

Hydrocarbon fire protection design of oil & gas industry's hazardous facilities

Konstantin Nagay – Head of Design Department, JSC O3-ENGINEERING

Passive fire protection of building structures is one of the bases of industrial safety at oil & gas production and refining facilities. Performance of fire protection works is preceded by the development of design and (or) specification documents.

The process of fire protection design includes the following stages as source data capture and predevelopment analysis; integration of international and Russian standards used in the design; analysis and classification of facilities to be fire protected by the fire hazard rating, the fire resistance rating and possible fire types; fire protection materials' specifying depending on the operational conditions; verification of technical solutions for the use of fire protection materials in accordance with the requirements for the fire hazard, the fire resistance rate, and possible fire types.

The core requirements for fire protection of oil and gas facilities applicable in the territory of the Russian Federation are presented in Federal Law No.123-FZ, Set of Rules 2.13130.2012, Set of Rules 4.13130.2013. International standards including UL 1709, Lloyd Register, Det Norske Veritas, etc, are applied in the world practice of design of similar facilities, where the most likely fire scenario is hydrocarbon.

If an object is not subject to regulatory requirements Project Specific Technical Specification (PSTS) is developed. Further on all design documentation is developed taking into account the requirements of PSTS.

Structural areas of oil and gas facilities that directly interact with hydrocarbons are exposed to the risk of hydrocarbon fire; while there is a risk of cellulosic fire in the service and office buildings of these facilities.

Hydrocarbon fire is the general description for a fire fueled by oil and oil derivatives or natural gas. These are characterized by a very rapid temperature rise up to 1100°C in the first 5-10 minutes, which has a significant effect on the safety of strength characteristics of steel structures.

It should be pointed out that only one fire heating regime – standard (cellulosic) – was identified in the Russian regulatory base until 2015. This fire regime is fueled by wood, fabrics and other finishing materials. The temperature during cellulose fire reaches 550-800°C in the first 5-10 minutes with subsequent growth to 950-1100°C.

Since June 1, 2015, GOST R EN 1363-2-2014 “Building structures. Fire resistance tests. Part 2. Alternative and additional procedures” has entered into force in the territory of the Russian Federation. This standard is a translation of the European standard EN 1363-2:1999 “Fire resistance tests - Part 2: Alternative and additional procedures”. This standard became the first official standard that distinguishes a hydrocarbon fire as a separate combustion regime.

When developing a design documentation for hazardous facilities of the oil and gas sector, it is necessary to carry out an analysis of reliability of structures with the use of fire protection materials, designed for hydrocarbon and cellulosic fires, as well as an analysis of risks in case of replacement of the materials certified for use under conditions of hydrocarbon fire according to UL 1709 or GOST R EN 1363-2-2014, by the materials certified according to GOST 53295 (conditions of cellulosic fire).



Fire tests in the standard fire regime do not cover the rate of temperature increase and, in principle, a higher temperature of hydrocarbon fire, therefore the use of fire protection coatings certified by the results of tests under conditions of cellulosic fire (according to GOST R 53295-2009) does not ensure the required fire resistance rates in a hydrocarbon fire.

It is necessary to use the test results under hydrocarbon fire scenario in accordance with GOST R EN 1363-2-2014 or UL 1709 when specifying fire protection coatings for steel structures of the facility in the area of possible hydrocarbon fire.

Fire protection materials based on epoxy binders are usually used for protection of steel structures under fire conditions of hydrocarbon fire heating regime. When temperature increases rapidly to 1100°C, the matrices consisting of thermoplastic polymers (acrylates, styrene acrylates, etc.) are subject to rapid melting, which leads to the flow of material from the surface of the structure, and only three-dimensional cross-linked polymers – especially epoxies – ensure the temporary retention of a mass of fire-retardants and gas generators, sufficient for effective formation of coked cellular material. The resulting high-strength coked cellular material can ensure the protection of steel not only under conditions of an ordinary hydrocarbon fire, but also in case of exposure to a jet fire.

Used on offshore platforms, FPSO's, refineries, petrochemical plants, LNG terminals and storage facilities globally and in Russia, epoxy passive fire protection for hydrocarbon fire FIRETEX M90 series (manufactured by the world's largest manufacturer of coatings SHERWIN-WILLIAMS) has become the first choice for the oil and gas industry.

O3 Company is the exclusive partner of SHERWIN-WILLIAMS Protective & Marine Coatings in Russia, specializing in fire protection of hazardous facilities in hydrocarbon fire conditions using FIRETEX M90 series materials.

Also, O3 Company manufactures protective coatings and provides comprehensive technical services for corrosion protection, passive fire protection and thermal insulation of facilities of the oil and gas industry, power generation and civil construction: from development of a fire protection design to inspection check-up and commissioning of works to independent supervisory authorities.

At the present date O3 Company is implementing a number of projects using the materials of FIRETEX M90 series: facilities of OJSC Yamal LNG, the wellhead platform of Yuri Korchagin Field, PJSC LUKOIL.



FIRETEX M90 series is an epoxy thick layer coating, provides up to 240 minutes hydrocarbon pool and jet fire protection. The material has high chemical resistance, it can be used at operating temperatures as low as -60°C and as high as $+75^{\circ}\text{C}$, which allows its use under conditions of an open industrial atmosphere of a cold climate.

FIRETEX M90 series is independently tested, verified and certified to the most stringent international standards, including UL 1709, Lloyd's Register, Det Norske Veritas, American Bureau of Shipping as well as it complies with the requirements of the Russian regulatory documentation.

The project of Yamal LNG includes the construction of a liquefied natural gas (LNG) plant and related infrastructure based on South Tambey Field on the Yamal peninsula, which is the largest gas condensate field in Russia. The field's reserves are 1.3 billion cubic meters, the project is implemented by NOVATEK together with a French oil and gas company TOTAL.

Key facilities of the plant – compressor shelters of technological lines No.1, 2, 3, as well as top platforms of LNG storage tanks – were protected from hydrocarbon fire with the FIRETEX M90 series. The main fire protection works were performed by O3 Company's specialists at steel production plants in Nizhnekamsk and Kaliningrad. Only the repair of field joints was carried out onsite, resulting in a more cost-effective solution for providing passive fire protection of the steel structure.

FIRETEX M90 series was also chosen for hydrocarbon fire protection of steel structures of the wellhead platform of Yuri Korchagin Field Phase 2 development in the Russian sector of the Caspian Sea, PJSC LUKOIL. The specialists of our company performed technical services for passive fire protection of this facility: development of a fire protection project, supply of materials, fire protection application and inspection check-up of the works.

Following the mission of O3 Company – PROTECT THE FUTURE TOGETHER – we offer effective corrosion and passive fire protection materials, protect industrial and infrastructure facilities from corrosion, fire and heat loss, contributing to the conservation of non-renewable natural resources and the ecosphere of the Earth.

We are ready to develop fire protection and thermal insulation design for your facilities, just write to us hello@o3-e.ru or call 8-800-500-56-35. O3 Company's track record is available on our web-site www.o3-e.ru.