

# Electricity Specification 322

Issue 12      September 2021

## Ground Mounted Distribution Transformers



## Amendment Summary

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## 1 Foreword

This specification sets out the technical requirements for the purchase of Ground Mounted Distribution Transformers by Electricity North West Limited (Electricity North West), for connection to its network.

## 2 Scope

This specification covers ground mounted single phase transformers with ratings in the range 25kVA to 100kVA operating at voltages of 6,600V or 11,000V and three phase transformers with ratings in the range 50kVA to 1000kVA operating at voltages of 6,600V or 11,000V, for continuous service at 50Hz. It covers two winding oil immersed naturally cooled transformers with off circuit tap selectors suitable for outdoor or indoor service.

## 3 Compliance with Standards

The equipment shall be in accordance with the requirements of IEC 60076, except where otherwise stated. References to Energy Networks Association (ENA) Technical Specifications (TS) 35-1 Parts 1 and 3 are provided to clarify the critical interfaces where connections of a specific method are required.

Tenderers are requested to confirm that the equipment complies with the Electromagnetic Compatibility (EMC) Directive or to state those items that are not considered a requirement for EMC Conformity.

## 4 Definitions

<b>Approval</b>	Sanction by the Electricity North West Plant Policy Manager that specified criteria have been satisfied
<b>Contract</b>	The agreement between Electricity North West and the Contractor for the execution of the Works including therein all documents to which reference may properly be made in order to ascertain the rights and obligations of the parties under the said agreement.
<b>Contractor</b>	The person or person's firm or company, including personal representatives, successors and permitted assigns, who's Tender has been accepted by Electricity North West.
<b>Specification</b>	The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.
<b>Sub-Contractor</b>	Any person (other than the Contractor) named in the Contract for any part of the Works or any person to whom any part of the Contract has been sub-let with the consent in writing of the Electricity North West Plant Policy Manager, and the legal representatives, successors and assigns of such person.
<b>Supplier</b>	Any person or person's firm or company who supplies goods to Electricity North West or to its Contractor.

<b>Tender</b>	An offer in writing to execute work or supply goods at a fixed price.
<b>Tenderer</b>	The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a Tender.
<b>Ground Mounted Distribution Transformer Types</b>	For the purposes of this Specification, ground mounted distribution transformers shall be classified according to the following definitions.
<b>Cable Connected Transformer</b>	A three phase transformer with a rating between 100kVA and 1000kVA with suitable fittings to accept HV and LV cable terminations on opposite sides of the transformer. HV terminations shall be via separable connectors. A fuse cabinet may be mounted on the LV side of the transformer.
<b>Unit Substation Transformer</b>	A three phase transformer with a rating between 315kVA and 1000kVA with flanges on the same side of the transformer for direct mounting of an 11kV ring main unit and a low voltage fuse cabinet, assembled in a manner that allows the "package" to be installed as a single unit. Alternatively, HV terminations shall be via separable connectors and LV by a cable box.
<b>Packaged Substation</b>	An assembly comprising a Unit Substation Transformer with integral HV ring main unit and LV fuse unit.
<b>Compact Substation Transformers</b>	A three phase transformer with rating of 200kVA or 315kVA which has its tank extended to form a housing in which may be mounted a high voltage fuse switch (or equivalent) and a low voltage fuse board. It shall be capable of being assembled in such a manner that the whole unit may be handled, transported and installed as a unit. This type is additional to those in ENA TS 35-1 and is detailed in Appendix A. It shall comply wherever relevant with ENA TS 35-1.
<b>Pad Mounted Transformer</b>	A transformer with rating not exceeding 100kVA Single Phase and 200kVA Three Phase which has its tank extended to form a housing in which is mounted a high voltage fused cable termination and a low voltage fuse board. It shall be capable of being assembled in such a manner that the whole unit may be handled, transported and installed as a unit.

**Borrowdale Transformer**

A transformer with rating not exceeding 50kVA Single and Three Phase with suitable fittings to accept HV cable terminations and one low voltage fuseway, neutral link and neutral-earth link in a LV lockable cabinet. HV terminations shall be via a HV protection device such as a high voltage fused cable termination or other protection device and preferably with an isolation and earthing device and incorporate separable connectors. It shall be capable of being assembled in such a manner that the whole unit may be handled, transported and installed as a unit.

## 5 General Requirements for Approvals and Testing

### 5.1 Product not to be Changed

No change in the product, packaging or labelling shall be made after Approval has been granted without prior notice to the Electricity North West Plant Policy Manager, and receipt of a written agreement to the proposed change from the Electricity North West Plant Policy Manager.

### 5.2 Electricity North West Technical Approval

The Tenderer shall submit, with this Tender, proposals for testing which will demonstrate, to the satisfaction of the Electricity North West Plant Policy Manager, compliance with this Specification. Such tests shall be carried out without expense to Electricity North West.

Alternatively, technical reports and other data may be submitted that the Tenderer considers will demonstrate, to the satisfaction of the Electricity North West Plant Policy Manager, compliance with this Specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Plant Policy Manager but will not be unreasonably withheld.

Approval shall be 'factory specific' and is not transferable to another factory without the written Approval of the Electricity North West Plant Policy Manager.

The Supplier and product shall comply with all the relevant requirements of Electricity North West document CP311.

### 5.3 Quality Assurance

The Tenderer shall confirm whether or not Approval is held in accordance with a quality assurance scheme accredited under ISO 9000. If not, the Tenderer shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of Suppliers and Sub-Contractors.

The right is reserved for the repeat of such tests, from time to time, that the Electricity North West Plant Policy Manager may deem to be reasonably necessary to demonstrate continued compliance with the Specification.

The Tenderer shall submit, with the Tender, a list of tests and inspections which are carried out on the product prior to despatch which shall demonstrate, to the satisfaction of the Electricity North West Plant Policy Manager, fitness for installation and service.



The Tenderer shall provide free of charge to Electricity North West such samples as may, in the opinion of the Electricity North West Plant Policy Manager, be reasonably required for inspection and/or retention as quality control samples. The Electricity North West Plant Policy Manager will confirm the requirement for samples at the time of Tendering.

The right is reserved for inspections to be made of Tenderer's facilities, from time to time, as deemed reasonably necessary by the Electricity North West Plant Policy Manager to ensure compliance with this Specification and any Contract of which it forms a part.

The Tenderer shall submit, with the Tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001 - Environmental Management Systems.

## 5.4 Formulation

The Tenderer shall submit, with the Tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act 1974 and the Control of Substances Hazardous to Health Regulations 2002, in the use, storage and disposal of the product. The Tenderer may stipulate, prior to submission of such information, that it is to remain confidential, and the Electricity North West Plant Policy Manager will, if requested, confirm agreement to this prior to receipt of the information.

## 5.5 Identification Markings

The Tenderer shall submit, with the Tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the Approval of the Electricity North West Plant Policy Manager and shall in all cases include the Electricity North West approved description and commodity code number.

The Tenderer shall submit, with the Tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations 1992, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the Approval of the Electricity North West Plant Policy Manager.

## 5.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this Specification is 40 years.

## 5.7 Product Conformity

Preference will be given to those Suppliers who can provide suitable product conformity certification to a recognised or specified standard, or an equivalent certification.

## 5.8 Confirmation of Conformance

The Tenderer shall complete the conformance declaration sheets in [Appendix E](#). Failure to complete these declaration sheets may result in an unacceptable bid.

## 6 Requirements for Type and Routine Testing

The Electricity North West Plant Policy Manager shall set out the requirement of the following tests to be carried out by the Supplier at the Supplier's cost.

### 6.1 Requirement for Type Tests at Suppliers Premises

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the Electricity North West Plant Policy Manager.

These may or may not be destructive tests.

### 6.2 Requirement for Routine Tests at the Supplier's Premises

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the Electricity North West Plant Policy Manager.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased or retained for inspection, at a period to be determined by the Electricity North West Plant Policy Manager.

### 6.3 Requirement for Onsite Tests

These will normally be included within the scope of onsite commissioning but may be included if appropriate.

