MINUTES OF THE MEETING OF THE HVDC CONVERTER TRANSFORMERS & SMOOTHING REACTORS S.C. IN PITTSBURGH, PA, OCT. 6, 2003

The S.C. met in the Grand Station III Meeting Room of the Sheraton Station Square Hotel in Pittsburgh, PA on Oct. 6, 2003 from 1:45 p.m. to 3:00 p.m. There were 11 members and 12 guests present. One guest requested membership. Note that 2 new members were added since the Raleigh meeting; Les Recksiedler of Manitoba Hydro and Sten Andersson of ABB. The following are the highlights.

1. Introductions were made and the minutes of the Raleigh meeting were approved. The S.C. was briefed re the Administrative S.C. meeting.

2. Richard Dudley delivered the sad news that S.C. member Einar Purra had passed away during the summer. His valuable contributions and cheerful good natured approach will be deeply missed by the S.C.

3. The issue of transformers used in conjunction with voltage source converter based HVDC schemes was discussed. As agreed in previous meetings an ANNEX will be included in the next revision of IEEE C57.129 covering such transformers. Pierre Riffon has prepared a draft and comments have been received from Peter Heinzig and Lars-Erik Juhlin. Different schemes are currently utilized and others will be developed. The type of scheme impacts the operational characteristics of the transformer. The ANNEX will make note of these issues but will not provide details. Papers will be referenced. Pierre Riffon will prepare a revised draft reflecting the preceding discussions/inputs.

4. Christoph Plotner made a presentation on the core losses of a transformer used in conjunction with a voltage source converter based HVDC scheme; transformer directly connected to the VSC. Note other schemes are used. Christoph's presentation will be sent to S.C. members with the minutes. Christoph will prepare an IEEE paper based on his presentation and it will be referenced in the ANNEX on transformers used in conjunction with VSCs. It was also noted that operational losses of transformers associated with VSC schemes can be higher than tested losses. This comment will be added to the ANNEX on transformers used with VSC's; including papers in a bibliography.

5. Lars-Erik Juhlin made a presentation on converter transformer failures. A copy of his presentation will be sent to S.C. members with the minutes. One major caution raised by Lars-Erik is that it is very important to fully understand the cause of converter transformer failures before any action is taken re test code. Pierre Riffon also noted that converter transformer failures often result in very large revenue losses; in many cases larger than the cost of the converter transformer.

6. Lars-Erik Juhlin also provided copies of previously published papers on the subject of converter transformer failures; CIGRE (ELECTRA).

"In-Service Performance of HVDC Converter Transformers and Oil-Cooled Smoothing Reactors", Electra No. 155, August 1994.

"The Relationship Between Test and Service Stresses As a Function of Resistivity Ratio For HVDC Converter Transformers and Smoothing Reactors", Electra No. 157, December 1994.

7. There is a current effort within CIGRE re converter transformer failures; JTF B4.04/A2-1 which is chaired by Jack Christoferson of the USA. Pierre Riffon obtained permission to distribute the draft version of their report "Analysis of HVDC Thyristor Converter Transformer Performance" and associated written documents to minutes of our S.C. This was done prior to the S.C. meeting. Discussion took place on this CIGRE project. The latest version of the report is Draft 10a. The project is not final. One of the associated documents was prepared by Yanny Fu of KEMA (Netherlands) and dealt with possible test methodology modification etc. to address possible failure causes. These comments may not be part of the final CIGRE report. Pierre Riffon and Peter Heinzig have commented on Yanny Fu's test proposals. The consensus of the HVDC Converter Transformers and Smoothing Reactor S.C. is that any modification to the test code in IEEE C57.129 will have to be well thought out and fully justified. Testing is expensive. The CIGRE report and associated documents are only an additional information source for consideration by the S.C.

8. Les Recksiedler of Manitoba Hydro made a brief presentation re their experiences with converter transformers. He also included input from the recent HVDC Users Group Conference held in Winnipeg. Some ideas he tabled are:

- Factors important to converter transformer performance are testing (will not address all failures), design review (should reference CIGRE report "Guidelines For Conducting Design Reviews for Transformers 100 MVA and 125 kV and Above") and quality. Perhaps the preceding can be covered in a brief information annex in C57.129.

- Converter transformers have passed all required tests and still experience in-service problems. Why?

- A separate oil conservator should be required for the tap changer to avoid possible erroneous interpretation of dissolved gas analysis for the main tank oil.

- In specifying the tap changer, derating of the tap changer should be considered due to the high duty level.

- Does the dc bushing standard adequately address bushings for converter transformers? Input from Fred Elliot will be sought.

9. The Chairman stated that he would attempt to prepare a draft revision of IEEE C57.129 that includes all submissions and discussion consensus prior to the San Diego meeting.

The meeting adjourned at 3:00 p.m.

Richard F. Dudley

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