Internal Hotspot Detection of MV Bus Bars by Measuring Compartment Surface Temperature

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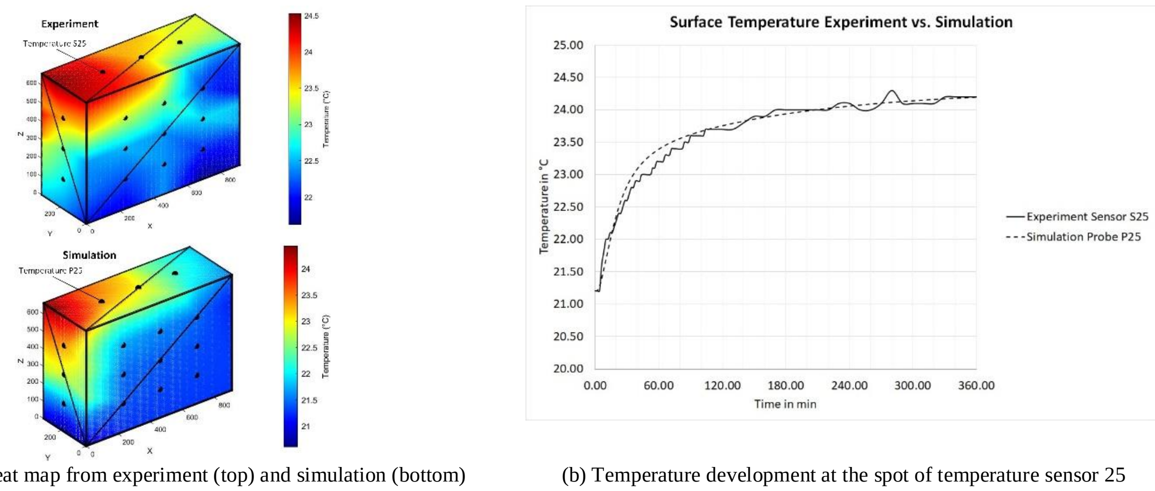
***Abstract*— Temperature hot spots within medium voltage (MV) switchgears are identified to be one of the main causes for insulation degradation. Therefore, the detection of irregular temperature rise within switchgear has become a priority in the electrical industry. So far, temperature detection is performed by the application of temperature sensors directly attached on “live” parts or by applying infrared methods through specially created monitoring windows on compartments. The attempt of this work is to investigate whether it is possible to diagnose over-temperatures within a bus bar compartment by measuring the temperature on the outer surface walls. That would avoid taking the system out of service and reduce monitoring costs. A simulation study is conducted by the application of finite element methods (FEM) followed with experiments on a mock bus bar compartment. It is demonstrated that the surface temperature changes depending on the location where the hot spot occurs within the compartment. In addition to that, a good match between simulation and experiments is achieved.**

BACKGROUND & MAIN RESULTS

Hot spots within MV switchgear appear over service time due to increase of contact resistances which are caused by loose contacts or contaminants within the compartment. Due to power flow this can lead to local heat increases, which reduces the insulation withstand capability and the switchgear life expectancy. Meanwhile, there are many methods proposed how to detect local overheating by the application of temperature sensors directly attached on “live” parts or using infrared methods in combination with specially created monitoring windows on compartments [1], [2].

The attempt of the current work is to detect hot spots by the application of temperature sensors by mounting them on the outer surface wall of the compartment. This would avoid service outages and additional modifications on switchgears. In the particular case, 27 temperature probes are attached along the outer surface wall of an MV bus bar compartment. A heat source is applied at the phase L1 emulating a local temperature increase to 100°C. The extracted sensor data is used and heat maps created over the compartment walls. In Fig. 1(a) the extracted heat maps from experiments and simulations are shown. In Fig. 1(b) the measured and the simulated temperature development of for example probe 25 is displayed, which is on the top left side on the chamber. As it can be seen, there is a good match achieved from the heat map and temperature development.



(a) Created heat map from experiment (top) and simulation (bottom) (b) Temperature development at the spot of temperature sensor 25

Figure 1: (a) Extracted heat maps over bus bar compartment, and (b) recorded and simulated temperature development at sensor 25

CONCLUSIONS

Throughout the work it is shown that a local temperature increase within the compartment can be detected by the application of heat maps. Further, by the application of proper simulation models particular heat map patterns may be created for hot spot which could be used for switchgear monitoring systems in the field. Further work will be undertaken to estimate the optimal position and number of temperature probes for efficient switchgear temperature monitoring.

REFERENCES

[1] ABB, "Switchgear temperature monitoring – Early hot spot detection enabling condition-based maintenance," White paper, ABB, July, 2016.
[2] Emerson, "The Eye on Medium Voltage Switchgear," White paper, Emerson, January, February, March, 2016.