



MR 41/2017

**PREFERRED SUPPLIER
FOR
DESIGN, MANUFACTURE, TESTING AND SUPPLY OF
GROUND MOUNTED AND PAD-MOUNTED
DISTRIBUTION TRANSFORMERS**

FIJI ELECTRICITY AUTHORITY

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REVISION HISTORY & DOCUMENT CONTROL

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1 INTRODUCTION AND SCOPE OF WORK

Fiji Electricity Authority (“FEA”) is responsible for generation, transmission and distribution of electricity in Viti Levu, Vanua Levu, Ovalau and Tavueni in Fiji. By the end of 2016, the FEA had 174,530 customers. This included residential, commercial and institutional customers. By the end of 2016, it had an installed capacity of 605,961 kVA of distribution transformers in its various distribution networks.

FEA is seeking tender bids from reputable transformer manufacturers and suppliers for design, manufacture, testing and supply of ground-mounted and pad-mounted distribution transformers for a period of three years for various project work and operations.

The transformers required are as outlined below.

FEA Stock Code	Item Description
I04376A	200kVA, 11kV/433V, 3-phase, ground-mounted
I04377	300kVA, 11kV/433V, 3-phase, ground-mounted
I04381	300kVA, Dual primary 11kV, 6.6kV/433V, 3-phase, ground-mounted
I04378	500kVA, 11kV/433V, 3-phase, ground-mounted
I04380	1000kVA, 11kV/433V, 3-phase, ground-mounted
I04407	750kVA, 11kV/433V, 3-phase, ground-mounted
I04408	300kVA, 11kV/433V, 3-phase, pad-mounted
I04411	750kVA, 11kV/433V, 3-phase, pad-mounted
I04414	500kVA, 11kV/433V, 3-phase, pad-mounted
I04421	1000kVA, 11kV/433V, 3-phase, pad-mounted

This tender specification outlines the instruction to bidders, design and performance criteria for the ground-mounted or pad-mounted distribution transformers, and supply of these for use in FEA's distribution networks.

Transformers upto a rating of 1000kVA will be used in FEA's distribution networks. Transformers above 2000kVA will be used in FEA's generating stations.

The transformers shall comply to the current version of AS 60076 Power transformers – all parts and amendments as current, AS 2374 Power transformers – all parts and amendments as current, and as detailed in this specification.

2 INSTRUCTIONS TO BIDDERS

2.1 Eligible Bidders

This invitation is open to all Bidders who have sound Financial Background, and have previous experience in design, manufacture and supply of such transformers.

Bidders shall provide such evidence of their continued eligibility satisfactory to FEA as FEA shall reasonably request. Bidders who are not manufacturer of such transformers shall provide evidence of agency.

Bidders shall not be under a declaration of ineligibility for corrupt or fraudulent practice.

2.2 Eligible Materials, Equipment and Services

The materials, equipment, and services to be supplied under the Contract shall have their origin from reputable companies as specified by FEA and from various countries and all expenditures made under the Contract will be limited to such materials, equipment, and services. Upon request, bidders may be required to provide evidence of the origin of materials, equipment, and services.

For purposes of this Contract, "services" means the works and all project-related services including design services.

For purposes of this Contract, "origin" means the place where the materials and equipment are mined, grown, produced or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing or substantial or major assembling of components, a commercial recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.

The materials, equipment and services to be supplied under the Contract shall not infringe or violate any industrial property or intellectual property rights or claim of any third party.

2.3 One Bid Per Bidder

Each bidder shall submit only one bid. A bidder who submits or participates in more than one bid will cause all those bids to be rejected.

2.4 Cost of Bidding

The bidder shall bear all costs associated with the preparation and submission of its bid and FEA will in no case be responsible or liable for those costs.

2.5 Site Visits

No site visits are required for this project.

2.6 Contents of Bidding Documents

The bidder is expected to examine carefully the contents of this Bidding document. Failure to comply with the requirements of bid submission will be at the bidder's own risk. Bids which are not substantially responsive to the requirements of the bidding documents will be rejected.

2.7 Clarification of Bidding Documents

A prospective bidder requiring any clarification of the bidding documents may notify FEA in writing by fax (hereinafter the term "fax" is deemed to include electronic transmission such as facsimile, cable and telex), or email addressed to:

Tuvitu Delairewa
General Manager Corporate Services
2 Marlow Street, Suva, FIJI.
Phone: 679 3224 185
Facsimile: 679 331 1882
Email: TuvituD@fea.com.fj

FEA will respond to any request for clarification which it receives earlier than 10 days prior to the deadline for submission of bids.

2.8 Amendment of Bidding Document

At any time prior to the deadline for submission of bids, FEA may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the bidding documents by issuing addenda.

2.9 Language of Bid

The bid, and all correspondence and documents related to the bid, exchanged between the bidder and the FEA shall be written in the English language.

2.10 Bid Prices

Unless specified otherwise, Bidders shall quote for the entire facilities on a "single responsibility" basis such that the total bid price covers all the Supplier's obligations mentioned in or to be reasonably inferred from the bidding documents in respect of the design, manufacture, including procurement and subcontracting (if any), testing and delivery.

Bidders shall give a breakdown of the prices in the manner and detail called for in this bidding document, or any issued addenda.

Bids shall be given on DDU basis. The point of delivery shall be FEA's Navutu Depot in Lautoka. The term DDU shall be governed by the rules prescribed in the current edition of Incoterms, published by the International Chamber of Commerce, Paris.

2.11 Bid Currencies

Prices shall be quoted in a single currency only.

2.12 Bid Validity

Bids shall remain valid for a period of **180 days** from the date of Deadline for Submission of Bids specified in Sub-Clause 2.15.

2.13 Format and Signing of Bids

The bidder shall prepare one original and four (4) copies of the technical and financial proposals, clearly marking each one as: "ORIGINAL-TECHNICAL & PRICE PROPOSAL", "COPY NO. 1 - TECHNICAL & PRICE PROPOSAL", etc. as appropriate. In the event of discrepancy between the original and any copy, the original shall prevail.

The original and all copies of the bid shall be typed or written in indelible ink (in the case of copies, Photostats are also acceptable) and shall be signed by a person or persons duly authorized to sign on behalf of the bidder. All pages of the bid where entries or amendments have been made shall be initialed by the person or persons signing the bid.

The bidder shall provide one electronic copy of the Technical and Financial proposals on FEA's electronic tender hosting website, <https://www.tenderlink.com/fea>.

The bid shall contain no alterations, omissions or additions, except those to comply with instructions issued by FEA, or as necessary to correct errors made by the bidder, in which case such corrections shall be initialed by the person or persons signing the bid.

2.14 Sealing and Marking of Bids

The bidder shall seal the original copy of the technical proposal and the original copy of the price proposal and each copy of the technical proposal and each copy of the price proposal in separate envelopes clearly marking each one as: "ORIGINAL-TECHNICAL & PRICE PROPOSAL", "COPY NO. 1 - TECHNICAL & PRICE PROPOSAL", etc. as appropriate.

The bidder shall seal the original bids and each copy of the bids in an inner and an outer envelope, duly marking the envelopes as "ORIGINAL", "COPY No. 1", etc.

The inner and outer envelopes shall

- a) be addressed to FEA at the following address:

Tuvitu Delairewa
General Manager Corporate Services

2 Marlow Street, Suva, FIJI.
Phone: 679 3224 185
Facsimile: 679 331 1882
Email: TuvituD@fea.com.fj

And

b) bear the following identification:

- Bid for: Preferred Supplier for Design, Manufacture, Testing and Supply of Ground-mounted and Pad-mounted Distribution Transformers
- Bid Tender Number: MR 41/2017
- DO NOT OPEN BEFORE: 1600hrs on 19/04/2017

In addition to the identification required, the inner envelope shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared "late" pursuant to Deadline for Submission of Bids.

If the outer envelope is not sealed and marked as above, FEA will assume no responsibility for the misplacement or premature opening of the bid.

2.15 Deadline for Submission of Bids

Bids must be received by FEA at the address specified above no later than 1600 hours (Fiji Time) 19/04/2017.

FEA may, at its discretion, extend the deadline for submission of bids by issuing an addendum, in which case all rights and obligations of FEA and the bidders previously subject to the original deadline will thereafter be subject to the deadlines extended.

2.16 Late Bids

Any bid received by FEA after the deadline for submission of bids prescribed above will be rejected and returned unopened to the bidder.

2.17 Modification and Withdrawal of Bids

The bidder may modify or withdraw its bid after bid submission, provided that written notice of the modification or withdrawal is received by FEA prior to the deadline for submission of bids.

The bidder's modification or withdrawal notice shall be prepared, sealed, marked and delivered in accordance with Sealing and Marking of Bids, with the outer and inner envelopes additionally marked "MODIFICATION" or "WITHDRAWAL", as appropriate. A withdrawal notice may also be sent by fax but must be followed by a signed confirmation copy.

No bid may be modified by the bidder after the deadline for submission of bids.

2.18 Rejection of One or All Bids

FEA reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for the rejection.

2.19 Process to be Confidential

Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process.

Any effort by a bidder to influence FEA's processing of bids or award decisions may result in the rejection of the bidder's bid.

Lowest bid will not necessarily be accepted as successful bid.

2.20 Clarification of Bids

To assist in the examination, evaluation and comparison of bids, FEA may, at its discretion, ask any bidder for clarification of its bid. The request for clarification and the response shall be in writing or by fax, but no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by FEA in the evaluation of the bids in.

3 GENERAL CONDITIONS OF CONTRACT

The General Conditions of Contract shall be based upon AS 4912 – 2002 General Conditions of Contract for Periodic Supply of Goods.

The Conditions of Contract comprises two parts:

1. Part 1 – General Conditions; and
2. Part 2 – Conditions of Particular Application

4 CONDITIONS OF PARTICULAR APPLICATION

1. Interpretation and Construction of Contract

Add the following:

“Bid has the same meaning as tender.”

Replace

“Base contract sum means the sum of the products ascertained by multiplying the quantities of goods stated in Item 13 by the corresponding unit prices, excluding any additions or deductions which may be required to be made under the Contract.”

With

“Contract sum means:

- (a) Where the Purchaser accepted a lump sum, the lump sum;*
- (b) Where the Purchaser accepted unit prices, the sum of the products ascertained by multiplying the quantities of goods and the corresponding unit prices in the schedule of unit prices; or*
- (c) Where the Purchaser accepted a lump sum and unit prices, the aggregate of the sums referred to in paragraphs (a) and (b),*

Excluding any additions or deductions which may be required to be made under the Contract.”

7. Assignment

Replace “7. Assignment” with “7. Assignment and Subcontracting”

Add “7.1 Assignment” after “7. Assignment and Subcontracting”

Add the following after paragraph 7.1 Assignment.

“7.2 Subcontracting

The Supplier shall not subcontract any part of the Contract without the prior written approval of the Purchaser, which approval shall not be unreasonably withheld. Any sub subcontracting shall not relieve the Supplier from any liability or obligation under the Contract. The Supplier shall if requested by the Purchaser provide copies of the proposed subcontract documents without prices.”

