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Functional Specification

220kV Instrument Transformers

Revision	Date	Description	Originator	Reviewer	Checker	Approver
R0	18/05/2022	First Issue	Vitali Garon	Niall McMahon Daniele Giustini	Leon Notkevich, Neil Cowap	Aidan Corcoran, Richard Blanchfield
R1	29/09/2022	Issued for use after industry feedback	Vitali Garon	James Staunton Daniele Giustini	Neil Cowap	Louise O'Flanagan

1 SCOPE

This Functional Specification is applicable for use in offshore wind transmission links delivered by the Customer as Contestable Works, to be owned and operated by EirGrid. The specification relates to the Onshore Compensation Compound (OCC) and Offshore Substation Platform (OSP).

This functional specification, together with the accompanying technical schedules[1], defines requirements for 220 kV and 400 kV instrument transformers (refer to OTS-SSS-424).

This specification covers the following types of instrument transformer:

- Oil Insulated instrument transformers for air insulated switchgear (AIS)
- Gas insulated instrument transformers (within GIS switchgear)
- Ring type current transformers

This specification should be read in association with the project specific contestable works pack and project documentation and all other relevant functional specifications as issued by EirGrid.

For the purpose of this specification the term Customer shall refer to Offshore Wind Power Developers, Independent Power Producers responsible for the design and build of assets to be handed over to EirGrid.

2 LEGISLATION CODES AND STANDARDS

2.1 LEGISLATION

Equipment offered shall be compliant with the provisions of the latest applicable versions of all relevant Irish legislation and directives of the European Communities.

These include the following or latest versions/ amendments as appropriate:

SI No. 132	Safety signs regulations 1995 (implements EEC Directive 92/58)
SI No. 291	Safety, Health and Welfare at Work (Construction) Regulations
SI No. 299	Safety, Health and Welfare at Work (General Application) Regulations 2007
SI No. 445	Safety, Health and Welfare at Work (General Application) (Amendment) Reg. 2012
Reg (EC) No 1907/2006	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
Reg (EC) No 1272/2008	Classification, Labelling and Packaging of Substances and Mixtures (CLP)
Reg (EU) No 517/2014	Fluorinated greenhouse gases and repealing regulation (EC) No 842/2006

[1] The Customer shall submit a completed set of Technical Schedules for EirGrid review. For the purpose of this specification the term Customer shall refer to Offshore Wind Power Developers, Independent Power Producers responsible for the design and build of assets to be handed over to EirGrid.

Reg (EU) 2015/2068	Format of labels for products and equipment containing fluorinated greenhouse gases
Reg (EU) 2015/2065	Format for notification of the training and certification programmes of the Member States
Reg EU 2015/2066	Minimum requirements and the conditions for mutual recognition for the certification of natural persons carrying out installation, servicing, maintenance, repair or decommissioning of electrical switchgear containing fluorinated greenhouse gases or recovery of fluorinated greenhouse gases from stationary electrical switchgear
Directive 2011/65/EU	Restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS)
Directive 2012/19/EU	Waste electrical and electronic equipment (WEEE)
Directive 2014/30/EU	Harmonisation of the laws of the Member States relating to electromagnetic compatibility
ECE/TRANS/275	Vol. I and II ("ADR 2019") European Agreement Concerning the International Carriage of Dangerous Goods by Road

Unless the Customer can document that CE, marking is not required, equipment shall carry the CE Mark in accordance with Directive 768/2008/EC and the EU Construction Products Regulation (No. 305/2011 – CPR) and adequate documentation to demonstrate full compliance should be retained.

In order to prove compliance, the equipment shall carry the CE Mark in accordance with Direction 768/2008/EC and the EU Construction Products Regulation (No. 305/2011 – CPR) where required.

2.2 National International and Other Applicable Standards

The equipment shall comply with the latest editions of the standards, codes and normative references indicated below, and the latest editions of the standards that they reference.

Where a particular subject is not covered by one of the listed international standards then a recognised national standard shall apply.

