

DISCUSSION MEETING

Study Committee A2

(Power transformers and reactors)

2022-09-01

SUMMARY

Chairman: Pascal MUELLER

Secretary: Marc FOATA

Special Reporters: Mahdi RAHIMBAKHSI (PS1), Zhongdong WANG (PS2), Laetitia MAUGAIN (PS3)

1. INTRODUCTION

The 2022 discussion meeting of Study Committee A2 was held on 30th of August in Amphitheatre Bleu at the Palais des Congrès in a full day session.

The GDM was related to the following three Preferential Subjects (PS):

PS1: Experience and new requirements for transformers for renewable generation

PS2: Beyond the oil-immersed transformers and reactors

PS3: Best practices in transformers and reactor procurement

GENERAL STATISTICS

Participants: There was a total of 330 participants over the full day with a peak at about 200 participants (during the morning session). A total of 52 prepared contributions were presented addressing all 21 questions of the special report, all subjects stimulated very active spontaneous discussions from the audience.

PS1

13 paper, 6 questions, 1 NGN paper

17 written and presented contributions to 6 questions. There was a total of 13 spontaneous contributions with discussions.

PS2

14 paper, 6 questions

19 written and presented contributions to 6 questions. There was a total of 16 spontaneous contributions with discussions.

PS3

13 paper, 9 questions

16 written and presented contributions to 9 questions. There was a total of 24 spontaneous contributions with discussions.

2. RUNNING OF THE MEETING

The Discussion Group Meeting was chaired by the Study Committee Chairperson, Pascal MUELLER, with Mahdi RAHIMBAKHSI (PS1), Zhongdong WANG (PS2), Laetitia MAUGAIN (PS3) as Special Reporters and Marc FOATA as SC A2 Secretary.

The morning session started with a brief summary by the chairperson of the scope of the work of SC A2. The chairperson also provided a quick summary of the procedure for running the GDM. The chairperson then introduced the special reporters and the preferential subjects, and indicated that the special reporters would provide a brief discussion of each preferential subject prior to the contributor presentations at the end of each PS.

3. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 1

Prepared contributions for Preferential Subject 1 (PS1) “Experience and new requirements for transformers for renewable generation” included:

- Adoptions in the design of step-up transformer for renewable generation, such as aramid materials and mechanical stress distribution, to meet the special requirements, such as vibrations, swaying and cooling.
- For PV converters the specific harmonic content, frequent switching (inrush current) and unbalanced load should be considered during the thermal and dielectric design. Moreover, remote installations could require special environmental aspects, such as bio degradability and high flash point of the insulating liquid. Furthermore, transformer could be de-energized or the voltage could be reduced close to 0 V to reduce no-load losses during the night-time.
- The digitalization of transformer can help to increase the operational transparency and condition monitoring in installations with limited or complicated access for inspections.
- Regarding the condition assessment of HVDC transformers, the selection of appropriate diagnostic method and the combination of these methods can help to improve the conditions assessment, including OLTCs. Regarding bushing failures, it was recommended to use vertical installed bushing to prevent the loss of insulation in case of an insulation leakage. Moreover, the dielectric stress on tap windings were investigated with the result that current design practice considers the stresses already.
- The decision to use of dry-tape or liquid-immersed GSU transformers for PC applications should consider especially the temperature environment of the transformer. Dry-type transformer should have a well-controlled temperature environment, whereas liquid-immersed transformer may be used in harsher environment, due to the better cooling performance.
- Increasing harmonics could be mitigated by using the VSC technology instead of the LCC technology, if applicable in the specific case.

There were 13 spontaneous contributions from the audience and the web application during the first discussion round.

KEYNOTE PS1

The keynote for PS1 was given by Tara-Lee McARTHUR with the title “10 tips in 10 Minutes” for transformer procurement.

NGN PRESENTATION PS1

Christian PÖBNIKER “Bubble Formation in Power Transformers – a Potential Risk for the Future Network Reliability?”

4. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 2

Prepared contributions for Preferential Subject 2 (PS2) “Beyond the oil-immersed transformers and reactors” included:

- New transformer design concepts: New design concepts are available and can be also a cost-effective alternative to established transformer designs. The applicability of new designs need to be evaluated for each individual project.
- Experience of reliability of alternative transformer technologies: positive experience gained with alternative liquid-immersed transformers up to 574 MVA. Depending on the specific application, the design and insulation liquid should be adopted. Dry-type transformer are mainly affected by the aging of the insulation and the subsequently caused breakdown of insulation.
- Maintenance challenges in demanding applications: Liquid-immersed transformers may be maintained similar. Dry-type transformer may require special maintenance, depending on the specific environment.
- New type of alternative transformer designs: Further research are required to investigate components like bushings, OLTC, and gaskets in transformer alternative designs.
- Experience of alternative transformer designs at elevated temperatures: Different case studies and tests were presented with positive experience. The usage of alternative insulation liquids can help to produce eco-friendly and cost-effective customized solutions. The usage of a specific liquid depends on the actual application and boundary conditions of the individual project.
- Prospective for SSTs: The development of SSTs is driven by applications, such as e-mobility, railway systems and MVDC distribution.

There were 16 spontaneous contributions from the audience and the web application during the first discussion round.

KEYNOTE PS2

The keynote for PS2 was given by Janusz SZCZECZOWSKI with the title “Experience and new requirements for transformers for renewable generation”.

NGN PRESENTATION PS2

Pedro J. QUITANILLA “Analysis of new dielectric fluid alternatives using the design of a thermal distribution test platform model and CFD methods”.

5. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 3

Prepared contributions for Preferential Subject 3 (PS3) is “Best practices in transformers and reactor procurement” included:

- Qualification, specification, standardization and end-of-life of components: different examples are presented where standardization combined with qualification and specification are used from the manufacturers and the users to reduce the costs and to increase the reliability, sustainability and availability of the assets.
- Changes due to COVID-19: due to COVID-19 remote inspections were used and are still used. Nevertheless, remote inspections may also introduce vulnerabilities of the process, e.g. due to different time zones.
- Varistors in transformers: Varistors can be avoided if the design can be adopted. If design adoptions are not feasible, it could be required to use varistors. Currently there is no best practice to trace the condition of the varistors over life time. A 1 mA DC finger print measurement was proposed to trace the condition of the varistors.

- Black and white box transformer models: white box models are used by the manufacturers for the electric design of the transformer. For different purposes, black box models can be derived from white box models. Research reveals that no extra margins for very fast transients (VFT) need to be considered. VFT are already considered in the design.
- Short-circuit testing: The manufacturers agreed on short-circuit tests from time to time and not only rely on numerical calculations. The full scale short-circuit test should be used to increase the accuracy of the models.
- GIC capability: To validate the GIC capability of transformer numerical calculations methods are available to assess the electrical and thermal capability of transformer under GIC bias. Field or laboratory measurements require special laboratory equipment and a sufficiently large power source.

There were 24 spontaneous contributions from the audience and the web application during the first discussion round.

KEYNOTE PS3

The keynote for PS2 was given by Fabio SCATIGGIO with the title “Beyond the mineral oil transformer”

NGN PRESENTATION PS3

Pablo NARVAEZ “Experiences and risks when dealing with remote inspections of Factory Acceptance Tests on EHV Inductive Equipment”.

6. CONCLUSION

A total of 52 written and presented contributions, as well as 53 spontaneous contributions, suggestions, and comments provided many interesting aspects and stimulated useful discussions.