST High Voltage AC and 1500 V DC Traction Power Supply Cable

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Requirements

EP 00 00 00 13 SP Electrical Power Equipment – Design Ranges of Ambient Conditions

EP 02 00 00 01 SP Transformer Loss Evaluation

7.2 Equipment supplier deliverable

Replace the reference to EP 00 00 00 12 SP *Electrical Power Equipment – Integrated Support Requirements* with a reference to T HR EL 00002 PR *Electrical Power Equipment – Integrated Support Requirements*.

Replace the existing Section 8.1 Type tests and Section 8.2 Routine tests with the following:

8.1 Type tests

Type tests to AS/NZS 60076.1 *Power transformers Part 1: General* and AS/NZS 60076.11 *Power transformers Part 11: Dry – type transformers* shall be carried out on one transformer of a batch. Type test certificates for each of these tests shall be accepted if it can be demonstrated that the transformer supplied is of a similar design to a previously type tested transformer.

The following additional tests shall be carried out on each transformer as follows:

- Lightning impulse voltage withstand tests including chopped wave tests on maximum tap, mid tap and minimum tap positions for the three phases respectively.
- Sound power level tests shall be conducted in accordance with AS 60076.10.

  Sound pressure check readings shall be carried out at full rated output during load loss testing and shall be included in the determination of the sound power level as per AS 60076.10.

A short circuit withstand test is not required however the designer is required to provide the short circuit design calculations.

8.2 Routine tests

Routine tests to AS/NZS 60076.1 and AS/NZS 60076.11 shall be carried out on each transformer.

Replace the existing Section 10 (including Section 10.1) with the following:

10 Data set associated with the equipment

The following data shall be supplied by the manufacturer and maintained for the transformer.

This data will remain the property of TfNSW.

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10.1 Equipment manual

An operation and maintenance manual shall be provided for the equipment in accordance with the requirements of T HR EL 00002 PR. The requirements for the scope of the operations and maintenance manual are as detailed in T HR EL 00002 PR with additional content and emphasis required for photographs to be included from the manufacturing of transformer showing the winding and core:

Add the new section below after Section 10.4:

10.5 Drawings and information

All drawings shall conform to the requirements of the TMD 0001 *CAD and Drafting Manual – Electrical Design – Section 4*. The following drawings are required. Please note that this list does not include component drawings which are required as part of the integrated support requirements and are included in the operations and maintenance manual.

- transformer arrangement drawings shall be drawn to scale with the following detail:
  - complete detail of the transformer with views of all sides of the transformer and detailed sections as required
  - dimensions, including overall size, position of HV and LV connectors relative to the centre lines of the tank and the level of the foundations
  - mass of the complete transformer
  - complete listing of all fittings, accessories and parts with the associated manufacturer, part or model number and relevant ratings
- schematic and wiring diagrams

  Schematic diagrams are to include the following:
  - schematic diagrams of the transformer windings showing connections, tappings and tabulations of current and voltage rating of all windings
  - schematic diagram of alarm and trip circuits
- drawings of the rating plate. Details shown on these drawings shall not vary from that shown on the plates fixed to the transformer.

All the above drawings shall bear the plant serial numbers of all units.

The calculation of inrush current is required.

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Appendix A Technical schedule

The following additional information shall be submitted as part of the technical schedule:

Additional Parameters for Dry Type Transformers

Degrees of Protection provided by the enclosure ……

Environment class ……..

Climate class ……

Fire behaviour class ……

Appendix D Requirements for technical aspects of tender evaluation

Appendix D has been deleted.

Authorisation:

	Technical content prepared by	Checked and approved by	Interdisciplinary coordination checked by	Authorised for release
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Engineering Specification
Electrical

EP 16 40 00 01 SP

DRY TYPE CAST RESIN DISTRIBUTION TRANSFORMER FOR INDOOR SUBSTATIONS

Version 1.0

Issued May 2013

Owner:	Chief Engineer, Electrical		
Approved by:	Neal Hook Chief Engineer Electrical	Authorised by:	Neal Hook Chief Engineer Electrical

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Document control

Version	Date	Summary of change
1.0	May 2013	First Issue

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1 Introduction

This document details the whole of life performance requirements for the purchase and maintenance of 3 phase indoor, dry type cast resin distribution transformers for use in the RailCorp electrical network. It covers primary voltage of 11kV and secondary voltage of 433V. The standard design is based on dry type transformers for use in indoor substations only.

