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Comparison of Systems Formed of Moulded Pressboard Barriers and Fully Wrapped Crepe Paper Insulation in the Case Study of UHV Winding Exits

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INTRODUCTION

- New CIGRE report informed that about 50 % of major failures occur in the Windings
- Main problem is breakdowns of insulation materials and components which are caused by partial discharge (PD)
- One of the risky part is the exit insulations of the HV- UHV windings
- Due to PD, properties of this parts deteriorate very often
- Qualitywise, the pressboard barrier system is much better to compare with full wrapped crepe paper insulation in terms of moisture and ageing
- Barrier system (oil gap) is used also in the windings. For design of that, there are FEM programs with special design curves
- New worldwide target for the life time of power transformers is more than 50 years under proper conditions

Experimental Design and Procedures

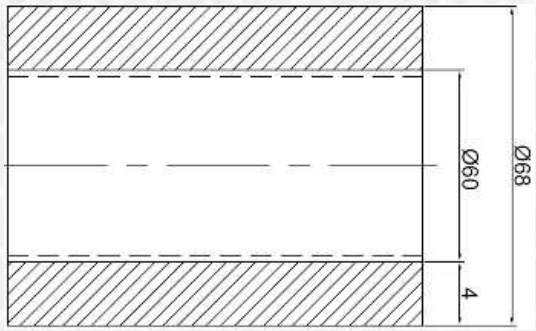


Figure 1 - Model A – Crepe Paper (CP)

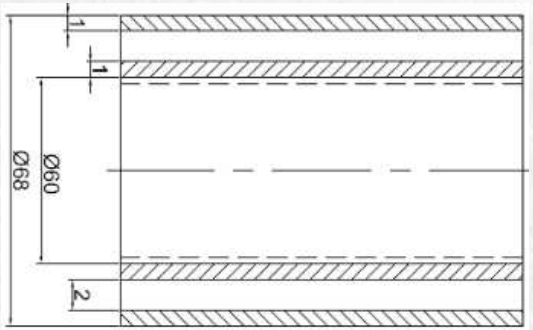


Figure 2 - Model B – Moulded

There are two models to present, as basic experiment in a case study, one is the full wrapped crepe paper insulation and the other is moulded pressboard barrier

Electrical Experiments

Comparison curves and results between Moulded Pressboard Barriers and Fully Wrapped Crepe Paper

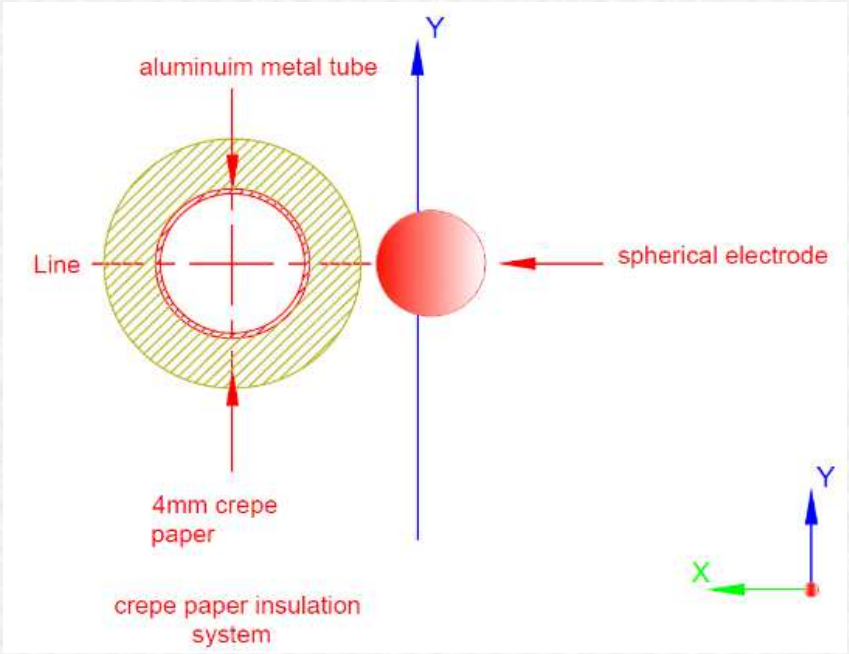


Figure 3 - Model A
Geometry of Crepe Paper Insulation (Wrapped)

