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Transformer Specifications Beyond Standards

-- Presentation, Monday, October 21, 4:45 p.m. --

by Jeff Fleeman and Loren Wagenaar

1. Abstract

Utilities in the twenty-first century will be faced with purchasing transformers from relatively unknown manufacturers throughout the world. In the United States, for example, there are presently no domestic manufacturers of 550 or 765 kV transformers, only two for 345 kV, and the trend of fewer domestic manufacturers continues for the lower voltage ratings. This situation, in conjunction with the current emphasis on obtaining the least expensive equipment possible, requires that more transformers be purchased from offshore manufacturers, some of them not so sophisticated as others. In order to maintain reliability, a more comprehensive specification, one that spells out requirements not presently appearing in the ANSI/IEEE C57 standards, is required.

2. Learning Objectives

This presentation outlines the steps that American Electric Power (AEP) has taken, starting in the late 1980s, to improve reliability of its EHV transformers and reports on the results to date:

- Explanations are given for the changes has made to its transformer specifications. These changes go substantially beyond C57 Standards. They started with more stringent dielectric requirements for EHV transformers and gradually expanded to the thermal, mechanical and magnetic requirements for all voltage ratings.

- Standards have also made advancements in the past 15 years, and explanations are given for how some of these advancements were incorporated into the specifications.

- The reliability record of all EHV transformers purchased to this new specification is presented. It will be shown that the reliability record of these transformers is greatly improved, thereby saving substantial money in the long run.

- A case study of things learned with one of the failures has resulted in a new test being added. This test has been specified by some other utilities, and the in-service failure demonstrated the need for including it in the EHV transformer specification.

The environment in which transformers are purchased and applied is continually changing. In this sense, the specifications are living documents, having been changed an average of every three years. Explanations are therefore outlined for the internal and external processes that have been developed to revise these documents.

3. Learning Outcomes

Participants will become acquainted with how and why a large electric utility has made significant improvements to its transformer specifications, how these changes have improved the reliability record of its transformer fleet, and how the process continues to create even better specifications for the ever changing environments in which transformers are being purchased, manufactured and used.

4. Presenter's Biographies

Jeff Fleeman: Mr. Fleeman is Director of Station Projects Engineering at American Electric Power (AEP). He is responsible for the engineering and design of all substations in AEP's 11-state territory, which currently comprises roughly 600 projects annually. He also chairs AEP Energy Transmission's co-operative education program. Mr. Fleeman joined AEP in 1981, beginning in the Major Transmission Equipment Section. He became manager of that section in 1991, Manager of Station Engineering in 1996, and was named to his present position following the merger with Central and Southwest Company in 2000. He graduated from The Ohio State University with his BSEE in 1979, and his MSEE in 1987. Mr. Fleeman is a registered professional engineer in Ohio. He is a Senior Member of IEEE's Power Engineering Society, a member of the IEEE/PES Transformers Committee, and is a past chair of PES Columbus Chapter. He currently serves as Vice Chair of the Substation Engineering & Construction Working Group of Edison Electric Institute's Transmission Committee and is a past expert advisor to the US Technical Advisor to CIGRE SC 12 (Transformers). He has contributed technical papers to IEEE, CIGRE and Inter-RAM, in the subject area of major equipment reliability, maintenance and equipment design specifications.

Loren Wagenaar: Mr. Wagenaar (F-'96) is a Principal Engineer in the AEP Transmission Asset Management Department responsible for procurement of power and current transformers, and is involved with specifications, in-house and industry standards, performance evaluation, cost of loss analysis, design reviews, test witnessing, vendor selection and performance, and analysis of in-service failures. Prior to 1982, he worked for Westinghouse Electric Corp. for 17 years, where experience included transformer design, bushing design, development and manufacture, and development of insulation systems. He received a BSEE degree from South Dakota State University, a MSEE degree from Akron State University, and a MS Math degree from Ball State University. He is a member of IEEE PES, DEIS, SCC 4, HVTT and the Transformers Committee, where he is chair of the Dielectric Test Subcommittee and past chair of the Bushing Subcommittee. He is also a US representative to IEC Technical Committee 14, Transformers, and is a member of IEC Working Group 24, which is concerned with dielectric tests and external clearances on transformers. He has eight US patents, has co-authored 13 technical publications, and is a registered Professional Engineer in Indiana.