**NOTE:** Further details of the tests required are provided in [Section 12](#).

## 7 Principal Characteristics

### 7.1 Rated Power

Transformer rated powers shall comply with the ratings provided in [Appendix B, Table B1](#). Cyclic and overload capabilities of the transformers shall comply with the requirements of BS IEC 60076-7:2005 Power Transformers. Loading Guide for Transformers for oil-immersed power transformers, unless otherwise stated.

### 7.2 Rated Voltage

Transformers shall comply with the no-load voltage ratios specified in [Appendix B, Table B1](#).

### 7.3 Tapchanger

Transformers can be supplied with either off load or on load tapchangers. The tapchanger to be supplied shall be specified in the order.

## 7.4 Off Load Tapchanger

### 7.4.1 Tapping Range

Tappings are required on all ground mounted transformers on the higher voltage winding for a variation of the no-load primary voltage of  $\pm 2.5\%$  and  $\pm 5\%$ .

### 7.4.2 Tapping Methods

Tap changing shall only be carried out with the transformer in the de-energised state by means of an externally operated, self-positioning tapping switch. Switch position number 1 shall correspond with the maximum +% tapping.

Tap selector switches shall be capable of being securely locked in any position rendering the switch inoperable. The locking method shall be by a padlock of 5mm diameter shackle.

Direct drive Tapchangers are preferred. Where used, all cable driven Tapchangers shall have a fully insulated and mechanically secured cable. Cable ties shall not be used to secure the cable.

## 7.5 On Load Tapchanger (OLTC)

### 7.5.1 Tapping Range

Tappings shall be provided on the HV winding for a variation of the LV no-load primary voltage of +7.5 to -12.5% in 8 steps of 2.5% per step. Totalling 9 positions.

### 7.5.2 Tapping Methods

On-load tap changers shall comply with IEC 60214 and shall be suitable for power flow in both directions. Only designs which have been type tested in accordance with these standards will be accepted.

Component parts of the tap changing equipment shall be accessible for examination, adjustment and repair.

Equipment shall be designed for minimum maintenance and shall be capable of withstanding a minimum of 30 000 operations at not less than the maximum rated through current, without requiring attention.

The manufacturer shall supply a Tap Position Indicator on the Tap Changer.

A non-resettable counter shall be fitted to the driving mechanism of the OLTC to indicate the number of operations completed.

### 7.5.3 Control Methods and Interface with NMS

The tap changer control system shall be capable of operating and accurately regulating from a single-phase supply. It shall also be capable of operating at the supplied LV voltage range as specified in [section 7.5.1](#). Where this isn't possible a step-down transformer shall be supplied within the control kiosk.

The tap changer shall maintain the voltage around a set point and shall be capable of accepting a new set point sent from the Network Management System (NMS).

The tap changer shall communicate either via a GSM network or a hardwired connection utilising the DNP3 protocol.

The tap changer shall be capable of accepting over the air firmware and configuration updates.

The measured voltage shall be reported back to the NMS if it changes by more than a configurable pre-set amount.

The Tap Changer shall identify a loss of communications and should this persist for more than a configurable time period the device shall revert to a predefined voltage set point.

To allow for maintenance scheduling a resettable electronic counter shall report the number of operations to the NMS. This will be reset following maintenance.

The following shall be reported to the NMS:

- Tap change fail
- Tap change incomplete
- Tap change supply fail

The following controls shall be made available:

- Tap auto / non-auto
- Tap raise
- Tap lower

All Tenderers shall submit along with their Tender full technical details of the tap changer Control Scheme and how it connects to NMS. It shall also state how the tap changer is operable on site with respect to Local/Remote selection, Raising, Lowering and Fixing Taps on site, along with how the local controls are lockable with an Electricity North West Limited padlock to prevent inadvertent operation. The locking method shall be by a padlock of 5mm diameter shackle.

#### **7.5.4 Operation and Maintenance Manuals**

The Tenderer shall provide the operation and maintenance manuals in Adobe Acrobat (pdf) format to the Electricity North West Plant Policy Manager.

#### **7.6 Windings and Connections**

High voltage windings and wire wound low voltage windings shall be of copper construction. LV windings utilising the foil (or sheet) design shall preferably be of copper construction.

Alternative designs which offer HV and/or LV windings manufactured from aluminium foil or wire may be acceptable subject to the Tenderer clearly demonstrating a satisfactory service history over a significant period of time, subject to the approval of the Electricity North West Plant Policy Manager.

Where the Tenderer is offering LV windings of the foil or sheet type, details of the interturn insulation and lead attachment method shall be provided with the tender.

All connection leads from the HV and LV windings to the bushings or lugs shall be fully insulated. The method of crimping shall be detailed within the tender. Where more than one lead is used per phase the lug shall be suitable for crimping two cables without fracturing. Where more than one lead is used per phase the leads per phase shall be mechanically held together. The use of cable ties is not acceptable. Details of the method used shall be submitted with the Tender.

On all Unit type transformers where solid leads are used on the HV connections from the windings to the Switchgear Bushings shall be set appropriately for the task. The HV lugs shall be set 140mm from the outer edge of the HV flange and inline with the horizontal centreline of the flange.

Three phase transformers require to be connected Delta-Star in accordance with Vector group reference Dyn11 of IEC 60076.

Cable connected transformer designs with BS EN 50180 type separable connectors shall be fitted with a mechanical protection cover designed to prevent inadvertent contact or damage to the connectors.

## 7.7 Losses

Tenderers shall ensure that all Three Phase Ground Mounted Transformers comply with the losses as stated within the European Union Commission Regulation for Transformers No 548/2014 as part of the European Union Ecodesign Directive (2009/125/EC).

### 7.7.1 Single Phase Ground Mounted Transformers

Single Phase Ground Mounted Transformer losses shall be in accordance with the following table:

**Table 1 – Single Phase Ground Mounted Transformer Losses**

	IRON LOSS (W)	COPPER LOSS (W)
TRANSFORMER RATING (KVA)		
25	70	525
50	110	800
100	175	1,700

The loss values in [table 1](#) above shall be taken as the guaranteed losses and the tolerances shall be measured in accordance with IEC 60076.

The total actual losses for transformers supplied in any one year will be monitored. Overall losses exceeding the tolerances in IEC 60076 will be subject to a penalty requiring a refund of the same percentage on the total value of transformers supplied.

### 7.7.2 Three Phase Ground Mounted Transformers.

All three phase Ground Mounted Transformers shall comply with the losses as stated within the European Union Commission Regulation for Transformers No 548/2014 as part of the European Union Ecodesign Directive (2009/125/EC).

**Table 2 – Three Phase Ground Mounted Transformer Losses**

	IRON LOSS (W)	COPPER LOSS (W)
TRANSFORMER RATING (kVA)		
25	63	600
50	81	750
100	130	1250
200*	225	2015
315	324	2800
500	459	3900
800	585	6000
1000	693	7600

The loss values in [Table 2](#) above shall be taken as the guaranteed losses and the tolerances shall be measured in accordance with the European Union Commission Regulation being:

- (a) Load Losses – The measured value shall not be greater than the declared value by no more than 5%.
- (b) No Load Losses – The measured value shall not be greater than the declared value by no more than 5%.

The total actual losses for transformers supplied in any one year will be monitored. Overall losses exceeding the tolerances as stated within European Union Commission Regulation and Eco Design Directive will be subject to a penalty requiring a refund of the same percentage on the total value of transformers supplied.

\*200kVA losses are via linear interpolation as stated in the Eco Design Directive.

## 7.8 Sound Power Level

The sound power level derived from measurements made in accordance with IEC 60551 shall not exceed the values given in [Appendix B Table B1](#).

## 7.9 Impedances

The guaranteed impedances measured on the principal tap position shall be as stated in [Table B1 of Appendix B](#), subject to the tolerances specified in IEC 60076.

## 7.10 Insulation Levels for Ground Mounted Transformers

Completed transformers arranged for service shall be capable of withstanding the test voltages stated in [Table B2 of Appendix B](#).