Except where otherwise stated in the functional specification, materials shall be designed, manufactured, tested, and installed according to relevant IEC/EN standards. Where applicable the Irish adaptation of the standard (IS EN version), including any national normative aspects, shall apply. Where no IEC standard has been issued to cover a particular subject then an EN, International or British Standard shall be applied. The latest edition and amendments shall apply in all cases. Where no IEC/EN standards have been issued to cover a particular subject, a recognised international standard shall be applied.

ET103	National rules for electrical installations – Power installations exceeding 1 kV AC
IS 10101	National Wiring rules for electrical installations
IEC 62474	Material Declaration for Products of and for the electrotechnical industry
IEC 60815	Guide for the selection of insulators in respect of polluted conditions
IEC 60529	Degrees of Protection provided by Enclosures (IP Code)
IEC 61869 All Parts	Instrument Transformers
IEC 60296	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear
IEC 62271-301	High voltage switchgear and controlgear - Part 301: Dimensional standardisation of HV terminals
IEC 62271-302	High-voltage switchgear and controlgear – Part 302 Gas-insulated metal-enclosed switchgear for rated voltages above 52kV
ISO 12944 All Parts	Corrosion Protection of Steel Structures by protective paint systems
VDE 0635	Low Voltage Fuses
CIGRE TB512	Transformer Reliability Survey WG A3.06

This Specification shall take precedence in case of conflict between it and any of the listed standards.

In addition, there shall be compliance with the provisions of all relevant Directives of the European Communities relating to work equipment, i.e. in regard to safety of personnel who operate and maintain the equipment. In order to prove compliance, the equipment shall carry the CE Mark in accordance with Direction 93/465/EEC.

3 NETWORK PARAMETERS

The equipment shall be suitable for installation on the Transmission system. The design parameters are specified in EirGrid's functional specification OFS-SSS-400, OCC General Requirements.

4 OIL INSULATED INSTRUMENT TRANSFORMERS

4.1 GENERAL

All instrument transformers shall be single phase units. They shall be connected to three phase networks in groups of three.

Instrument transformers shall be inductive type single phase units suitable for mounting on support steelwork. They shall be suitable for outdoor use unless installed indoor and agreed by EirGrid. See also corrosion protection requirements in section 11 of this document.

All current transformers, and the current transformer portion of combined units, shall have the required number of secondary windings on independent magnetic cores, but a common primary winding. The primary winding shall be suitable for series/parallel connection to give the required ratio where specified. Ratio selection by secondary terminal selection shall be provided for instrument transformers where specified.

Oil-filled instrument transformers shall be fitted with a capacitive voltage tap to facilitate insulation power factor testing.

4.2 INSULATING OIL REQUIREMENTS

Insulating oil shall be new, unused mineral oil according to IEC 60296 and to the Doble Transformer Oil Purchase Specification (TOPS). Details of the Water Hazard Classification of the oil shall be provided.

The Customer shall ensure that at all stages in the manufacture, test and installation of the instrument transformer, the instrument transformer and insulating oil shall be free of all contaminants including cross-contamination by other insulating fluids. There shall be a means of regular confirmation, by systems testing / auditing, to ensure that the oil in instrument transformers is not contaminated by silicone or other substances which may cause incorrect oil test results when in service.

All the provisions of REACH 1907/2006 and CLP Regulation (EC) No 1272/2008 shall be complied with.

A certificate guaranteeing that the PCB content of insulating oil is less than 1 ppm shall be provided for review.

4.3 OIL / GAS COMPARTMENT TO LOW VOLTAGE TERMINAL BOX INTERFACE

The materials used to bring the low potential end of the Voltage Transformer primary winding from the oil / gas compartment to the LV terminal box shall be of non-moisture absorbing and shall remain so for the life of the transformer

The materials used to bring the secondary windings of CTs, VTs and CT/VTs from the oil / gas compartment to the LV terminal boxes shall be non-moisture absorbing and shall remain so for the life of the transformer.

4.4 OUTER INSULATION

Instrument transformer enclosures shall be of composite silicone rubber material. The composite insulator should not fragment and project parts in case of a failure.

Designs using porcelain as external insulation are not accepted.

