ABSTRACT

The eleventh part of the column includes a list of international standards and CIGRE technical brochures covering the installation, operation and maintenance of power transformers, essential for ensuring their proper operation.

KEYWORDS

installation, maintenance, operation, power transformers, standards

This collection of standards ensures the proper operation of the transformers through guidelines for transport, installation, commissioning, operation, maintenance, monitoring, and asset management

Standards relevant to transformers – Part XI

Installation, operation and maintenance

1. Introduction

After successful testing at the factory, the power transformer is transported to the site as an over-dimensioned, heavy-weight consignment. The installation process at the plinth is a skilled job to be done very carefully, usually under the supervision of the manufacturer. To remove the moisture absorbed during the installation stage, controlled processing is carried out after the installation work. The transformer is energized after carrying out pre-commissioning tests. National standards and CIGRE technical brochures are available for covering the above stages of transport, installation, and commissioning of transformers. Similar standards cover transformers' operation, maintenance, monitoring, and asset management.

2. Standards

	IEC	ANSI/IEEE	CIGRE Technical Brochure (TB)
Power installations exceeding 1 kV AC and 1,5 kV DC - Part 1: AC	IEC 61936-1 Ed 3.0 – 2021 (2010)		
Guide for the transportation of transformers and reactors rated 10,000 kVA or higher		C57.150 - 2012	Brochure 673 – 2016
Installation, application, operation and maintenance Oil-filled transformer		C57.93 - 2019 (2007)	Brochure 445 – 2011 – Maintenance guide
Installation, application, operation and maintenance Dry-type transformer		C57.94 - 2015 (1982) (R2006)	
On-site assembly			Brochure 857 – 2021 On-site assembly, on-site rebuild, and on-site high voltage testing
UHV AC transmission systems Part 301: On-site acceptance tests	IEC TS 63042-301 Ed 1.0 - 2018		
Paralleling of transformers	60076-8 Ed 1.0 - 1997	C57.153 - 2015	

	IEC	ANSI/IEEE	CIGRE Technical Brochure (TB)
Loading guide: Oil-filled transformer	60076-7 Ed 2.0 – 2018 (2005) (IEC 60354)	C57.91 - 2011 (C57.91 +C57.95 - 1984) C57.115 - 1991)	
Loading guide: Dry-type transformer	60076-12 Ed 1.0 - 2008 (IEC 60905–1987)	C57.96–2013	
Loading guide: Step voltage regulators		C57.95 - 1984	
Failure investigation, documentation, analysis, and reporting for power transformers and shunt reactors		C57.125 - 2015 (1991)	Brochure 642 – 2015 Transformer reliability survey
Reporting failure data		C57.125 - 2015 (C57.117-1986)	
HVDC transformer failure survey			Brochure 617 – 2015 Converter transformer failure survey results from 2003 to 2012. Brochure 859 - 2021 HVDC transformer failure survey results from 2013 to 2020
Evaluation and reconditioning of liquid immersed transformers		C57.140 - 2017 (2006)	Brochure 761 - 2019
Diagnostic field testing	ISO 18095 – 2018 Condition monitoring and diagnostics of power transformers	C57.152 - 2013 (IEEE 62-1995)	
Monitoring equipment for transformers and accessories		C57.143 - 2012	Brochure 409 - 2010 Gas monitors Brochure 783 - 2019 DGA monitoring systems
Monitoring of distribution of transformers		PC57.167 - D3.55 - 2022	
Condition monitoring and assessment			Brochure 298 – 2006 Guide on transformer lifetime data management Brochure 343 – 2008 Recommendations for condition monitoring and condition assessment facilities for transformers Brochure 393 – 2009 Thermal performance Brochure 630 – 2015 Guide on transformer intelligent condition monitoring (TICM) systems Brochure 676 – 2016 Partial discharges in transformers Brochure 761 – 2019 Condition assessment of power transformer

	IEC	ANSI/IEEE	CIGRE Technical Brochure (TB)
Substation: Fire protection Containment (firewalls) and control of oil spills in substations (oil sumps) “Power installations exceeding 1 kV AC	IEC 61936-1 Ed 3.0 - 2021 (2010)	979-2012: Guide for substation fire protection (1994) 980 - 2021 (2013,1994) Guide for containment and control of oil spills in substations	Brochure 537 - 2013 Fire safety practices
Guide for safety in AC substation grounding		IEEE 80 - 2013	
Guide for the design, construction, and operation of electric power substations for community acceptance and environmental compatibility		IEEE 1127 - 2013 (1990)	
Recommended electrical clearances in air insulated electrical power substations		IEEE 1427 – 2020 (2006)	
Cleaning of insulators		IEEE 957 – 2005 (1995)	
Guide for application, maintenance, and evaluation of room temperature vulcanized (RTV) silicone rubber coatings for outdoor ceramic insulators		IEEE 1523 – 2018 (2002)	Brochure 837 – 2021
Protection of substations from the direct lightning strike		IEEE 998 – 2012 (1996)	
Seismic guide for transformers and reactors		C57.114 - 1990 (withdrawn in 1996)	
Recommended practice for seismic design of substations		IEEE 693 – 2018 (2005, 1997)	
Guide for animal deterrents for electric power supply substations		IEEE 1264 – 2022 (2015)	
The permissible temperature rises for terminals	IEC/TR 60943 Ed 2.1 - 2009		
Transformer capability under geomagnetic disturbances		C57.163 - 2015	
Health indices			Brochure 858 - 2021 Asset heath indices for substation equipment
Life management			Brochure 227 - 2003 Life management techniques for power transformers Brochure 248 – 2004 Guide on economics of transformer management Brochure 887 - 2022 Life extension of oil-filled transformers

	IEC	ANSI/IEEE	CIGRE Technical Brochure (TB)
Asset management Overview, principles, and terminology Requirements Management system requirements Guidelines for application	ISO 55000 - 2014 ISO 55001 - 2014 ISO 55002 - 2014		
Life cycle management: System engineering planning Process System life cycle process Content of life cycle information	ISO/IEC 27748-4 - 2016 ISO/IEC 12207 - 2008 ISO/IEC 15288 - 2015 ISO/IEC 15289 - 2019		
Operation of electrical installations - general requirements	EN 50110-1 - 2013		
Standard for preparation of product instruction manual - principles and general requirements	IEEE-IEC 82079-1 - 2019		
Instruction manual content for AC HV breakers above 1000 V	C37.12.1 - 2018 (2007)		

3. Conclusion

The paper has summarised various international standards, guides, and technical brochures available for the ready reference of designers and users on the installation, operation, and maintenance of transformers.

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