## 7.11 Flux Density

For normal business as usual Distribution Transformers, the maximum flux density in any magnetic part shall not exceed 1.9 Tesla with a system voltage of 110% and at a frequency of 47Hz. Transformers shall not over flux under these conditions.

There are occasions where Electricity North West requires Distribution Transformers with lower noise levels. These transformers shall have a maximum flux density in any magnetic part shall not exceed 1.2 Tesla with a system voltage of 110% and at a frequency of 47Hz. Transformers shall not over flux under these conditions. These transformers will be ordered on a case by case basis and the noise levels shall comply with the levels specified in [Appendix B Table B1](#).

The Tenderer shall complete and submit all the Technical Details in [Appendix C](#) for both 1.9Tesla and 1.2Tesla options with their Tender return

# 8 Rating and Connection Plates – Marking of Terminals

## 8.1 Rating and Connection Plates

Transformers shall be fitted with a rating plate generally in accordance with section 8 of ENA TS 35-1 Part 1.

A connection plate is required to show the winding connections and tappings and shall be generally in accordance with section 8 of ENA TS 35-1 Part 1. The connection plate may be part of the rating plate.

Rating and connection plates shall be of durable and non-corrodible material and shall be securely fixed to suitable supports without forming water traps. The use of adhesives is not permitted as a means of fixing the rating and connection plate.

## 8.2 Marking of Terminals

Terminals shall be clearly marked and identified. The method of marking shall be subject to the approval of the Electricity North West Plant Policy Manager. The phase markings when facing the terminals shall be c, b, a, yn, A, B, C left to right. Phase colours shall not be used.

## 9 Oil

Transformers shall be supplied complete with the first filling of insulating oil, unless otherwise specified. For testing and commissioning, the oil shall be naphthenic base and comply with the requirements of IEC 60296 with the following additions:

- (a) Gassing tendency shall be less than 5mm<sup>3</sup>/min
- (b) Polycyclic aromatics shall be less than 3%
- (c) Additives shall not be used
- (d) It shall be certified free from Polychlorinated Biphenyls (PCB).
- (e) Corrosive sulphur and potentially corrosive sulphur content shall be classified as “Non-corrosive” as determined by the test methods prescribed in IEC 62535 and ASTM D 1275B.

For compatibility, the oil shall conform to the requirements of Electricity North West’ current type of oil, particulars of which shall be obtained from Electricity North West at the Contract stage. In the event that the oil to be supplied is other than the Electricity North West’ standard oil, the Contractor shall substantiate its compliance with IEC 60296 and that there will be no long term detriment to the mixing of oils as a result of chemical reaction between additives from his oil and additives from Electricity North West’ oil.

Where free breathing transformers are offered, oil levels shall provide sufficient coverage of all live parts at an oil temperature of –10°C without compromising the integrity of the transformer.

Electricity North West reserves the right to enter into a separate Contract for the supply of insulating oil for use in any transformers ordered as a result of this enquiry. The names of oil Suppliers shall be stated and alternative prices less oil quoted in the price schedule. Should this method be adopted it is envisaged that Electricity North West will order oil to be delivered in reasonable bulk quantities to the works of the Tenderer, free of charge. The timing of such delivery or deliveries is to be negotiated.

Where Tenderers offer designs which are hermetically sealed systems, and which may require the seal to be broken as part of the site installation works, additional oil shall be supplied to allow for a shortfall where the temperature on site is significantly lower than the factory. Where on site works require the breaking and re-creation of the hermetically sealed conditions, Tenderers shall provide a comprehensive procedure detailing the method to be followed.

## 10 General Construction and Fittings

### 10.1 General Construction

Transformers shall normally be free-breathing and without conservators, although transformers of alternative system designs may be acceptable subject to approval.

### 10.2 Tank Covers

Tank covers shall be designed and constructed to prevent the ingress and accumulation of water. Fixings shall be suitably protected to prevent corrosion.



### 10.3 Gaskets

All gaskets shall be capable of providing a service life of 40 years without leaking. Gasket compression shall be limited so that the compressed thickness is not less than 50% of the uncompressed thickness.

### 10.4 Fittings

All ground mounted transformers shall be equipped with the following items of equipment:

- (a) Earthing terminal
- (b) Combined drain/sampling valve (non brass)
- (c) Rating plates
- (d) Lifting lugs as detailed in section 15 of this specification
- (e) Tapping switch handle

In addition, all transformers shall be equipped with sufficient jacking points at each corner of the unit suitable for accepting toe type jacks to engage axle/wheels. Jacking points under the main tank are not acceptable.

Ground mounted transformers which are designed to be free breathing shall have the following additional equipment:

- (a) Oil level gauge with indication of oil level at 15°C, visible range -10°C to +80°C, and fitted with internal anti-vandal baffles.
- (b) Plain weatherproof breathing device as detailed in ENA TS 35-1 Part 1 Fig 2 or similar.

Ground mounted transformers that are designed to be hermetically sealed shall have the following additional equipment:

- (a) Filler pipe fitted with oil presence indicator
- (b) Pressure relief device
- (c) Drain/Sampling valve suitable for filling transformer from the bottom.

### 10.5 Radiators

Integral cooling fins provided as part of the main tank construction are acceptable as an alternative to separate panel type radiators.

On unit type transformers, integral cooling fins are not permitted on the tank wall to which the HV and LV switchgear is mounted.

Cable connected transformers shall not have radiators or cooling fins on the LV side of the transformer on the left hand side of the LV connection flange in accordance with ENA TS 35-1 Part 3 Fig 2 Option A. This is necessary to permit the fitting of larger style LV distribution cubicles.

Where panel type radiators are offered, these shall be provided with flanges for attachment to the main tank.

## 10.6 Key Connection Interface Points

The critical interfaces are as follows:

- (a) HV and LV connections on a unit substation transformer
- (b) HV and LV connections on a cable connected transformer.
- (c) HV switchgear mounting locations on unit type transformers (as detailed in ENA TS 35-1 Part 3 Fig 6.)

### 10.6.1 Unit Substation Transformers

Unit substation transformer interfaces shall be in accordance with ENA TS 35-1 Part 3 section 4.3.4 and Figs 3, 4, 6 and 7 of ENA TS 35-1 Part 3. The HV interface is designed to accept a directly coupled ring main unit to ENA TS 41-36 and will consist of a HV transformer flange Type 'E' to BS 2562. This flange may be fitted with a suitable blanking plate or suitable bushings designed to accept the ring main unit in a "plug in" mode. Steelwork arrangement shall be dimensionally as shown on Fig 6 of ENA TS 35-1 Part 3 for mounting the ring main unit.

LV connections shall be in accordance with section 4.4 of ENA TS 35-1 Part 3 fitted with three phase and neutral moulded bushings or equivalent, suitable for accepting a directly coupled low voltage Distribution Switchboard to ENA TS 37-2. The low voltage Distribution Switchboard shall usually include Transformer links and either 3, 5 or 7 outgoing ways. The phase marking shall be in accordance with section 8.2 of this specification.

### 10.6.2 Cable Connected Transformers

HV connections and HV cable box shall be located in accordance with ENA TS 35-1 Part 3 section 4.3.2 and Fig 2 Option A.

The High voltage connection bushings shall comply with ENA TS 35-1 Part 3 section 4.4.3 and BS EN 50180 Table 14 Type C complete with stud suitable for use with separable connectors. Separable connectors will be supplied by Electricity North West.

The bushings shall be installed into and enclosed in a metallic cover assembly complete with a bottom plate suitable for 3 single core cables. A suitable method of securely supporting the cables is required. Tenderers shall provide details of protection box as part of their submission. The tender shall provide a gland plate predrilled to a dimension which will be confirmed by Electricity North West Plant Policy Manager. The cable box housing the bushings shall be mounted onto HV transformer flange Type 'E' to BS 2562 and be interchangeable with existing cable boxes on the network.