9. Warranties

Replace “9. *Designated Items*” and its contents with the following

“9. *Warranties*

9.1 *Ownership*

The Supplier represents and warrants that:

- a) It is the legal and beneficial owner of the goods; and*
- b) that upon payment of the contract sum no person other than the Purchaser will be entitled to hold any interests in, or hold any encumbrance over, the goods.*

9.2 *Supplier’s Warranty*

The Supplier represents and warrants that the goods will upon delivery:

- a) comply in all respects with the Contract;*
- b) be suitable for the purpose stated in Item 5;*
- c) be of merchantable quality;*
- d) conform to any sample provided by the Supplier and approved by the Purchaser.*
- e) in the absence of any specific provision of the Contract, meet any relevant Australian Standard and industry best practice;*
- f) be free of design defects;*
- g) be, unless otherwise agreed, new.*

If the Supplier is in breach of any of the warranties in this clause 9, the Purchaser may, in addition to the Purchaser’s other rights and remedies, at any time give 7 days’ written notice to the Supplier to rectify such breach, and if the Supplier fails to comply with such notice, the Purchaser may employ others to carry out works required to satisfy the warranty. The cost thereby incurred shall be moneys due and payable to the Purchaser.

The representation and warranties in this clause survive the completion or earlier termination of the Contract and each warranty in this clause is independent of, and is not limited by, reference to any other warranty.

The Supplier shall obtain all warranties relevant to the goods from manufacturer or suppliers or as otherwise specified in the Contract, including any warranties that are provided by any sub-contract and ensure that the Purchaser has the benefit of those warranties.”

19. Delivery

Add the following to 19.1 Date and Place for Delivery, at the end,

“The Supplier must ensure that all goods are properly, safely and securely packaged and labeled for identification and safety as follows:

- a) the goods must be individually packaged for transport so that they are protected from all reasonably foreseeable condition which might cause corrosion, deterioration or physical or bearing damage during handlings and transport. All packaging and preservation materials must be supplied by the Supplier; and*

- b) *each package must be clearly and indelibly inscribed with the Purchaser's name, the address of the delivery place, the Purchaser's contract number and any safety warnings for the contents."*

28. Dispute Resolution

Replace "28.2 Conference" and contents with the following:

"28.2 Conference

Within 14 days after receiving a notice of dispute, the parties shall confer at least once to resolve the dispute or to agree on methods of doing so, including, but not limited to, mediation, conciliation, binding expert determination and arbitration, of the whole or any part of the dispute. Where arbitration is agreed method of resolution, the arbitration shall be conducted in accordance with the rules of Item 38(b) and the arbitrator, unless otherwise agreed, shall be nominated by the President of the Fiji Institute of Engineers.

At every such conference, each part shall be represented by a person having authority to agree to such resolution or methods. All aspects of every such conference except the fact of occurrence shall be privileged.

If the dispute has not been resolved nor a method of resolution agreed within 56 days of service of the notice of dispute, that dispute shall be dealt with in accordance with subclause 28.3."

Replace "28.3 Arbitration" and contents with the following

"28.3 Elevation of Disputes

If the parties are unable to resolve the dispute or agree a method of resolution in accordance with sub clause 28.2:

- a) *the dispute shall be referred to the Chief Executive Officer, or a duly authorized representative, of the Purchaser and the Chief Executive Officer/Managing Director, or a duly authorized representative, of the Supplier to resolve the dispute or agree on a method of resolution;*
- b) *the individuals referred to in sub clause 28.3 (a) shall meet within 14 days after referral of the dispute in an effort to resolve the dispute or agree a method of resolution;*
- c) *if the individuals referred to in sub clause 28.3 (b) are unable to resolve the dispute but agree at that meeting on a method of resolution, they shall also nominate a timeframe for the commencement and conclusion of the method of resolution; and*
- d) *if the individuals so referred to in sub clause 28.3(b) are unable to resolve the dispute or agree a method of resolution, each within 14 days of the dispute being referred, either parts may give written notice to the other stating that the parties have been unable to resolve the dispute or agree a method of resolution.*

*Where arbitration is the agreed method of resolution, the arbitration shall be conducted in accordance with the Rules stated in Item 38(b) and the arbitrator, unless otherwise agreed, shall be nominated by the **President of the Fiji Institute of Engineers.**"*

Replace "28.4 Summary Relief" and the contents with the following:

“28.4 Instituting Proceedings

Neither party shall proceed to resolve a dispute by instituting court proceedings until issuing to, or receiving from, the other party, a notice in accordance with sub clause 28.3(d).”

Add the following after 28.4 Institutional Proceedings

“28.5 Summary Relief

Nothing herein shall prejudice the right of a party to institute proceedings to enforce payment due under the Contract or to seek injunctive or urgent declaratory relief.”

5 REFERENCES

5.1 Applicable Standards - Transformers

Transformers shall be designed, manufactured and tested in accordance with the following Australian Standards and all amendments issued prior to the date of closing of tenders except where varied by this Specifications.

AS 1100	Drawing Practice Scales – Part 7
AS 1194	Winding Wires Parts 1 – 4
AS 1265	Bushings for Alternating Voltages Above 1 000 V
AS 1319	Safety Signs for the Occupational Environment
AS/NZS 1580	Paints and Related Materials – Methods of Test
AS 1627	Metal Finishing – Preparation and Pretreatment of Surfaces
AS 1650	Galvanized Coatings
AS 1767	Insulating Oil for Transformer and Switchgear
AS 1824	Insulation Co-Ordination
AS 1931	High Voltage Testing Techniques – Part 1
AS 2067	Substations and High Voltage Installations Exceeding 1kV AC
AS 2129	Flanges for Pipes, Valves and Fittings
AS 2312	Guide to Protection of Iron and Steel Against Exterior Atmospheric Corrosion
AS 2374	Power Transformers – Part 1 to 3, 5, 6 and 7
AS 2700	Colour Standards for General Purpose
AS 2768	Electrical Insulating Materials
AS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3750	Paints for Steel Structures
AS 4398	Insulators – Ceramic or Glass – Station Post for Indoor and Outdoor Use – Voltages greater than 1 000V a.c.
AS 4436	Guide for the selection of insulators in respect of polluted conditions
AS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS 60076	Power transformers (including all parts and normative references as current)
AS/NZS 60137	Insulated bushings for alternating voltages above 1000 V
AS 60214	Tap-changers (including all parts and normative references as current)
AS 60270	High voltage testing techniques – Partial discharge measurements
AS 62271.200	High-voltage switchgear and controlgear - A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
AS 62271.301	High voltage switchgear and controlgear – Dimensional standardization of terminals
AS/NZS 9001	Quality Systems Model for Quality Assurance in Design, Development, Production, Installation and Servicing
IEC 61619	Insulating liquids - Contamination by polychlorinated biphenyls (PCBs) - Method of determination by capillary column gas chromatography

5.2 Applicable Standards – Switchgears

Switchgears supplied with pad-mounted transformers shall be designed, manufactured and tested in accordance with the following Standards and all amendments issued prior to the date of closing of tenders except where varied by this Specifications.

AS 1580.0	Paints and related materials – Methods of test
AS 1824	Insulation Coordination: Part 1 – Definitions, principles and rules
AS 1931	High voltage testing techniques - Part 1 – General definitions and test requirements
AS 2024	High voltage ac switchgear and controlgear – Switch-fuse combinations
AS 2067	Substations and High Voltage Installations Exceeding 1kV AC
AS 2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2650	High voltage ac switchgear & controlgear - Common requirements.
AS 3947.3	Low-voltage switchgear and controlgear – Switches, disconnectors, switch-disconnectors and fuse combination units
AS/NZS 4680	Hot-Dip Galvanised (Zinc) Coatings on Fabricated Ferrous Articles
AS 60044	Instrument Transformers – Part 1: Current transformers
AS 60044	Instrument Transformers – Part 2: Inductive voltage transformers
AS 60137	Insulated bushings for alternating voltages above 1000 V
AS 60265	High-voltage switches – Part 1: Switches for rated voltages above 1 kV and less than 52 kV
AS 60529	Degrees of protection provided by enclosures (IP Code)
AS 60947	Low-voltage switchgear and controlgear - General rules
AS 62271.1	High Voltage switchgear and controlgear – Part 1 : Common specifications
AS 62271.100	High voltage switchgear and controlgear – Part 100: High-voltage alternating-current circuit-breakers
AS 62271.102	High voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches
AS 62271.200	High-voltage ac switchgear and controlgear - Metal-enclosed – Rated voltages above 1kV up to and including 72.5kV.
AS 62271.202	High-voltage switchgear and controlgear - High-voltage/low-voltage prefabricated substation
AS 62271-301	High voltage switchgear and control gear – Dimensional standardization of terminals
IEC 60376	Specification of technical grade sulphur hexafluoride (SF6) for use in electrical equipment
IEC 60480	Guidelines for the checking and treatment of sulphur hexafluoride (SF6) taken from electrical equipment and specification for its re-use
IEC 60282-1	High-voltage fuses - Part 1: Current-limiting fuses
IEC 62271-105	High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations

Should inconsistencies be defined between Standards and this Specifications, this Specification will take precedence. However, significant inconsistencies shall be referred to FEA for resolution.

5.3 Applicable Laws

The Bidder warrants (without limiting any other warranties or conditions implied by law) that all Goods have been produced, sold and delivered to FEA in compliance with all applicable laws (including all workplace health and safety and electrical safety legislations and codes of conduct).

6 SERVICE CONDITIONS

6.1 Environmental Conditions

The transformers shall be suitable for installation indoors and outdoors and shall be designed to withstand the following service conditions of:

Atmosphere	:	Saliferous, corrosive and dusty
Ambient temperature	:	Peak : 40°C
	:	24 Hour Average: 30°C
	:	Annual Average: 22°C
	:	Minimum: 10°C
Relative Humidity (Average)	:	85%
Rainfall	:	Annual Average: 1900 mm
Wind Speed	:	Sustained : 55 m/s
	:	Gusts : 70 – 110 m/s
Isokeraunic Level	:	60 Thunder days per year
Seismic	:	To a maximum of 7 on the open-ended Richter Scale

Note: Fiji is situated in a region where cyclones are experienced frequently. All plant and equipment shall be designed and constructed to withstand these extreme conditions.

6.2 System Conditions

The rated frequency of FEA's power system is 50 Hz. Each unit shall be suitable for use on its respective system position.

	System Voltages		
Particulars	230V/415V	11kV	33kV
Nominal System Voltage	230V (p-n), 415V (p-p)	11kV	33kV
Highest (Equivalent) System Voltage:	244V (p-n), 440V (p-p)	12kV	36kV
Number of phases:	1 or 3	3	3
Impulse Withstand voltage (peak):	AC 10kV rms	28kV	70kV
Power frequency withstand voltage:		95kV (peak)	200kV (peak)

FEA's 11kV & 33kV systems are 3 phase, 3 wire, 50 Hz. The transformers may be installed in effectively earthed and non-effectively earthed situations. When installed in non-effectively earthed situations, significant voltage variations (up to line to neutral voltage) may be produced at the neutral terminal during an earth fault.