The composite insulator should have stable leakage currents to ground, during 10 kV insulation tests, in different weather conditions and throughout the life of the instrument transformer. If a single insulator is not offered the preference is for stacked, horizontal jointed insulators, rather than a continuous top to bottom joint.

The Reference Unified Specific Creepage Distance (RUSCD) for the phase to earth insulators shall be in accordance with EN 62271-1 and EN 60815 for rated 245 kV or 420 kV and for very heavy pollution level of 53.7 mm/kV higher RUSCD value corresponding to 31 mm/kV phase to earth creepage distance.

The RUSCD shall be corrected for insulator diameter using the method given in IEC 60815-2 and the profile factors (as defined in EN 60815-2 or-3) provided for the proposed insulator design.

4.5 INTERNAL ARC WITHSTAND

Instrument transformers offered for use shall be designed to ensure the safety of staff during regular inspection and maintenance visits to the installations. The Instrument transformer design shall take into consideration that staff will be working in the vicinity of the instrument transformers for prolonged periods.

Pressure-relief vents or rupture discs shall be located in the upper part of the instrument transformers to minimise the hazard posed to staff on the ground.

The design of instrument transformers shall consider any possible failure mechanisms which could result in the rupture or shattering of external insulation and jettison of liquid insulation. Mitigation methods incorporated in the instrument transformer design shall be provided, along with any history of such failures, to prove the evolution in the safety of the instrument transformers' design.

The safety of the instrument transformer design shall be subject to review by EirGrid. All hazards and resultant risks shall be considered to determine if the design proposed is acceptable for the lifetime use intended in line with Irish Health and Safety Regulations.

Customers may offer instrument transformers that comply with internal arc fault protection Class 1 or Class 2, as defined in EN 61869-1. Evidence of any type testing for internal arc classification shall be provided for the design of instrument transformers

offered. Where no type test evidence can be provided, Customer shall inform EirGrid for review.

4.6 INSULATION SYSTEM REQUIREMENTS

An oil sampling device shall be provided in the instrument transformer head or lower body. The mechanism should be such that no air escapes into the oil volume when performing the test. This shall enable at least five 50 ml oil samples to be taken with a syringe over the lifetime of the instrument. When taking samples an additional 50 ml of oil shall be consumed to flush the syringe and sample tube. The oil volume above the sampling point should therefore be at least 500 ml to enable this sampling throughout the instrument transformer's life.

In addition to the sampling point the following requirements apply:

- The instrument transformer shall have an oil level indicator visible from ground level.
- All instrument transformer sealing joints shall be below the oil level.
- The instrument transformer shall have an oil expansion system level indicator which is clearly visible to staff from the ground.
- The instrument transformer oil expansion system to be a non-corrosive metallic type and be impervious to moisture throughout its life.
- The bellows indication shall be visible from ground level.

The material and construction of the bellows shall be subject to review by EirGrid to determine compliance with the corrosion protection requirements.

4.7 MOUNTING

Instrument transformers shall be suitable for mounting vertically on steel supports to be provided by the Customer.

The supports shall be such that the lowest point of live insulators is a minimum of 2300 mm above ground level.

The P1 terminal is typically oriented towards the circuit breaker. Refer to the EirGrid standard single line diagram OFS-SSD-500 for confirmation of the required orientation.

Terminal boxes for oil insulated instrument transformers shall be mounted on support steelwork at a suitable height for personnel working from a standing position.

4.8 ELECTRICAL INSULATION REQUIREMENTS

4.8.1 PRIMARY WINDINGS

The withstand voltages of primary windings shall be in accordance with OFS-SSS-400 specification.

The earthed end of the primary voltage winding of VTs shall be terminated using a bushing inside the terminal box and shall be rated for a highest equipment voltage U_m of 0.72 kV and corresponding power frequency withstand voltage of 3 kV.

Refer to OFS-SSS-400 specification for further information relating to system ratings.

4.8.2 SECONDARY WINDINGS

The rated power-frequency withstand voltage shall be 2 kV for 1 min.

4.8.3 PARTIAL DISCHARGE

The partial discharge levels shall not exceed the following values, where U_m is the highest network voltage.

