

CURRENT TRANSFORMERS FOR PROTECTION AND GENERAL USE

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PURPOSE AND SCOPE

This document describes the technical requirements for User's equipment directly connected to the England and Wales Transmission system and located within NGET's busbar protection zone operating at nominal voltages of 400 kV, 275 kV, 132 kV and 66 kV unless otherwise agreed with the user as defined in the Bilateral agreement. The principles of this document applies to equipment connected at other voltages".

This Specification defines the functional and performance requirements for current transformers (CTs) for protection and general use on The Transmission System in England and Wales. It supports the more general requirements defined in the companion documents TS 1 (RES), and TS 2.2 (RES).

This is a functional and performance specification for CTs used for protection and measurement application.

PART 1 – PROCEDURAL

1 GENERAL REQUIREMENTS

All CTs shall comply with TS 1 (RES), TS 2.2 (RES), IEC 61869-1 & IEC 61869-2. In addition, the following clauses apply:

1.1 General Requirements for all Current Transformers

1.1.1 Secondary ratings and transformation ratios of CTs forming part of an NGET protection scheme shall be selected from the attached Schedules

1.1.2 Secondary terminals and connections shall be suitable for their required purpose regarding rating, reliability and the effects of environmental conditions and corrosion.

- 1.1.3 Primary and secondary terminal markings, and rating plate markings shall be in accordance with IEC 61869-2
- 1.1.4 The rated continuous primary current of the current transformer shall be chosen to exceed the maximum continuous rating of the associated circuit and shall be selected from the standard values detailed in IEC 61869-2
- 1.1.5 A thermal short-time current rating (I_{th}) shall be assigned to all current transformers in accordance with IEC 61869-2. The value of I_{th} shall not be less than the corresponding value for the associated switchgear or transformer primary plant.
- 1.1.6 Current transformer secondary terminals should allow the application of shorting/earthing links or wiring for maintenance purposes. Separately, a terminal for earthing purposes shall be provided within the terminal box and shall be clearly marked.
- 1.1.7 Both ends of the CT secondary windings shall be earth free.

Informative: The clause relates to the internal CT wiring; the CT earthing connection relates to the site installation

1.2 Additional Requirements for Current Transformers for GIS Application

- 1.2.1 Current transformers may be mounted internally or externally to the GIS enclosure.
- 1.2.2 Adequate protection against adverse environmental conditions shall be provided for externally mounted CTs as required in TS 2.2 (RES).

1.3 Additional Requirements for Ring-Type Current Transformers

- 1.3.1 Current transformers supplied as loose equipment for power transformer application shall be equipped with secondary terminals or shall be supplied with leads of suitable length for this application. Such leads shall be capable of satisfying the test requirement of Clause 3.3.3.
- 1.3.2 Current transformers supplied with throughwall bushings can be mounted internally or externally to the bushing. Current transformers mounted internally shall be capable of operating within that environment. Current transformers mounted externally shall be suitably protected against the effects of adverse environmental conditions as required by TS 2.2 (RES).
- 1.3.3 Current transformers supplied as loose equipment for other switchgear applications shall be capable of operating within that environment. Current transformers for other switchgear applications, mounted externally, shall be suitably protected against the effects of adverse environmental conditions as required by TS 2.2 (RES).

1.4 Additional Requirements for Measurement/Protection and Class PX Protective Current Transformers

- 1.4.1 Measurement/Protection and class PX protective current transformers with a rated primary current of 2500 A or below and with untapped secondary windings shall have a rated secondary current of 1A (as selected from IEC 61869-2). The rated secondary current for current transformers of this primary rating with tapped secondary windings shall be 1 A corresponding to the highest transformation ratio.
- 1.4.2 Measurement/Protection and class PX protective current transformers with a rated primary current in excess of 2500 A shall have a rated secondary current selected from the values stated in IEC 61869-2

2 PERFORMANCE REQUIREMENTS

2.1 General

All current transformers shall comply with the performance requirements of IEC 61869-2 for the primary ratings detailed in TS 1 (RES) and TS 2.2 (RES). The following requirements shall also apply as appropriate:

2.2 Protection Type PX-A Current Transformers

2.2.1 Protection type PX-A current transformers shall meet the requirements given in IEC 61869-2 providing accurate transformation up to the maximum fault current rating of the associated main plant. This performance shall be maintained under both fault and steady-state conditions without saturation

2.2.2 Type PX-A current transformers shall also meet the performance requirements of Schedule 10 of this Specification.

2.3 Protection Type PX-B Current Transformers

2.3.1 Protection type PX-B current transformers shall meet the requirements given in IEC 61869-2 providing accurate steady-state transformation up to the maximum fault current rating of the associated main plant.

