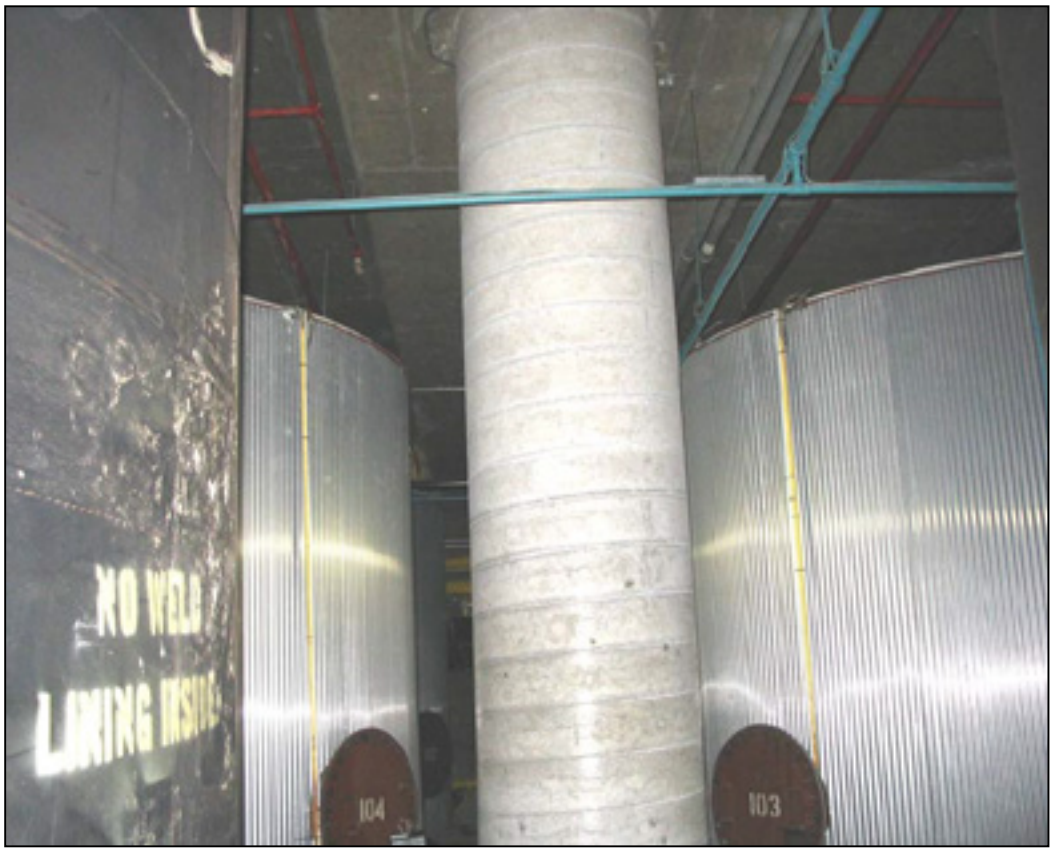
Integrated Compressed Air Foam Systems for Fixed Piping Networks



ICAF Case Study Series:

Protection of Flammable Liquid Storage Rooms

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Overview

Flammable liquids storage rooms are present in many of today's industrial installation. Liquids that can be stored in small drums or in large storage tanks represent a risk of fire that should be carefully addressed by the designer.

Sprinkler systems represent a simple solution for many of these installations to control the fire but what the designer often requires is to actually extinguish the fire quickly in order to minimize fire damages to the facility and downtime, not simply control the fire until the fire department shows up.

The following case study describes the use of the Compressed Air Foam (CAF) technology installed in an underground oil storage facility and highlights the advantages of this design compared to other available technologies.

Application

Fire protection was required in an existing underground facility used for bulk storage of transformer oil in ten (10) large tanks of 8,000 gallons (30,283 Ltrs.) capacity each.

Room dimensions were 83 feet long by 35 feet wide with a ceiling at 15 feet, constructed of concrete. Also part of the hazard was an access tunnel measuring 26 feet long by 5 feet wide with a ceiling at 9 feet, constructed of concrete as well.

Problems with the use of traditional technologies

This hazard could theoretically have been protected with either of these two typical methods:

- **Low Expansion Foam:** A low expansion AFFF foam-water sprinkler system designed as per NFPA-11 with a density of 0.16 gpm / square feet, discharging during 60 minutes (AFFF stands for Aqueous Film Forming Foam and is a fire fighting foam widely used to extinguish fires in hydrocarbon fuels).

The main problem with this design was the high cost of the infrastructure that would be required to collect and drain the foam-water solution. Indeed, the drainage system was never designed to handle the high volume of water produced by the discharge of a typical foam-water sprinklers system and the cost of upgrading its drainage system would have been prohibitive, which is a common issue in existing facilities.

- **High Expansion Foam:** A high expansion foam system designed as per NFPA-11 to completely flood the area, discharging during 12 minutes.

While partially resolving the issue of water drainage with a water flow of 250 gpm, the main problem with this type of system was the difficulty of physically installing the large volume air receivers necessary for such a system.

Also an issue was the reluctance of the local fire marshal to send a fire fighters squad in an underground facility filled to the ceiling with foam, to fight a fire they can not see. Compounding the problem was the real possibility of spatial disorientation for the squad in such an environment during a fire.

High expansion foam systems indeed do represent a problem in confined and cluttered spaces such as these.

Designing with ICAF

A solution to these problems exists by using FireFlex Systems ICAF Integrated Compressed Air Foam system for fixed piping network.