LV connections shall be in accordance with sections 4.4.1 and 4.4.2 of ENA TS 35-1 Part 2 fitted with three phase and neutral moulded bushings or equivalent, suitable for accepting a directly coupled low voltage Distribution Switchboard to ENA TS 37-2. The low voltage Distribution Switchboard shall usually include Transformer links and either 3, 5 or 7 outgoing ways. The phase marking shall be in accordance with section 8.2 of this specification. The option for a LV cable box shall be provided with the Tender as per section 4.4.2 of ENA TS 35-1 Part 3 and be located in accordance with ENA TS 35-1 Part 3 section 4.3.2 and Fig 2 Option A.

## 11 Cleaning and Painting

Cleaning and painting shall be in accordance with ENA TS 35-1 Part 1, section 14.2 as a minimum requirement. The Tenderer shall detail the painting process used. The Tenderer shall ensure that the earthing tag is adequately covered prior to painting.

The Tenderer shall offer the colour which reflects the most economic offer. This will be subject to approval by the Electricity North West Plant Policy Manager.

Where the Tenderer proposes an alternative method of protection that can be demonstrated to have a superior performance, then this will be acceptable subject to approval. Tenderers are requested to provide details of service experience of departures from the requirements of ENA TS 35-1.

## 12 Tests

Electricity North West reserves the right to witness any of the routine or type tests. This will comprise a minimum of all tests on the first of a new design from any factory will be witnessed by Electricity North West. The Contractor shall cover travelling, accommodation and other reasonable expenses incurred whilst two Electricity North West representatives are witnessing the type tests. The Contractor shall provide a minimum of four weeks notice of any intended type testing elements.

Electricity North West also reserves the right to return at random one unit of each type or design supplied to the factory for repeat witnessed type tests where all costs shall be covered by the Contractor.

Electricity North West reserves the right to witness routine tests on any subsequent units.

Routine tests as specified in IEC 60076 are required to be carried out on all transformers. Test results shall be provided on test certificates with key parameters included in the transformer rating plate.

An electronic copy of the test results in PDF format shall be forwarded to the Electricity North West Policy & Implementation Section for the attention of the Plant Policy Manager.

Type tests in addition to routine tests shall be carried out on the first unit of any design and shall include lightning impulse tests in accordance with IEC 60076, including chopped impulses. The sequence being 1 Reduced Full Wave, 1 100% Full Wave, 1 Reduced Chopped Wave, 2 115% Chopped Waves, 2 100% Full Waves, based on the basic lightning impulse level as defined in [Appendix B](#) of this specification.

Temperature rise tests shall be carried out as part of the type test program and shall be carried out on the most onerous tap position. For unit type transformers, the temperature rise test shall be carried out with the transformer fitted with assemblies that reflect the actual service condition of a HV ring main unit and a LV distribution cabinet.

Sound pressure level tests shall be carried out in accordance with IEC 60551 as part of the type test program.

Calculations demonstrating the short circuit withstand capabilities of the transformers units may be accepted in lieu of short circuit tests subject to the approval of the Electricity North West Plant Policy Manager.

## 13 Tender Information

Tenderers are requested to complete the Schedules provided in [Appendices C, D](#) and [E](#) of this specification. During the tender assessment process further information may be requested from the Tenderers.

## 14 Drawings

General arrangement drawings shall be provided electronically in pdf and .dxf or .dwg file format for each design type. Where requested by the purchaser, the Tenderer may be required to provide more detailed drawings showing construction details or any associated features or fittings.

## 15 Requirements of Specific Types

### 15.1 Cable Connected Transformers

The overall limiting dimensions are indicated in Option A in Fig 2 of ENA TS 35-1 Part 3.

Transformers shall have the capability of being fitted with wheels to allow access to difficult sites. Wheels will be removed from the transformer prior to commissioning.

Lifting lugs are required to allow for the 350kg weight of the fuse cabinet (as detailed in ENA TS 35-1 Fig 9) in addition to the weight of the complete transformer. The lugs shall be positioned in order to ensure the lift of the transformer and fuse cabinet is in a reasonably upright manner.

### 15.2 Unit Substation Transformers

The overall limiting dimensions are indicated in ENA TS 35-1 Part 3 section 4.3.4 and Fig. 3, 4, 6 and 7 of ENA TS 35-1 Part 3.

A stable fixing for an HV ring main unit complying with ENA TS 41-36 shall be provided by supports attached to the tank. The details of the supports shall be in accordance with Fig 6 of ENA TS 35-1 Part 3.

The phase marking when facing the terminals shall be c, b, a, yn, A, B, C left to right.

Lifting lugs are required to lift the transformer in a reasonably upright position when:

- (a) Fitted with LV bushings and HV blanking plate
- (b) With HV flange fitted with a cable box to ENA TS 35-1 and the LV side fitted with a fuse cabinet.
- (c) With a complete package substation including HV ring main unit and LV fuse cabinet when fully assembled and ready for service.

The transformer tank with the cover removed shall be capable of withstanding the loads of the HV ring main unit and the LV fuse cabinet without distortion. The transformer will not be moved or lifted without the cover fitted.

Suitable extensions to the transformer under base are required to ensure stability when the complete package substation is sitting on a level surface.

### 15.3 Pad Mounted Transformers

The design shall be submitted for approval complying with the following outline requirements:

- (a) The High voltage connection bushings shall comply with BS EN 50180 Table 14 Type C complete with stud suitable for use with separable connectors. Separable connectors will be supplied by Electricity North West.
- (b) A fused HV cable termination shall be provided suitable for 3 single core cables in accordance with ENA TS 12-11. It shall be possible to prove the HV incoming cable dead without having to remove the HV cable termination cover and risk exposure to live connections. Provision shall be made for anti-vandal fixings.
- (c) Provision shall be made to permit isolation of the transformer from the HV network i.e. by removal of HV fuses.
- (d) Provision shall be made for earthing the incoming cable and the HV fuses using an accessory earthing kit. Removal of the cable termination or HV fuse shall not remove the earth from the item remaining in situ.
- (e) The HV fuses for use in the padmount shall be Fuse links complying with Electricity North West ES334 shall be used to provide short circuit protection of the distribution transformer circuit.
- (f) The mounting and location of the HV fuses shall be such that it is possible to easily change the fuses on site. It is not acceptable to have to change the complete padmount unit for a blown HV fuse.
- (g) Capacitor bushings shall be used to provide a voltage indication on the cable side of the HV fuse. This voltage indication to be in LV chamber allowing HV to be tested before opening cable box.

Single phase transformers shall have provision for:

- (a) Terminating three single core HV cables
- (b) Selecting the phases to be utilised, which shall be achieved by altering the connection of the HV flexibles, not by means of a selector board and links.

For delivery, the HV flexibles on single phase transformers shall be connected to the left and right hand HV fusing positions.

One LV way shall be provided complying with the Fully Shielded Pattern as defined in ENA TS 37-2.

Permanent connections of an approved type shall be provided to allow connection of a generator to the outgoing side of the LV fuseways.

A two stage locking arrangement shall be provided for the LV compartment door.

When operating as a two-wire LV supply provision shall be made so that no contacts at differing potentials can be exposed. Any removable links shall be labelled. LV fuse carriers shall not be used except as a fuseway.

## 15.4 Borrowdale Transformers

These are Single and Three Phase Cable Connected Transformers with an E-Type Flange as per ENA TS 35-1. The Single Phase units shall be supplied with three High Voltage bushings and the phasing shall be selected by internal bushing selection.