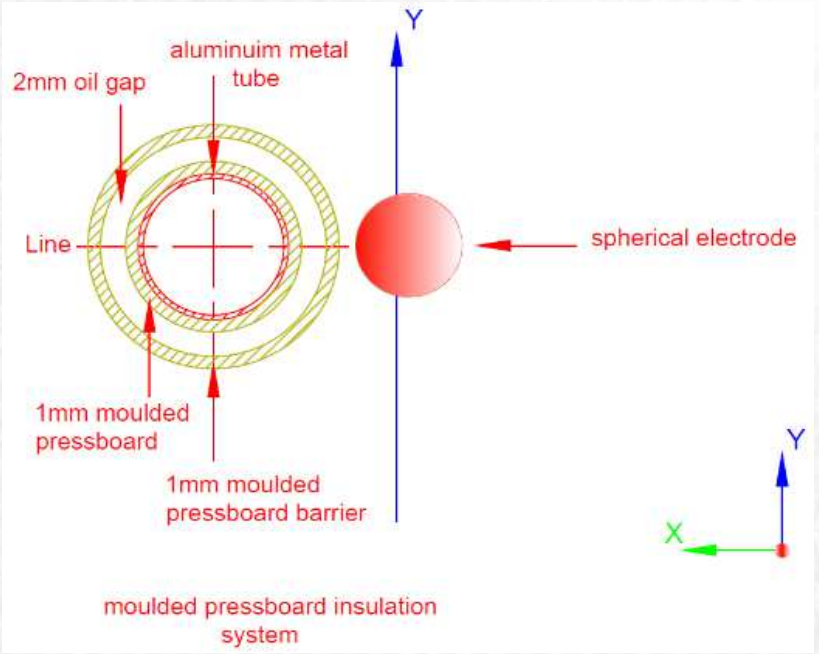


Figure 4 - Model B
Geometry of Moulded Pressboard Barrier

Electrical Experiments

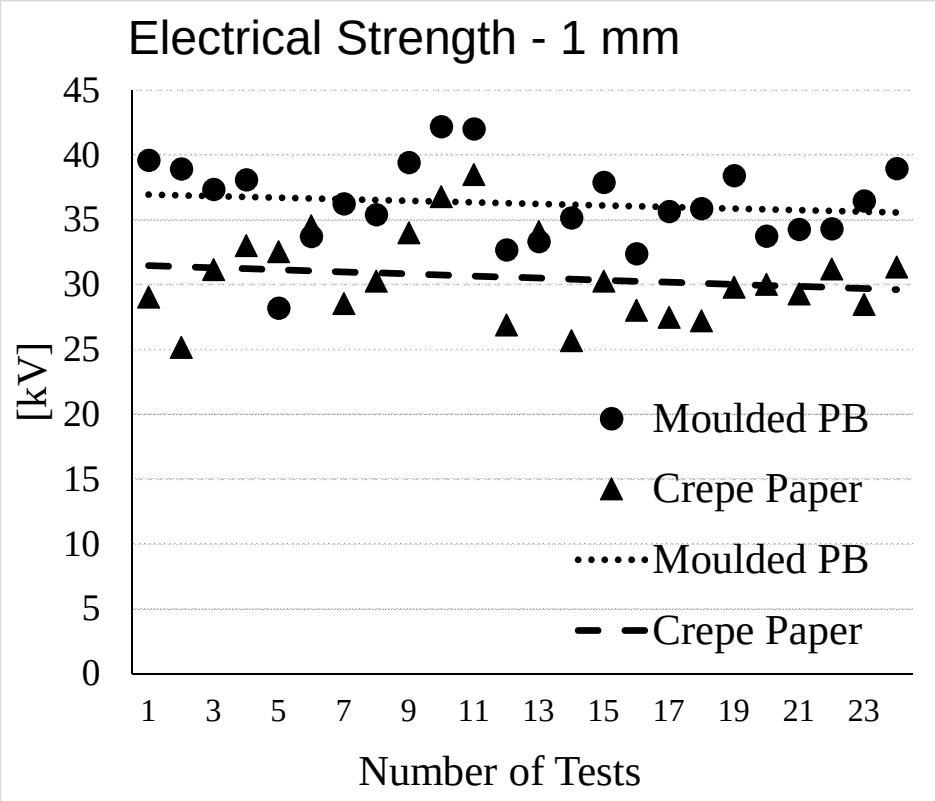


Figure 5 – Electrical Strength of 1 mm Insulation

Partial Discharge Inception Voltages seem similar as per trend lines.

Nevertheless Mouldable Pressboard produces better results compared to crepe paper in terms of Electrical Strength.

Electrical Experiments