The requirements of this document apply to all new indoor, dry type distribution transformers.

2 References

2.1 Australian Standards

The following Australian Standards are either referenced in this document or can provide further information.

AS 1627.4	*Metal finishing- Preparation and pre-treatment of surfaces Part 4: Abrasive blast cleaning of steel.*
AS 2067	*Substations and high voltage installations exceeding 1kV a.c.*
AS 2374.1.2	*Power transformers Part 1.2: Minimum energy performance standard (MEPS) requirements for distribution transformers*
AS 2374.2	*Power transformers Part 2: Temperature rise.*
AS 2374.5	*Power transformers Part 5: Ability to withstand short-circuit.*
AS 2629	*Separable insulated connectors for power distribution systems above 1kV*
AS 2700	*Colour standards for general purposes*
AS 3953	*Loading guide for dry-type power transformers.*
AS 60076.1	*Power transformers Part 1: General.*
AS 60076.4	*Power transformers Part 4: Guide to the lightning impulse and switching impulse testing – Power transformers and reactors.*
AS 60076.11	*Power transformers Part 11: Dry-type transformers.*
AS 60270	*High Voltage test techniques – Partial discharge Measurements*
AS 60529	*Degrees of protection provided by enclosures (IP Code)*
AS 62271.301	*HV Switchgear and control gear – Dimensional standardisation of terminals*
AS/NZS 2344	*Limits of electromagnetic interference from overhead a.c. power lines and high voltage equipment installations in the range 0.15 to 1000 MHz*
AS/NZS 3750.15	*Paints for steel structures Part 15: Inorganic zinc silicate paint.*
AS/NZS 4680	*Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.*
AS/NZS 60076.10	*Power transformers Part 10: Determination of sound levels.*
AS/NZS 60137	*Insulated bushings for alternating voltages above 1000V.*

2.2 RailCorp Documents

EP 02 00 00 01 SP	*Transformer Loss Evaluation*
EP 00 00 00 15 SP	*Common Requirements for Electrical Power Equipment*

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2.3 Drawings

The following drawings form part of this document:

None

The following drawings can provide further information:

None

3 Definitions & Abbreviations

For the purpose of this document, the definitions given in *AS 60076* apply. In addition, the following definitions also apply:

Distribution Transformer A transformer that transforms and controls the system voltages to a secondary voltage of nominally 415 V.

Dry-type Transformer A transformer of which the magnetic circuit and windings are not immersed in an insulating liquid.

Primary winding The winding that receives the active power from the supply system, usually the winding having the highest rated voltage.

Principal tapping The tapping to which the rated quantities are related.

Secondary winding The winding that delivers the active power to the load circuit, usually the winding having the lowest rated voltage.

4 Functional Characteristics

4.1 General

The transformer covered by this document shall supply railway stations, signals, workshops, traction substations and sectioning huts auxiliary supplies as well as various other low voltage loads. They are not used for supplying DC traction loads.

The transformer shall be in accordance with *AS 60076*, except as detailed in this document.

4.2 Whole-of-Life Cost

The selection of the most suitable transformer shall be made on the basis of minimising the whole-of-life-cost. The following factors must be considered in determining this:-

- Initial purchase price.
- Cost of changes to the Technical Maintenance Plan & Service Schedules or the creation of new manuals & schedules.
- Cost of manuals.
- Cost of maintenance.
- Cost of replacement parts.
- Cost of inventory spares.
- Environmental costs.
- Electrical Losses. Refer to document *EP 02 00 00 01 SP - Transformer Loss Evaluation* for the method of evaluating transformer losses.
- Cost of installation.
- Reliability and cost of failures.
- Cost of modifications to other parts of the installation.