The design shall be submitted for approval complying with the following outline requirements:

- (a) The High voltage connection bushings shall comply with BS EN 50180 Table 14 Type C complete with stud suitable for use with separable connectors mounted within the HV Cable Box. Separable connectors will be supplied by Electricity North West.
- (b) The HV cable termination shall be provided suitable for 3 single core cables in accordance with ENA TS 12-11.
- (c) The HV incoming side shall be via a HV protection device. Where HV fuses are used in the Borrowdale Transformer they shall be Fuse links complying with Electricity North West ES334 to provide short circuit protection of the distribution transformer circuit. The mounting and location of the HV fuses shall be such that it is possible to easily change the fuses on site without the need to open the main tank. It is not acceptable to have to change the complete Borrowdale unit for a blown HV fuse.
- (d) Electricity North West require the Tenderer so submit details on options to permit isolation of the transformer from the HV network i.e. by removal of HV fuses links or another isolatable device. The ability to earth the incoming cable should also be possible by either a rated earthing device or applying portable earthing equipment. Where portable earthing equipment is used it shall be possible to prove the HV incoming cable dead without having to remove the HV cable termination cover and risk exposure to live connections. Removal of the cable termination or HV fuse shall not remove the earth from the item remaining in situ. Provision shall be made for anti-vandal fixings. Full details shall be submitted with the Tender.
- (e) The HV Cable Box shall be supplied and fitted with an earthing bar as detailed in [Section 15.5](#).
- (f) An LV box or cabinet shall be supplied on the opposite side to the HV Cable Connections. The box shall have a gland plate pre-drilled with a 32mm hole to take a stuffing gland. The box shall be provided with an LV J Type fuse carrier and separate neutral link. There shall be also the facility to segregate the neutral-earth via a removable link as per ENA TS 37-2. The link shall be suitably labelled. The box shall be lockable to prevent access. The locking point shall be capable of accepting a 4.7mm or 10mm hasp without allowing access to the LV box or affecting the IP rating.

These transformers shall be approximately 500mm x 500mm x 1500mm in dimension. The Tenderer shall detail the actual dimensions within the Tender return including detailed drawings.

## 15.5 Earthing Bar for use with Cable Connected and Pad Mounted Transformers

An Earthing Bar shall be provided and positioned on the cable box gland plate on all Cable Connected Transformers. Pad Mounted Transformers shall have the Earthing Bar suitably positioned below the bushings which shall be agreed with the Electricity North West Plant Policy Manager. The bar shall be tested to a fault rating of 21kA.

The bar is to be constructed from flat copper and minimum dimensions are 30mm wide x 8mm deep x 250mm long. A 90 degree bend is to be positioned at 160mm / 90mm along the length.

Drilled holes are to be made along the bar. The long section requires 3 x 12.5mm and 2 x 9.6mm holes evenly spaced. The short length requires 1 x 10.5mm hole at a position of 15mm from the edge of the bar.

Corresponding slot and fixing holes are to be drilled into the cable box gland plate to allow Earth Bar mounting using the spacing washers. (As shown in [Appendix F](#)).

Accessories to be provided with the bar:

- (a) 3 x M12 zinc plated steel bolts 30mm in length
- (b) 3 x M12 zinc plated steel hexagonal nuts
- (c) 6 x M12 zinc plated steel washers
- (d) 3 x M12 zinc plated steel single coil spring washers
- (e) 2 x M8 zinc plated spacing washers
- (f) 2 x M8 zinc plated steel bolts 50mm in length
- (g) 4 x M8 zinc plated steel hexagonal nuts
- (h) 4 x M8 zinc plated steel washers
- (i) 2 x M8 zinc plated steel single coil spring washers
- (j) 1 x M10 zinc plated steel bolt 30mm in length
- (k) 1 x M10 zinc plated steel hexagonal nut
- (l) 2 x M10 zinc plated steel washers
- (m) 1 x M10 zinc plated steel single coil spring washer

## 16 Tools and Equipment

Any specialist tools and equipment which may be required to operate and maintain the transformer shall be supplied as part of the Contract. The quantity of each type of tool or equipment required shall be subject to agreement between the purchaser and Supplier.

## 17 Training

The Contract shall include for any training required as a consequence of the introduction of new types of transformer. Tenderers shall detail the level of training support offered.

## 18 System Parameters

The impedance of the transformers has been chosen to ensure that the system fault level on the low voltage side of the transformers shall not exceed 25MVA.

## 19 Documents Referenced

DOCUMENTS REFERENCED	
European Union Commission Regulation for Transformers No 548/2014	
European Union Ecodesign Directive (2009/125/EC).	
Health and Safety at Work Act 1974	
Control of Substances Hazardous to Health Regulations 2002	
Manual Handling Regulations 1992	
ISO 9000	Quality Systems –Guide to Dependability Programme Management
IEC 60076	Power Transformers
BS IEC 60076-7	Power Transformers: Loading Guide for Transformers for oil-immersed power transformers
IEC 60551	Determination of Transformer and Reactor Sound Levels
IEC 60296	Unused mineral insulating oils for transformers and switchgear



<b>IEC 62535</b>	Insulating liquids. Test method for detection of potentially corrosive sulphur in used and unused insulating oil
<b>BS EN 14001</b>	Environmental Management Systems
<b>BS EN 50180</b>	Specification for Bushings above 1kV up to 36kV and from 250A to 3.15kA for liquid filled transformers
<b>BS EN 60217</b>	Tap-changers. Performance requirements and test methods
<b>BS 381c</b>	Specification for colours for Identification, Coding and Special Purposes
<b>BS 2562</b>	Specification for Cable Boxes for Transformers and Reactors
<b>ENA TS 12-11</b>	Indoor and Outdoor Cable Boxes for Switchgear
<b>ENA TS 35-1</b>	Part 1 - Distribution transformers – Common Clauses
<b>ENA TS 35-1</b>	Part 3 - Ground Mounted Transformers – close coupled.
<b>ENA TS 37-2</b>	LV Distribution Fuseboards
<b>ENA TS 41-36</b>	Distribution Switchgear for Service up to 36kV (cable and overhead conductor connected)
<b>ES319</b>	LV Distribution Fuseboards
<b>ES334</b>	LV and HV Fuses
<b>CP311</b>	Equipment Approval Policy and Process

## 20 Keywords

Transformer; distribution

## Appendix A – Compact Substation Transformers

### A1 Dimensions

Limiting dimensions are indicated in [Figure. 1](#).

### A2 Construction

A stable fixing for an HV fuse switch or non-extensible Circuit Breaker shall be provided by supports welded to the tank side, and a mounting pocket as detailed in Fig. 6 of ENA TS 35-1 Part 3.

A 5mm thick gasket shall be provided for the transformer/fuse switch interface.

The fuse switch or non-extensible Circuit Breaker shall not be supplied.

The low voltage bushings, connections and low voltage fuseboard shall be provided to the approval of the Purchaser.

**NOTE:** A transformer isolator, two outgoing distributor ways, MDIs etc., shall normally be provided, meeting the requirements of Electricity North West specification ES319.

Any underbase shall be provided suitable for skidding in any direction and forming a stable support for the whole substation.

Four lifting eyebolts shall be provided of adequate strength suitable for use one pair at a time to lift either unit with HV switchgear or without HV switchgear in a reasonably upright position.

The eyebolts shall be removable and exchangeable with blanking screws, a stowage for one or the other being provided within the enclosures.

Cooling tubes or radiators shall only be provided on the side remote from the switchgear.

The enclosure shall be provided with a solid roof.

For those units with a fuse switch the section above the HV switchgear shall be hinged for access to the top of the switchgear. A stay shall be provided to hold the hinged section in the vertical position. The hinged section shall be retained in the closed position by a closed door.

The front of the enclosure shall be provided with double doors each opening 180° retained by shoot bolts operated by a central handle which can be padlocked, the padlock provision being a 12mm diameter hole.

The enclosure shall be provided with a floor, the front section(s) being removable for cable installation cable access shall be provided for:

- (a) One HV cable to fuse switch or non-extensible Circuit Breaker or alternatively to a cable box mounted on the transformer flange.
- (b) Two LV distributors.

- (c) Two earth cables.

### **A3 Terminals**

The HV terminal flange shall be positioned as detailed in Fig. 4 of ENA TS 35-1 Part 3. Unless otherwise stated the HV flange shall be provided with a non-returnable blanking plate of minimum thickness 3mm for transport purposes, together with a gasket supplied loose for permanent use.