Table 1 Maximum Permissible Partial Discharge Levels

PD Test Voltage (rms)	**Maximum Permissible PD Level** pC	
	Oil / Gas	**Solid**
U_m	10	50
$1.2 * U_m/\sqrt{3}$	5	20

4.8.4 DIELECTRIC DISSIPATION FACTOR

The dissipation factor (tan δ) of the HV winding shall be less than 0.5% at 20°C and shall be reproducible on site.

4.9 HIGH VOLTAGE TERMINALS

HV terminals shall be rated for the required continuous current and any short time overload conditions.

High voltage terminals shall be flat aluminium plates meeting EN 62271-301.

HV terminals for CTs and CT/VTs shall be in accordance with Table 2

Table 2 - High Voltage Terminals for CTs and CT/VTs

System Voltage	Nominal Plate Size	Current Rating	Hole Diameters and spacings
220 kV 400 kV	100 mm x 100 mm	≤ 2000 A	4 off 14 mm holes at 50 mm centres
	125 mm x 125 mm	> 2000 A	9 off 14 mm holes at 40 mm centres

[3]

HV terminals for VTs shall be in accordance with Table 3.

Table 3 - High Voltage Terminals for VTs

System Voltage	Nominal Plate Size	Current Rating	Hole Diameters and spacings
220 kV 400 kV	125 mm x 125 mm	≤ 3150 A	9 off 14 mm holes at 40 mm centres

The Customer shall include full particulars of the proposed terminals in the Technical Schedules.

4.10 MECHANICAL TERMINAL LOAD

The rated static withstand loads shall be as specified in the TECHNICAL SCHEDULES. The instrument transformers shall be capable of withstanding the specified static loads which include for the effects of wind and ice. During tests to prove rating, it is intended that the specified load for a particular unit be applied in any direction to the primary terminals.

Under normal conditions, the sum of the static loads should not exceed 50% of the specified withstand load.

The equipment shall withstand rarely occurring extreme dynamic loads (e.g. short circuits), in addition to the static loads, as per relevant IEC standards. The combined loads shall be minimum 1.4 times the static withstand load.

4.11 TERMINAL BOXES

The degree of protection provided by the terminal boxes shall be IP54 in accordance with IEC 60529 and they shall be ventilated to prevent condensation. The bottom plate of the box shall be furnished undrilled, but sufficiently large to accommodate minimum 3 holes each of 25 mm diameter at 35 mm centres for cable glands. Combined units shall have separate terminal boxes for current and voltage terminals.

In addition to the earthing terminal for the earthed end of the primary winding, an earthing terminal shall be provided within each terminal box for earthing the secondary windings.

5 GAS-INSULATED INSTRUMENT TRANSFORMERS

5.1 GENERAL

All instrument transformers shall be single phase units. They will be connected to three phase networks in groups of three.

Gas-insulated instrument transformers shall be inductive type single phase units and shall comply with IEC 61869 and applicable parts of IEC 62271 including IEC 62271-203.

Gas-insulated instrument transformers have their primary terminals connected to the system as part of a GIS installation.

In addition to the requirements of this specification, please refer to OFS-SSS-413 “Gas insulated switchgear functional specification”.

5.2 ELECTRICAL INSULATION REQUIREMENTS

The electrical insulation requirements for gas insulated instrument transformers are the same as for oil insulated instrument transformers.

6 RING TYPE CTS

6.1 GENERAL

All instrument transformers shall be single phase units. They will be connected to three phase networks in groups of three.

Ring type current transformers are used to detect currents flowing in third party conductors not forming part of the current transformer. Applications of ring CTs include insulated primary phase conductors such as HV cables and currents from neutral to earth.

Ring CTs are mainly required for indoor use but may also be required for outdoor applications where described.

Ring type current transformers shall be constructed of solid type insulation material, e.g. epoxy resin or polyurethane and suitably protected if installed in outdoor applications.

One of the main applications for ring type current transformers is the detection of phase currents in HV cables immediately outside the boundary of gas insulated switchgear.

