CFD analysis of proposed shelter unit for hotspot detection and optimization

Executive summary

A shelter unit housing various supporting equipment for a communication tower were studied for effective removal of heat generated from its surfaces so that it would operate under a safe point temperature of 50 degree Celsius. The equipment in the unit was switch-mode power supplies, battery banks, and power interfacing units.

The study was conducted in two parts:

1. The thermal boundary conditions for building envelope have been derived from the hourly heat analysis for a worst case scenario.
2. This boundary condition has been used for different design alternatives for effective heat dissipation from the unit to avoid the regions of high heat (Hotspots).

This study was carried out using 3D Computational Fluid Dynamics (CFD), to obtain the temperature field, velocity field, iso-surfaces and surface temperature gradients of the entire domain. 2012bs01

The proposed case was analysed to find out the hotspots and equipment surface temperatures. Two design alternatives were studied in terms of (a) modified equipment layout and (b) lowering the mounting height of the extraction. Both these designs resulted in lowering the hotspot region around the equipment and the latter being the most effective. Further, two additional cases were run to improve the ventilation by localized extraction to the equipment and increased air flow rate through an additional inlet. Results suggested better heat dissipation. However, in the worst case scenario, the surface temperatures could not be brought under threshold temperature, though the space temperature (volume weighted average) remained under it.