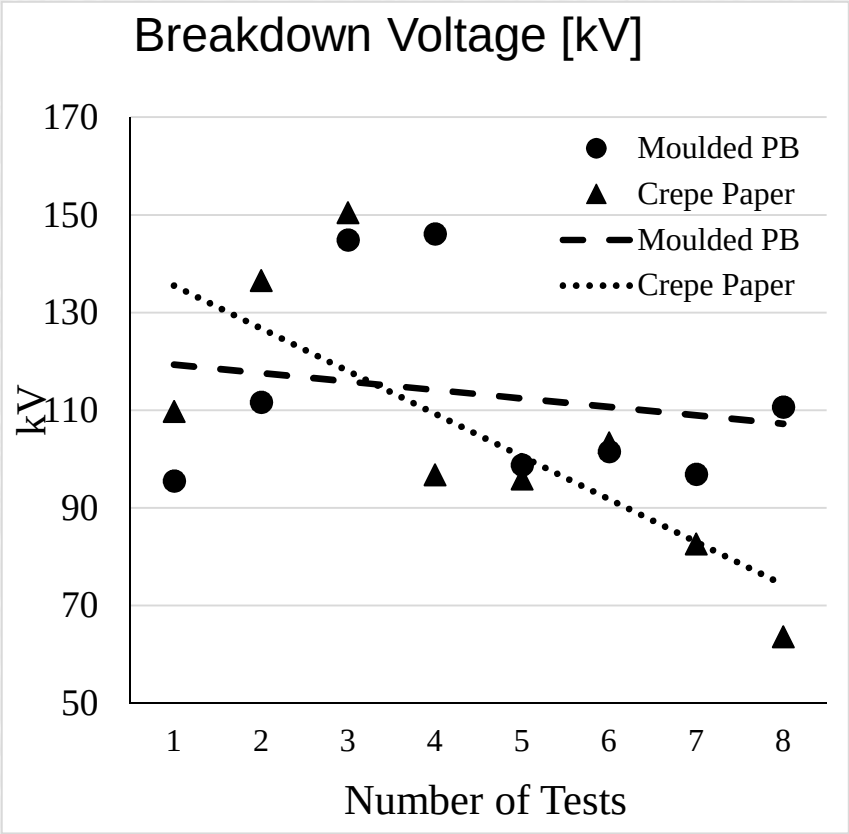


Figure 6- Breakdown Voltage of Insulation Systems (Model A and B)

Although crepe paper system is the same as the barrier system with Moulded Pressboard in regards to oil duct strength in the simulation results, the barrier system with Moulded Pressboard is stable when the test results are compared.

Partial Discharge Inception Voltages seem similar as per trend lines.