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- Lifetime of equipment.
- Discount Rate.
- Cost of staff training.
- Cost of Decommissioning and Disposal.
- Cost of special tools.
- Cost of changes and management of drawings.

5 Performance Characteristics

Technical Parameter		11 kV Transformers
Applicable standards		AS 60076
Transformer type		Indoor, dry type
No. of winding		Two winding
No. of phases		3 phase
Rated voltage	HV winding	11,000 Volts (ph – ph)
	LV winding	433 V
No load ratio		11,000/433 V 3 phase
Frequency		50 Hz
Rated power (preferred ratings, other sizes subject to RailCorp's approval)		3 phase: 75, 200, 500, 1000, 1500, 2000 kVA
Neutral terminal		Star point or neutral of lower voltage winding shall be connected to a bushing and fully insulated from earth.
System earthing		Non-effectively earthed
Type of Cooling		AN
Vector Group		Dyn1
Impedance voltage (AS 2374.5 - Table 1)		4% for up to 500 kVA 5% for 1000 kVA 6.25% for 1500, 2000 kVA
Taps, on HV windings through externally operated off-circuit switches, capable of being locked in position.		± 2.5%, 0% and ± 5%
Insulation class		F 155 deg. C
Environment class		E1
Climatic class		C1
Fire behaviour class		F1
Max Dimensions		To be advised for site conditions as required

Table 1 – Performance Characteristics

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5.1 Rated insulation level

Rated Voltage	System Highest Voltage	Rated Insulation Level	
		Lightning Impulse	Power Frequency
433 Vrms	1.1 kVrms	-	5 kVrms
11 kVrms	12 kVrms	95 kVp	28 kVrms

Table 2 – Rated insulation level

5.2 Minimum Energy Performance Standard (MEPS)

The distribution transformer shall meet the minimum power requirements for transformer efficiency at 50% load as specified in *AS 2374.1.2* Table 2.

The following table provide power efficiency levels for RailCorp standard sizes as per *AS 2374.1.2*. They only apply to transformers on the 11kV network.

Minimum power efficiency @ 50% load (MEPS)			
500kVA	**1000kVA**	**1500kVA**	**2000kVA**
98.84%	99.03%	99.12%	99.16%

Table 3 – RailCorp power efficiency levels

6 Technical Characteristics

6.1 Construction

A minimum IP21 enclosure shall be provided for the transformer as per Section 4 of RailCorp Standard *EP 00 00 00 13 SP*. The enclosure shall allow access to the transformer and all associated fittings, terminals and tapping links for maintenance either through lift off lockable doors, hatches or covers removable with aid of tools. The enclosure shall be removable without need for disconnection of bushings/terminals from the transformer. The transformer shall be designed to withstand indoor environments where it can be dusty and moist. Dry cast epoxy resin or equivalent insulation material shall be used.

6.2 Rating Plate

The rating plate shall meet the requirements of *AS 60076.1*, Section 7, and shall include a diagram of connections. A terminal marking plate complying with the requirements of *AS 60076.1*, Section ZB7 shall also be attached to the transformer. In addition, a reference to RailCorp specification *EP 16 40 00 01 SP* shall be included. The plates shall not be attached to a removable cover.

6.3 Terminal Arrangement

The primary and secondary winding terminal shall be located on opposite sides of the transformer frame. The arrangement for both sets of terminals shall be A B C phases from left to right when viewed from the primary side. When a neutral terminal is fitted, it shall be on the extreme left (of A phase) unless otherwise agreed to by RailCorp.

Generally the cables shall enter from below, but provision must be made for either top or bottom entry of both HV and LV cables with suitable non magnetic gland plates that can be drilled to suit appropriate cable glands.

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For connections using lugs or terminals not insulated to the appropriate voltage, the following minimum clearances shall apply:

11 kV terminals:	Between different phases	185 mm
	Between phase and earthed metal	160 mm
433 V terminals:	Between different phases	110 mm
	Between phase and earthed metal	60 mm

The standard terminal dimensions shall comply with AS 62271.301 for accommodation of individual cables.

