Electrical Cable Tray Fire Protection

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One of the most significant fire protection requirements for processing facilities and offshore locations is the need to protect control cables and control valves in the event of a fire. Several options are on the market, including fire blanket systems, calcium silicate board, and flexible mats that absorb heat in the event of a fire. Each has its benefits and operators need to weigh the pros and cons of the available cable fire protection solutions to ensure that they select one that is the best for a particular application.

Protection By Separation

American Petroleum Industry (API) 2218, Fireproofing Practices in Petroleum and Petrochemical Processing Plants, provide guidelines for “selecting, applying, and maintaining fire proofing materials that are designed to limit the extent of fire-related property loss in the petroleum and petrochemical industries.” Separating refinery operations into fire zones that can be isolated and safely shut down is a key objective, so if a fire breaks out, the flow of the product being refined doesn’t feed the fire. The API 2218 guidelines include a variety of protective measures, including fireproofing to improve the capacity of equipment and its support structure to maintain their structural integrity during a fire. Shielding essential operating systems when they are exposed to fire is another important measure.

To protect the refinery and its components, the standard requires control valves that turn off the flow in the event of a fire, along with control cables that signal when to shut off the fuel. Under the API standards, this control valve and cable must itself be able to withstand a fire, usually for 20 minutes, but in some circumstances for 30 minutes or more. Examples of cable tray systems designed to protect the

cables from fire include:

- Vendor-certified fireproofed cable tray systems
- Standard cable trays completely enclosed with insulating, fire-resistant fiber mats, or endothermic mats
- Cable trays encased with calcium silicate insulating panels with calcium silicate sleepers to hold cables away from bottom of the cable tray
- Trays with exterior surfaces made of galvanized sheet metal coated with mastic or intumescent fireproofing material.

The material used to provide 30-minute fire protection against a hydrocarbon pool fire for grouped electrical cables inside conduit or a cable tray must be tested before installation, using the ASTM E 1725-95 method, Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components. The method is based on a model of the type of fire that could happen at a refinery; one that gets to 1500 degrees F at 3 minutes, and between 1850 to 2150 degrees F after 5 minutes. Testing is carried out in accordance with hydrocarbon pool fire temperature-curve conditions outlined in ASTM E 1529 (50,000 +/-2,500 BTU/ft2hr).

The test is run at positive pressure over at least half the test assembly. Thermocouples are arranged in sets, with thermocouples peened every 6 inches on both rails of the cable tray, and every 6 inches on a bare copper wire centered in the tray. The cable tray is intended to be run empty of cables, which provides approval for zero to 100 percent cable loading. Failure is determined when one “set” reaches an average temperature rise of 250 degrees F, or any single thermocouple reaches a temperature rise of 325 degrees F.

Meeting Fire Protection Standards

A wide range of options are available to protect control valves and grouped electrical cables against extended exposure to fire and maintain control of equipment operated by the cables. One option involves wrapping cable trays and conduits with a nonflammable high temperature resistant insulating blanket. The fire exposure period is rated in proportion to the wrap thickness and the material is typically weatherproofed in the field.

The blanket wrap system consists of a single layer of 2-inch, 8 pound per cubic foot material, and is designed for up to 12-inch cable trays and conduits. The lightweight flexible blanket wrap is easy to cut, reducing installation problems in complex designs. A simple wrap design allows easy re-entry for cable modifications. The insulation is supplied with full encapsulation in a glass fiber reinforced foil and polypropylene (FSP) facing as standard, to provide superior handling strength for installation. Optional weather and mechanical abuse protection may be added. The fire protection system can result in significant material cost and labor savings compared to composite products or rigid board installations. It is also lightweight, preventing the need for additional support structures and associated costs.

The blanket wrap system has achieved third-party certification through Factory

Mutual (FM) Approval, a global program that includes objectively testing property loss prevention products and services and certifying those that meet rigorous loss prevention standards.

Another available option is calcium silicate board—an inorganic, noncombustible high temperature insulation. The material can offer some weather resistance and durability in many environments, but it can be heavy (around 54 pounds per cubic foot), which together with the cutting and fastening methods required, can make it relatively difficult to install. In addition, while the board itself is relatively inexpensive, the waste from cutting and the additional labor required for cutting and fastening, makes it expensive to install. It is also less adaptive to complex cable tray runs.

A third option is an endothermic mat (e-mat), which protects structural steel, cable trays, and conduit circuits by chemically absorbing heat energy, blocking heat penetration. The product requires the installation of between three to five layers, resulting in increased weight and material costs—up to five to ten times higher than insulation or board alternatives. These multilayer solutions also have additional labor costs. On the plus side, flexible mat solutions are not as insulating, so they can often be used to protect power cables, which generate heat. The other options discussed are more appropriate for use to protect control cables, which do not generate a significant amount of heat.

The intent of petroleum industry standards is to separate refinery fire zones by enough distance so that if a fire breaks out, it is possible to turn off the flow of chemicals, oil, or gas to the affected area so the fire does not feed itself. In that scenario, the cables and valves controlling the shut-off valves must be adequately protected. When selecting the most appropriate options to maintain control over these components, be sure to evaluate the total material, labor, and installation costs; durability under the particular facility’s location; and any associated differences in long term maintenance and replacement costs.