Chemical Experiments

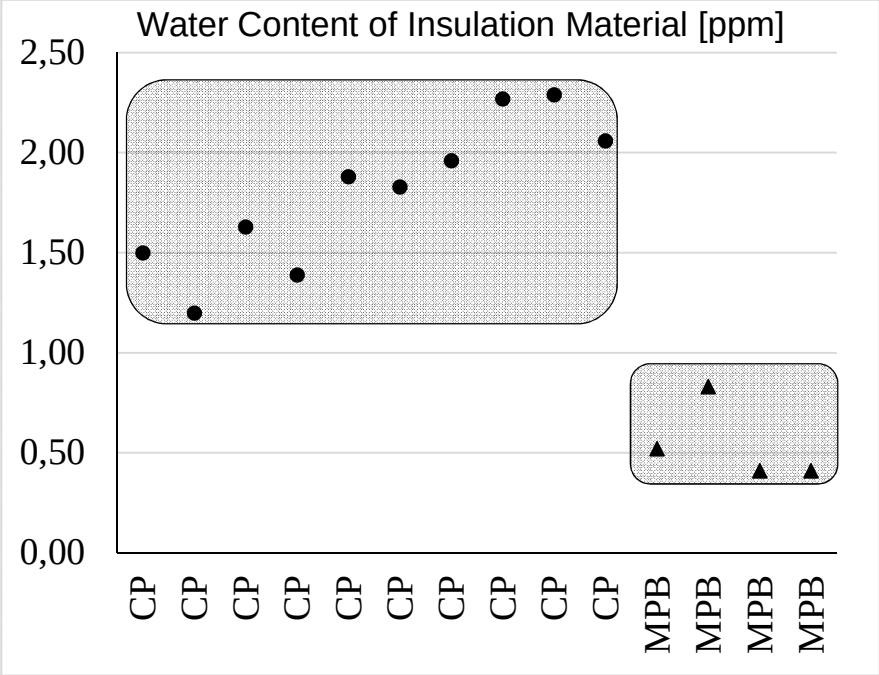
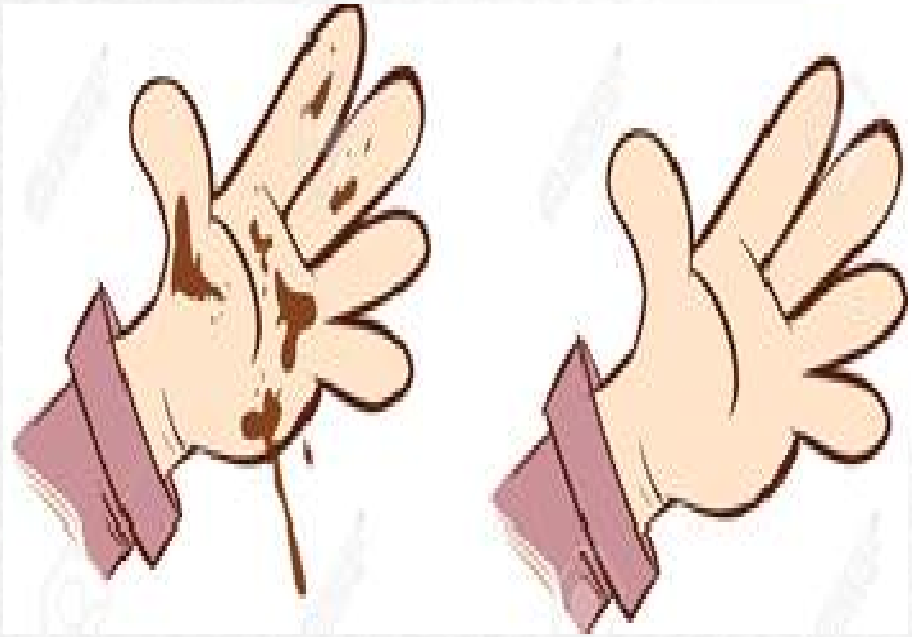


Figure 7 – Water Content of Insulation Material

Moulded pressboard (MPB) reached to required values but it was concluded that the water content of crepe paper was not at acceptable level. A water content of 1-2 % was measured on crepe paper.

