

# Shock-proof plan for hazardous areas

By Darrel Ramhorst

From engineering studies, preliminary engineering, and requirements gathered through commissioning and ongoing maintenance, system integrators and end users have more than enough on their plates to ensure the successful implementation of a control and information system project.

But, still, there are issues that remain "outside" a project's traditional life-cycle continuum that you cannot ignore.

Not the least of which are areas in a plant considered by the National Electrical Code as hazardous, either from flammable vapors that might be present (Class I), or from fine-grain dust in the air (Class II). In these hazardous areas, equipment grounding becomes even more important than ever.

What is the most dreaded thing in these hazardous areas? An arc or a spark.

How does a poor equipment grounding system contribute to this?

First of all, if there is a fault in the electrical system, there is likely to be an arc. If the insulation on a conductor wears through or a motor fails, the arc should remain inside the conduit system initially.

What is wanted is the circuit to clear as quickly as possible. How quickly depends largely on just how good the equipment grounding system is. A few ohms, or perhaps only a few tenths of ohms, introduced by a loose connection, a rusted coupling, a poor flex connection, etc., could stretch out the operating time of the circuit breaker. These few seconds of extra time could allow the arc of the fault to burn

through the conduit system or the motor housing, and then expose the arc to the hazardous atmosphere.

The result is a big fire and another fire marshal's report that determines the cause to be "faulty wiring."

In these hazardous areas, there are special, more stringent rules regarding equipment grounding. If the motor is in the hazardous area, liquid-tight flexible metal conduit cannot be relied on to make the required ground connection.

It must bond with a properly terminated conductor — a "jumper bond" — either inside or outside of the flex. Also, you cannot rely upon standard knockouts, locknuts, or bushings for good connections all the way back to where the equipment ground bus ties to

the neutral bus, usually at the main switchboard. All these intervening connections must bond with a proper-sized conductor and proper terminations.

As stated, a user must size the jumper bond properly. In each case, there is a circuit breaker somewhere in a properly designed circuit that should operate if there is a fault. As described earlier, the fault path resistance will determine how much fault current will flow, and the circuit breaker time-current curve will determine how much time it will take for the circuit to clear. The bonding jumper must carry this current for that length of time without melting, or it still won't clear the fault.

Most circuits utilize alternating current (AC). Without going into a detailed engineering description of what's involved, it is advisable to proceed with the understanding that wires conducting AC current have magnetic properties that have to go into consideration dur-

ing design and installation.

The general rule that affects grounding is the resistance to current flow will increase if all the circuit conductors are not near each other. During a fault, that also includes the equipment-grounding conductor. That is why we can't just tie equipment to the nearest steel beam or drive a ground rod next to each light pole to consider them grounded.

Some rules to keep in mind to help ensure a fire-safe control system environment:

- Ground systems (literally tie them to earth with a conductor) to limit the potential on the grounded object to, at, or near earth's zero potential.
- Connect the non-current carrying metal parts of equipment to ground to minimize shock hazard and to minimize damage.
- The reaction time of a circuit protective device depends heavily on the resistance of the grounding path. The resistance must be maintained at a very low number to assume proper circuit protection.

Routing of grounding conductors is very important to assure the proper operation of the circuit protective devices.

Hazardous areas require special attention to the National Electrical Code rules for the grounding to minimize the potential for explosion and fire.

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