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"Preparation of Transformer Specifications"

-- Technical Presentation --
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1. Abstract

This tutorial will assist end-users and consultants in preparation of transformer specifications to procure economical and reliable transformers which meet system and operational needs. By knowing the implications of transformer parameters on operation and on cost, functional specification can be prepared. Some topics covered in the tutorial are: ratings, voltages, transformer types, vector groups, loss capitalization, over-excitation, insulation levels, cooling types, sound levels, tap range, taps in HV or in LV, operation of taps to compensate input voltage fluctuations or to compensate for regulation, impedance, overloads, short-circuits, accessories, parallel operation, alternative solutions etc.

By knowing the usefulness and limitations of standards (IEEE C57.12.00, CSA C-88, IEC 60076-1 etc.), their reference in the specification can be better understood. Risks and limitations when the standards are used solely as specifications and when the transformer design engineers are considered as system engineers are elaborated.

Knowledge of available materials and accessories used in transformers will help further to evolve a specification that would help the end user. The tutorial provides some of this information.

2. Learning Objectives

This tutorial will help transformer personnel to learn/familiarize the following:

- Work towards evolving a functional specification.
- Minimize ambiguity in the transformer specification to get a satisfactory product.
- Understand the significance of capitalization cost.
- Understand the importance of information to be included in the specifications such that user requirements are understood and fully met by bidders.
- Understand the usefulness and limitations of IEEE, IEC and CSA standards.
- Gain knowledge on factors that influence MVA rating, number of phases, winding connections, vector groups etc.
- Understand the consequence of specifying different insulation levels with reference to standards
- Avoid requirements in specification that are ambiguous or that will add cost with no benefit to the user.
- Establish a quote process beneficial to users and manufacturers.
- Effective tender review and design review meetings.
- Use of globalization to get maximum benefits.
- To encourage innovations.

3. Learning Outcomes

Attendees will gain understanding of the following by attending this tutorial.

- Achieve improved team work between manufacturer and user by understanding and appreciating each other's efforts.
- Develop a functional specification.
- Procure energy efficient transformers with minimum capitalized cost.
- Determine major parameters like ratings, insulation levels, impedance, capitalization of losses, sound levels without ambiguities.
- Decide winding connections (wye, delta etc.) and vector groups (Yy, Yd, Dy, etc.) to reap maximum benefits and to avoid design complications.
- Knowledge for selection of type of taps and their location (in HV or in LV, in wye winding, in delta winding etc.).
- Understand influences of taps on short-circuit stresses and on dielectric stresses.
- Knowledge for deciding the location of the taps (in input winding or in output winding) and their operation for constant flux taps or variable flux taps or combined voltage variation taps.
- Specify requirements for parallel operation.
- Information to be included on the data sheets and on the nameplate.
- Tests to be specified.
- Salient precautions in transport and during the installation.

4. Presenters' Biographies

K. Vijayan Master's in High Voltage Engineering from Indian Institute of Science, Bangalore, India. Member of IEEE. Has 25 years of experience in design and development of EHV transformers and reactors. Presently working as Head of Electrical Engineering at CG Power Systems Canada Inc., Published many papers on transformer technology that includes, development of phase shifting transformers, universal spare transformers, and high voltage power transformers insulation design. Won best paper award at Trafotech conference, in Mumbai, India in 2010.

V. Sankar Master's in High Voltage Engineering from Guindy Engineering College, Chennai, India. Life Member of IEEE. Worked for 48 years with transformer manufacturers and users in Asia, England and Canada. Presented three tutorials at IEEE Transformers Committee Meetings. Published many papers on transformer topics. The latest publication is "Five-Limbed Transformer Cores" in March 2013 Journal of Central Power Research Institute, Bangalore.