In case that you produce your winding exit parts with crepe paper wrapping, take care that the hands of workers must be clean enough

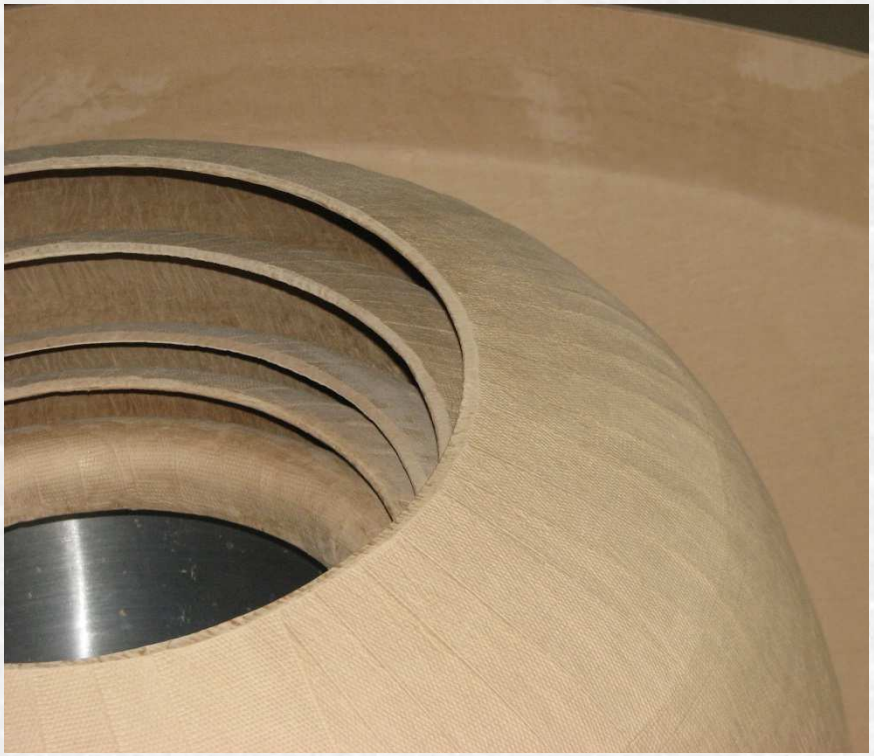


Handling process is very critical that hands must be sufficiently clean.
Dirty hands are strictly forbidden during wrapping of crepe paper.

Are you sure that your hands are clean enough?

Electrodes (Shields)

With Moulded Pressboard Barriers



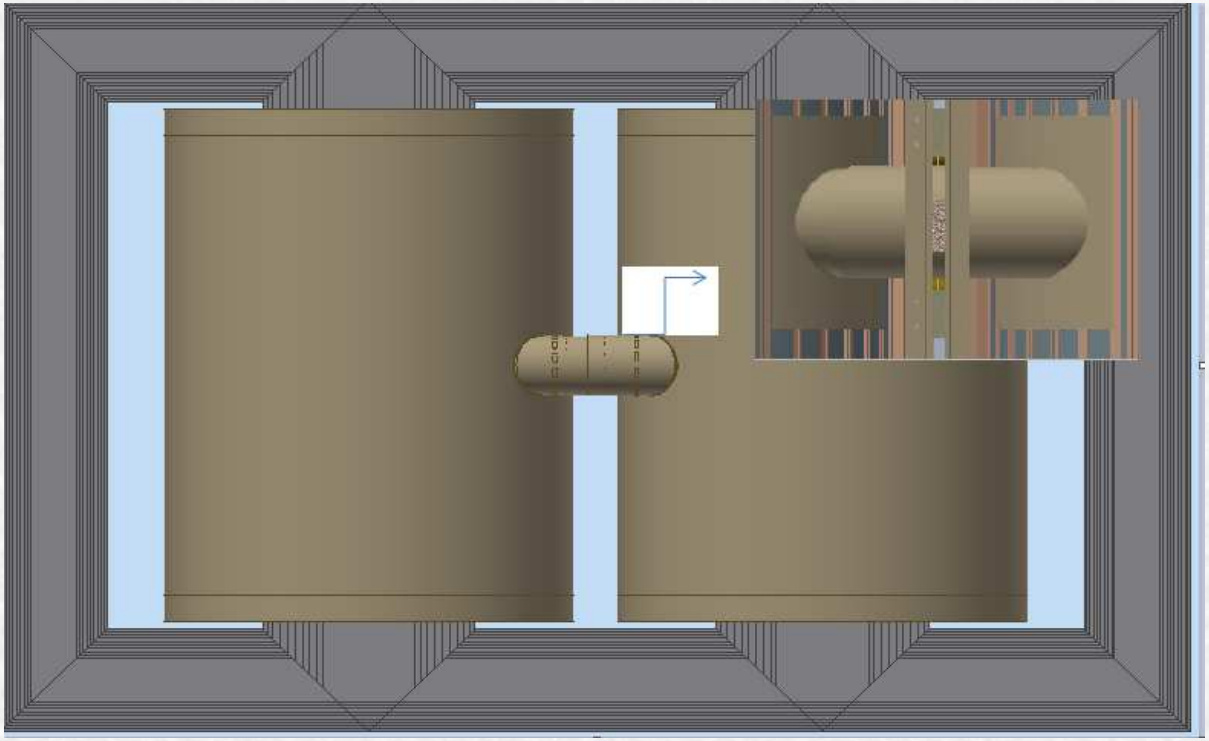
Electrically and mechanically better solution