The equipment must be rated to withstand:

- 31.5kA for 1second for 415V
- 25kA for 3second for 11kV
- 25kA for 3seconds for 33kV

7 DESIGN AND PERFORMANCE CRITERIA FOR TRANSFORMERS

7.1 General

Generally, all design and construction of the items and their components and parts must be Fit for Purpose and Fit for Duty, including for Normal Cyclic and Emergency Cyclic Duty as described in this specification and applicable documents to prevent distortion or damage under service conditions and during handling and transport.

The transformers will be suitably stiffened and braced to prevent distortion or damage under service conditions or during handling and transport.

All sharp points on transformer exterior will be removed to prevent injury.

All bolts nuts and washers (fasteners, studs, lifting lugs etc.) will be to Australian Metric Standards and be stainless steel Grade 316 or 304. Compatibility, with regard to corrosion prevention, between the fasteners will be observed. To prevent binding, different grade stainless steel nuts and bolts will be used together with anti-seizing lubricant on all bolt threads.

It is desirable that pad-mounted transformer units with switchgears supplied under this specification are compatible with existing pad-mounted substations in certain key aspects. The key aspects include:

- i. the same operating and maintenance features as existing pad-mounted transformers;
- ii. the same arrangement of bushings;
- iii. the same mounting heights for MV and LV cables;
- iv. a similar overall footprint of transformer-and-MV/LV cubicle assembly.

The Bidder is requested to pay close attention to providing physical compatibility with the existing pad-mounted transformers. All points of physical incompatibility with existing substation packages should be noted in Departures from the Technical Specification.

It should be understood that physical variations from the existing pad-mounted transformer designs will not automatically be treated as non-compliances with this specification.

FEA will consider the consequences of accepting changes from the existing pad-mounted transformer designs.

The Bidder's attention is drawn in this context to dimensional changes which would compromise FEA's ability to replace or interchange pad-mounted transformer units.

7.2 Loadings

The transformer shall be loaded in service in accordance with the following:

Normal cyclic	1.5pu
Long-time Emergency Cyclic	1.8pu
Short-time Emergency	2.0pu

The overloads are in accordance with AS 2374, Part 7 and apply to well ventilated situations. Any limitations to loading above 'normal cyclic', as per Clause 1.5 of AS 2374, Part 7, shall be stated in the tender.

7.3 Oil Preservation System – Type

Sealed tank type construction will be used; however, the transformers will not be pressurized or incorporate gases other than air. Diaphragm sealing is not acceptable.

7.4 Tanks and Lids

All surfaces will be designed to prevent the accumulation of water.

All seams will be electrically welded and oil tight.

On the external areas of the tank, welding of horizontal and vertical joints will be on both sides of the joint. Welding in all cases will be continuous.

All metal work will be electrically bonded to the tank to permit earthing by FEA. If a part cannot be adequately bonded it will be constructed from a suitable insulating material instead of metal.

The tanks will be so designed that with a top oil temperature of 105°C, the oil level in the tank will be below the tank lid flange. The lid of the transformer will be capable of being removed without having to take off other components first (eg. cable box) and will be capable of supporting up to 100 kg of a person's weight without permanent deformation.

The tank will incorporate all mounting studs necessary for the fitment of an LV cable box. It will also incorporate two mounting lugs sufficiently above ground level for attachment of the LV cable support bracket.

7.5 Joints and Gaskets

All joints will be oil tight. All gaskets/seals will be designed to last the intended life of the transformer. Joints in gaskets will not occur at bolt holes.

7.6 Core and Windings

All transformers will have electrically separate high and low voltage windings connected to comply with vector group Dyn11 as relevant to the items as stated in Attachment 1, of AS 60076.

The core and winding assembly will be supported by the main tank and not by the cover.

Means will be provided at both the top and bottom of the core and coil assembly for locating the transformer core centrally in the tank and securing it in position to prevent movement, particularly during transport.

The core and all metalwork will be electrically bonded to the tank. The bonding will be brought to one point only.

The insulation between the core and the frame will have a resistance no lower than 50 MΩ after assembly, and will withstand 2.5 kV for one minute. The core and frame will then be electrically connected together at one point only.

7.7 Tappings

Each transformer shall be capable of off-circuit tap changing by means of an externally operated switch. The tapping switch shall have a permanent overload capacity of 50 percent. The tapping switch shall be located near the top of the transformer for ease of access and to readily facilitate untanking of the transformer.

Tapping shall be provided on high voltage winding. The principal tapping shall correspond to rated voltage. The tapping range for each applicable rating shall be as detailed in Appendix A with step voltages of 2.5 percent.

The tapping selector switch shall be capable of being locked into each of the positions. The locking arrangement shall be such that it is not possible to lock the switch between taps. The tap switch shall be provided with the same number of positions as tapings. However, if a tap selector switch with more positions (via extra undefined positions) is used, it shall be provided with stop pins (or similar) to prevent tap rotation into non-tap positions. Stop pins shall be of the permanently fixed type, i.e. bolts, etc. shall not be used.

Each tapping selector switch position shall be identified by a number clearly and indelibly stamped or cast onto either the switch operating handle or the transformer tank.

Tap position No. 1 shall correspond to full winding in circuit.

The tap position selector switch shall be manufactured in such a way that it may be coupled with its operating handle only in the correct manner, not 180° out of adjustment. This shall be done so no inadvertent open or short circuit can occur due to incorrect assembly following out of tank repair/inspection.

A sealing gland shall be provided on the tapping selector switch operating shaft where it passes through the transformer tank or prevent any breathing or leaking along the shaft.

The tapping switch shall be mounted on the side of the transformer where the neutral bushing is positioned.

7.8 Impedance Voltage

The impedance voltage at rated current on principal tapping shall be specified in submission by Bidder as per Appendix A of this document.

7.9 Cooling

The method of cooling each transformer shall be ONAN.

7.10 Insulating Oil

Each transformer shall be supplied with standard mineral insulating oil that meets the requirements of AS 1767 and be proven to be non-corrosive by Method B of ASTM D1275-06 Standard Test Method for Corrosive Sulphur in Electrical Insulating Oils and, IEC 62535 Ed. 1.0: Insulating liquids – Test method for detection of potentially corrosive sulphur in used and unused insulating oil.

The oil shall be new, supplied direct from the oil refinery and its bulk delivery shall be certified to contain less than 1 ppm of PCBs. The supplier shall follow approved quality procedures to ensure that the oil cannot be contaminated while under their control. The Bidder shall supply full identification, specifications and test results for any and each oil offered.

The quality of any offered insulating oil at the time of filling (i.e. on release from supplier) is such as to have a moisture content of at least <20 ppm and a Breakdown Voltage of >50kV.

The cold oil level shall be above the radiator inlet point (if radiators fitted).

7.11 Drying out and Oil Filling before Delivery

The transformers shall be thoroughly dried out at the manufacturer's works and shall be delivered filled with oil to the correct level and ready for service. All transformers shall be vacuum filled. The degree of vacuum applied to the production units shall be identical to that applied to the units that are type tested. The moisture content of the oil shall be less than 25 ppm at time of filling.

7.12 Bushings and Terminals

7.12.1 General

All bushings will comply with AS/NZS 60137, AS 4436 and the Service and Environmental Conditions as specified in this technical specification. All porcelain components will be glazed and fully vitrified.

All terminal palms will be arranged vertically and comply with AS 62271.301. They will be copper with their contact.

7.12.2 LV Bushings

The LV bushings will be mounted horizontally on the side of the transformer opposite the HV cable box.

The part of each LV bushing within the tank will be completely covered with oil when the transformer is old (with an outside temperature of 15°C), and will be readily accessible with the tank cover removed.

The distance between centre lines of the LV bushings will not be less than 200 mm for all ratings. The taut string metal to metal clearances of the bushing terminals will be not less than 100 mm, phase to phase, and 60 mm phase to earth.

The neutral connection to the star point on the secondary winding will be brought out of the tank unearthed and insulated in the same manner as the phase terminals.

7.12.3 Marking of Terminals

The terminals will be marked in accordance with AS 2374. The use of adhesives to attach marking plates will not be accepted.

7.13 HV Cable Box

7.13.1 Compliance to AS 62271

The cable box will be designed to conform with the internal arc withstand requirements of AS 62271.200 : High-voltage switchgear and controlgear - A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV, Annex A, A.2 Types of accessibility, Accessibility Type A, A.6 Acceptance criteria, Criterion No. 1 to Criterion No. 5 inclusive, for an IAC classification test current.

7.13.2 General Requirements for HV Cable Boxes

The access cover of the cable box shall be capable of being removed/installed by two persons without mechanical aids. A brushed aluminium cover fitted with suitable lifting handles is preferred by FEA. As a minimum, the top edge of the access cover shall have a return to ensure the ingress of moisture through the gasket is prevented. It is preferred that both side edges also include a return.

The minimum clearances between exposed live parts shall generally be in accordance with the requirements of AS 2067 for the required impulse withstand voltages of 200 kVp. When determining minimum clearances, due consideration shall be taken of the flexible cable connections. Where manufacturers use clearances that are less than those shown in AS 2067, type test results are to be provided by the Supplier indicating that the clearances selected are capable of meeting the above test voltages.

The design of the cable box shall be such that the cable termination connections can be left bare without the need for further insulation. The provision of easily removable phase barriers is acceptable.

Lightning impulse withstand voltage tests shall be carried out with the cable lugs suitable for the applicable cable fitted within the box (to remain fitted to transformer during test including cover) to prove compliance with the specified impulse withstand voltage level.

The cable box shall be completely weather and vermin proof and shall be adequately ventilated to eliminate the possibility of build-up of moisture internally.

The cable box shall be fitted with a removable gland plate made of aluminium, brass, or other corrosive-resistant material to the FEA's satisfaction, bolted to the underside of the cable box to allow the cables to be laid into and removed from the box without the need to thread the cables through the entry holes. This feature provides ease of jointing and facilitates the changing of transformers.

An earth bar for cable sheath earths, insulated from the transformer steelwork, shall be provided in the cable box. The earth bar shall have sufficient holes provided to allow for individual connection of each cable sheath. Provision shall be made for external connection to the earth grid.

The minimum distance from the gland plate to ground level shall be 460 mm.

The cable box front cover shall be fastened using galvanised bolts, nuts and washers.

The cable openings shall be located directly below the corresponding phase cable connection points.

7.13.3 LV Cable Box

FEA requires an air insulated cable box as standard for the LV bushings utilizing the mounting studs described in these specifications.

The cable box will maintain the clearances given in these specifications and have a detachable un-drilled gland plate made of aluminium, brass, stainless steel or other non-corrosive material that is not subject to inductive heating and fit for purpose, to FEA's satisfaction.

The cable box shall be supplied complete with all necessary accessories, supports and flexible connections suitable for termination of single or multiple 300mm² Copper or Aluminium cables as required. Additionally a 'unistrut' or equivalent type cable support bracket to accommodate up to 4 x 300mm² cables per phases and 2 x 300mm² cables for the neutral shall be provided. The bracket shall be suitable for attachment to the mounting lugs provided on the tank and shall be clear of the transformer cooling fins (if any are installed).