HV cable terminals for receiving of HV cables shall be sized suitably to allow successful termination with RailCorp cables without further modifications.

LV terminal palms for receiving of LV cables shall be suitably sized to allow successful termination with RailCorp cables without further modifications and provide for two M12 bolts per cable lug. Low voltage bus-duct may be considered for the 1500 and 2000kVA transformers depending on site situation.

Cable quantities and sizes or provision of low voltage bus-duct shall be determined and advised for the particular site application and advised at tender.

Cable support clamps shall be provided to support both external HV and LV cables such that there is no unnecessary stress on the cable terminal connectors.

6.4 Earth Terminal

A suitable earthing terminal shall be located externally, near the bottom of the enclosure.

2 additional earth terminals shall be provided external to the enclosure on diagonally opposite sides of the transformer.

The earth terminals shall be a minimum M12 stud to accommodate a 70mm^2 copper cable lug.

6.5 Lifting Attachments

Suitable lifting lugs shall be provided for lifting the transformer (with and without enclosure) and for securing to vehicles during transport using standard slings. Suitable base channels or brackets for insertion of forks from fork lift trucks shall be provided to allow the transformer to be lifted. Brackets if provided shall not be less than 200mm from the ground.

6.6 Transformer Manoeuvrability

The transformer shall be fitted with removable bi-directional rollers for future relocations. The rollers shall be lockable to prevent unwanted movement.

6.7 Anti Vibration

Anti-vibration pads shall be supplied for installation under the transformer.

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6.8 Forced cooling

Cooling method of the transformer is by air naturally; however provision shall also be made for forced cooling.

6.9 Temperature protection

Transformers shall be provided with thermal protection via combination of PT100 sensors and an electronic relay to display temperature digitally in real time of the hottest spot in each winding per phase. The electronic relay shall also provide alarm and tripping functions. Relay shall be mounted external to the transformer enclosure at a height for easy reading. The relay shall be powered via the transformer's secondary unless specified otherwise by RailCorp. It shall be protected from over voltages with a manufacturer's recommended surge limiter and HRC fuse. The relay shall provide an Alarm contact and Trip contact. The alarm contact shall be set at 10 degrees Celsius less than the maximum allowable insulation system temperature and the trip contact set at 5 degrees Celsius less than the maximum allowable insulation system.

6.10 Directly earthed neutral terminal

The manufacturer must be made aware that the secondary side neutral terminal of the distribution transformer is separately earthed within RailCorps modified directly earthed distribution system under normal service conditions. The source power transformer may not be effectively earthed at the system substation so that over voltages due to the capacitances between windings and between windings and earth can be allowed for in the transformer design.

6.11 Finish

All internal and external surfaces shall be treated with a coating that provides protection against corrosion caused by water such as hot dipped galvanising.

All welds shall be made smooth, rough edges rounded and weld splatter removed. The transformer shall remain corrosion free for the life of the transformer. The internal and external surfaces shall be prepared and the paint applied strictly in accordance with the manufacturer's instructions.

When an existing transformer suffers damage to its finish, the repair shall be to the original standard of finish.

6.12 Painting

Painting of the transformer external surfaces shall be as per Section 4.2.1 of RailCorp Standard EP 00 00 00 15 SP.

Deviation from RailCorp Standard requirements may be accepted subject to RailCorp Engineering approval.

6.13 Marking

Marking and labelling of the transformer shall be as per the requirements of Section 4.9 of RailCorp Standard EP 00 00 00 15 SP.

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6.14 Environment

The installation ambient air temperature shall be: -5°C to 50°C as per the requirements of Section 4 of RailCorp Standard EP 00 00 00 13 SP.

6.15 Sound Level

The transformer sound level shall be measured in accordance with *AS/NZS 60076.10* and shall comply with the "Standard limit" as per Annex ZA of *AS/NZS 60076.10*.