With Fully Wrapped Crepe Paper Insulation

The insulation made with crepe paper might get loose after drying or during service in time.

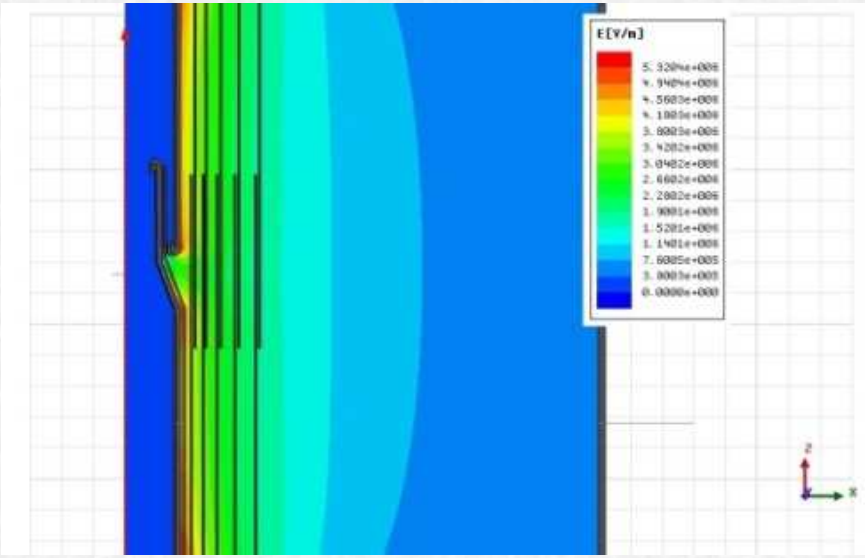
Case study :

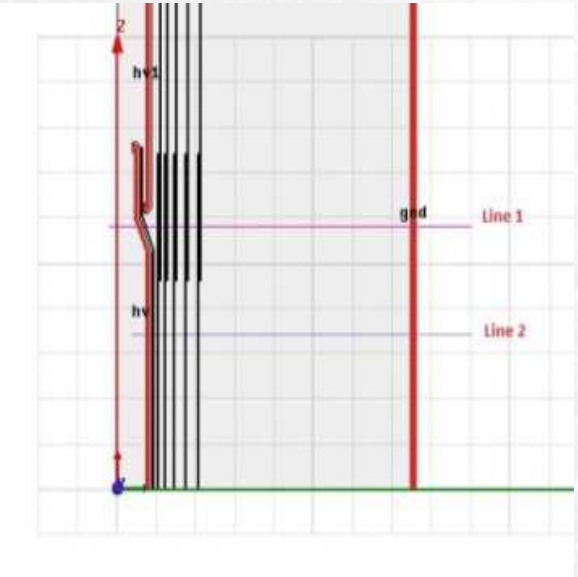
Connection System with Pressboard Barriers for 765 kV, HV windings



•This is a special study of the connecting windings, because Preferring the model with thick crepe paper insulation was problematic in terms of test, drying difficulties and assembly limitations.

Electrostatical design:





Each oil duct is analysed for critical points. The system is optimized for high electrostatic stress density. Reliable design is created step by step in each iteration.