All necessary nuts, bolts, etc for the mounting of the bracket shall be provided. The bracket design and attachment shall be to the FEA's satisfaction.

FEA prefers that Low-voltage cable box dimensions/ designs be equivalent and interchangeable, while meeting all minimum statutory clearance requirements, for any designs of ground mounted distribution transformers where the Bidder produces ranges of 11kV and 33kV ground mounted distribution transformers.

Detail drawings of the cable boxes offered, including a list of accessories such as supports and flexible connections (expansion joints), shall be submitted with the Tender.

The LV extension palms/ flexible connectors (expansion joints)/ cable support boards must suit installation on all the Bidder's kVA ratings listed above.

7.14 Sound Level

The design and construction of each transformer shall be such that the sound level of the transformer, measured in accordance with the AS 2374.6, shall be no greater than the applicable 'reduced limit' as per Appendix AA of AS 2374.6.

7.15 Radio and Television interference

The design and construction of each transformer shall be such that it will not cause unacceptable radio or television interference.

7.16 Fittings

The transformers shall be supplied with fittings as detailed below:

7.16.1 Rating/Terminal Marking Plate

Each unit will be supplied with a rating plate complying with AS 2374 and AS 60076. The rating plate will be made from stainless steel (or non-ferrous metal) and be clearly marked, the lettering etched or otherwise formed in relief and colored black (except for values which vary from nameplate to nameplate) such that the lettering is in sharp contrast with the background.

The rating/Terminal Marking Plate shall be in accordance with Clause 7 and Appendix ZC of AS 2374, Part 1, and shall include a Voltage Vector Diagram. In addition it shall state:

- That the transformer is 'sealed'
- Temperature rises (even though normal values apply)
- Type of insulating oil (even though it is mineral oil)
- Impedance on principal tap only.

All quantities on the rating/terminal marking plate shall be stated in metric units.

The FEA item stock code and Corrosion Protection Category shall be shown on the plate or the separate tag permanently attached in close proximity to rating/terminal marking plate.

The display of Corrosion Protection Category may be omitted on unplanned fully hot dipped galvanized units. For painted units the indication of the standard or heavy duty protection shall be given.

The rating/terminal marking plate shall be located on the side of the transformer near the tapping switch in a position that can be easily read when the transformer is in service.

7.16.2 Lifting and Transport Facilities

Lifting lugs shall be provided with a minimum hole diameter of 32 mm for:

- a. Lifting the transformer when filled with oil and ready for service, and,
- b. Holding down the transformer during transport.

The transformer tank walls shall be strengthened to allow the above. The lugs shall be positioned so that:

- a. They are suitable for connection to lifting beams;
- b. They are suitable for attaching slings, each 1 m in length. The slings may be shortened such that transformers will require the holes in the lifting lugs to be spaced not more than 1.2 m that transformers will require the holes in the lifting lugs to be spaced not more than 1.2 m apart. The maximum enclosed angle of the slings would be 120° during any lifting procedure.
- c. Any beams or slings attached during lifting or transporting shall not foul any part of the transformer and when suspended by them the transformer shall hang by acting through the center of gravity, with a maximum angle of tilt of 2.5 degrees from the plane of the mounting brackets.

The base of each transformer shall be raised above ground level by a suitable supporting structure so that protective coating of the main transformer tank cannot be damaged during reasonable storage or transport.

All heavy parts of the transformer, including the core/coil assembly, which must be removed for inspection or repair shall be fitted with lifting facilities suitable for use with slings and shackles. (Note that an exception shall be allowed for single phase transformer provided slings can be fitted under the coil to allow for lifting).

7.16.3 Earthing Terminal

A stainless steel flag of at least 50 x 40 x 5 mm with an M14 hole will be provided near the bottom of the tank (as close as practicable to vertically below the secondary neutral terminal) in an easily accessible position. The earth flag will be welded directly to the tank.

An M12 x 40 mm Grade 304 stainless steel bolt and stainless steel nut, locknut and two flat washers will be supplied fitted to the flag.

7.16.4 Oil Level Indicator

Oil level indication shall be provided on the inside of all transformer tanks (visible from the filler cap for rectangular tank units). The indication inside the tank shall take form of horizontal 50 mm long stenciled mark in contrasting colour. This indication shall include safety margin, permitting inaccuracy in mounting.

No external indicator is required.

7.16.5 Thermometer Pocket

Transformer shall not be fitted with a thermometer pocket.

7.16.6 Oil Draining

An oil drain valve is required for transformers with ratings of 1000kVA and above – items 5, 6 & 7. The drain valve will have a 25 mm BSP internal thread fitted with a flanged plug and shall be of the metallic sealing gate type. The valve will be positioned so that all sludge and thick oil can be drained from the bottom of the tank and that clear access is provided to operate the valve.

7.16.7 Filler Cap

Rectangular tank transformers with multiple lid shall be fitted with a filler cap (or plug) on the lid as near as possible to one corner of the cover, such that if moisture did enter it would drop to the bottom of the tank.

Gaskets or thread sealing may be used to prevent water drops being inhaled into the transformer.

7.16.8 Tank Markings

The transformer capacity and FEA's stock code number shall be stenciled in black numerals onto the tank where it can be easily seen from the ground with the transformer mounted on a pole. Each numeral shall be 75 mm high and have a body width of not less than 12 mm.

7.17 Spark Gaps

No HV spark gaps are required.

7.18 Protective Coating

FEA requires all internal and external surfaces to be protected against corrosion.

The external corrosion protection for all items shall suit Long Term Corrosion Protection in Atmospheric Classifications of "Mild", "Moderate" and "Tropical" per clause 2.2 of AS 2312.

FEA intend to use transformers in severely populated industrial or marine environments, therefore the Bidder should provide the additional costs (if any) associated with additional heavy duty protective coating.

The final colour, except when surface is galvanized and unpainted, shall be storm grey, N42 to AS 2700.

The paint system must be a proven one, fully documented and applied by trained and experienced personnel.

The Bidder shall guarantee protective coating system for a minimum period of five (5) years from commissioning against corrosion which would require repair/replacement of the transformer. In such case, the normal warranty provision shall apply, with all associated costs to be borne by the manufacturer. Warranty provisions would only apply if the transformers are installed in the appropriate environment.

Warranty claims would cover any transformer requiring replacement due to corrosion as well as the repair of rusty tanks in situ to prevent the premature need to replace units. Repairs in situ would normally be performed by FEA. Providing one week notice is given to Bidder to investigate, all labour and material costs (but excluding consequential costs) would be passed from FEA to the Bidder on a recoverable basis.

The successful Bidder shall provide details on the method of protective coating repair to allow FEA to carry out touch-up (before commissioning) and field maintenance.

The surface coating inside the transformer tank shall not react with unpassivated transformer mineral oil (including additives if applicable).

7.19 Transformer Losses

Guaranteed load and no-load loss figures are to be specified in the Schedules.

Load losses are to be corrected to a reference temperature of 75deg C.

7.19.1 Guaranteed Losses

In evaluating the tenders, FEA will capitalize the guaranteed losses and so determine the economic advantages of the transformers offered. Capitalization of losses will be based on the guaranteed losses at the required power rating for each item as stated in the Schedules. Load losses will be those specified on

the principal tapping. For this contract, the following values will be used for the purpose of making a fair economic comparison.

Transformer Rating	F (Capitalized No-load loss)/ kW	C (Capitalized Load-loss)/kW
Upto and including 50kVA	\$6,300	\$700
100kVA and above	\$6,300	\$1,800

F and C are the \$/kW capitalization figures for the no-load and load-losses respectively.

A unit with total losses over 10 percent or individual no load and load losses over 15 percent in excess of a guaranteed figure may not be shipped to FEA without written permission and only by special arrangement.

7.20 Minimum Power Efficiency

All transformers must meet or exceed the minimum power efficiency levels specified in Table 1 of AS 2374.1.2-2003 Minimum Energy Performance Standard. Transformers with efficiencies not meeting or improving performance upon these Minimum Energy Performance Standards are unacceptable.

During the term of the Contract, FEA reserves the right to negotiate with the Supplier to enhance the transformer power efficiency levels to meet any future amendments to the Minimum Energy Performance Standard requirement of AS 2374.1.2, or if that is superseded.

8 DESIGN, PERFORMANCE CRITERIA AND CONSTRUCTION FOR HIGH-VOLTAGE AND LOW-VOLTAGE SWITCHGEARS

8.1 High Voltage Switchgear

8.1.1 General

The scope for switchgear applies to padmounted distribution transformers. Suitably rated leads and terminations will be fitted between the transformer terminals and the switchgear.

The high voltage switchgear will be bonded to the station earth using (green/yellow) PVC insulated 70 mm² copper cable.

A cable support bracket will be included to help restrain the HV cables entering the substation. The bracket will be located so that it does not interfere with the laying in of cables.

8.1.2 Clearances and Insulation

The minimum electrical clearance in air to earth for all high voltage parts of the equipment shall be not less than that specified in AS 2067.

All current carrying MV conductors that are air insulated (not in SF6 gas tank) shall be enclosed with either cold shrink or thermofit insulation. Bidders who offer equipment with cast resin (or similar material) encapsulated current carrying MV conductors shall provide test reports to demonstrate that the cast resin or similar material shall not be affected by the operation of the equipment under the service conditions detailed in this specification.

In particular, load cycling due to the different coefficient of expansion of the metallic conductor and the insulation material at different temperatures over time.

8.1.3 Equipment Housing

The design of the HV switchgear shall be such that all electrically active parts of each switchgear function (switch-disconnector, earth switch, and fuse-switch except the HRC fuse compartment) and inter-bay busbars are housed in a sealed enclosure.

The enclosure shall be SF6 gas insulated and sealed for the operational lifetime of the equipment. This tight housing together with the HRC fuse chamber shall constitute a fully insulated design so as to render the switchgear functions completely insensitive to the outside environment.

The IP rating of the main electric circuits shall be IP64.

8.1.4 Operation

The HV switchgear shall be ergonomically designed with operating handles preferably of the removable type. The handle shall be of such a length that it complies with the relevant internal arc protection requirements and extends beyond the enclosure to enable ease of operation. The effort exerted on the handle by the operator should not be more than 250 N.

8.1.5 Switch Disconnecter

The switch disconnector along with the earth switch shall be load breaking and fault making type and comply in all respects with AS 60265.1-2001, AS 62271.102-2005 and AS 62271.100-2008. Switches shall be designed for interrupting full rated current as stated in Appendix D as well as small inductive or capacitive currents involved in disconnecting cables or overhead lines.

Each switch-disconnector shall be provided with an interlocked earthing switch for earthing the isolated feeder cable. Option of having two independent manual operating mechanisms for switch disconnector and earth switch is also acceptable. However the Bidder shall ensure that the safety of operators is not compromised and the interlock systems are provided as required in Section 8.1.8.

