Innovative Utility Installs Cost-Saving Transformer Fire Containment Walls in Record Time

Effective Fire Containment with Minimum Installation Time

In less than twenty-four hours, a six-man crew at Imperial Irrigation District (IID) retrofitted three large transformer fire walls at a critical transmission substation. The fire walls are needed to contain transformer oil fires from spreading between three 230 kV transformers, a control house, and other equipment at the Coachella Valley Substation. This substation is a vital power hub for power transfers between Arizona, California and Mexico; hence, outage time must be minimized. The key to such a construction success lies in IID management's selection of *TruFireWalls*™.

Simple and Quick Installation: One Day - One Wall*

Each fire wall measures 40 by 24 feet. The walls were quickly assembled in the field from fire resistant precast columns and panels. First, the columns were bolted to the existing* foundation and aligned. Next, the panels were slid down the grooved columns and assembly was then complete. Disassembly of these removable maintenance-free fire walls is equally simple and quick.

Step One - Position, align, and secure the columns.

Step Two - Slide in the panels and …

The installation is COMPLETE!

Substation Fire Hazard Conditions and Potential Consequences

A power substation by its nature contains all the right ingredients to generate the perfect fire storm. A typical transmission transformer bank consists of three or more transformer tanks, each containing 10,000 to 45,000 gallons of mineral oil. The initial spark is likely to come from electrical arcing inside the tank, which also generates heat and pressure high enough to rupture the tank. Oxygen immediately rushes into the tank. The oil violently explodes accompanied by a blast of intense radiation, flying shrapnel, and flaming oil. The radiation's effect is instantaneous and has been documented to ignite other transformers more than 60 feet from the initial fire.

The temperature of an oil fire is in the range of 960°C to 1,200°C. A power transformer's fire duration ranges from 4 to 28 hours, which is in most cases the time it takes the fire to burn itself out. As larger substations are often located in outlying areas, the fire department's response time is long. In addition, fire trucks are rarely equipped to suppress these supersized oil fires.

Fire walls are only a third of the total solution to effectively protect a substation against fire. The other two components needed are an early detection and alert system and the correct fire suppression system. Hence, the installation of effective fire walls is the bare minimum to protect a transformer bank and neighboring equipment.

In general, existing standards and codes do not realistically address the actual conditions of large hydrocarbon pool fires in open air. Therefore, performance-based criteria need to be applied to ensure effective fire protection in substations. To replicate real-world requirements, a transformer fire wall must be exposed to a four-hour fire followed immediately by a high-pressure water jet blast on the **same** test sample.

The replacement cost of a large transformer is about $1.5 million to $2.5 million per phase. However, the higher cost by far is the replacement energy, which must be purchased from the spot market at premium prices. During peak hours, rates could spike up to $200,000 per hour.

Compounding the problem, the delivery time on a rush basis for these transformers is about 18 months. Insurance premium increases may be imposed (conversely, insurance companies have reduced rates when fire walls are installed), and long-lasting unfavorable public relations with the community, regulators, and investors can result.

Effective Containment of Transformer Fires

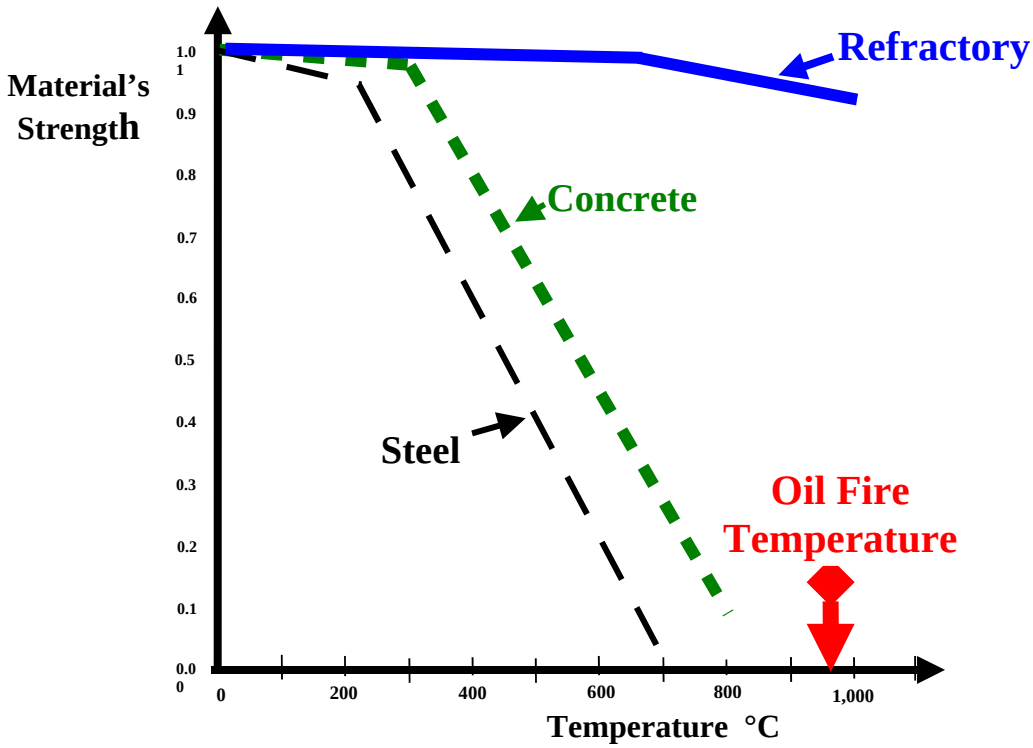
Effective transformer fire walls must be:

(1) made from materials that can withstand the intense high temperature and long duration of these fires;

(2) designed such that both thermal and mechanical requirements are met before, during, and after the fire.

Traditionally, transformer “fire walls” have been built from reinforced concrete and/or concrete blocks. The initial cost of these walls is deceptively low, because these materials do not perform as needed under high temperature. At 650°C, concrete retains only about 35% of its room temperature strength, and steel has practically no strength left at that same temperature, which is about 350°C lower than the oil fire’s ‘working’ temperature as shown below.

Hence, concrete walls fail under the actual conditions of a transformer fire. Furthermore, concrete walls are large and heavy, requiring deep reinforced foundations, and they must be torn down and rebuilt when major transformer maintenance is performed.



The fire wall must also have sufficient impact resistance to survive shrapnel impingement because it is quite possible that the fire will initiate a transformer explosion. As there is yet no standard for fire wall impact loading, ballistic and explosion experts have recommended applying UL Standard 752. This is equivalent to a fire wall panel stopping a 44 Magnum projectile with no through-penetration, as the IID wall panels are capable of doing.

An IID fire wall panel stops a 44 Magnum bullet.

Refractories as used in the IID fire walls are water-based and totally inorganic with nothing to burn. The relatively lightweight thermal panels and columns are cast from time-tested refractory concrete. Refractories emit no volatile organic compounds or hazardous material when manufactured, during the fire, or when disposed. The **time-proven** refractory cements that have been used for centuries to handle molten metal in foundries and smelters clearly meet the thermal and mechanical requirements over the service life of the substation.

Field-proven refractories and the well-established manufacturing process by Oldcastle Precast, with 80 plants throughout the United States, ensure that the required thermal and mechanical performance is achieved at a competitive cost. ***TruFireWalls*** by ***ThermaLimits*** are designed and certified to meet thermal, wind loading, seismic, and substation layout requirements. The modular design reduces manufacturing and installation costs.