Thermal analysis of an outdoor switchboard

Dara Switchboards

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Introduction

A thermal analysis was carried out to investigate the temperature profile inside a switchboard, which was exposed to direct heat from the sun and internal heat generation from switchgear. The switchboard (Figure 1) was designed for motor control centre of Broome electrical upgrade..

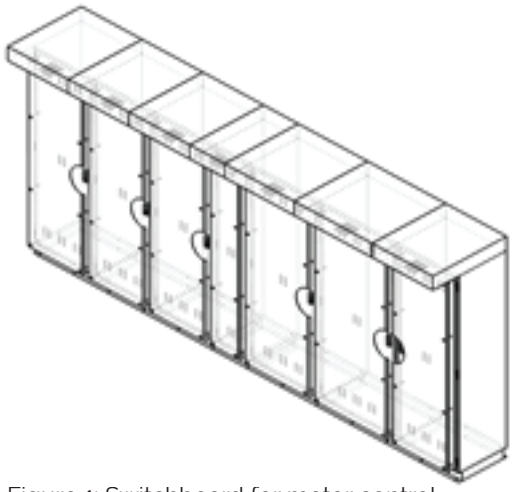

Figure 1: Switchboard for motor control centre of Broome electrical upgrade

According to bureau of Meteorology of Australia, the daily maximum temperature recorded in Broome Airport was 44.8 ˚C. Therefore, the ambient temperature for this study was selected as 45 ˚C.

Finite element analysis

Steady state thermal analysis was carried out to investigate the temperature rise inside the switchboard due to solar irradiation and internal heat generation from switchgear. 800 mm tier was chosen to study this behaviour due to complexity of the switchboard and limited computational ability of computers.

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Boundary conditions

Heat flux (solar irradiation) of 1000 W/m2 was applied to the front, top and a side wall of the switchboard to represent sun facing from a side of the switchboard. This was to study the worst case scenario.

In addition, convection and radiation heat transfer from the switchboard and soft starter to the air was defined. The convection heat transfer coefficient was selected as 25 W/m2 ˚C.

By assuming 25% of the soft starter volume as copper, 100 W losses from each soft starter was defined.

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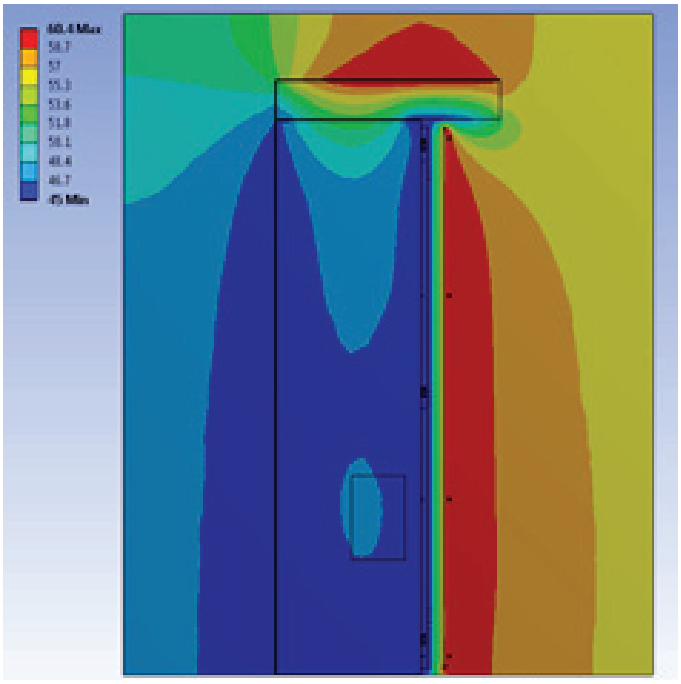

Figure 2: Temperature profile of air domain

Results

The results showed that the temperature of the air (Figure 2) around the switchboard can rise up to 60.4 ˚C due to convection heat transfer from the switchboard. However, since the sun shield and the rain hood avoiding the direct contact of sun rays with the switchboard, the maximum temperature rise around switchgear was around 2-3 ˚C above the ambient temperature.

Conclusion

Sun shields with 60 mm air gap and ventilation louvers on the door and rain hood could minimized the temperature rise inside the switchboard due to solar irradiation. Thus, the temperature rise in switchgear mainly depends on their power loss. Furthermore, with natural ventilation the temperature inside the switchboard will be closer to ambient temperature.

Finally, the results of this study shows that, sun shields with optimum air gap and providing enough openings for ventilation can prevent temperature rise inside the switchboard.

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