IEEE/PES Transformers Committee
Spring 2011 Meeting
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"Transformers Used with Alternative Energy Sources - Wind & Solar"

-- Technical Presentation --
Monday, April 11, 2011
4:45 - 6:00 pm

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1. Abstract

With the goals set forth in the "American Clean Energy and Security Act" (ACESA) the need for more production of energy from Wind and Photo-Voltaic energy sources is required in order to meet the mandate to have 20% of all energy produced by Wind, Solar (DPV) and Geothermal by the end of 2020. This will drive the need for collector system transformers to an ever higher demand and the transformers will need to change along with the technology. We will look at anomalies imposed directly on the transformer from these energy sources, the typical operating conditions observed and ideas to remediate constraints on safety for the end user by NFPA-70E.

2. Learning Objectives

This tutorial is planned to:

- Provide background information on the technologies being discussed, current levels of the existing energy market, and how the goals in the ACESA affect these technologies.
- Explain the impact on transformers due to harmonics, frequency variations, current and voltage spikes/dips due to wind gusts and Low Voltage Ride Through (LVRT) conditions.
- Explain the end user's current safety practices to comply with NFPA-70E and how the industry can assist in helping the end user minimize down-time and loss of operations during routine maintenance.
- Introduce the user and interested parties to the effects of primary and secondary valued variables that can affect the working of a transformer connected to a solar generator.
- Discuss the analytical aspects of systems with voltages as high as 38 kV and power ratings up to 10 MVA. shedding light on some finer nuances that affect operations of such systems. Explain the impact on transformers due to vacuum switching and probability of failure due to excessive operations.
- Give an overview of possible future directions of new designs for improved performance and safety for the end user.

3. Learning Outcomes

As a result of attending this tutorial session, members will gain an understanding of the following:

- What impacts the aggressive goals for clean energy place on the transformer industry.
- What impacts Wind and Solar (DPV) energy sources have on the performance of small power and distribution transformers.

- Relationship between performance parameters of a system where transformers are a major contributor on the Master Grid and to comply with requirements of NERC, FERC, local entities and the Large Generator Interconnect Agreements (LGIA)
- Members will learn to apply the concepts learned to solar systems of larger capacity. Demand for such systems is rapidly increasing and government oversight is stringent. Expansion of system capacities in conjunction with local electrical bodies is understood effectively by the user.
- Members will gain valuable information whether as a system designer or transformer manufacturer on mitigating damage to transformers and operational considerations.
- Possible future directions of new designs for improved performance and safety for the end user.

4. Presenters' Biographies

Dr. David Buckmaster: David is a self-employed consultant, specializing in transformers, stationary power systems, MV, HV and EHV design parameters. David has ventured into the wind energy field and has studied the impact on transformers from this technology and the hurdles to overcome associated with new requirements of NFPA-70E. David received his Honorary Ph.D. degree from Moscow State University in Moscow, Russia, in Electrical Power Engineering in 1998. He has over 36 years of combined experience (professional and pre-professional) in the area of power, distribution, transformers, and transmission grid designs. Dr. Buckmaster co-authored a new chapter in an electrical engineering handbook on transformer design with Dr. Shertukde and Mr. Jim Harlow. He is active in the IEEE Transformers Committee and several subcommittees including but not limited to the IEEE-USA Climate Change Technology Subcommittee.

Dr. Hemchandra Shertukde: Hemchandra is a Senior Member of IEEE, AIAA and SPIE since 1991. He received his MS and Ph.D. from the University of Connecticut, Storrs, CT in 1985 and 1989 respectively in Controls and Systems Engineering. He is a Professional Engineer in the State of Connecticut. He obtained his Bachelor of Technology degree - B.Tech (High Hons) from the Indian Institute of Technology, Kharagpur in 1975 with specialty in Controls and Power. He is on the faculty of the Electrical Engineering Department at the University of Hartford since 1988. Dr. Shertukde holds several patents for his inventions in the power and transformer field. Dr. Shertukde has published more than 75 journal and proceedings articles in controls, signal processing, power and multi-sensor, multi-target tracking. He recently authored the books "Transformers: Theory, Design and Practice with Practical Applications" and "Tracking of Crossing targets with Passive Sensors". Recently Dr. Shertukde co-authored a new chapter in an electrical engineering handbook on transformer design with Dr. Buckmaster and Mr. Jim Harlow.

Phil Hopkinson: Phil is an IEEE Life Fellow and long service Transformer Engineer. He received his BS in EE from Worcester Polytechnic Institute in 1966. He also graduated from GE's Advanced Engineering Course in 1970 and simultaneously received his MS in System Science (EE) from Brooklyn Polytechnic Institute. In 2001, Phil formed a power transformer consulting company, called HVOLT Inc. He currently holds 15 US patents, is a Registered Professional Engineer in North Carolina, and is Technical Advisor (TA) to the US National Committee for IEC TC14 for Power Transformers and past TA for IEC TC96. Phil's numerous contributions to IEEE, promoting the engineering field and the transformer industry are too numerous to enumerate in this document.