IEEE/PES Transformers Committee
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"Fault Current Limiting High Temperature Superconducting Transformers"

-- Technical Presentation --
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by Russell Neal, Sam Mehta and others

1. Abstract

Superconducting power system apparatus is of considerable interest to the electrical power delivery industry due to the number of advantages High Temperature Superconducting (HTS) transformers offer. Because of this interest, major ongoing efforts are taking place around the world in the development of HTS transformers, most notably in the USA, Japan, South Korea and Europe.

This tutorial will provide background and historical information about superconductivity. High Temperature Superconductors, Gen-1 (BISCCO) and Gen-2 (YBCO) superconductors, and their architecture--along with a discussion of the factors affecting their performance--will be presented. The many benefits of HTS transformers and fault current limiting HTS transformers will be discussed. Details of a new project, partially funded by the DOE, to manufacture and install FCL HTS at the Southern Cal Edison Irvine substation will be summarized. Finally, some of the challenges leading up to development of industry standards in support of these next generation transformers will be presented.

2. Learning Objectives

This tutorial will provide background and historical information related to superconductivity. Both Low Temperature Superconductors (LTS) and High Temperature Superconductors (HTS), their applications and factors that affect their performance in general and for specific application will be studied. Discussion will focus on the Gen-2 (YBCO) conductor and its architecture to provide understanding of complexity in manufacture and quality assurance of these conductors. Small but finite magnitudes of AC losses that must be managed for optimal apparatus performance, along with cryogenic system considerations for managing conductor and cryogen temperatures, will be presented. Considerations for development of cryo-dielectric materials and design approaches for reliable operation in all conditions will also be discussed.

3. Learning Outcomes

Attendees will gain the following information from their attendance at this tutorial:

- Historical background
- Recent developments and conductor research
- USA efforts in HTS transformer development
- Benefits of HTS transformers
- Added benefits of Fault Current Limiting HTS transformers
- Technical challenges and the need for Industry Standards

4. Presenters' Biographies

Russell (Russ) Neal is a Strategic Program Manager for Southern California Edison, specializing in Smart Grid with an emphasis on distribution. He is responsible for advancing SCE projects in this area. Russ was responsible for SCE's Distribution Circuit of the Future and is currently the Chief Engineer for the Irvine Smart Grid Demonstration.

Mr. Neal holds a BSEE from the US Naval Academy, an MEEE from the University of Idaho, an MBA from Azusa Pacific University, and has lectured at the University of California at Irvine. He is a registered Professional Engineer in both Electrical and Nuclear Engineering in the State of California. His previous experience includes five years as an officer in the surface nuclear Navy, seventeen years at Southern California Edison's San Onofre Nuclear Generating Station, and fifteen years in the Transmission and Distribution Business Unit including service in distribution apparatus engineering, as a district superintendent, and as Manager of Distribution System Engineering.

Shirish (Sam) Mehta is Vice President of Research and Development at SPX Transformer Solutions, Inc. He has over 40 years of power transformer industry experience with Allis Chalmers and SPX. Some of the DOE research programs worked on included development of HTS transformers and transformers for secure power applications. Development of non-arcing, resistance bridging on-load tap changers and development of high temperature insulation systems for high voltage power transformers are ongoing projects, while other pioneering work includes publication of NIST tech note 1204 dealing with accurate measurement of power losses in transformers.

Sam is the past US representative to CIGRE for the A2/Transformers study committee, and he was named an Attwood Associate by the U.S. National Committee of CIGRE for his contributions to the industry. He holds a BSEE degree from the University of Baroda, India; an MSIE from the University of Wisconsin - Madison; and an MSEE from the University of Wisconsin - Milwaukee.