Arc Fault Exhaust Ducts and Cold Weather Installations

May 11, 2012

Most ANSI rated switchgear is rated for operation in a temperature range between -30°C and +40°C. In the case of indoor equipment it is hard to imagine ever encountering such extremes, however it is possible. One specific case where it is a common occurrence involves the installation of Arc Resistant Switchgear fitted with a plenum and exhaust duct in locations where temperature extremes are normal. The protective cover at the end of the exhaust duct is exposed to the hostile weather conditions and it must be treated differently than the exterior walls of the building where the equipment resides.

Examining the two extreme conditions, exposure to the upper limit does not create much concern. The cover will get hot and radiate some of that heat into the duct and plenum air. The additional heat build-up is outside the normal air flow path for cooling the equipment and should not present a significant operating temperature change. Should it be a concern, the solution is simply to have air conditioning in the building and adjust the thermostat accordingly. Assuming the air conditioning also de-humidifies the air, condensation should not be an issue.

The cold extreme creates two potential problems. The most commonly discussed issue is the potential for condensation. The simple solution for condensation alone would be to insulate the cover. The second, less obvious, potential problem is ice build-up on the exterior that prevents the cover from opening. In this case, insulation on the vent cover is not recommended so the cover can absorb heat from the room and from the switchgear to help prevent ice from forming on the exterior. While this can solve the potential ice build-up issue, the now un-insulated cover is again vulnerable to condensation.

Condensation may occur at many different temperatures, but it is most often discussed when the installation location is in extreme cold. Many controllable factors influence the development of condensation. Assuming the gear in a building, is the building heated? Is the gear energized? If so, at what level is it operating? Energized gear will produce some heat which will rise into the plenum and help keep the area dry. This heat will find its way into the vent duct and help keep the duct air dry as well. How much heat gets to the duct depends on how hot the gear is running and how warm the room is. Additional heaters may be required and are an absolute necessity if the gear is not energized for extended periods of time.

What damage will condensation cause on this assembly? If the duct is properly angled away from the switchgear any damage caused by condensation will be confined to the bottom of the vent cover. In the worst case scenario, a build-up of condensation over a time period sufficient to oxidize the metal vent cover would only result in the cover tearing away from the building if it is ever called upon to operate. It will not cause a failure to open.
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Adding additional heat to the exhaust duct is a simple process. The typical switchgear heating element can be placed at the end of the duct neat the vent cover and wired back to control power in the designated low voltage instrument compartment. A thermostat is not mandatory. The air temperature in the duct need only be warm enough to keep the vent cover surface above freezing. Because the duct is away from the main plenum and switchgear and is a relatively small and confined space, the heater element may be run at ½ voltage, or even ¼ voltage, and left on constantly. As previously stated, the additional heat will not adversely affect the equipment thermal performance when the ambient temperature rises above freezing.

While outside the scope of evaluation for arc resistant switchgear testing, the user should be aware of the potential for the heater element to become a projectile in the event of an arcing event. Placing a securely mounted guard of expanded metal around the element will prevent the possibility of ejecting the heater element when exhausting the by-products of an arcing event.

Michael Wactor, P.E.
Technical Director – Research and Development