Electrostatical design:

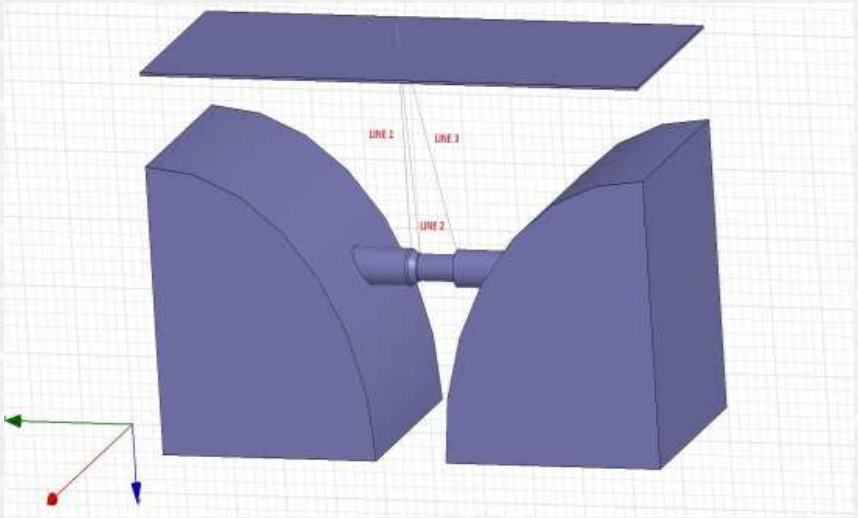


Figure 6

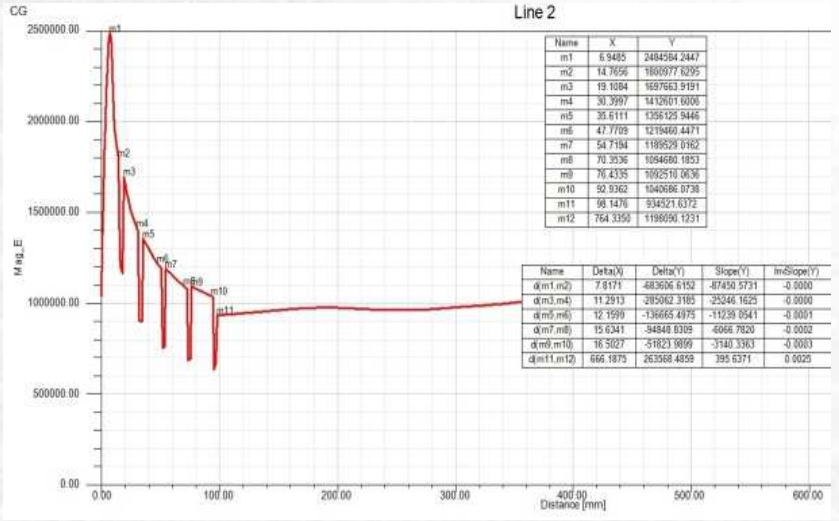


Figure 7

Barrier system (oil gap) is using also in the windings. For design of that, there are FEM programs with special design curves