The design shall prevent simultaneous closing of the main switch contacts and the earth switch contacts. The switch-disconnectors and earth switches shall be three-phase, spring assisted and manually gang operated. The earth switch contacts shall be designed to close into a fault and shall have the same short circuit capacity as that of the main switch disconnector itself. The front panel of each switch unit shall incorporate a mimic display of the switching arrangement with clear signs to ensure a high level of safety in operation. The operating positions shall be clearly marked, indicating the "ON" and "OFF" position for both the switch-disconnector and earthing switch.

8.1.6 Switch Fuse

The fuse-switch combinations and earth switch shall comply in all respects with AS 2024-1991, AS 62271.102-2005 and IEC 62271-105:2002 (Ed. 1.0) Fuse-switches with High Rupture Capacity (HRC) fuse carriers shall have a "trip all phases" device to trigger on the operation of one or more fuses. The fuse-switches and earth switches shall be three-phase, spring assisted and manually gang operated. The front panel of each switch unit shall incorporate a mimic display of the switching arrangement with clear signs to ensure a high level of safety in operation. The operating positions shall be clearly marked, indicating the "ON" and "OFF" position for both the fuse-switch and earthing switch.

Each fuse-switch unit when earthed via its associated earth switch shall be earthed on both sides, upstream and downstream, of the fuses. The fuse carrier shall remain effectively earthed on both sides during fuse replacement by the earth switch provided with the fuse-switch.

Fuse-switches shall take fuses complying with IEC 60282-1, IEC 62271-105:2002 (Ed. 1.0) and DIN 43265. The Bidder shall detail the maximum allowable HRC fuse power loss (in Watts) values for the fuse-switch units under normal operation. Bidders who offer switchgear with vertically laid out fuse arrangement, shall comment on the effect of heat build up at the upper portion of the fuse housing and any over-temperature tripping feature incorporated with the HRC fuse tripping arrangement.

8.1.7 Insulating and Switching Mediums

Switch units shall be of vacuum or SF6 gas interrupter type. Oil immersed switchgear will NOT be considered.

Vacuum Interrupters may be used for Circuit Breakers and switch-disconnectors. The contacts for vacuum interrupters shall be positively driven in both the OPEN and CLOSE directions and in no way be dependent on the interrupter vacuum. The vacuum bottles shall be sealed for life. Bidders shall state the method by which FEA may carry out in-situ tests on the integrity of vacuum in the bottles.

The design of the interrupter shall be such that the level of x-rays emitted under all operating and test conditions shall not constitute a health hazard to any personnel working on the particular switchgear

panel or adjacent switchgear panels with any panels or parts of the switchgear removed. Bidders shall state the levels of x-radiation emitted by the switchgear under all likely operation and test conditions.

Bidders shall state whether the vacuum switchgear offered is subject to any random flashovers across the contact gap of an open bottle under voltage conditions less than or equal to the switchgear test and service voltages specified.

The detailed procedure for replacing a vacuum bottle shall be stated in the instruction manual.

SF6 gas Interrupters may be used for switch-disconnectors. The SF6 gas used shall comply with the requirements of AS 62271-200. Switchgear that requires the periodic filling of SF6 gas shall not be considered. A stainless steel label shall be fixed to the switchgear stating the total mass and volume of SF6 gas present in the switchgear at a specified date. The Bidder shall state the nominal SF6 gas filling pressure and nominal fill temperature.

The annual loss rate of SF6 gas shall not exceed 0.1% of the total mass. The Bidder shall confirm that this requirement can be achieved and detail the guaranteed annual loss rate for the Switchgear. Any departure from this requirement shall be clearly stated in the Technical Schedules. The Bidder shall guarantee that pressure of the SF6 gas shall be above the operating limit throughout the lifetime of the switchgear. The switchgear shall not remain energised with load connected if there is no SF6 gas inside the tank.

A robust SF6 gauge(s) shall be provided for visual indication of SF6 gas pressure inside the switchgear chamber. The SF6 gauge shall be readily visible from the front of the unit without the necessity to remove any covers and be clearly marked to indicate the normal gas pressure by a green area on the gauge face and the low gas pressure by a red area on the gauge face. The gauge shall incorporate temperature compensation or have a gauge face that corresponds to different temperature ranges. The SF6 gauge shall be fitted to a non-return valve that prevents loss of SF6 gas. The non-return valve shall facilitate the following:

- i. The removal of a defective gauge while the equipment is in service,
- ii. SF6 gas reclamation at end of life of switchgear

Bidder shall state in Technical Schedules if a SF6 gas non-return valve is NOT provided. The switchgear and busbar housing containing SF6 gas shall be sealed for life except one common access point for the SF6 gas gauge sensor via the SF6 gas non return valve. A separate low pressure SF6 gas switch shall be provided for low pressure alarm. The low pressure switch is to be set to operate at pressure which will indicate loss of SF6 within switchgear and will not generate false alarms as the SF6 gas pressure drops due to the ambient temperature drop or change.

Bidder shall state the pressure at which the switch is activated (in bar or kPa) which shall be greater than atmospheric pressure.

8.1.8 Interlocks

An adequate mechanical interlock system shall be provided to prevent mal-operation and to ensure operator safety. The design of the interlock system must be such that it shall not be possible for the operator to physically override the interlock controls. The Bidder shall specify how the following interlock system is achieved:

1. It shall not be possible to remove partially or completely the cable compartment covers unless the main switch has first been turned OFF and then the earth switch turned ON.

2. Once the compartment cover has been removed, it shall be possible to take the earth switch OFF (for testing purposes).
3. It shall not be possible to turn the main switch to the ON position while the cable compartment cover is removed at any time.
4. It shall not be possible to access the fuse chamber unless the upstream and downstream earth switch has been turned ON.
5. It shall not be possible to turn the fuse switch to the ON position if the fuse cover is not properly closed or if the earth switch corresponding to the fuse switch is not in the earth position upstream and downstream or if fuse holder is not placed correctly or if any fuse is blown.
6. The following additional requirements apply if the unit offered has two independent manual operating mechanisms for switch disconnecter and earth switches:
 - a. It shall not be possible to operate the earth switch to ON/OFF unless the ON/OFF switch of the switch disconnecter is in the OFF position.
 - b. It shall not be possible to operate the switch disconnecter to ON/OFF unless the earth switch is in the OFF position.

8.1.9 Padlocking

The switchgear shall have robust padlocking facilities for locking each switch operating handle entries in the "ON" or "OFF" position. This provision includes switch-disconnector and fuse-switch and earth switch. These locking facilities shall prevent inadvertent operator switching as well as unauthorized switching.

The switchgear shall have a minimum 10 mm diameter hole for attaching the padlock at the lips of the operating handle entries. The padlocking facility material shall be robust and compatible with the life of the switchgear. The Bidder shall ensure that the padlocking facilities are properly secured so that they are not susceptible to damage during transportation.

8.1.10 Voltage Indication

The switchgear shall provide a means of permanent voltage indication with bright indicators on all phases. Provision shall also be made for the use of test lamps as an additional means of voltage indication. Bidder shall detail the method of voltage indication and compliance to IEC 61958 Ed.1:2000 or IEC 61243-5:1997. The switchgear shall have voltage test points to allow phasing out of the switchgear. Voltage indication systems that require an external power supply will not be accepted.

8.1.11 Cable Connections

The switchgear shall be provided with a cable box, enclosure or compartment suitable for the cable terminations.

The switchgear shall be equipped with facilities for earthing and testing of all connecting cables. There shall be adequate clearances so that MV testing of a feeder or transformer cable may be carried out with safety for both the tester and equipment when all other parts on the switchgear are energised at the system voltage.

Bidders shall state the cable type and maximum size that can be terminated in the cable compartment of all items being offered and the associated termination to use.

8.1.12 Cable Entry and Cable Support

Incoming cables shall be bottom entry for both switch-disconnectors and fuse switch units. Suitable cable supports in the form of cable mounting plates and cable cleats complete with mounting accessories shall

be supplied at the base of the switchgear units to support incomer cables so that the weight of the cables is not transferred to the switchgear terminal bushings.

The cable box shall have a bottom plate and cable clamp. The bottom plate shall be of split gland plate type with cable entry holes. Cable clamps shall be fixed to the bottom plate at the base of the cable compartment for all switch functions.

Cable support shall be provided for supporting the weight of the cables. Cable supports shall be capable of forward and backward adjustment, and left to right adjustment to ensure the cable is correctly aligned.

8.1.13 Earthing

Earth connection points for terminating suitably sized cable lugs for the purpose of making earth connections shall be provided. All earth bars shall be rated for fault currents to allow for the termination of cable screen wires. The preferred location of these earth connection points shall be located inside the front left and right hand panel near the base of the leftmost and rightmost cable compartments respectively and away from the cable terminations.

8.1.14 Nameplate

A nameplate shall be provided for the switchgear, labelled in accordance with AS 62271.1-2012 and AS 62271.200-2005, and fitted such that it is clearly visible on the front of the panel. The true rating of each of the component parts shall be marked by etching or stamping on the plate. The serial number shall also be etched or stamped on this plate. The rating plate shall be made of stainless steel and shall be permanently fitted - by means of rivets or firmly bolted down using stainless steel bolts. Stick-on, glued-on or painted-on nameplate labels are NOT acceptable.

8.1.15 Surface Protection

The Equipment may be installed in severely corrosive condition mainly induced by water, salt laden atmosphere and low levels of industrial pollutants. FEA requires all exposed internal and external surfaces to be cleaned, prepared and treated with a coating system suitable for severe marine environments corrosion category E-M in accordance with AS 2312-2002. It is not expected that the switchgear will require re-coating during the anticipated lifespan of the Equipment.

The estimated life of the protective coating shall also be specified.

Bidders shall provide details of all tests (accelerated aging, salt spray, fog, impact, etc.) that prove the effectiveness of the proposed protective coating. All testing shall be carried out in accordance with AS 1580.0-2004 or equivalent international standards.

8.1.16 Mounting Bases

Mounting bases shall be provided, for all switchgear, to prevent deformation of the equipment and its functionality during handling, lifting or transportation.

The mounting bases shall be:

1. designed so as to maintain the structural integrity and the IAC classification of the Equipment;
2. galvanised mild steel
3. designed to withstand the maximum weight of the Equipment, the cables and terminations

Bidders shall submit details of the handling, lifting or transportation instruction for such a design with the bid. Separate designs and installation instructions along with details of centre of gravity.

8.2 Low Voltage Switchboard

8.2.1 General

The switchboard will be dead front and be designed such that all installation, maintenance and repair activities can be easily performed without the need to access the rear or approach live terminals. The switchboard design will allow for the replacement of individual switchgear units while the busbars remain energised. It will be possible to terminate all outgoing circuits from the front of the switchboard.

The switchboard frame will be constructed to include a cable support bracket.

Sufficient space will be provided on the switchboard (or switches) for the attachment of operating labels to the switches and phasing labels for the LV busbars. The operating labels will be 50 mm long x 25 mm wide and the phasing labels 20 mm long x 20 mm wide.

The labels for the transformer switch-disconnector and LV busbars will be supplied fitted to the switchboard. The transformer switch-disconnector is to be labelled "Transformer Isolator". The busbar will be labelled 'a', 'b', 'c' (top to bottom).