6.16 Radio Interference

The transformer shall comply with the limits of radio interference above 30MHz as specified in Table B1 of *AS/NZS 2344*. For an 11kV system voltage the interference limit is 17 µV/m

7 Integrated System Support Requirements

7.1 Integrated Support Objectives

The tenderer must establish and provide the information required to operate and maintain the equipment throughout its operational life, in a cost effective manner and to a level that is consistent with the planned operational performance and usage of the Reactor.

This includes:

a) Specifying Maintenance Requirements

b) Spares Support

c) Operations and Maintenance Manuals

d) Training, and

e) Support Equipment and Tooling

7.2 Equipment Supplier Deliverable

The Integrated support requirements are a significant deliverable in the procurement of a new reactor. Manuals, training, documentation and other support deliverable's shall be in accordance with *EP 00 00 0012 SP Electrical Power Equipment – Integrated Support Requirements*.

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8 Tests

In order to ascertain quality of the products manufactured for RailCorp, active cooperation from suppliers/manufacturers is sought by agreeing to:

- Informing RailCorp the type test program and routine test scheduled date at least 4 weeks prior to the tests so that RailCorp personnel can witness the tests if desired. The cost of tests shall be borne by the manufacturer.
- Visits by RailCorp staff for inspections of the transformer manufacturing process. RailCorp shall be provided with a production schedule indicating dates to inform when transformers under a specific contract to RailCorp are being manufactured.
- RailCorp may choose to conduct further tests on transformers at RailCorp's expense. In the event that this occurs, the manufacturer shall be informed of the tests and given a choice to witness the tests. In the event that any type or special tests conducted by RailCorp through an independent tester fails to conform to specifications, further tests may be carried out in consultation with the manufacturer at their expense. If these further tests still fail to meet acceptable criteria, cost of any tests on this transformer carried out by RailCorp shall be re-imbursed by the manufacturer as well as any costs pertaining to transactions resulting from these failures.

8.1 Type Tests

The following type tests shall be performed on the transformer. RailCorp reserves the right to witness the tests. Type test certificates of the performed tests shall be provided by the manufacturer.

- Short circuit test* to *AS 2374.5*
- Temperature rise test to *AS 2374.2*
- Lightning impulse test to *AS 60076.3*, clause 13, 14 and *AS 60076.4*.
- Sound level test to *AS/NZS 60076.10*

RailCorp may accept type test certificates that have been previously conducted on similar transformers.

**RailCorp may accept calculations that prove that the transformer design is capable of withstanding short circuit conditions.*

8.2 Routine Tests

The following routine tests shall be carried out on each transformer supplied to RailCorp. RailCorp reserves the right to witness the tests.

- Measurement of winding resistance to *AS 60076.1*
- Measurement of voltage ratio and check of phase displacement to *AS 60076.1*
- Measurement of short circuit impedance and load loss to *AS 60076.1*
- Measurement of no-load loss and current to *AS 60076.1*
- Induced AC withstand voltage to *AS/NZS 60076.3*
- Separate source AC withstand voltage to *AS/NZS 60076.3*
- Insulation resistance to *AS/NZS 60076.3*
- Partial discharge test to *AS60076.11* and *AS 60270*

Relevant tests listed in Section 6.2 of RailCorp Standard EP 00 00 00 15 SP shall also be performed on the transformer.

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9 Quality Management System

9.1 Supplier's Accreditation

The Supplier must have obtained accreditation to *AS/NZS ISO 9001* or other relevant standard from a recognised authority for its manufacturing procedures and quality management systems. These procedures and systems shall be applied to manufacture and testing of each transformer.

Details of quality management certificates held shall be provided with the Tender including the accreditation authority, document registration number and year.

The quality management documentation shall be made available for review by RailCorp if requested during tender evaluation.

9.2 Inspection and Test Plan

RailCorp shall have the right to make inspections during the manufacturing period and to witness works testing.