In addition to the requirements of this specification, please refer also to EirGrid functional specification OFS-SSS-413 for particular requirements relating to the use of ring type CTs in conjunction with gas insulated switchgear applications.

The inner diameter of ring type CTs shall be sufficient to accommodate the diameter of the cable and the return of the insulated cable screen.

6.2 MOUNTING

Ring type current transformers shall be mounted on steelwork which is located to the side and running parallel to the direction of the HV cable. Suitable mounting plates or brackets shall be supplied with the ring CT and shall be capable of supporting the weight of the CT and secondary termination box without additional supports.

Ring type current transformers shall be suitable for mounting in a horizontal position with the conductor running vertically from floor to termination point.

The P1 terminal is typically oriented towards the switchgear.

6.3 OUTDOOR APPLICATION

Ring type current transformers for outdoor applications shall be fully weatherproof in any orientation and comply with the corrosion protection requirements given in EirGrid specifications.

Where the outer insulation is epoxy resin an additional anti-UV or weatherproof coating shall be provided to prolong the life of the insulation and increase the resistance to moisture absorption.

6.4 ELECTRICAL INSULATION REQUIREMENTS

Ring CTs shall have a minimum primary to secondary insulation rating of 0.72 kV.

The minimum secondary winding power frequency withstand shall be 2 kV for 1 minute.

7 SHORT TIME CURRENT WITHSTAND

All current transformers must be capable of withstanding the system three phase rms short circuit current and the dynamic short circuit current without suffering harmful effects or damage.

Required system short circuit withstand ratings are quoted in OFS-SSS-400.

8 RATING OF CURRENT TRANSFORMERS

The following shall apply to CT's and the CT part of CT/VT's.

8.1 PRIMARY CURRENT

The primary current ratings shall be as per project design requirements to be developed by Customer and reviewed by EirGrid.

8.2 SECONDARY CURRENT

The rated current of secondary windings shall be as per project design requirements to be developed by Customer and reviewed by EirGrid.

The rated current shall be typically 1 A. See OFS-GEN-016 Protection, Control and Metering for additional information.

8.3 OUTPUT

The ratios, including primary dual connections requirements and numbers of secondary windings, shall be as per project design requirements to be developed by Customer and reviewed by EirGrid.

8.4 TRANSFORMATION RATIO

The ratios, including primary dual connection requirements and numbers of secondary windings, shall be as per project design requirements to be developed by Customer and reviewed by EirGrid.

8.5 RATING PLATE

All rating plates shall meet IEC 61869.

IEC 61869 states that all information shall be marked in an indelible manner on the instrument transformer itself or on a rating plate securely attached to the transformer. Unless otherwise stated all such information shall be marked on the rating plate.

All rating plates shall be engraved, clear, indelible, corrosion proof, and shall be in English.

Drawings of all rating plates shall be submitted to EirGrid for review.

Rating plates for current transformers shall meet the requirements of IEC 61869-2.

In addition to the requirements of IEC 61869-2, the following items shall also be stamped on the rating plate:

- % power factor of oil insulated transformers. (See also Clause 4.8.4)
- Capacitance of oil insulated transformers. (See also Clause 4.8.4)
- The upper limit of secondary winding resistance (Rct) for all protection CTs.
- The CE Mark, where appropriate (see section 4.1)

8.6 ADDITIONAL REQUIREMENTS FOR INSTRUMENTATION CT'S

8.6.1 EXTENDED CURRENT RATING

The specified errors and phase displacements shall be

- 1.2 times rated primary current for most applications
- 2 times rated primary current for transformer bays to allow for transformer overloads.

8.6.2 INSTRUMENT SECURITY FACTOR

The instrument security factor shall be 5.