All solid insulating materials used will be fire resistant. They will not ignite spontaneously and will cease to smoulder or melt immediately on removal of the heat source.

A suitable conducting grease will be applied to all electrical connections of the LV switchboard and associated cable connections. Busbar configurations designed to minimise EMF levels are preferred.

Full details of the LV switchboards will be provided by the Bidder and will be subject to approval by the Purchaser. Any minor costs associated with modifications to suit the Purchaser will be provided at no cost.

8.2.2 Switchgear

Vertically arranged, DIN type switchgear complying with AS 3947.3/IEC 60947.3 is required.

It will provide three phase switching, single pole operation is unacceptable. It is preferred that all Low-voltage switchgear including the LV Transformer Isolator / Disconnecter be a minimum utilisation category at 500 V of AC22B however a lower performance utilisation category minimum AC21B at 500 V may be considered by the Purchaser for DIN3 630A switchgear and the LV Transformer Isolator / Disconnecter only.

The switchgear will be suitable for isolation and will be padlockable to accommodate the Purchaser's approved padlocks. It will be possible to close and lock the LV compartment door with all switches locked in their open positions.

The electrical contacts of all switchgear will be silver plated copper. The silver plating will be in accordance with AS 1856 and have a thickness no less than .010 mm. All silver plated parts are to be guaranteed to be free from verdigris under the specified service conditions.

8.2.3 Busbars

The busbar system of all switchboards will be rated for a minimum short circuit current of 31.5 kA. To allow for a range of switchgear and prevent binding between operating handles, 185 mm busbar centres will be used and a 10 mm gap will be provided between all switches.

All holes will be predrilled with "nutserts" (or equivalent) fitted and all spare holes will be fitted with switchgear mounting bolts. Removable insulating covers will be provided over all unused/spare switch positions.

8.2.4 Transformer Switch Disconnecter

A switch-disconnector will be used to provide isolation between the transformer and the switchboard busbars. It will be located on the extreme left hand end of the switchboard. A rear connected, fixed link type switch-disconnector is required. It will be capable of continuously carrying 150% of the transformer's rated current at an ambient temperature of 50 deg Celsius.

Up to two switches may be ganged together to achieve the required rating. To limit the stresses on the transformer's LV bushings and help prevent leaks, flexible leads will be used to connect the switch-disconnector to the transformer. The leads will have a temperature rating of 110 deg Celsius (or better).

8.2.5 Circuit Fuse Switch Disconnectors

Fuse-switch-disconnectors will be used to protect and switch outgoing cable circuits and will be mounted to the right of the transformer switch-disconnector. Two types are required, a unit capable of accepting up to 400 A DIN size 2 fuses and a unit capable of accepting up to 630 A DIN size 3 fuses. The 630 A rated unit will also be capable of accepting DIN size 2 fuses.

The switches will be capable of continuously carrying 400 A and 630 A respectively at an ambient temperature of 50 deg C. Equally rated bases are required for both units to enable the Purchaser to uprate the 400 A units to 630 A at a later date (if required).

Fuse-switch-disconnectors will be capable of being fitted or removed with the bus bars energised.

Each switch will have terminals suitable for the termination of up to 2 x 240 mm² aluminium cables (fitted with 45 mm wide lugs) per phase. It is essential that the electrical connections be of compatible materials.

Tinned aluminium terminals are not acceptable.

M12 stainless steel nuts, bolts and belleville washers for cable termination will be supplied with each switch.

8.2.6 Insulation Level of Cable Terminations

An insulation level of 2500 V rms will be maintained between phases of each unit and adjacent units when the switch is terminated with uncovered lugs to suit the maximum cable size. The maximum cable lug dimensions shall be provided by the Bidder. Insulating barriers of fire resistant material would be acceptable for this purpose.

The switches will be supplied fitted with insulating covers to fit over the cable terminations.

8.2.7 Earth and Neutral Bars

The LV switchboard will be fitted with a neutral bar and an earth bar. The neutral and earth bars will be supported on insulators and attached to the switchboard frame. The insulators will provide an insulation level of at least 6 kV between the bars and the frame.

All holes in the bars will be fitted with "nutserts" (or equivalent) suitable for M12 bolts. A short section of bar (with the same cross-section as the neutral and earth bars) will be used to bond the earth and neutral bars. This bond will be located at the far right hand end of the switchboard.

The earth bar will have ten holes to allow for the connection of equipment and cable earths. It will not impede clear cable access to LV terminals and will not hinder connection of neutrals of outgoing circuits to the neutral bar.

A tinned copper neutral bar will be provided with hole centres to allow for the connection of the transformer neutral, LV surge arresters, LV feeder cables and large consumer's mains.

The neutral bar will extend around the left hand side of the switchboard to allow for the connection of large consumer's mains. Three holes will be provided in the extension.

The neutral bar will extend around the right hand side of the switchboard to allow for the connection of LV surge arresters. Three holes will be provided in the extension.

Six additional holes will be provided to allow for the connection of the transformer neutral, LV earth bar link and outgoing LV feeder cables.

The additional holes provided for the outgoing feeder cables will be positioned clear of (and not behind) phase terminations. Short (black) insulated bridging cables fitted with M12 lugs may be provided between the neutral bar and the front of the switchboard for this purpose.

8.2.8 Earth Bonds

The switchboard frame and earth bar will be bonded to the main earth using separate cables and connections. Green/yellow PVC insulated cables with 70 mm² copper conductors will be used for this purpose. M12 lugs and bolts will be used for all connections.

The bond between the earth bar and the station earth will be easily accessible to allow its removal (by the Purchaser if required). This bond will be used to reconfigure the substation earthing system and will be labelled "For Separate Earthing Remove This Cable".

8.2.9 Low Voltage Surge Arrestors

The Purchaser requires the pad-mounted transformer units to be supplied fitted with low voltage surge arresters.

The arresters will be fitted between each LV phase and the extension on the neutral bar. Red conductor colour PVC insulated, 50 mm² Cu cable complying with AS/NZS 5000.1 will be used to bridge the arresters to the transformer terminals. If surge arresters are not bolted straight to the Main neutral bar, black conductor colour PVC insulated, 50 mm² Cu cable complying with AS/NZS 5000.1 will be used to bridge the arresters to the main neutral bar.

The arresters will be located so that they can be easily replaced, even when all outgoing cable circuits are in place and energised. Each arrester will be taken to its own termination point on the neutral bar (that is, one M12 bolt will be used for each arrester lead).

8.2.10 Switchboard Configurations

FEA invites Bidders to offer different switchboard configurations as part of their offer for FEA consideration and review.

9 TESTING

9.1 Transformer Tests

9.1.1 Routine Tests on Transformers

The following tests, as specified in AS 2374, shall be carried out:

AS2374	Clause No.
1. Measurement of winding resistance	Part 1 – Clause 10.2
2. Ratio and phase relationship checks	Part 1 – Clause 10.3
3. Impedance voltage, short circuit impedance and load losses	Part 1 – Clause 10.4
4. No load loss and currents	Part 1 – Clause 10.5
5. Induced over-voltage withstand	Part 3 – Clause 12
6. Separate-source voltage withstand	Part 3 – Clause 11
7. Insulation resistance	Part 3 – Clause 16

9.1.2 Type Test on Each Design

The following type tests, as specified in AS 2374 or elsewhere in the specification, shall be conducted on each design:

AS2374	Clause No.
1. Temperature rise test	Part 2 – Clause 5
2. Impulse voltage withstand test	Part 3 – Clause 13
3. Impulse voltage withstand test including chopped wave test	Part 3 – Clause 14
4. Sound level tests	Part 6 – Clauses 5, 6, 7
5. Pressure test on sealed transformer	As per specification
6. Short circuit test	Part 5

9.1.3 Type Test Obligations

All units of the same design shall be identical in all respects relating to materials, design and manufacture.

A copy of the type test certificates shall be provided upon request, free of charge, to FEA for any item purchased against this specification. If a specific item was not tested in the past, FEA shall allow the tests to be performed on units purchased at the Supplier's expenses.

Should FEA require any test(s) to be repeated despite the earlier certificate being available for an identical (or similar, as allowed below) unit, the cost of such test be borne by the FEA.

Where units are offered of a similar design to those previously tested, FEA may consider (in accordance with AS 2374, Part 1, Para 3.11.2) to accepting previous type test reports. The Bidder shall state if such tests, that would qualify for consideration exist. The Bidder may be requested during the tender evaluation period to substantiate that claim with written engineering evaluation. Such evaluation shall provide all relevant details permitting FEA to establish validity of existing type tests.

Any modification, resulting from a type test failure or change of design instigated by the Supplier or change of design to comply with the specification, which could affect the result of earlier type tests, shall require a repeat of such earlier type test. Any repeat type tests to provide compliance with the Standard's requirements shall be to the Supplier's cost.

The insulation of the HV winding shall be capable of withstanding impulse voltage testing including chopped waves in accordance with AS 2374, Part 3, Clauses 13 and 14.

The lightning impulse withstand voltage and power frequency withstand voltage of the HV windings and connected parts shall be specified in the Specification Requirement.

Extrapolations of temperature rise for guaranteed load and no-load losses shall be incorporated in the test report to verify conformance. During the test, sealing around thermometers, etc. shall be adequate to ensure the units are sealed during the test. Also, tap switch operation shall be free, i.e. not over tightened during the test. Internal pressures shall be measured and recorded.

Bidders are required to conduct an overload temperature rise type test on the same unit which underwent the temperature rise type test to verify that the maximum hot spot winding temperature of 140° C is not exceeded when the ambient is 25° C for an overload condition of 1.5 times the normal rated load on any tapping for up to 2 hours after continuous operation at 0.6 times the normal rated load. Internal pressure shall be measured and recorded. The result of this test shall be incorporated in the test reports for temperature rise. Bidders shall state in the schedule the guaranteed top oil/winding temperature rise for this condition.

Oil leaks during temperature rise tests would constitute failure of the test.

A short-circuit test in accordance with AS 2374, Part 5 shall be carried out on the transformers. Should a unit fail test, subsequent tests to provide compliance with the standard's requirements shall be to the supplier's costs. At the conclusion of tests to FEA's account, FEA reserves the right to attend the out of tank inspection at the testing premises.

9.1.4 Pressure Tests on Sealed Transformers

To prove the sealed transformers are adequately designed and sealed, the following type test shall be required on each fully assembled transformer:

- Establish and monitor internal transformer pressure. The test pressure shall equal the maximum pressure stated on the rating plate.
- If, after 30 minutes, the pressure has not dropped more than 2 kPa, the transformer will be considered to have passed the test.

Ambient temperature variation shall be within $\pm 2^{\circ}$ C.

9.1.5 Batch Tests

All conductors shall have been inspected and tested in accordance with AS 1194.

The dielectric strength of oil is to be tested in accordance with AS 1767.

9.1.6 Porosity Tests

Porosity tests shall be carried out by the Supplier or their subcontractor for porcelain components in accordance with the requirements of Clause 5.6 of AS 4398, Part 2.