A draft Inspection and Test Plan (ITP) and associated Inspection and Test Checklist (ITC) shall be submitted with tenders for assessment. The ITP must nominate hold points for witness tests and inspections by RailCorp.

Manufacture shall proceed according to an agreed version of the ITP and ITC negotiated prior to awarding the contract.

10 Data Set associated with the Equipment

The following data shall be maintained for each transformer. This data shall be the property of RailCorp and maintained by the Maintenance Provider responsible for the installation in which the transformer is installed.

10.1 Equipment Manuals

The Equipment Manuals must be provided for the installation and shall include full instructions for the preventative, surveillance and corrective maintenance, comprehensive fault diagnosis, rectification procedures and staff training requirements. It shall include all drawings needed for the above. All drawings shall show sufficient detail to enable satisfactory maintenance of the equipment.

10.2 Test Results

The results of all tests relating to the transformer including acceptance tests and periodic and corrective maintenance tests shall be recorded.

10.3 Life Cycle Costing

All the data and assumptions pertaining to the determination of the whole-of-life cost calculations shall be recorded.

10.4 Technical Schedule

The information listed in the attached Technical Schedule of **Error! Reference source not found.** shall be maintained for each transformer.

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Appendix A Technical Schedule

Manufacturer	.....	
Serial number	.....	
Year of manufacture	.....	
Number of phases	.....	
Rated primary voltage	.....	V
Rated secondary voltage	.....	V
Rated power	.....	kVA
Rated input frequency	.....	Hz
Rated input current	.....	A
Rated output current	.....	A
Inrush current	.....	A
Connection vector symbol	.....	
Efficiency	.....	
Input power factor	.....	
Input current distortion at rated input current	.....	% THD
Total output voltage distortion	.....	% THD
Short circuit capability	.....	
Overload capability	.....	
Maximum temperature rise of windings	.....	°C
Impedance voltage at rated current (Expressed as percentage of rated voltage)	.....	%
No-load current with rated voltage applied to the principal Tapping (Expressed as percentage of rated current)	.....	%
No-load current with 110% of rated voltage applied to the principal Tapping (Expressed as percentage of rated current)	.....	%
No-load loss	.....	W
Load loss	.....	W
Type of core steel - hot or cold rolled	.....	
Brand or trade name and grade of core steel	.....	
Flux density based on net cross-section of steel with rated voltage at rated frequency applied to the principal tapping		
– Limbs	.....	T
– Yoke	.....	T
Mass of windings only	.....	kg
Sound level	.....	dBA

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Terminals, minimum clearance in air

between phases

- Primary ……..... mm
- Secondary ……..... mm

Phase to earth

- Primary ……..... mm
- Secondary ……..... mm

Palm Terminals type provided – Please provide General Arrangement drawing

Voltage withstand test which the bushings will withstand without puncture or flashover in accordance with Section 7.2.1 and Table 7 of *AS/NZS 60137*

primary bushings

- Lightning impulse withstand voltage ……..... kVp
- Power frequency withstand voltage ……..... kVrms

secondary bushings

- Lightning impulse withstand voltage (if required) ……..... kVp
- Power frequency withstand voltage ……..... kVrms

Bushings, minimum clearance in air:

between phases

- Primary ……..... mm
- Secondary ……..... mm

Phase to earth

- Primary ……..... mm
- Secondary ……..... mm

Is heat-shrink material provided on the higher volt terminals? * Yes/No

Type of insulating material used for windings …….....

Type of material used for windings - copper or aluminium …….....

Temperature class of insulation …….....

Overall transformer dimensions

Frame & core

- Length ……..... mm
- Width ……..... mm
- Height ……..... mm

Enclosure

- Length ……..... mm
- Width ……..... mm

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– Height	…….....	mm
Degree of protection provided by Enclosure		
– Upper enclosure	…….....	IPxx
– Underbase	…….....	IPxx
Protective treatment applied to		
– Internal surfaces	…….....	
– External surfaces	…….....	
Mean time between failures	…….....	
Mean time to repair	…….....	
Availability / uptime	…….....	
Failure modes	…….....	
Critical components / spare parts	…….....	
Other relevant information	…….....	