2.3.2 Type PX-B current transformers shall also meet the performance requirements of Schedule 10 of this Specification.

2.4 Dual Purpose Measurement/Protection Current Transformers

2.4.1 Current transformers intended for the dual purpose of measurement and protection shall meet the performance requirements of IEC 61869-2, Clause 4.2.1 and Schedule 10 of this Specification.

3 TESTING REQUIREMENTS

3.1 Type Tests

3.1.1 All current transformers shall be type tested in accordance with IEC 61869-2 (type tests) and IEC 61869-2 (special tests). The additional requirements for protection class PX cores given in Appendix B. Current transformers using a gas insulation system, a leakage test on the gas system shall be performed by the supplier to demonstrate compliance with TS 2.2 (RES).

3.1.2 Radio interference voltage tests to IEC 60694 are to be performed on open-terminal current transformers.

3.1.3 A multi chopped impulse test shall be performed on all oil filled current transformers rated 72.5 kV and above. The test method is given in Appendix A.

3.1.4 Temperature Rise - The thermal time constant of all equipment shall be determined on both rising and falling temperature.

3.1.5 For oil filled equipment oil samples for DGA shall be taken before and after the dielectric type tests and shall comply with Appendix A3.

3.1.6 Accuracy at Short-Term Continuous Current Levels - Current transformers which have a measurement specification shall have their errors determined at a current of 12000 A for 420 kV rating and 7500 A for 300 kV rating respectively. These currents shall be withstood for a period of 3 minutes.

3.1.7 Routine tests shall be performed before and after all type tests.

3.2 Routine tests

3.2.1 All current transformers shall be routine tested in accordance with:

IEC 61869-2 (routine tests)

IEC 61869-2 (special tests)

3.3 Additional Routine Tests

3.3.1 Accuracy Tests

a) These shall be performed in a laboratory having traceability to National/International standards.

b) The overall accuracy and uncertainty of the measurement shall be demonstrated prior to testing and shall be commensurate with the accuracy class of the transformer under test.

c) Full accuracy routine tests to IEC 61869-2.

3.3.2 Capacitance and dielectric loss angle ($\tan \delta$) measurements of the primary insulation over the voltage range 10 kV to rated voltage shall be performed.

3.3.3 Leads for loose current transformers as detailed in Clause 1.4.2 of this Specification shall withstand a power frequency test voltage of 5 kV

4 LIST OF SCHEDULES

Schedule 6 Bus Sections and Couplers and other users Directly Connected via NG bus bar protection

Schedule 10 Table of Particulars for 420 kV, 300 kV and 145 kV Current Transformers

SCHEDULE 6 - BUS SECTIONS AND BUS COUPLERS

ALSO OTHER USER CT's AT CONNECTION POINTS AND ASSOCIATED WITH NG BUSBAR PROTECTION

System Voltage	Rated Current of Switchgear	Class X Protection Current Transformers		Measurement/Protection Current Transformers		
		Rated Continuous Thermal Current	Turns Ratio	Extended Primary Current Rating %		Rated Transformation Ratio
			Busbar	Thermal	Accuracy	
kV	A	A				
275	2000	2000	1/600/1200	170	420	<u>1200/600/1</u>
275	2500	2500	1/600/1200	210	420	<u>1200/600/1</u>
400	4000	4000	1/1000/2000	200	500	<u>2000/1000/1</u>