9.2 Low Voltage Switchboard Tests

The Purchaser reserves the right to negotiate with the successful Bidder a fee schedule to obtain type tests to AS 62271.202 as a complete unit or as component functional parts, including:

- Dielectric tests
- Temperature-rise tests
- Short-time and peak withstand current tests on main and earthing circuits
- Functional tests
- Verification of the degree of protection
- Calculations and mechanical tests
- Internal arcing test
- Electromagnetic compatibility test (EMC)
- Special Tests e.g. sound level of a prefabricated substation

A copy of the type test certificates will be provided, free of charge, to FEA for each item purchased against this specification and prior to the first delivery of each item. If an item has not been previously tested, FEA will allow the tests to be performed on purchased units at the Suppliers expense.

A list of all accessories that have been satisfactorily tested with the substations offered, giving details of the manufacturer and product identification, is to be provided in the bid.

9.3 High Voltage Switchgear Tests

The Bidder shall undertake all type, routine, sample and special tests according to this specification and as per the requirement of relevant Australian or International Standards. The tests shall be carried out to the satisfaction of FEA's Representative.

FEA reserves the right to reject the equipment even if it passes all the tests but does not comply with the specification when installed on site.

Evidence shall be submitted by the Bidder indicating that all type tests required by the relevant Australian and International Standards have been satisfactorily carried out on the Equipment.

Where Equipment has been tested to International Standards only, sufficient type test evidence shall be submitted to confirm equivalence to the relevant Australian standard if one exists.

The Bidder shall carry out as many IAC tests necessary to gain compliance with AS 62271.200 and AS 62271.202 at their own cost. Any design modification done to the equipment must comply with the IAC test requirements. These tests will have to be carried out by the Bidder at their own cost.

The indoor IAC test on the switchgear equipment itself shall be carried out in accordance with AS 62271.200. The minimum test current shall be equal to the rated short circuit withstand current of the ring main unit for a period of three (3) seconds.

The outdoor IAC test for the switchgear in kiosk shall be carried out in accordance with AS 62271.202 for short circuit withstand current for one (1) second as above. The Preferred Bidder shall perform the IAC type tests with at least 2 switch disconnectors and 1 fuse switch unit (2 +1 configuration).

Type test results of equipment along with kiosks shall be provided with the tender to show internal arc compliance (IAC) with requirements of the Standard requirements above or IEC equivalent Standard. The test result shall indicate the accessibility type including sides and include internal arc current and duration with supporting test reports.

If the various tests associated with fault levels of 25kA have not been carried out on the design offered, the Bidder shall state what tests it guarantees to have made and by which testing authority and shall demonstrate that the tests.

Impact test must be carried out on the kiosk unit complete with doors, covers and ventilation openings; as described in Section 2.5.8 of AS 1170.2-2011. The kiosk must pass the test for the maximum wind speed as per the operating conditions in Section 6. The doors shall be kept closed during the period of the test.

Details of any visible effects and the position of the impacts on the switchgear shall be recorded by photographs and included in the test report. This is not limited to deformation on any part of the kiosk and stand including door hinges and tabs.

Routine tests shall be carried out on each item or component thereof. For components that have not mentioned below, all routine tests as described in the respective Australian or International Standard need to be carried out.

- i. Switchgear as per AS 62271.1 and AS 62271.200 - All routine tests as described by the above standard need to be carried out. In addition partial discharge measurement tests need to be carried out as per AS 62271.200 Annexure B.
- ii. Fuse-switch combination per AS 2024-1191 and IEC 62271.105-2011
- iii. Mechanical Operating Tests
- iv. Power Frequency Dry Tests (Dielectric Test)
- v. Tightness Test
- vi. High-voltage switches per AS 60265, AS 62271.102-2005 and AS 62271.1
- vii. Power Frequency Voltage Tests
- viii. Voltage Withstand tests on Auxiliary and Control Circuits
- ix. Measurement of Resistance of Main Circuit
- x. Mechanical Operation and Endurance Tests

9.4 Acceptance Tests

FEA reserves the right to repeat any or all tests (subject to provisions in respective standards for transformer, low voltage switchgear and high voltage switchgear and at FEA's Cost) during their acceptance test stage.

9.5 Witnessing of Tests

The Bidder shall make allowance for up to two FEA's Engineers to witness the type tests which shall be requested to be performed. All costs for the witnessing of such type tests shall be borne by the Bidder.

The Bidder shall also make allowance for witnessing of routine tests on selected samples by two FEA Engineers. These tests may be witnessed once in a calendar year.

Where applicable, the Supplier shall give FEA not less than four (4) weeks' notice of when each and every type test will be carried out.

9.6 Test Certificates

Two certified copies of all test results shall be supplied to FEA. Electronic copies shall also be submitted.

All test certificates shall include the manufacturer's serial number. On allocation, the corresponding FEA transformer number or stock code, the order number, contract number, item number, specification number and guaranteed losses must be added to the certificate, or attachment to the test report.

Test reports must not be more than five (5) years old from the closing date of the tender.

10 RELIABILITY

10.1 Service Life

Bidders are required to comment on the reliability of the equipment and the performance of the materials offered for a service life of 35 years under the specified system and environmental conditions.

10.2 Spare Parts and Maintenance

The supplier shall supply a list of recommended spare parts, special tools and appliances required for the whole of life operation and maintenance of the transformer installation. The list, together with prices, shall be indicated in the appropriate schedule. The supplier must also provide details (if required) of the recommended maintenance and the frequency at which it must be carried out. Details of the manufacturers repair capability and options shall be provided

10.3 Evidence in Support of Reliability

The supplier shall indicate and provide updates to FEA the mean time between failures (MTBF) of the transformer and its components including the recommended maintenance regime and maintenance tasks and intervals. This regime shall be based on the mean time between failure (MTBF) and the critical failure modes identified by the failure mode, effects and criticality analysis (FMECA) of the equipment. Details substantiating the FMECA analysis shall be included in the offer.

Such comments will include evidence in support of the reliability and performance claimed including information on Failure Mode and Effect Analysis.

11 ENVIRONMENTAL CONSIDERATIONS

Bidders are required to comment on the environmental soundness of the design and material used in the manufacture of the items offered. In particular, comments should address such issues as recyclability and disposal at end of service life.

Bidders are required to provide with the tender, EMF levels at transformer normal (balanced) maximum load. Such EMF levels are required at a point midway along each side, and diagonally out from each corner, at a distance of 1m above and beyond the base.

12 PACKAGING AND MARKING

The packaging of items by the Bidder must ensure that they are capable of being delivered undamaged giving due consideration to the quantity, distance of transportation and the preferred method of handling at each location.

The Bidder shall take all necessary precautions to ensure safe handling of all transformers and associated accessories supplied.

13 QUALITY REQUIREMENTS

13.1 Quality System

Bidders are required to submit evidence that the design, manufacture and testing of the transformers are in accordance with AS/NZS 9001.

Documentary evidence shall be provided concerning the level of Quality System Certification associated with the supplier and or manufacturer. This documentation shall include the Capability Statement associated with the Quality System Certification.

14 STOCK AVAILABILITY

The bidder is required to show the size of his/her stock holding and the ability to meet the required estimate quantity per annum. The movement of the pole-mounted transformers is as outlined in the table below.

FEA Stock Code	Item Description	3-year Stock Movement
I04376A	200kVA, 11kV/433V, 3-phase, ground-mounted	1
I04377	300kVA, 11kV/433V, 3-phase, ground-mounted	3
I04381	300kVA, Dual primary 11kV, 6.6kV/433V, 3-phase, ground-mounted	0
I04378	500kVA, 11kV/433V, 3-phase, ground-mounted	5
I04380	1000kVA, 11kV/433V, 3-phase, ground-mounted	4
I04407	750kVA, 11kV/433V, 3-phase, ground-mounted	2
I04408	300kVA, 11kV/433V, 3-phase, pad-mounted	8
I04411	750kVA, 11kV/433V, 3-phase, pad-mounted	16
I04414	500kVA, 11kV/433V, 3-phase, pad-mounted	19
I04421	1000kVA, 11kV/433V, 3-phase, pad-mounted	13

15 PRODUCT WARRANTY PERIOD

The Bidder is required to provide the warranty period as part of the proposal. A minimum warranty period of twenty-four (24) months from time of dispatch from factory shall be provided.

16 INFORMATION TO BE SUPPLIED BY THE BIDDER

16.1 Documentation to be supplied with the tender

To enable FEA to fully evaluate the transformer(s) offered, (in addition to the completed Specification Requirement and Guaranteed Performance schedules) the Bidder will submit the following information with their tender:

- List showing similar equipment supplied to or on order for other utilities in Australia or New Zealand or the Oceania region
- Typical arrangement drawings and full details of the dimensions of the transformers and switchgears
- Type test certificates for the transformers offered, or transformers of similar design and rating (if available).
- Type test certificates for the switchgears offered for the pad-mounted transformers
- Typical loading curves (for loading transformers in accordance with AS 2374, Part7)
- Short circuit test details for equipment of similar design and rating.
- Sample inspection and test plans for the transformers and switchgears where applicable
- Typical installation and maintenance manuals for all components
- Full details of the protective coatings offered
- End of service life disposal method
- Calculations for MEPS efficiencies
- Detailed procedure for receiving, handling, lifting and storage
- A list of all departures of the tender from this specification
- Evidence of quality management systems
- Evidence of Health, Safety and Environmental plans
- Evidence of financial ability to provide the level of service and support
- Origin of materials used in manufacture of the transformer and switchgears
- Names and resumes of key team members who will be assigned to work with FEA upon successful award of the three-year supply contract (if Bidder is successful).

Bidders may be asked to provide additional information during tender assessment period or following award of contract.

16.2 Documentation to be supplied during the course of the contract

Within two (2) weeks of the placing of the order, the successful Bidder shall supply three (3) copies of the following:

- a) A certified outline drawing for each rating of transformer with:
 - i. Centre lines and centers of gravity
 - ii. An electrical clearance table
 - iii. Overall dimensions
 - iv. Surge arrester mounting positions
- b) A drawing showing the rating and terminal marking plates for each rating of transformer (may incorporated in the outline drawing).

The Bidder must exercise reasonable diligence in the design of items in order to satisfy FEA's specific integration requirements between the Bidder's offered item and FEA's requirement for the item to be utilized in its electricity distribution network. FEA will comment on the drawings supplied under the contract in relation to how the equipment interfaces with FEA's design, construction, operation, maintenance and other requirements. Comments about drawings by FEA shall not in any way absolve the Bidder of responsibility for the safety and reliability aspects of the plant or equipment supplied. The Bidder shall amend the drawings as directed and resubmit them to FEA within one week.

Drawing shall be to scale and in accordance with AS 1100. The contract number shall be shown prominently on all contract drawings. All drawings shall be produced on standard FEA borders.

An inspection and test plan for transformers shall be provided and FEA's comments (if any) shall be addressed and resolved before commencement of manufacture.

16.3 Samples

Samples of typical units may be required during the tender assessment period. Sample will be required only from Bidders who have previously not supplied transformers to the FEA.

When samples are required, production samples shall be delivered freight free, suitably packaged and labeled including reference to the Tender Number.

