IEEE PES Transformers Committee
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Dual-Rated Distribution Transformers

— Technical Presentation —
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By Phil Hopkinson, Dan Mulkey, Steven Rosenstock, Kevin Rapp, Casey Ballard, Tom Prevost, Al Traut

1. Abstract

Transformer power ratings are defined as the amount of output power that can be delivered without exceeding nameplate temperature rise. Materials improvements have led to greater output ratings and smaller physical sizes. However, mandatory energy efficiency requirements by the U.S. DOE and physical design restraints for smaller units have resulted in designs that are not limited by the rated temperature rise, and loading guides have struggled to accurately reflect true capability. Distribution transformer loading studies show generally light loading but confusion for load-ability. New high thermal class fluids and improved solid insulating materials for liquid-filled transformers are timely for expected major increased loads due to electric vehicle charging and greater heat pump use and suggest new dual nameplate ratings for distribution transformers. The base rating would continue to reflect traditional kVA parameters, while the second rating would be the nameplate kVA rating based on thermal class of the insulation system. This panel examines several factors to show the usefulness of this proposed change.

2. Learning Objectives

This tutorial provides the following learning opportunities:

- A look at present loadings
- EEI forecast of loading increases to be expected
- We see RMS-equivalent loading not exceeding 50% of nameplate ratings but peak loads in present transformers will go well beyond nameplate
- Higher loading normally means higher temperature rises
- New solid and liquid insulating materials appear to be able to handle considerably higher top-end loading without size increases in new dual kVA nameplate transformers
- We have examined new hypothetical designs that look particularly interesting
- Summary of what we see for dual kVA nameplate designs

3. Learning Outcomes

By attending this tutorial, attendees will gain an understanding of the following:

- Present day transformers are lightly loaded; new loading will increase up to 50% over the next 10 years from electric vehicle charging and new electric heat pump conversions
- RMS-equivalent loads will get close to DOE assumption of 50% of nameplate kVA, but peak loads will go well beyond nameplate
- New thermal materials in new designs can handle the higher loading without change to physical size
- New dual kVA nameplate designs can meet DOE electrical efficiency and handle new peak loads

4. Presenters' Biographies

Phil Hopkinson is a Life Fellow of IEEE and presently working as President and CEO of HVOLT Inc. in Charlotte, North Carolina, a position that he has held for 21 years. His 56-year career includes design and engineering management assignments at GE, Cooper and Square D/Schneider. Phil has a BSEE from Worcester Polytech, a Masters of System Science from Brooklyn Polytech and is a graduate of GE's Advanced Engineering Courses A-B&C. He is a registered PE in North Carolina and is Technical Adviser to the USNC for Power Transformers, IEC TC 14, a position he has held since 1996. Phil holds 15 U.S. patents and is a long-time member of the IEEE Transformers Committee.

Dan Mulkey is Vice President of Mulkey Engineering Inc., offering consultation and expert witness testimony on distribution power matters—with specialization in distribution transformers—since 2015. Prior to that, Dan had 42 years with Pacific Gas & Electric Company designing, maintaining and operating electric power distribution systems. Dan graduated from Fresno State University with a BSEE and is a registered PE in the State of California. He is a Life member of IEEE, holding numerous working group and task force chair positions and currently serves as chair of the Padmount Enclosure Integrity working group.

Steven Rosenstock is Senior Manager of Customer Technical Solutions with the Edison Electric Institute (EEI) in Washington, DC. Steve is a registered PE in Virginia and has dealt with distribution transformer energy efficiency issues for many years. In EEI, he constantly collects electrical use forecasts and has a tremendous depth of data that has been extremely useful in looking ahead to the future of our electrical systems.

Kevin J. Rapp is the Principal Scientist for the Global Dielectric Fluids business of Cargill since June 2012. Previously, Kevin spent 36 years with Cooper Power Systems, including 27 years in R&D where he co-invented Envirotemp™ FR3™ fluid and found that ester liquids enhance the life of cellulose insulation which can extend the life of an insulation system in transformers. He earned his BS in Chemistry from the University of Wisconsin-Parkside. Kevin is involved in many international standards working groups as Technical Advisor/Chairman of the USNC of ANSI/IEC TC10 (insulating fluids), USNC technical expert of IEC TC 14 (power transformers), ASTM D27.15 and D27.91 insulating fluids subcommittees. He received the IEC 1906 Award in 2011, the US-EPA Presidential Green Chemistry Award in 2013 for the FR3 fluid in transformer development, an ASTM Service Award in 2015 and was installed as an ASTM Fellow with the Distinguished Merit Award in May 2018. He holds many patents and has published numerous papers. Kevin is a member of ACS, ANSI, AOCS, ASTM, CIGRE, IEC and IEEE.

Tom Prevost is a senior member of IEEE. He is the Vice President of Technology and Innovation in the Americas region for Weidmann Electrical Technology, where he has worked for 30 years. He has a BSEE degree from Virginia Tech. Tom is active in ASTM committee D27 on Insulating Fluids, CIGRE A2 & D1 Committees, IEC TC 14 and the IEEE Transformers Committee. He has written many technical papers on the subject of electrical insulation materials, transformer diagnostics and condition monitoring.

Casey Ballard is currently employed by DuPont, where he is the Global Technology Manager for the company's Electrical Infrastructure business. Casey has had an extensive background in dry type transformers, where he recognized the importance of Nomex® solid insulation for its extraordinary dielectric, mechanical and thermal strength. He also is extensively involved with liquid-filled transformers, where he increasingly sees similar benefits as in the dry type. Casey is a graduate of Virginia Polytechnic Institute and State University and a Senior Member of the IEEE Transformers Committee, leading the Dry Type Transformers Subcommittee.

AL Traut is a transformer engineer with over 40 years of experience in the design, development, manufacture and application of liquid-filled distribution transformers. Al has held numerous positions in engineering and engineering management with Cooper Power Systems, General Electric, Kuhlman Electric, Power Partners and Howard Industries. He received his BS in Electrical Engineering from Northwestern University and is a registered Professional Engineer in Wisconsin. Al is an active member of the IEEE Transformers Committee and is presently Working Group Chair for Overhead Pole-Mounted Transformers.