8.7 CALCULATIONS

Current transformer burden calculations are required typical calculations are below

$$k_{Rated} \cdot \frac{P_{BN} + P_{int}}{P_{BC} + P_{int}} \geq 2 \cdot \frac{I_{k\_Max}}{I_{PRated}}$$

$$k_{Rated} \cdot \frac{P_{BN} + P_{int}}{P_{BC} + P_{int}} \geq 8 \cdot \frac{I_{k\_Max\_Z1}}{I_{PRated}} \cdot$$

$$k_{Rated} \cdot \frac{P_{BN} + P_{int}}{P_{BC} + P_{int}} \geq \frac{I_{k\_Max}}{I_{PRated}} \cdot \left\{ 1 + \frac{X}{R} \cdot \left(1 - e^{-\omega \cdot 0.07 \cdot R/X} \right) \right\}$$

Equation 1 Burden Calculations

Where: -

K_{Rated} =	Rated accuracy limit factor.
P_{BN} =	rated burden
P_{BC} =	Maximum external burden (in VA), at rated current, connected to any individual phase of the CT including the electrical path from the CT phase terminals, the burden of the relay itself and any other relays or meters sharing the core. Where the fault current corresponds to a single-phase EF, the full loop burden (between the CT "S1" and "S2" terminals) should be used; and for multi-phase faults half of the loop burden should be used.
I_{Prated} =	nominal primary current rating (>Maximum load current/extended continuous rating).
P_{int}=	Internal power consumption of the CT at rated current (in VA) [Type-test].
Ik_Max=	Maximum short circuit current in any phase of the CT for a close-in fault.
Ik_Max_Z1 =	Maximum short circuit current in any phase of the CT for a fault at the end of Zone 1/1B.
X/R=	Reactance to resistance ratio of the fault current path for the maximum short circuit current to the close-in fault.
ω =	System frequency (rad/s)

9 RATINGS OF VOLTAGE TRANSFORMERS

The following shall apply to VT's and the VT part of CT/VT's.

9.1 VOLTAGES AND TRANSFORMATION RATIOS

The rated primary voltages shall be $\frac{220}{\sqrt{3}}$ kV or $\frac{400}{\sqrt{3}}$ as appropriate.

The rated secondary voltage shall be $\frac{100}{\sqrt{3}}$ V for windings to be star connected and $\frac{100}{3}$ V for windings to be connected in open delta.

9.2 OUTPUT

The rated outputs shall be as per project design requirements to be developed by Customer and reviewed by EirGrid.

9.3 ACCURACY CLASS

9.3.1 OPEN DELTA/RESIDUAL VOLTAGE WINDING

The broken delta winding shall conform to the following requirements, as permitted by IEC 61869-3 Clause 5.6.302.

The standard accuracy class shall be Class 0.2 in accordance with sub-clause 5.6.302.1, with accuracy defined by Table 301 of Clause 5.6.301.3 for any voltage between 80 % and 120 % of rated voltage.

In addition, the accuracy class shall be Class 3P in accordance with accuracy defined by Table 302 of Clause 5.6.302.3 for voltages of 5 % and 190 % of rated voltage. The higher errors at 2 % rated voltage imposed by that clause shall also apply.

The residual voltage windings shall fulfil their accuracy requirements over a range of outputs from 5 to 100% rated value while at the same time the other windings supply a total output of any value from zero to 100% of their rating.

9.3.2 STAR CONNECTED WINDING

The accuracy class shall be as per project design requirements to be developed by Customer and reviewed by EirGrid.

Class 0.2 is typically required for main and check revenue metering.

Class 0.2 3P i.e. dual designation is typically required for mixed instrumentation and protection applications.

9.4 VOLTAGE FACTOR

The rated voltage factor shall be 1.2 for continuous operation and 1.9 for 30 s.

9.5 RATING PLATE

All rating plates shall meet IEC 61986-1.

IEC 61986-1 states that all information shall be marked in an indelible manner on the instrument transformer itself or on a rating plate securely attached to the transformer. Unless otherwise stated all such information shall be marked on the rating plate.

All rating plates shall be engraved, clear, indelible, corrosion proof, and shall be in English.

Drawings of all rating plates shall be submitted to EirGrid for review.

Rating plates for voltage transformers shall meet the requirements of IEC 61869-3.

