ABSTRACT

Transformers are protected throughout their operational lifespan using surge arresters, protective relays, fuses, and surge absorbers. In the case of transformers filled with mineral oil, fire protection measures are also necessary. In this column, we explore different IEC/IEEE standards and CIGRE Technical Brochures that transformer engineers can refer to when choosing a suitable protection scheme for a specific application.

KEYWORDS

protection, protection devices, surge arresters, protective relays, fuses, surge absorbers, IEC/IEEE standards, CIGRE Technical Brochures

Robust protection measures, including surge arresters, protective relays, fuses, and surge absorbers, are deployed to ensure the safety and reliability of transformers

Standards relevant to transformers – Part XII

Protection

1. Introduction

During their service life, transformers are protected by surge arresters, protective relays, fuses, and surge absorbers. Mineral oil-filled transformers require fire protection as well. This part of the series covers various IEC/IEEE standards and CIGRE Technical Brochures available to transformer engineers for selecting an appropriate protection scheme suitable to a particular application. Protection coordination and fault current withstand guides are also available to power engineers for grading the protection levels.

2. Standards

Title	IEC	ANSI/IEEE	CIGRE Technical Brochure (TB)
Metal-oxide surge arresters without gaps for a.c. systems	60099-4 Ed3.0 – 2014 (2009)	C62.11-2020 (2012)	
Metal oxide surge arrester –Selection & application guide	60099-5 Ed3.0 – 2018 (2013)	C62.22-2009 (1997)	
Application guide – Amendment 1 – Supplement to consider energy handling capabilities		C62.22a-2013	CIGRE Brochure 287-2006 – Protection of MV & LV networks against lightning – Part 1 Common topic CIGRE Brochure 441 2010 – Protection of MV & LV networks against lightning – Part 2 Lightning Protection of MV networks
Connection of Surge Arresters to protect insulated shielded Electric Power cable systems		C62.22.1-1996/IEEE 1299	
Gapped silicon-carbide surge arrester –			
Specifications		C62.1-1989	
Application Guide		C62.2-1987	

Title	IEC	ANSI/IEEE	CIGRE Technical Brochure (TB)
Protection against lightning General principles Risk management Physical damage to structures and life hazard Electrical and electronic systems within structures	 62305-1 Ed 2.0 – 2010 (2006) 62305-2 Ed 2.0 – 2010 (2006) 62305-3 Ed 2.0 – 2010 (2006) 62305-4 Ed2.0 – 2010 (2006)		
HV expulsion and current limiting fuses and fuse disconnecting switches– Specifications Design tests		 C37.46-2010 C37.41-2016 (2008)	
Guide for protecting power transformers Guide for protection of secondary network transformers		C37.91-2021(2008) C37.108-2021(2002)	CIGRE Brochure No. 463-2011 Modern techniques for protecting, controlling, and monitoring Power Transformers CIGRE Brochure No. 432-2010 Protection relay coordination
Guide for the application of protective relaying for phase-shifting transformers		C37.245-2018	
Standard requirements for secondary network protectors		C57.12.44-2014 (2005)	
Guide for the protection of shunt reactors		C37.109-2006 (Inactive)	CIGRE TB 546-2013 Protection, monitoring and control of shunt reactors
Application of CTs used for protective relaying purposes Guide for the grounding of instrument transformer secondary circuits		C37.110-2007/COR 1-2010 (1996) C37.13.3-2014 (2005)	
Guide for through fault current withstand duration Liquid-immersed transformers Dry-type transformers		Annexure A of C37.91-2008 C57.109-2018 (1993-R2008) C57.12.59-2015 (2001)	
Protection and coordination of industrial and commercial power systems (Buff Book)		242-2001 (1986)	
Electrical power system – Device function numbers, acronyms, contact designations	61850-7-4 Ed 2.0 – 2010 (2003)	C37.2-2022 (2008)	
Guide for early detection, mitigation preventive measures and response to smoke, fire, and explosions in underground electrical structures		2417-2022	

Title	IEC	ANSI/IEEE	CIGRE Technical Brochure (TB)
Guide for tank rupture mitigation of liquid-immersed power transformers and reactors		C57.156-2016	
Power installations exceeding 1 kV a.c. – Common rules Substation – Fire protection Containment & control of oil spills in substations	IEC 61936-1 Ed3.0-2021(2010)	979-2012 (1994): Guide for substation fire protection (Inactive) 980-2021(2013) Guide for containment and control of oil spills in substations	CIGRE TB 537-2013 – Guide for transformer fire safety practices
Guide for the design, construction, and operation of electric power substations for community acceptance and environmental compatibility		1127-2013 (1998)	
Degrees of protection provided by enclosures (IP code)	60529 – Ed 2.1 2001 (1989 AMD2-2013)		

Different IEC/IEEE standards, as well as CIGRE Technical Brochures, are presented on the topic of the transformer protection

3. Conclusion

The paper offers a summary of various available international standards, guides, and technical brochures on transformer protection for the ready reference of transformer application engineers and users.

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