FEA may at its discretion either purchase the samples at the tendered price or return the samples to the respective Bidder after the contract has been awarded.

16.4 Training

Training material in the form of drawings, instructions and/or audio visuals shall be provided for all the items offered and accepted by FEA.

This material shall include but is not limited to the following topics:

- Handling
- Storage
- Installation
- Maintenance program
- Environmental performance
- Electrical performance
- Mechanical performance
- disposal

APPENDIX A: SPECIFICATION REQUIREMENT – TRANSFORMER

This table is to be filled for each item offered.

Ref.	Particulars	Units	Specify FEA Stock Code
1	Transformer Description		
2	Rated Power	kVA	
3	Number of Phases		
4	Rated Voltages:		
4.1	HV winding:	V	
4.2	LV winding:	V	
5	Winding inter-connection vector group symbol		Dyn11
6	Impedance voltage at rated current on principal tapping		
7	Tap Changer Type		
8	% Tap Change		
9	No load Loss	kW	
10	Load Loss @ 75 Deg C	kW	
11	Power Frequency Insulation Level (HV/LV)	kV rms	
12	Impulse Withstand Voltage (1.2/50 micro-sec)	kVp	
13	Insulation Class		
14	Winding Conductor Type		
14.1	High Voltage:		
14.2	Low Voltage:		
15	Magnetizing Current (% of full load)		
16	Sound Power Level	dB (A)	56
17	Volume of Insulation Oil	liters	
18	Maximum Total Mass	kg	
19	Temperature rise limits		65
19.1	Winding	Deg C	60
19.2	Top Oil	Deg C	
20	Tappings		6 HV winding taps, rated, -7.5%, -5%, -2.5%, 0, +2.5%, +5%
21	Country of Manufacture of complete transformer		

22	Lifting & Transport Facilities Clearly marked with permanent label or stencil? Fully rated?	Yes/No Yes/No	
23	Protective Coating Are full details of protective coating included with the tender documents? Time to first maintenance	Yes/No Years	
24	Maximum Dimensions: Width (including Base) Length Height (including base) maximum, interchangeability requirements have changed	mm mm mm	
25	Guard provided over transformer radiators	Yes/No	
26	All bolts (Fasteners, Studs, etc.) nuts and washers 316/304 grade stainless steel?	Yes/No	
27	Tamper proof bolts used for all unenclosed components accessibility to the public?	Yes/No	
28	Serviceable life expectancy	Years	
29	Inspection free interval	Years	
30	Maintenance free interval	Years	

APPENDIX B: GUARANTEED PERFORMANCE - TRANSFORMER

The following is to be filled for each unit tendered for by the Bidder.

Ref	Particulars	Units	FEA Stock Code
1	Losses on Principal tap at 75 °C		
1.1	Load:	W	
1.2	No Load	W	
2	Temperature Rise limits during overload conditions	°C	
2.1	Top Oil:		
2.2	Winding (by resistance)	°C	
3	Minimum insulation resistance at 20 °C (1 kV test after 1 minute) for		
3.1	HV winding:	Mega Ohms	
3.2	LV winding:		
4	Continuous permissible overvoltage at any tap	%	
5	Power efficiency at 50% load	%	
6	Rated power at 40deg C ambient temperature	kVA	
7	Positive sequence impedance as vector coordinates: (Rectangular form: $Z(\Omega)=R(\Omega)+jX(\Omega)$)		
8	Zero sequence impedance as vector coordinates: (Rectangular form: $Z(\Omega)=R(\Omega)+jX(\Omega)$)		
	Oil Preservation System - Type		
6	Rated Voltage		
6.1	Primary Voltage	V	
6.2	Secondary Voltage (No Load)	V	
7	Method of cooling		
8	Suitable for loading in accordance with AS 2374, Part 7.	Yes/No	
9	Normal loading curves supplied with Tender (corrected for maximum ambient temperature)	Yes/No	
10	Maximum ambient temperature	°C	
11	Tappings: 7 HV winding tapings, rated +10% to -5% of rated voltage, 2.5% steps, off-circuit	Yes/No	
12	Insulation Level:		
12.1	HV winding impulse voltage withstand	KV	
12.2	Power frequency voltage withstand of HV winding	peak KV rms	
12.3	Power frequency voltage withstand of LV winding	KV rms	
13	HV Terminals		
13.1	Cast epoxy pad type capable of accepting a	Yes/No	

13.2	Holec 502-0024 termination kit (or similar)? HV terminal height above base	mm	
14	Clearance in air (minimum)		
14.1	LV Phase-Phase	mm	
14.2	LV Phase- to-earth (and neutrals)	mm	
15	Insulating Oil		
15.1	Does it comply with AS 1767 and non-corrosive? Type	Yes/No	
15.2	Brand of oil used	-	
15.3	Method of Filling	-	
15.4	PCB in oil detection limit	-	
15.5		ppm	
16	Material Thickness		
16.1	Tank sides/floor	mm	
16.2	Lid	mm	
16.3	Fins	mm	
17	Maximum deflection of side walls	mm	

APPENDIX C: PERFORMANCE REQUIREMENT FOR HV SWITCHGEAR

ITEM	REQUIREMENTS	UOM	12kV 3-PH SWITCHGEAR OPERATING AT 11kV NOMINAL SYSTEM VOLTAGE
D1 GENERAL			
D1.1	System highest voltage	kV (rms)	12
D1.2	Nominal system voltage	kV (rms)	11
D1.3	Lighting impulse withstand voltage	kV (peak)	95
D1.4	Power frequency withstand voltage (1 –minute) (rms)	kV – min (rms)	28
D1.5	Rated frequency	Hz	50
D1.6	Internal arc withstand (3s) (rms)	kA	25
D1.7	Design fault level (minimum 3s) (rms)	kA	25
D1.8	Maximum dimensions		
D1.9	Details of protective coating		
D1.10	Serviceable life expectancy		
D2 BUSBAR SYSTEM			
D2.1	Rated current (rms)	A	630
D2.2	Rated short – time withstand current (3s) (rms)	kA	25
D3.0 SWITCH-DISCONNECTOR			
D3.1	Rated normal current (rms)	A	630
D3.2	Power frequency withstand voltage (1-min) (rms)	kV	28
D3.3	Lightning impulse withstand voltage	kV (peak)	95
D3.4	Rated short- time withstand current (3s) (rms)	kA	25
D3.5	Rated peak withstand current	kA	50
D3.6	Making capacity (peak)	kA	50
D3.7	Load breaking capacity	A	630
D3.8	Busbar Current Rating	A	630
D3.9	Maximum cable sizes supported	-	<ul style="list-style-type: none"> 11kV 3x 1 core 300mm² Aluminium XLPE insulated PVC/HDPE sheathed. 11kV 3x 1 core 240mm² Copper XLPE insulated PVC/ HDPE sheathed.
D3.10	Minimum number of mechanical switching operations at no load	no.	1000
D3.11	Minimum number of mechanical switching operations at rated normal current (630A)	no.	100
D3.12	Minimum number of mechanical switching operations at rated short circuit current.	no.	5
D3.13	Padlocking facility provided with minimum padlock hole size (mm)	mm	As per specification
D3.14	Facilities for voltage indication (via Led	-	Yes

	lamp) and phase concordance provided per 3 – phase.		
D3.15	Switchgear main electric circuits degree of protection (IPxx)	-	IP64
D3.16	Switchgear drive mechanism degree	-	IP3X
D3.17	Switchgear MV cable compartment (with access cover closed) degree of protection	-	IP3X
D4 EARTH-SWITCH			
D4.1	Earth-Switches are provided for Switch-Disconnectors and Fuse-Switches panels.	-	Yes
D4.2	Power frequency withstand voltage (1-min) (rms)	kV	28
D4.3	Lightening impulse withstand voltage	kV (peak)	95
D4.4	Rated short-time withstand current (3s)	kA	25
D4.5	Rated Peak withstand current (3s)	kA	50
D4.6	Busbar Current Rating	A	630
D4.7	Stranded earth conductor size	mm ²	70/150
D4.8	Minimum number of mechanical switching operations at no load.	no.	1000
D4.9	Minimum number of mechanical switching operations at rated short circuit current	no.	5
D4.10	Padlocking facility provided with minimum padlock hole size (mm)	mm	10 mm hole
D5 FUSE-SWITCH			
D5.1	Rated current (rms)	A	200
D5.2	Power frequency withstand voltage (1-min) (rms)	kV	28
D5.3	Lighting impulse withstand voltage	kV (peak)	95 (75)*
D5.4	Rated short- time withstand current (3 s) (rms)	kA	25
D5.5	Rated Peak withstand current	kA	50
D5.6	Making capacity (peak)	kA	50
D5.7	Short – circuit breaking capacity	kA	25
D5.8	Load breaking capacity	A	200
D5.9	Busbar Current Rating	A	630
D5.10	Suitable cable types and maximum cable sizes supported	-	11kV 3x 1 core 240mm ² Al, w/HD Cu screen, XLPE insulated PVC/HDPE sheathed.
D5.11	Minimum number of mechanical switching operation at no load	no	1000
D5.12	Minimum number of mechanical switching operations at rated normal (200A) current load.	no	10
D5.13	Minimum number of mechanical switching operations at rated short circuit current.	no.	5
D5.14	Padlocking facility provided with minimum padlock hole size (mm)	mm	As per specification
D5.15	Switchgear main electric circuits degree of protection (IPxx)	-	IP64
D5.16	Switchgear drive mechanism degree of protection (IPxx)	-	IP3X
D5.17	Switchgear MV cable compartment (with cover closed) degree of protection (IPxx)	-	IP3X

APPENDIX D: PERFORMANCE REQUIREMENTS FOR LV SWITCHGEAR

Ref.	Particulars	Unit	Specified Value/ Response	Guaranteed Performance
				All Items
1	Dead front operation	Yes/No	Yes	
2	Busbar short circuit rating	mm	31.5kA, 1sec	
3	Busbar mounting centers	mm		
4	Gap provided between switches	mm		
5	All switchgear complying with AS 3947.3	Yes/No		
6	400 A switches capable of only accepting DIN 2 & 3 fuses?	Yes/No		
7	630 A switches capable of accepting DIN 2 & 3 fuses	Yes/No		
8	All switches padlockable?	Yes/No		
9	Circuit-fuse-disconnectors able to be installed or removed live?	Yes/No		
10	Distance between hole center of lowest phase terminals and base	mm		
11	Minimum thickness of silver plating switch contacts	mm		
12	Enclosure material	-		
13	Enclosure material Thickness	mm		
14	Enclosure IP Rating	-		
15	Minimum clear door opening	mm		
16	Enclosure fitted with removable lid?	Yes/No		
17	Base			
17.1	Material	-		
17.2	Removable sections for cable entries?	Yes/No		
17.3	Height	Mm		
17.4	Suitable for all standard foundations?	Yes/No		

APPENDIX E: DEPARTURE FROM SPECIFICATIONS

The Bidder shall nominate the Clause or relevant section of the tender specification and describe the departure.

Tender Specification Referenceⁱ	Departure

ⁱ Where possible, the Tender shall refer to the specific clause of the tender specification.