In addition to the requirements of IEC 61869-3, the following items shall also be stamped on the rating plate:

- % power factor of oil insulated transformers.
- The CE Mark, where appropriate

9.6 PROTECTION OF SECONDARY WINDINGS

Each secondary winding of voltage transformer units shall be protected by a 16A fuse in the connection to the "a" and "da" terminals (markings per IEC 61869-3). The fuse bases shall be accommodated in the terminal box of the unit and be suitable for screw-type fuses D in accordance with VDE 0635.

9.7 HV CABLE DISCHARGE CAPABILITY

Some voltage transformers may be required to discharge long lengths of high voltage cables, depending on the design solution. If this is the case, VT design and discharge capacitances shall be submitted to EirGrid for review.

10 EARTHING

10.1 GENERAL

All instrument transformers shall be provided with an earthing terminal or stud so that all metallic parts can be earthed.

Earthing terminals/ studs shall be suitable for connection to the station earth grid via a tinned copper bolted lug with a single fixing hole size of 14 mm diameter. The material selected for earthing terminals/ studs shall be a non-corroding metal galvanically compatible with the tinned lug.

Refer to OFS-SSS-407 “Functional Specification Earthing and Lightning Protection” for earthing system requirements.

10.2 Secondary Windings Earthing

An earthing terminal shall be provided within each terminal box for earthing the secondary windings.

All secondary windings of instrument transformers should be capable of being readily disconnected and isolated from ground for testing purposes, i.e. not permanently earthed.

10.3 VT Primary Earthing

The earthed end of the primary voltage winding shall be terminated using a bushing inside the terminal box. Refer to section 4.8.1 for the required insulation level.

An earth terminal shall be provided adjacent to this bushing and shall be connected to it by means of a removable strap. These shall be identified and be separate from the secondary terminals.

10.4 Ring Type CT Earthing

The earthing terminal or stud shall be clearly marked with the letter "E" and the diameter of the clamping screw or hole shall be minimum 12 mm diameter and suitable for the expected cable size. For indoor equipment in particular which may be placed close to a wall with consequential access difficulties, the terminal should be a fixed stud or a bolt (with head accessible under the transformer base) suitably locked in place to prevent rotation when securing the earth lead. Adequate access shall be ensured.

11 Corrosion Protection

All exposed ferrous parts, including nuts and bolts, shall be hot-dip galvanised to comply with EirGrid specification OFS-SSS-424, “Hot Dip Galvanising of Iron and Steel Other Than Wire”.

The Customer shall state clearly in the schedule of Corrosion Protection (part of TECHNICAL SCHEDULES) the corrosion protection applied to any aluminium or aluminium-alloy parts.

The Customer shall draw attention to all exposed points in their equipment at which aluminium or aluminium-alloy parts are in contact with or in close proximity to other metals and shall state clearly the protection employed at each point to exclude air and moisture.

Experience has shown that extreme precautions are necessary, because of the high humidity, to prevent the aggressive ingress of moisture between flange plates, around gaskets and 0-rings, at insulator/flange interfaces, etc.

The special test for corrosion protection described by IEC 61869-1 shall be carried out as part of the tests.

12 MARKINGS

The terminal markings shall comply with IEC Standards.

Rating plates, labels and other markings shall be clear, indelible, corrosion proof, and shall be in English. Drawings of all rating plates and labels shall be submitted for EirGrid review.

Refer also to section 8.5 and section 9.5 for rating plate requirements for current transformers and voltage transformers respectively.

All labels shall meet the requirements of XDN-LAB-STND-001 “Station Design Standard 110/ 220/ 400 kV Station Signage”

In addition, the equipment shall have the CE Mark in accordance with the requirements of the Section 2 of this specification.

13 TESTS

13.1 TYPE

All instrument transformers offered shall have been fully type-tested in accordance with the tests listed in the following IEC Publications and the results shall demonstrate, in relevant respects, the capability to meet the requirements of this specification.

- IEC 61869-1 General requirements for all instrument transformers
- IEC 61869-2 Additional requirements for CTs and the CT part of combined units.
- IEC 61869-3 Additional requirements for VTs and the VT part of combined units.
- IEC 61869-4 Additional requirements for particular test requirements for combined units.
- IEC 61869-6 Additional requirements for protective current transformers for transient performance.