The LV bushings shall be as detailed in ENA TS 35-1 and positioned by the manufacturer.

The phase markings shall be c, b, a, yn, A, B, C, left to right when facing the terminals.

### **A4 Fittings**

The fittings provided shall be as detailed in ENA TS 35-1, except that:

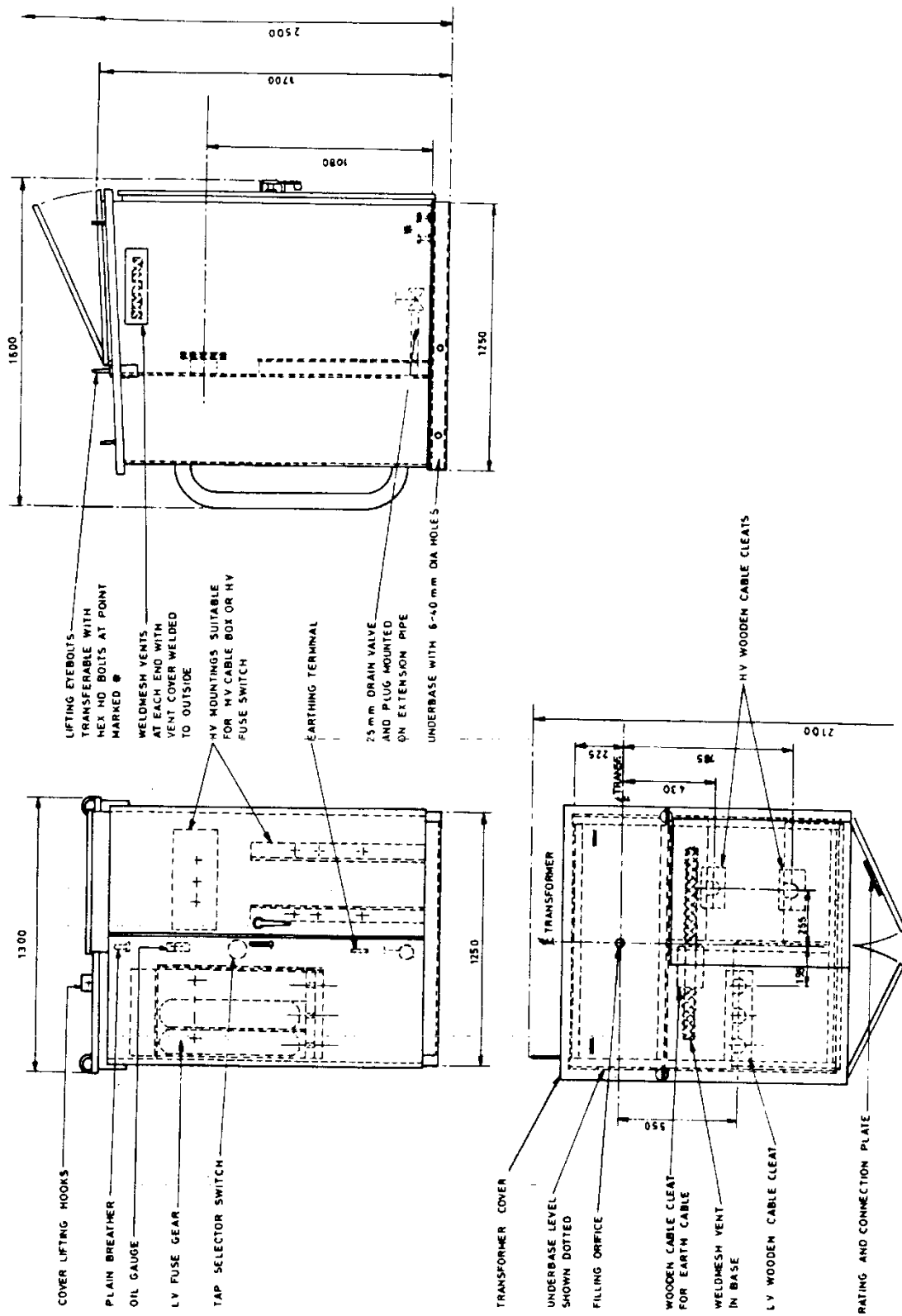
- (a) Breather need not be baffled
- (b) Combined drain and sampling valve to be mounted on a 300mm extension pipe.

The fittings shall be mounted on a vertical line between the LV and HV switchgear except that rating and connection plates shall be mounted on the inside of the door of the enclosure.

### **A5 Ratings and Tests**

The temperature rise test shall be conducted with the transformer fitted with a HV fuse switch or non-extensible Circuit Breaker. The floor shall be complete and the doors closed during the test. The nameplate rating shall be met under these conditions.

Figure 1 – 200kVA Compact Substation (HQ.A4.42.02.1)



## Appendix B – Ratings

Table B1 – Transformer Ratings

VOLTAGE RATIO	KVA RATING	IMPEDANCE	SOUND POWER LEVEL (DB(A)) <u>1.9 TESLA</u>	SOUND POWER LEVEL (DB(A)) <u>1.2 TESLA</u>
6600/433-250V	25	4.75%	45	40
	50	4.75%	45	40
	100	4.75%	48	40
	200	4.75%	52	40
	315	4.75%	54	40
	500	4.75%	56	43
	800	4.75%	58	45
	1000	4.75%	59	46
	11000/433-250V	25	4.75%	45
	50	4.75%	45	40
	100	4.75%	48	40
	200	4.75%	52	40
	315	4.75%	54	40
	500	4.75%	56	43
	800	4.75%	58	45

	1000	4.75%	59	46
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**NOTE:**

- (a) The above no-load secondary voltages are chosen so as to facilitate provision of the following nationally declared low voltages.
- (b) Sound Power Levels are maximum values. Refer to IEC 60551 for correlation between sound power level and sound pressure measurements.
- (c) Impedance voltages are corrected to 75°C and expressed as a percentage of normal voltage.

**Table B2 – Insulation Levels for Ground Mounted Transformers**

HIGHEST VOLTAGE FOR EQUIPMENT UM(RMS.) KV	NOMINAL SYSTEM VOLTAGE KV	RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE KV (PEAK)	POWER FREQUENCY WITHSTAND VOLTAGE KV (RMS.)
1.1	0.433/0.250	-	3
7.2	6.6	60	20
12	11	75	28
24	20	125	50

## Appendix C – Technical Details

### 6.6kV Ground Mounted Transformers

Item No.	Item	Cable-Connected Type					Unit Type			
		100	315	500	800	1000	315	500	800	1000
1	Guaranteed no-load loss 6.6kV (W)									
2	Guaranteed load loss at 75°C, 6.6kV (W)									
3	Impedance at 75°C, 6.6kV (% on rating)  (i) on nominal tap (ii) on maximum tapping (iii) on minimum tapping									
4	Maximum flux density in any magnetic component (Tesla)									
5	Type of core steel used  Weight, thickness, grade?									
6	Core construction details eg step lapped, bolted, banded etc									
7	HV windings  (i) type (ii) conductor material (ii) insulation type									
8	LV windings  (i) type (ii) conductor material (ii) insulation type									
9	Current Density  (i) in HV winding A/mm <sup>2</sup> (ii) in LV winding A/mm <sup>2</sup>									

10	Type of Off Load Tap Changer eg rotary, linear etc.									
11	Manufacturer and Make of On Load Tap Changer									
12	Tank details eg welded steel, corrugated etc.									
13	Guaranteed sound power level dB(A)									
14	Quantity of Oil (litre)									
15	Weight of tank and fittings (kg)									
15	Weight of core and winding assembly (kg)									
17	Weight of copper (kg)									
18	Total weight of Transformer (kg)									
19	Tank construction  (i) Material (ii) Thickness of sides (iii) Thickness of base (iv) Thickness of cover									
20	Type of Radiators  Bolt on or integral with tank									
21	Overall dimensions  (i) Length (ii) Width (iii) Height									
22	Oil Preservation system  eg free breathing, sealed, hermetically sealed									



