WHITE PAPER

CABLE MANAGEMENT SYSTEMS FOR THE PETROCHEMICAL INDUSTRY:

CHOOSE CABLE TRAY FOR A SAFER ALTERNATIVE TO CONDUIT

By Bob Crain

OVERVIEW

Properly engineered and correctly installed, cable tray wiring systems provide highly desirable safety features not offered by conduit. Cable tray is not an enclosed system, so problems due to moisture condensation and accumulation are not a factor. For the same reason, there is no heat sink effect to magnify damage due to fire and no significant pathway for toxic, corrosive or explosive gasses to travel into critical equipment enclosures or control rooms. Cable tray is also less prone to contribute to circuit failure during earthquakes.

MOISTURE AND CONDENSATION POSE PROBLEMS IN CONDUIT

When selecting a cable management system, the potential for moisture to flow into electrical equipment enclosures must be considered. Cabling systems provide safe service with minimal maintenance and not the source or contributing factor of electrical system outages. This is especially important in continuous process facilities where an electrical power or control system outage could pose critical safety problems for facility personnel and adjacent communities.

In most petrochemical facilities, the cable management system alternatives are either cable tray or conduit installations. When comparing these two systems, it is important to take the problem of moisture in conduit systems into consideration.

To provide safe, reliable service, cable management systems should be designed and installed to minimize the amount of rain or condensed moisture they carry into electrical enclosures. Conduit wiring systems draw in moist air during the day, where it is trapped and condenses during the night when temperatures fall. Moisture builds up in the system and drains into electrical enclosures, causing equipment deterioration or failure. This can result in electrical system outages and excessive maintenance costs.

Explosion proof seals installed in conduit systems do not function as moisture barriers at normal pressure. Since atmospheric pressure is equal on both sides of the seal, moisture and vapors normally leak past the sealing compound and the seal wall. It is also possible for moisture to leak past the seal along the conduit insulation surfaces.

It is difficult to completely block moisture from a conduit system. Therefore, these systems must be designed to release and drain moisture away from cabling. In some conduit runs, breathers and drains are required at critical positions while in other installations, controlled slopes must be built in. Because moisture can enter equipment enclosures through conduit pathways, these enclosures may also need to be modified with added drains.

Since cable tray is open and does not function as a moisture pathway, cable tray wiring systems do not require the degree of detailing in order to control for moisture. They are therefore much easier to design and more economical to install.

A PLAN FOR BETTER SAFETY

PROBLEM:

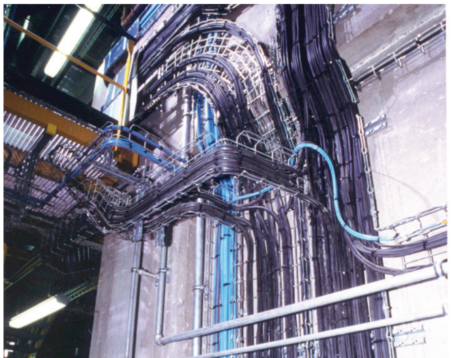
At an industrial facility near New Orleans, the vibration trip switches in an outdoor installation of a new compressor were housed in cast iron boxes mounted on the compressor frame. Vertical conduits contained the trip circuit conductors from the vibration switches, but moisture condensation from the conduits totally immersed the switches.

PARTIAL SOLUTION:

Weep holes could be added to the switch boxes to allow moisture from the conduits to escape the enclosures. But this would not fully solve the problem since the vibration switches would still be exposed to a high-moisture environment. The conduit system to the vibration switches would need to be redesigned.

BEST SOLUTION:

Install a cable tray system for the compressor trip circuits. Multi-conductor control cables could enter the vibration switch cast iron enclosures using cable compression fittings. This would allow no moisture to flow into the enclosure from the wiring system. Installation would be easy. No equipment modification would be needed.



CONDUCTOR INSULATION BURNS FASTER IN CONDUIT

In the event of an external fire, conduit becomes a heat sink and oven, decreasing the time required for conductor insulation failure and increasing the damage inside the conduit for a considerable distance. In addition, thermoplastic insulation may fuse to the steel conduit, requiring extensive replacement.

For an open cable tray system however, damage from fire is generally limited to the area of flame contact plus a few feet on either side. Repair costs for fire damage are normally much lower for cable tray systems than for conduit.

DAMAGE CONTROL

At a fire in a chemical plant in Ohio, banks of conduits as well as cable tray runs were both involved. Damage to the cable tray system was limited to a localize area requiring only two days of repair. The conduit system sustained damage for a much greater length and required six days with a great deal more manpower.

CONDUIT CAN TRANSMIT TOXIC, CORROSIVE AND EXPLOSIVE GASES

The heat from an external fire will decompose cable jackets and conductor insulation material. In conduit systems, if these materials contain PVC -- as most cables do -- hydrogen chloride vapors will concentrate and travel through the enclosed pathway to the control room. These fumes are highly corrosive to electronic equipment and hazardous to personnel.

In cable tray systems, flame impingement will not result in vapor entering the control rooms as there is no containment path. Gasses will instead disperse into the atmosphere.

CONDUIT CAN CONTRIBUTE TO EXPLOSIVE CONDITIONS

In some cases, conduit can provide a pathway for explosive gases to travel to other parts of the facility. This can occur even though seals are required. Conduit seals prevent explosions from traveling down the conduit, but they do not seal tight enough to prevent gas migration until an explosion or a sudden pressure increase seats them.

For example, an explosion at an electrical substation in Cove Point, Maryland allowed explosive gas to travel through a two hundred foot section of conduit even though correctly installed seals were in place. The substation was demolished, killing one worker and injuring another. In a similar incident at a chemical plant in New Jersey, the instrumentation and electrical equipment in one of the control rooms was destroyed.

Cable tray installations do not provide a pathway for explosive gases. These systems feature an open, breathable design that provides an important added level of safety for petrochemical and other critical industries.

CIRCUIT INTEGRITY DURING EARTHQUAKES MAY BE SUPERIOR IN TRAY VS. CONDUIT

Long runs of conduit are very likely to sustain damage during an earthquake of significant magnitude, compromising circuit integrity. An EMT conduit system made of rigid aluminum or steel has a very high probability of fracturing in the threaded areas at couplings, damaging conductor insulation and resulting in circuit failure. If conduits are used as an equipment grounding conductor and circuits remain live, unsafe shock hazards could result.

Failure of cable tray does not result in loss of circuit integrity. Cable tray systems can easily be designed and installed so that even during severe earthquakes, cable trays fail without producing a circuit failure. This would allow controls to continue functioning in critical systems such as pipelines, tank farms, loading dock, facility utilities, waste treatment plants, water preparation plants, and other commercial facilities. In some installations, additional seismic protection may be added with multi-directional bracing for cable tray supports.

CONCLUSION

Cable tray management systems offer the petrochemical industry a safer alternative to conduit for meeting the challenges of moisture, fire, toxic gas, explosive conditions, and earthquakes.

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Bob Crain, P.E. is a registered electrical engineer in the state of Illinois with 25 years of experience working for several leading US cable tray manufacturers. Bob is a leading expert on industry standards for the cable tray market. For the past 15 years he has been a member of the NEMA Technical Committee (5CT) and is currently a representative for the North American IEC, focusing on Standard 61537 for cable tray. Over his career, he has lent his expertise to numerous NEC code changes, written articles for industry trade magazines and published many white papers.

For the past 10 years, Bob has worked for Legrand/Cablofil in Mascoutah, IL, and currently holds the position of Director of Marketing/Product Development.

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2651 Compass Rd.
Glenview, IL 60056
(847)390-7700