Departures from Specification

Are there any departures from the requirements of this Specification	* Yes/No

Departures from the requirements of this Specification must be highlighted.

* Cross out where not applicable.

Superseded by T HR EL 16003 SP, 16/09/2016

Appendix B Request For Tender Checklist

Information to be supplied to tenderers

The following information shall be provided to tenderers

- Input voltage
- Output voltage
- Rated power
- Number of phases
- Purpose of the transformer – distribution or others
- Delivery location
- Delivery date
- Special transport or unloading requirements
- Special installation requirements such as limiting dimensions (see Section 5)
- Quantity and size of cables HV & LV or Low voltage bus-duct (see Section 6.3)
- Reliability, availability and maintainability targets (see Section 1)
- A statement stipulating that type testing, routine testing and site testing will be at the suppliers cost and that the purchaser reserves the right to witness tests carried out
- A statement stipulating that the purchaser reserves the right to inspect the transformer at any time during the manufacturing process

Information to be supplied by tenderers

The following information shall be provided by tenderers:

- Completed Technical Schedules (see Appendix A)
- Technical catalogues of all equipment tendered
- Complete Bill of Materials
- Schematics and general arrangement drawings of the proposal
- Typical layout drawing showing clearances from other objects
- Type test certificates
- Details of manufacturers' quality management system
- Proposed delivery schedule
- Information associated with reliability, availability and maintainability (see Section 1 of this specification)
- Data set associated with the equipment (see Section 10of this specification)
- List of emergency spares that should be stocked by RailCorp
- Reference list where similar equipment has been installed and is under satisfactory operation for the past two years as a minimum
- Whole of Life Cost – Selection of the transformer shall be made on the basis of whole of life cost as per Section 4.2 of this specification. Tenderers are required to provide all necessary information as required by RailCorp to estimate the whole of life cost.

Information to be supplied by the successful tenderer

Test Certificates

Copies of certified test certificates covering type tests and routine tests shall be provided prior to delivery of the transformer. Refer to Section 10.2 of this specification.

Transformer Manuals

The successful tenderer shall provide installation, user operation and maintenance manuals. Refer to Section 10.1 of this specification.

Superseded by T HR EL 16003 SP, 16/09/2016

Appendix C Requirements for Technical Aspects of Tender Evaluation

Evaluation of tenders

The Chief Engineer Electrical requires that persons evaluating the technical aspects of this tender have sufficient technical competence for the task.

Tender evaluation committees shall forward details of persons evaluating the technical aspects of the tender to the Chief Engineer Electrical for concurrence. This will normally be in the form of an email and is to include sufficient detail of the tender and the person to enable the Chief Engineer Electrical to satisfy themself of the merits of the evaluating person. A minimum of 4 weeks notice is required prior to the evaluation of the Tenders.

The Chief Engineer Electrical will advise only if the person is considered unsuitable for the technical evaluation.

Acceptance of product

A number of the specifications require acceptance of product at both the factory and at site. The purchaser is to advise the Chief Engineer Electrical the details of the person carrying out the acceptance testing for the concurrence of the Chief Engineer Electrical. A minimum of 4 weeks notice is required prior to the evaluation of the acceptance testing.

The Chief Engineer Electrical will advise only if the person is considered unsuitable for the acceptance testing.

The Chief Engineer Electrical reserves the right to nominate a representative to review and/or attend such acceptance.

Record Keeping

Where product is purchased against this specification, the Chief Engineer Electrical requires that relevant detail be provided so that it can be logged against this specification.

For RailCorp purchases, all records are recorded in Ariba.

Where this specification is utilised by parties external to RailCorp (Alliance parties, etc) then copies of all relevant technical information and evaluation shall be forwarded to the Chief Engineer Electrical for filing against the specification. In addition copies of selected commercial information pertaining to the ongoing support of the product as follows is also required.

- Warranty details
- Spare parts and associated availability
- Product support information.