These type tests shall have been carried out at an independent testing station or alternatively have been witnessed by a representative of an independent testing agency or other independent witness.

Certificates/Reports containing full details of type tests shall be submitted to EirGrid for review.

13.2 ROUTINE

All instrument transformers shall be routine tested in accordance with the test requirements of the following specifications.

- IEC 61869-1 General requirements for all instrument transformers
- IEC 61869-2 Additional requirements for current transformers and the current transformer part of combined units.
- IEC 61869-2 Additional requirements for transient class TPZ cores of CTs
- IEC 61869-3 Additional requirements for voltage transformers and the voltage transformer part of combined Units
- IEC 61869-4 Additional requirements for particular test requirements for combined units.
- IEC 61869-6 Additional requirements for protective current transformers for transient performance

Partial discharge measurements and dielectric dissipation factor (tanøδ) shall be measured and recorded for all units. The manufacturer shall measure the actual creepage distances to earth over external insulation on a representative sample of the instrument transformers prior to dispatch from works. The measured values shall be included with the Routine Test results.

The tests may be witnessed by EirGrid, with the customer to give at least two weeks notice of the test.

13.3 SPECIAL

The requirements in this section refer to oil insulated instrument transformers.

EirGrid reserves the right to witness these tests.

13.3.1 ONCE OFF SPECIAL TESTS

Where no previous type test evidence for the special tests below is available, EirGrid may require such tests to be performed on one production unit of each category, in accordance with IEC 61869-1:

1. Chopped impulse voltage withstand test on primary terminals (required for 400 kV instrument transformers only).
2. Mechanical tests.
3. Corrosion test.
4. Internal arc test.

13.3.2 SPECIAL TESTS ON ALL ITEMS

Measurement of capacitance and dielectric dissipation factor, although listed as a special test in IEC 61869, shall be measured and recorded for all units.

13.3.3 SPECIAL TESTS ON SAMPLE ITEMS

The manufacturer shall measure the actual creepage distances to earth over external insulation on a representative sample of the instrument transformers prior to dispatch from works. The measured values shall be included with the Routine Test results.

14 DELIVERY

14.1 TEST RESULTS

At the conclusion of routine tests, results shall be submitted to EirGrid for review

15 INSTALLATION INSTRUCTIONS

While Installation is the responsibility of the Customer, EirGrid require that a copy of the manufacture's installation instructions be provided. The instructions shall be in English and shall cover all aspects of installation including putting into service. The Customer shall ensure that the information supplied is clear and specific to the equipment being provided.

16 COMPLIANCE WITH SPECIFICATION

All deviations from the requirements of this Specification shall be listed in the schedule of deviations.

17 DOCUMENTATION

All documentation shall be in English

17.1 SUBMISSION FOR DESIGN REVIEW

The following information shall be submitted for review

1 Completion of all technical schedules as attached. Terms and definitions shall be in accordance with IEC 60050 and IEC 60694
2 Fully detailed Type test certificates and reports
3 Details of routine testing carried out on equipment at any stage prior to dispatch
4 Completed list of deviations.
5 Full details of any modifications made to the plant since type testing. This shall require a complete report of testing carried out to prove the modification.
6 Drawings showing arrangements for ratio reconnection, secondary terminal boxes, oil expansion devices, porcelains etc.
7 Complete technical documentation
8 Complete set of technical drawings
9 Complete list of recommended spare parts
10 Complete list of specialist tools
11 Complete installation instructions
12 Complete operational instructions
13 Complete maintenance instructions
14 Complete decommissioning and dismantling instructions
15 Statement of acceptance of EirGrid warranty
16 Reference list of the specific equipment proposed

The above list is not exhaustive and does not preclude the Customer from disclosing any further information pertaining to the Item of plant.

Plant offered without the complete submission of the above requirements may be rejected.

EirGrid request that the following information be submitted after design review:

1 Complete drawings, detailing physical dimensions, layout of equipment, support structures, fixing details and high voltage connections.
2 Complete set of Electrical drawings detailing in full all electrical circuits and associated accessories.