23	Oil head space filler material									
24	Tender drawing reference number									

**11kV Ground Mounted Transformers**

Item No.	Item	Cable-Connected Type					Unit Type			
		100	315	500	800	1000	315	500	800	1000
1	Guaranteed no-load loss 11kV (W)									
2	Guaranteed load loss at 75°C, 11kV (W)									
3	Impedance at 75°C, 11kV (% on rating)  (i) on nominal tap (ii) on maximum tapping (iii) on minimum tapping									
4	Maximum flux density in any magnetic component (Tesla)									
5	Type of core steel used  Weight, thickness, grade?									
6	Core construction details e.g. step lapped, bolted, banded etc									
7	HV windings  (i) type (ii) conductor material (iii) insulation type									
8	LV windings  (i) type (ii) conductor material (iii) insulation type									
9	Current Density  (i) in HV winding A/mm <sup>2</sup> (ii) in LV winding A/mm <sup>2</sup>									

Item No.	Item	Cable-Connected Type					Unit Type			
		100	315	500	800	1000	315	500	800	1000
10	Type of Tap Changer e.g. rotary, linear etc.									
11	Manufacturer and Make of On Load Tap Changer									
12	Tank details e.g. welded steel, corrugated etc.									
13	Guaranteed sound power level dB(A)									
14	Quantity of Oil (litre)									
15	Weight of tank and fittings (kg)									
16	Weight of core and winding assembly (kg)									
17	Weight of copper (kg)									
18	Total weight of Transformer (kg)									
19	Tank construction  (i) Material (ii) Thickness of sides (iii) Thickness of base (iv) Thickness of cover									
20	Type of Radiators  Bolt on or integral with tank									
21	Overall dimensions  (i) Length (ii) Width (iii) Height									
22	Oil Preservation system									

Item No.	Item	Cable-Connected Type					Unit Type			
		100	315	500	800	1000	315	500	800	1000
	e.g. free breathing, sealed, hermetically sealed									
23	Oil head space filler material									
24	Tender drawing reference number									

**6.6kV Ground Mounted Transformers**

Item No.	Item	Rural Transformer		Compact Transformer	
		100	200	200	315
1	Guaranteed no-load loss 6.6kV (W)				
2	Guaranteed load loss at 75°C, 6.6kV (W)				
3	Impedance at 75°C, 6.6kV (% on rating)  (i) on nominal tap (ii) on maximum tapping (iii) on minimum tapping				
4	Maximum flux density in any magnetic component (Tesla)				
5	Type of core steel used  Weight, thickness, grade?				
6	Core construction details eg step lapped, bolted, banded etc				
7	HV windings  (i) type (ii) conductor material (ii) insulation type				
8	LV windings  (i) type (ii) conductor material (ii) insulation type				
9	Current Density  (i) in HV winding A/mm <sup>2</sup> (ii) in LV winding A/mm <sup>2</sup>				
10	Type of Tap Changer eg rotary, linear etc.				
11	Manufacturer and Make of On Load Tap Changer				

Item No.	Item	Rural Transformer		Compact Transformer	
		100	200	200	315
12	Tank details eg welded steel, corrugated etc.				
13	Guaranteed sound power level dB(A)				
14	Quantity of Oil (litre)				
15	Weight of tank and fittings (kg)				
16	Weight of core and winding assembly (kg)				
17	Weight of copper (kg)				
18	Total weight of transformer (kg)				
19	Tank construction i) Material ii) Thickness of sides iii) Thickness of base iiii) Thickness of cover				
20	Type of Radiators  Bolt on or integral with tank				
21	Overall dimensions i) Length ii) Width iii) Height				
22	Oil Preservation system  e.g. free breathing, sealed, hermetically sealed				
23	Oil head space filler material				
24	Tender drawing reference number				

**11kV Ground Mounted Transformers**

Item No.	Item	Compact Transformer	
		200	315
1	Guaranteed no-load loss 11kV (W)		
2	Guaranteed load loss at 75°C, 11kV (W)		
3	Impedance at 75°C, 11kV (% on rating)  (i) on nominal tap (ii) on maximum tapping (iii) on minimum tapping		
4	Maximum flux density in any magnetic component (Tesla)		
5	Type of core steel used  Weight, thickness, grade?		
6	Core construction details eg step lapped, bolted, banded etc		
7	HV windings  (i) type (ii) conductor material (ii) insulation type		
8	LV windings  (i) type (ii) conductor material (ii) insulation type		
9	Current Density  (i) in HV winding A/mm <sup>2</sup> (ii) in LV winding A/mm <sup>2</sup>		
10	Type of Tap Changer e.g. rotary, linear etc.		
11	Manufacturer and Make of On Load Tap Changer		
12	Tank details e.g. welded steel, corrugated etc.		
13	Guaranteed sound power level dB(A)		

Item No.	Item	Compact Transformer	
		200	315
14	Quantity of Oil (litre)		
15	Weight of tank and fittings (kg)		
16	Weight of core and winding assembly (kg)		
17	Weight of copper (kg)		
18	Total weight of transformer (kg)		
19	Tank construction  (i) Material (ii) Thickness of sides (iii) Thickness of base (iv) Thickness of cover		
20	Type of Radiators  Bolt on or integral with tank		
21	Overall dimensions  (i) Length (ii) Width (iii) Height		
22	Oil Preservation system  e.g. free breathing, sealed, hermetically sealed		
23	Oil head space filler material		
24	Tender drawing reference number		



**6.6kV Ground Mounted Transformers**

Item No.	Item	Pad Mount Transformer				
		50 Single Phase	100 Single Phase	50 Three Phase	100 Three Phase	200 Three Phase
1	Guaranteed no-load loss 11kV (W)					
2	Guaranteed load loss at 75°C, 11kV (W)					
3	Impedance at 75°C, 11kV (% on rating)  (i) on nominal tap (ii) on maximum tapping (iii) on minimum tapping					
4	Maximum flux density in any magnetic component (Tesla)					
5	Type of core steel used  Weight, thickness, grade?					
6	Core construction details e.g. step lapped, bolted, banded etc					
7	HV windings  (i) type (ii) conductor material (ii) insulation type					
8	LV windings  (i) type (ii) conductor material (ii) insulation type					
9	Current Density  (i) in HV winding A/mm <sup>2</sup> (ii) in LV winding A/mm <sup>2</sup>					
10	Type of Tap Changer e.g. rotary, linear etc.					

Item No.	Item	Pad Mount Transformer				
		50 Single Phase	100 Single Phase	50 Three Phase	100 Three Phase	200 Three Phase
11	Manufacturer and Make of On Load Tap Changer					
12	Tank details e.g. welded steel, corrugated etc.					
13	Guaranteed sound power level dB(A)					
14	Quantity of Oil (litre)					
15	Weight of tank and fittings (kg)					
16	Weight of core and winding assembly (kg)					
17	Weight of copper (kg)					
18	Total weight of transformer (kg)					
19	Tank construction  (i) Material (ii) Thickness of sides (iii) Thickness of base (iv) Thickness of cover					
20	Type of Radiators  Bolt on or integral with tank					
21	Overall dimensions  (i) Length (ii) Width (iii) Height					
22	Oil Preservation system  e.g. free breathing, sealed, hermetically sealed					

Item No.	Item	Pad Mount Transformer				
		50 Single Phase	100 Single Phase	50 Three Phase	100 Three Phase	200 Three Phase
23	Oil head space filler material					
24	Tender drawing reference number					

**11kV Ground Mounted Transformers**

Item No.	Item	Pad Mount Transformer				
		50 Single Phase	100 Single Phase	50 Three Phase	100 Three Phase	200 Three Phase
1	Guaranteed no-load loss 11kV (W)					
2	Guaranteed load loss at 75°C, 11kV (W)					
3	Impedance at 75°C, 11kV (% on rating)  (i) on nominal tap (ii) on maximum tapping (iii) on minimum tapping					
4	Maximum flux density in any magnetic component (Tesla)					
5	Type of core steel used  Weight, thickness, grade?					
6	Core construction details eg step lapped, bolted, banded etc					
7	HV windings  (i) type (ii) conductor material (ii) insulation type					
8	LV windings  (i) type (ii) conductor material (ii) insulation type					
9	Current Density  (i) in HV winding A/mm <sup>2</sup> (ii) in LV winding A/mm <sup>2</sup>					
10	Type of Tap Changer e.g. rotary, linear etc.					