SCHEDULE 10 - TABLE OF PARTICULARS FOR 420 kV, 300 kV AND 145 kV CURRENT TRANSFORMERS

Reference Clauses	CT Designation	Ratio		Knee-Point Voltage (V_k) or IEC Rating and Class	Magnetising Current (mA)	Max Sec Res (ohms)
		Turns	Current			
4.2 to 4.4	420 KV, 4000 A					
	(I) PROT A	1/1000/ <u>2000</u>		300 ($R_{ct} + 7.5$)		
	(ii) Prot B	1/2000		60 ($R_{ct} + 5$)	40 at $\frac{V_k}{2}$	5.0 at 75°C
	(III)PROT B SPECIAL RATIO	1/600/ <u>1200</u>		82 ($R_{ct} + 3$)	60 at $\frac{V_k}{2}$	2.4 at 75°C
	(IV) MEASURE-MENT/PROTECTION	1/1000/2000	2000/1	30 VA Class 1 5P20		
			1000/1	30 VA Class 1 5P10		
4.2 to 4.4	300 kV, 2000 or 2500 A					
	(I) PROT A	1/600/ <u>1200</u>		160 ($R_{ct} + 7.5$)		
	(ii) Prot B	1/600/ <u>1200</u>		82 ($R_{ct} + 3$)	60 at $\frac{V_k}{2}$	2.4 at 75°C
	(III)PROT B SPECIAL RATIO	1/600/1200	1200/1	30 VA Class 1 5P20		
			600/1	30 VA Class 1 5P10		
4.2 to 4.4	145 kV, 2000A					
	(I) PROT A	1/600/ <u>1200</u> 1/500/ <u>1000</u>		50 ($R_{ct} + 17$) 60 ($R_{ct} + 12$)		
	(ii) Prot B	1/500/ <u>1000</u>		95 ($R_{ct} + 2.5$)	60 at $\frac{V_k}{2}$	2.4 at 75°C
	(III)PROT B SPECIAL RATIO	1/600/1200	1200/1	30VA Class 1 5P20		
			600/1	30VA Class 1 5P10		

Note - For tapped current transformers the knee-point voltage, magnetising current and secondary resistance are specified for the full winding, shown underlined.

5 FORMS AND RECORDS

PART 2 - DEFINITIONS AND DOCUMENT HISTORY

6 DEFINITIONS

The definitions used in TS1 (RES) and TS2.2 (RES) apply to this document.

7 AMENDMENTS RECORD

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	October 2014	New document	Richard Poole	GCRP

7.1 Procedure Review Date

5 years from publication date.

PART 3 - GUIDANCE NOTES & APPENDICES

8 REFERENCES

8.1 International, European and British National Documentation

This document makes reference to, or should be read in conjunction with, the documents listed below. Where a standard has been harmonised into a Euronorm, only this latter reference is given. The issue and date of the documents detailed below shall be applicable at the time of issue of this specification unless a specific issue date is given

IEC 61869-1	Instrument transformers- Part 1: General requirements
IEC 61869-2	Instrument transformers- Part 2: Additional requirements for current transformers
BS EN 60567	Oil-filled electrical equipment - Sampling of gases and of oil for analysis of free and dissolved gases - Guidance
BS EN 62271	High Voltage switchgear and control gear.

8.2 National Grid TS (RES) Documents

The following TS documentation is relevant to current transformers and should be read in conjunction with this document.

TS 1 (RES)	Ratings and General Requirements for Plant, Equipment, Apparatus and Services for use on and Direct Connections to the National Grid Transmission System
TS 2.2 (RES)	Switchgear for use on, and at Connection Points to, the National Grid System

APPENDIX A - MULTICHOPPED IMPULSE TYPE TEST SPECIFICATION

All oil filled CTs rated at 72.5 kV and above, shall be subjected to a 600 chopped negative polarity impulse test at 60% of the rated BIL level for that equipment. The time to chop shall be between 2-5µs. A full set of routine electrical tests shall be performed, and oil samples for dissolved gas analysis shall be taken, both before and after this test.

The supplier shall submit to the user details of how the test will be conducted.

The three criteria which must all be satisfied for the CT to pass the test are:

- A1** The results of the routine electrical tests, performed before and after the chopped impulse test, are the same within the error specification for the test field.
- A2** No evidence of degradation is found when the CT is dismantled and examined after the test.
- A3** Any increases in the DGA levels are within the limits listed below.

Dissolved Gas	Allowable increase after 3 days (ppm)
Hydrogen (H ₂)	5
Methane (CH ₄)	3
Ethane (C ₂ H ₆)	3
Ethylene (C ₂ H ₄)	2
Acetylene (C ₂ H ₂)	no detectable increase

The application of this test to CTs which have an ERIP or SRBP condenser core shall be subject to agreement between the user and the supplier.

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