Simulations for innovative designs

Through simulations, design configurations are validated. Simple, inexpensive and counter-intuitive solutions can be found for complex problems.

Case Study 4: Top Lead Exit Thermal Analysis

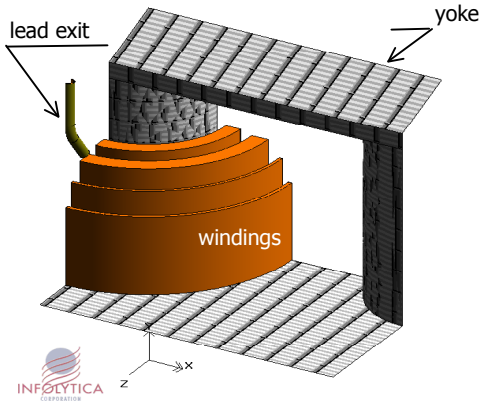
1. Summary

Lead exits in copper with or without slits have been simulated in order to determine the best design from a thermal point of view.

Simulations allow to search and find the best solution, exploring a wide range of possibilities.
Temperature rises depend on losses but lower losses do not necessarily mean lower temperatures. Simple, clever solutions like slits yield significantly lower temperatures, apart from the material choice.

2. Description

A 120/400 kV, 350 MVA transformer with 0/± 13 taps with the HV lead exit at the top.

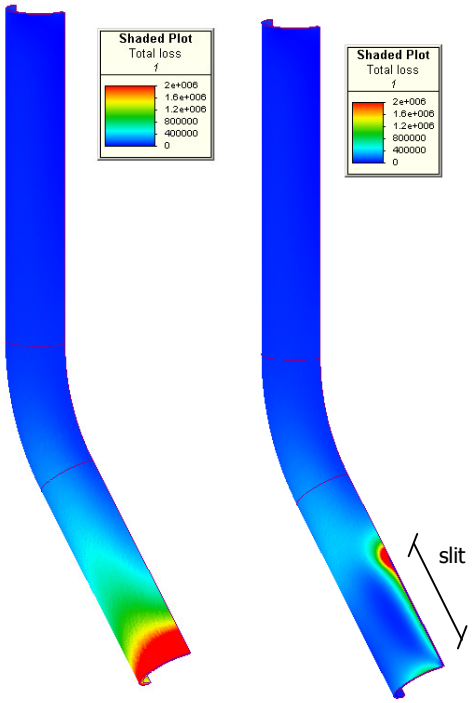


3. Technical Challenge

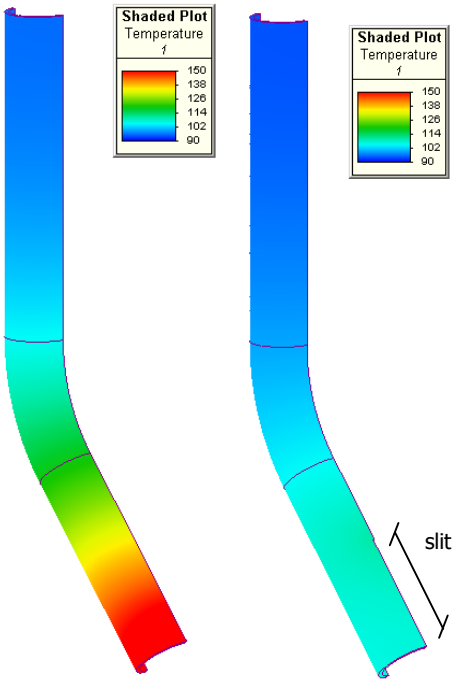
The tap changer position related to the highest leakage flux nearby the lead exit was identified, in order to simulate the configuration with maximum losses in the lead exit metal tube.
The simulation has taken into account:

- 3D Electromagnetic-Thermal coupled analysis of the lead exit tube without and with slits.
- Thermal convection on inner and outer lead exit surface.

4. Results



Specific losses / (without and with slits)



Temperatures / (without and with slits)

5. Conclusions

- Using a copper tube without slits leads to unacceptable temperature rise.
- Despite the uneven loss distribution, the high thermal conductivity of copper provides a uniform temperature distribution in the lead exit with slits.
- A simple solution like slits in the metal tube leads to significant improvements with small increase in costs.