Item No.	Item	Pad Mount Transformer				
		50 Single Phase	100 Single Phase	50 Three Phase	100 Three Phase	200 Three Phase
11	Manufacturer and Make of On Load Tap Changer					
12	Tank details e.g. welded steel, corrugated etc.					
13	Guaranteed sound power level dB(A)					
14	Quantity of Oil (litre)					
15	Weight of tank and fittings (kg)					
16	Weight of core and winding assembly (kg)					
17	Weight of copper (kg)					
18	Total weight of transformer (kg)					
19	Tank construction  (i) Material (ii) Thickness of sides (iii) Thickness of base (iv) Thickness of cover					
20	Type of Radiators  Bolt on or integral with tank					
21	Overall dimensions  (i) Length (ii) Width (iii) Height					
22	Oil Preservation system  e.g. free breathing, sealed, hermetically sealed					
23	Oil head space filler material					
24	Tender drawing reference number					

**Borrowdale Ground Mounted Transformers**

Item No.	Item	11kV Transformer Single Phase		6.6kV Transformer Single Phase		11kV Transformer Three Phase		6.6kV Transformer Three Phase	
		25	50	25	50	25	50	25	50
1	Guaranteed no-load loss (W)								
2	Guaranteed load loss at 75°C, (W)								
3	Impedance at 75°C, (% on rating)  (i) on nominal tap (ii) on maximum tapping (iii) on minimum tapping								
4	Maximum flux density in any magnetic component (Tesla)								
5	Type of core steel used  Weight, thickness, grade?								
6	Core construction details e.g. step lapped, bolted, banded etc								
7	HV windings  (i) type (ii) conductor material (ii) insulation type								
8	LV windings  (i) type (ii) conductor material (ii) insulation type								
9	Current Density  (i) in HV winding A/mm <sup>2</sup> (ii) in LV winding A/mm <sup>2</sup>								
10	Type of Tap Changer eg rotary, linear etc.								

Item No.	Item	11kV Transformer Single Phase		6.6kV Transformer Single Phase		11kV Transformer Three Phase		6.6kV Transformer Three Phase	
		25	50	25	50	25	50	25	50
11	Tank details eg welded steel, corrugated etc.								
12	Guaranteed sound power level dB(A)								
13	Quantity of Oil (litre)								
14	Weight of tank and fittings (kg)								
15	Weight of core and winding assembly (kg)								
16	Weight of copper (kg)								
17	Total weight of transformer (kg)								
18	Tank construction  (i) Material (ii) Thickness of sides (iii) Thickness of base (iv) Thickness of cover								
19	Type of Radiators  e.g. Bolt on or integral with tank								
20	Overall dimensions  (i) Length (ii) Width (iii) Height								
21	Oil Preservation system  e.g. free breathing, sealed, hermetically sealed								
22	Oil head space filler material								

Item No.	Item	11kV Transformer Single Phase		6.6kV Transformer Single Phase		11kV Transformer Three Phase		6.6kV Transformer Three Phase	
		25	50	25	50	25	50	25	50
23	Tender drawing reference number								







## Appendix E – Conformance Declaration

### SECTION-BY-SECTION CONFORMANCE WITH SPECIFICATION

The Tenderer shall declare conformance or otherwise for each product/service or range of products/services, section-by-section, using the following Conformance Declaration Codes.

**Conformance Declaration Codes:**

<b>N/A =</b>	Clause is not applicable/appropriate to the product/service.
<b>C1 =</b>	The product/service conforms fully with the requirements of this clause.
<b>C2 =</b>	The product/service conforms partially with the requirements of this clause.
<b>C3 =</b>	The product/service does not conform to the requirements of this clause.
<b>C4 =</b>	The product/service does not currently conform to the requirements of this clause, but the manufacturer proposes to modify and test the product in order to conform.

**Manufacturer:**

**Product/Service Description:**

**Product/Service Reference:**

**Name:**

**Company:**

**Signature:**

**SECTION-BY-SECTION CONFORMANCE**

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
3	Compliance with Standards		
5.1	Product not to be Changed		
5.2	Electricity North West Technical Approval		
5.3	Quality Assurance		
5.4	Formulation		
5.5	Identification Markings		
5.6	Minimum Life Expectancy		
5.7	Product Conformity		
61	Requirements for Type Tests at the Supplier's Premises		
6.2	Requirement for Routine Tests at the Supplier's Premises		
6.3	Requirement for On Site Tests		
7.1	Rated Power		
7.2	Rated Voltage		
7.3	Tap Changers		
7.4	Off Load Tap Changer		

<b>7.4.1</b>	<b>Tapping Range</b>		
<b>7.4.2</b>	<b>Tapping Method</b>		
<b>7.5</b>	<b>On Load Tap Changer</b>		
<b>7.5.1</b>	<b>Tapping Range</b>		
<b>7.5.2</b>	<b>Tapping Method</b>		
<b>7.5.3</b>	<b>Control Methods and Interface with NMS</b>		
<b>7.5.4</b>	<b>Operation and Maintenance Manuals</b>		
<b>7.6</b>	<b>Windings and Connections</b>		
<b>7.7.1</b>	<b>Single Phase Losses</b>		
<b>7.7.2</b>	<b>Three Phase Losses</b>		
<b>7.8</b>	<b>Sound Power Level</b>		
<b>7.9</b>	<b>Impedances</b>		
<b>7.10</b>	<b>Insulation Levels</b>		
<b>7.11</b>	<b>Flux Density</b>		
<b>8.1</b>	<b>Rating and Connection Plates</b>		
<b>8.2</b>	<b>Marking of Terminals</b>		
<b>9</b>	<b>Oil</b>		
<b>10.1</b>	<b>General Construction</b>		
<b>10.2</b>	<b>Tank Covers</b>		
<b>10.3</b>	<b>Gaskets</b>		

<b>10.4</b>	<b>Fittings</b>		
<b>10.5</b>	<b>Radiators</b>		
<b>10.6.1</b>	<b>Key Connection Interface Points – Unit Substation Transformers</b>		
<b>10.6.2</b>	<b>Key Connection Interface Points – Cable Connected Transformers</b>		
<b>10.6.3</b>	<b>Key Connection Interface Points – Earthing Bar for use with Cable Connected and Pad Mounted Transformers</b>		
<b>11</b>	<b>Cleaning and Painting</b>		
<b>12</b>	<b>Tests</b>		
<b>13</b>	<b>Tender Information</b>		
<b>14</b>	<b>Drawings</b>		
<b>15.1</b>	<b>Requirements of Specific Types – Cable Connected Transformers</b>		
<b>15.2</b>	<b>Requirements of Specific Types – Unit Substation Transformers</b>		
<b>15.3</b>	<b>Requirements of Specific Types – Pad Mounted Transformers</b>		
<b>15.4</b>	<b>Requirements of Specific Types – Borrowdale Transformers</b>		
<b>15.4</b>	<b>Requirements of Specific Types – Earthing Bar for</b>		

	<b>use with Cable Connected and Pad Mounted Transformers</b>		
<b>16</b>	<b>Tools and Equipment</b>		
<b>17</b>	<b>Training</b>		
<b>18</b>	<b>System Parameters</b>		
<b>Appendix A</b>	<b>Compact Substation Transformers</b>		
<b>Appendix B</b>	<b>Ratings</b>		
<b>Appendix C</b>	<b>Technical Details to be Completed by Tenderer</b>		
<b>Appendix D</b>	<b>Schedules to be Completed by the Tenderer</b>		

**Additional Notes:**

## Appendix F – Earthing Bar and Gland Plate Example

