

T&D General Systems Subcommittee
Practical Aspects of Ferroresonance WG
Adam's Mark Hotel, Denver, Plaza Court 6
Tuesday, June 8, 2004, 10:00-12:00

Meeting Minutes

Participants:

Francisco De La Rosa	fdelarosa@twaes.com
Manuel Gonzalez	manuel.gonzalez@centerpointenergy.com
David Jacobson	dajacobson@hydro.mb.ca
Michel Riouale	michelrioual@edf.fr
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Juan A. Martinez	martinez@ee.upc.ej
Albert Keri	ajkeri@aep.com
Bruce Mork	bamork@mtu.edu

Working Group Officers:

Bruce Mork, Michigan Tech Univ. is the chair of the WG. David Jacobson is co-chair and secretary. Reigh Walling is a backup (although our meeting time conflicts with Reigh's WG Distributed Generation Integration).

Discussion:

- Bruce went over the charge to the WG and outline of the WG document for new participants in the meeting. The documents can be downloaded from: http://www.ece.mtu.edu/faculty/bamork/FR_WG/
 - The WG is to provide a comprehensive literature survey of ferroresonance issues, provide a practical explanation of ferroresonance, document a set of ferroresonance case studies and a set of scenarios that involve overvoltages and harmonics that are not ferroresonance.
- The 2003 Toronto Panel session was discussed. Bruce Mork, David Jacobson, Roger Dugan, Reigh Walling, and Juan Martinez presented panel papers. There were approximately 50 attendees and the panel papers generated a lively discussion.
- The Jan. 20, 2004 San Diego WG meeting was cancelled as there was a conflict with many of the WG members who were attending the Orlando DistribuTech meeting.
- The minutes from the Toronto meeting were reviewed and accepted. Bruce will post the minutes on the WG web site.
- WG Document brainstorming
 - Basic ferroresonance modeling information will be provided in the document but no advanced ideas. Juan Martinez is willing to contribute a 3-legged duality-based transformer model and simple simulations showing the impact of cable length and loading. Noel Janssens has offered to contribute on iron core loss modeling.

- Michel Riouale volunteered to provide a temporary overvoltage example that was the result of remnant flux.
 - Bruce Mork volunteered to provide a sustained harmonic inrush example.
 - A cost-benefit analysis section could be provided. For example, three single phase transformers vs. a 5-legged padmount transformer, single pole switches/reclosers or fuses vs. 3-pole switches/reclosers. Mort Knodaie volunteered to write a cost-benefit section.
 - The document shouldn't make any hard guidelines based on simulation.
- Bruce mentioned that the IEEE has concerns about WGs posting draft documents. Bruce will modify the WG's website to have an area password protected. Bruce will work with the IEEE to have a link to our WG's website added to the IEEE T&D's web site.
 - Bruce is willing to keep maintaining the ferroresonance list server (frl@mtu.edu).
 - Presentation: "Ferroresonance in a cable-fed Distribution Transformer", Francisco De La Rosa
 - Francisco presented an example of single phase reclosing a 12.5 kV 250 kVA triplex core transformer through a 14 km overhead transmission line.
 - Francisco asked if there was interest on reporting on ferroresonance in low voltage networks. The WG agreed to allocate a section of the document to LV networks and Francisco will provide a contribution.
 - A question was raised on broadband communication over power lines. Could the capacitive devices being added to aid in 16-30 MHz communication have 60 Hz ferroresonance impacts? No one thought this was a problem. Capacitors are used in North Dakota for a 220 Hz load management signal and there haven't been any reported ferroresonance concerns.
 - Russ Patterson of TVA suggested in an e-mail to Bruce that the WG take a look at the PSRC D10 WG document "EMTP Reference Models for Transmission Line Relay Testing" as some of the basics of simulation, modeling and parameters may be covered already. Their WG page is located at <http://www.pes-psrc.org/d/>. Bruce will circulate a PDF file of the draft report to this WG.
 - Next meeting discussions:
 - Should we do another panel session in San Francisco (June 12-16, 2005) and then a tutorial in New Orleans (October 9-14, 2005)?
 - Albert Keri will send Bruce information on the feasibility of a tutorial. It was recommended to avoid video taping. If the tutorial doesn't work out a panel session could be held in New Orleans.
 - The consensus was that everyone thought it would be difficult to submit new panel papers for San Francisco by the December 13,

2004 deadline and provide contributions to the WG document at the same time.

- The WG decided to focus on completing the document before the San Francisco meeting.
- The end of September, 2004 was targeted as a deadline for contributions. (post meeting note: deadline for contributions should be revised to January 2005)
- A conference call or face-face meeting could be organized to review the draft document before the San Francisco meeting.
- A summary of the WG document should be published in the IEEE Power & Energy magazine.

WG Special Publication assignments

- Foreward/Executive Summary – Bruce Mork
- Introduction
 - What is Ferroresonance?-Bruce Mork
 - Transformer Core Structure & Equivalent Circuit Models-??
 - Typical Waveforms and Overvoltages-??
 - Nonlinear Behaviour-??
- Detailed Summary/Literature Search
 - Historical Background -David Jacobson
 - Basic Circuit Types Susceptible to Ferroresonance-David Jacobson
 - Basic Mitigation Techniques-David Jacobson
- Catalog of Ferroresonance Scenarios and Mitigation
 - Distribution Systems
 - Examples of Ferroresonance-Roger Dugan
 - Ferroresonance in Low-Loss Distribution transformers-Reigh Walling
 - Ferroresonance in a Cable Fed transformer- Francisco De La Rosa
 - Cost of Mitigation Options- Mort Knodaie
 - Subtransmission Systems
 - Open-Delta PT-David Jacobson
 - Transmission Systems
 - Transformer/grading capacitor-David Jacobson
 - Transformer Terminated Double-Circuit Line-David Jacobson
 - Capacitor Voltage Transformer-David Jacobson
 - Manifestation of Ferroresonance on Customer Side of Meter-??
 - Special Cases involving Instrument transformers, industrial Applications-??
 - Engineering Forensics, Identifying Ferroresonance, Symptoms, Damage-Atef Morched?
- Things that are NOT Ferroresonance
 - TOV Summary-Bruce Mork/David Jacobson

Refer to types described in IEEE TOV task force report, 1990
Cigre paper 33-210

- EDF TOV Example-Michel Riouale
- Voltage Magnification (cap bank switching)-??
- Sustained Harmonic Inrush-Bruce Mork
- Shunt reactor resonance-David Jacobson
- Switch Restriking-David Jacobson
- Misinformation in the literature-Bruce Mork
- Introduction to Modeling, Simulation, Parameters
(Goal of Chapter – provide the basics, make the engineer knowledgeable enough to continue on to more advanced techniques or to know when to seek help. Refer to TP-133-0 Modelling & Simulation of System Transients)
- Basic Orientation and Introduction-Bruce Mork/Juan Martinez
- Simulation Tools-Bruce Mork
- Introduction to Advanced Modeling
 - Duality based modeling-Juan Martinez
 - Iron-core loss modeling-Noel Janssens
- Conclusions
Should include general recommendations on preferred connections, operating strategies, how to avoid ferroresonance in the design stage or mitigate. The cost of mitigation could be included
- Appendices
 - Ferroresonance Literature Review-David Jacobson