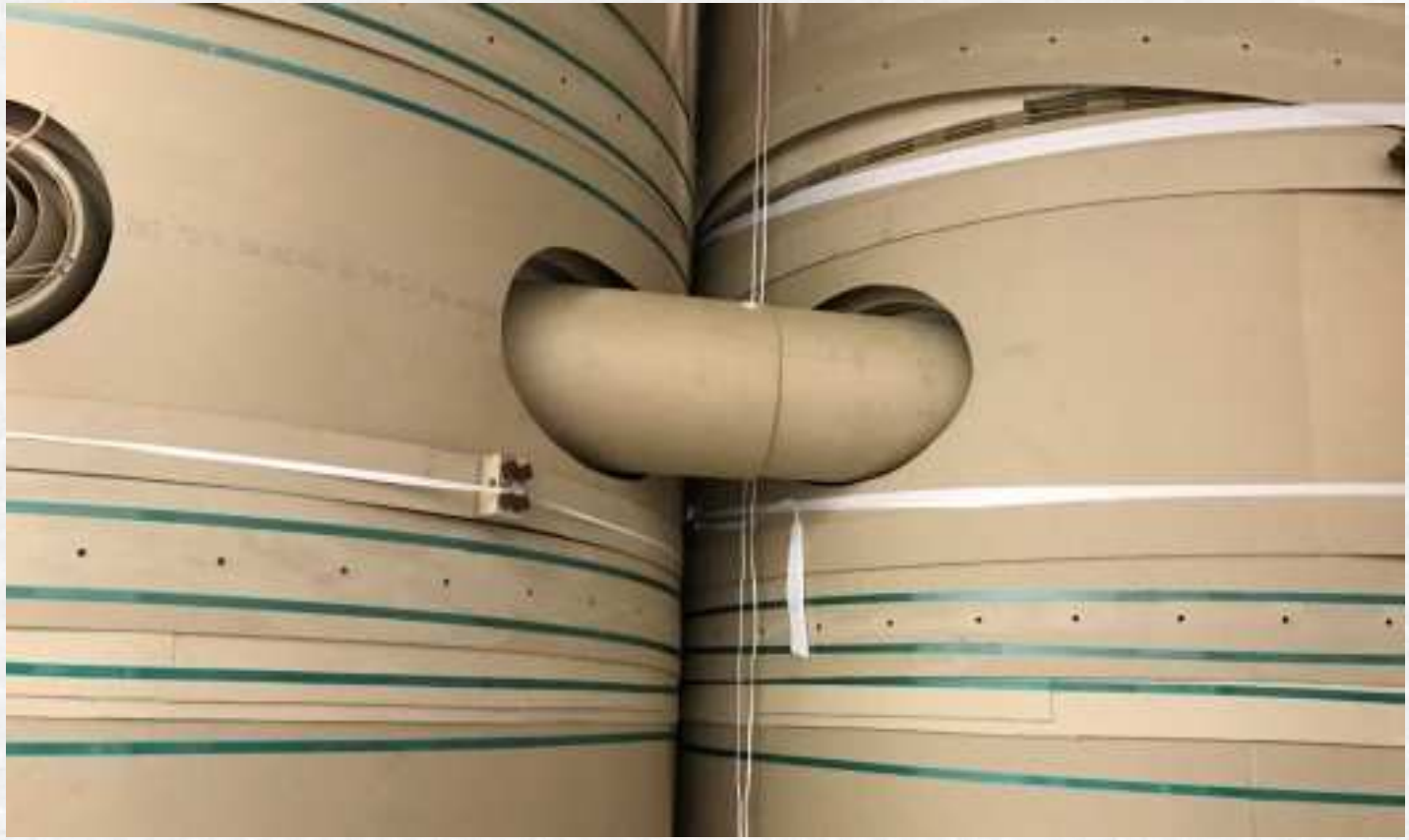
Mechanical design:

ADJUSTABLE OVERLAP

for between windings

Moulded Pressboard Barriers

The special connections needed different solutions



- You can minimize the risk

Moulded Pressboard Barrier Solution

Creppe paper wrapped solution

CONCLUSION

- **Main problem is breakdown of insulation materials and components which are caused by partial discharge (PD)**
- **Think that crepe paper causes the aging earlier, the more paper in active part, the sooner aging!**
- **The lead exits of the HV-UHV windings are very risky parts**
- **In a basic experiment, the differences between moulded pressboard barrier and full wrapped crepe paper insulations were illustrated.**
- **In the graphs some advantages of moulded pressboard barrier compared to fully wrapped crepe paper insulations can be seen.**

CONCLUSION

- **Instead of thick crepe paper wrapping it is better to use of moulded thin pressboard barriers (oil gaps)**

- **The case study shows that how in practice the changing of fully wrapped crepe paper insulation to moulded pressboard barriers system insulation in 765 kV power transformer, because the crepe paper insulation had some problems due to mechanical fixation for short circuit.**

- **The special connections needed different solutions**

Thank You
For Your Attention