



**IEEE/PES Transformers Committee  
Fall 2004 Meeting, October 24-28, 2004  
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**T A P S**

**-- Technical Presentation, Tuesday, October 26, 4:45 p.m. --**

**by V. Sankar**

**1. Abstract**

Users' aim is to procure reliable and economical transformers that meet their system needs. In this tutorial, use of standards and designs to achieve this aim are discussed. Purchasing specifications' role in optimum utilization of existing tap changers and manufacturing practices are covered. Precautions in operating transformers purchased with constant flux taps as variable flux taps are highlighted. Benefits to users and manufacturers by working as a team are listed. Future work for advancement of transformer industry is suggested.

**2. Learning Objectives**

Attendees of this tutorial session will be learning about the following:

- Types of Taps based on function, electrical connection, winding arrangement and tap changer operation.
- Effect of Taps on first cost and on life cycle cost of the transformer.
- Different types of tap changers available, their optimum utilization, limitations and maintenance cost.
- Types of tapping windings and design practices.
- Guidelines stated in standards, their usage and limitations.
- Various points to be considered in preparation of specifications, especially interaction between system people and transformer designers.
- Adoption of good manufacturing practices to avoid field problems during the life of transformers.
- Cooperation between factory and field personnel to create paths for innovations.

**3. Learning Outcomes**

The information in this session should help participants with the following:

- Selection of type of taps (constant flux or variable flux or mixed regulation) based on operational requirements.
- Determination of most economical tap range and number of taps.
- Selection of taps location (in HV or LV) to achieve least life cycle cost.
- Selection of type of DTC (de-energized) or LTC (on-load) taps based on their advantages and limitations.
- Selection of tank-mounted or in-tank tap changer based on first cost and cost of maintenance.
- Precautions in operating transformers different from their purchasing specifications.
- Use of linear, coarse/fine and reversing taps to obtain most economical transformers with trouble free operation.
- Preparation of functional specifications without imposing restrictions.

#### **4. Presenter's Biography**

**V. Sankar**: Sankar has been a member of IEEE for the past 25 years and a member of the IEEE Transformers Committee for the past 16 years. His earlier tutorials include "Standards, Specifications, Designs and Their Relationships" at the Transformers Committee Meeting in Orlando, Florida in October 2001. He also presented a technical paper entitled "Transformer Maintenance" for Pennsylvania Power and Light at Great Falls, Montana in February 2004.

Sankar's experience includes 21 years as a transformer design engineer at Pauwels, Westinghouse, and Federal Pioneer in North America, and transformer manufacturers in England and India. He also worked for 18 years at Ontario Hydro (Hydro One) in the "transformer maintenance and equipment" sections.

Sankar is a professional engineer in the province of Ontario, Canada. He has a Bachelor's degree in Electrical Engineering and a Master's degree in High Voltage technology. He then received training at Maschinenfabrik Reinhausen GmbH, Regensburg, Germany and at Bharat Heavy Electricals Limited, Bhopal, India. Sankar's technical publications include papers on transformer core configuration that reduce losses, and improvement of impulse voltage distribution.

Sankar retired in May 2000 and operates his own consulting company.