This new FM Approved AFFF foam system can be designed to protect this area using NFPA-11 TIA #05-1, and FireFlex Systems ICAF Design Manual. Article 7.16 of the TIA states that the system shall be designed to discharge compressed air foam for a minimum period of 10 minutes for this type of application.

Based on a nominal flow of 6 gpm per nozzle, the total water flow required for this application was limited to 192 gpm. Using TAR-225C Nozzles, the whole storage area is covered using 32 nozzles as shown in Figure 1 below.

The particularly high density of equipment and level of obstructions in the room caused by the large storage tanks mandated the use of slightly more nozzles than normal to make sure all areas would be adequately protected. Piping layout and number of nozzles branches have to be balanced, resulting in the symmetrical layout shown.

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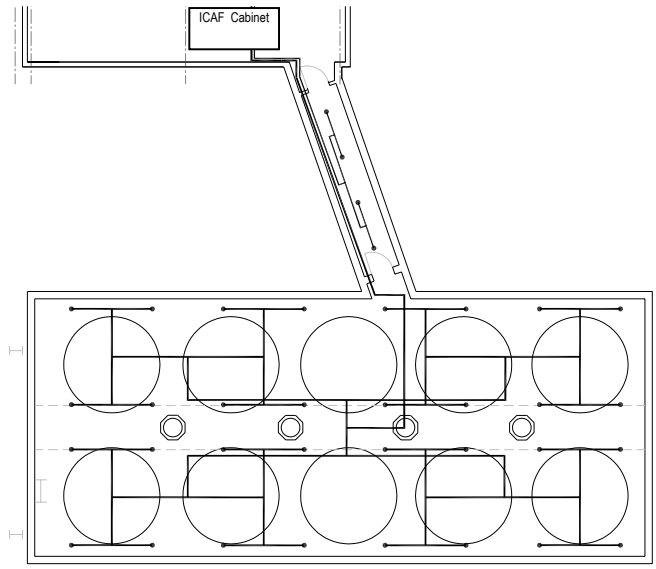
Detail of the obstructions in the facility:

This is a consideration that the designer always has to keep in mind as it is an important part of what is considered good design and engineering practices. A subsequent discharge test proved that the design covered every area adequately with compressed air foam.

An additional 4 nozzles were used to cover the access tunnel leading to the protected room.

Figure 1: Detail of the CAF Nozzles balanced layout.



Project Scope of Work

Figure 1 above shows a typical ICAF System installation with its grid of discharge nozzles installed at the ceiling level. The balanced flow piping is also much simpler to install and of smaller diameter than the equivalent foam-water system, reducing the costs for the installing contractor. The quantity of foam concentrate is also reduced by using the ICAF Systems since its high efficiency is achieved while using only a 2% concentration of AFFF foam concentrate instead of the usual 3% !

As shown in the following table, water usage was reduced enough by using the ICAF system so the existing drainage system did not require any modification or upgrade.

Table 1: Comparative water usage:

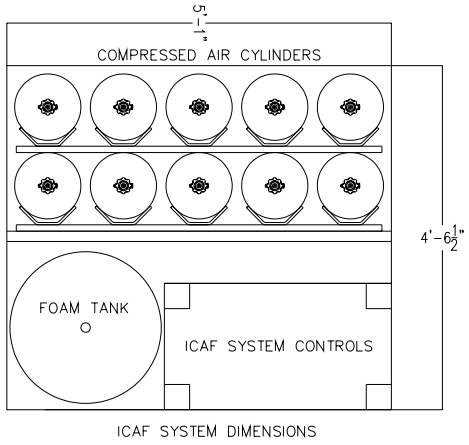
System	Water Flow (gpm)	Water Used (USgal)
Foam Water	600	36,000 (60 min.)
High-Expansion	250	3,000 (12 min.)
ICAF	192	1,920 (10 min.)

Note: Figures above are for the storage area only.

The complete ICAF System itself has a small footprint (see Figure 2). The foam concentrate is stored in a non-pressurized 50 gallons tank and does not use bladders or complicated inductors and trims. The entire foam trim is actually factory-built in a user-friendly cabinet measuring only 36" x 20" x 71".

A bank of ten (10) high pressure compressed air cylinders was supplied to provide the pressure to the system so the existing water pressure could also be used to feed the system.

Figure 2. ICAF System layout detail



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Detail of the ICAF System:

Conclusions

The selection of the ICAF System represented the ideal solution for the protection of such a facility which otherwise would not have been protected at all, or at much greater costs for the owner.

Not only was the installation substantially less costly but it also prevented major infrastructure modifications to the existing facility. Such considerations are often neglected by the designer in the feasibility studies for the installation of fire protection systems in special hazards.

Considerations would also have to have been made for the water supply portion of the installation.

Indeed, the supply and installation of fire pumps (vertical turbine or diesel powered), water storage tanks and redundancy would have increased the costs dramatically ! Those were not required by using an ICAF System to protect the facility.

Containment, collection and drainage of all that water is also an issue that is often neglected. The existing drainage system in this application was able to handle the small additional amount of water used by the ICAF System, but not from a typical Foam-Water System.

Should the High Expansion Foam System been retained as a solution, air intakes and exhaust louvers would have been required and the installation of these was more than problematic in this environment. The issue of visibility for safe evacuation of the occupants was also present.

Installation of the ICAF System proved to be easy for the contractor, used standard sprinkler piping and hangers and at the end, offered better fire protection without the associated water damage.

ICAF Systems only need a small quantity of foam concentrate to be kept in storage which is another advantage.

The physical layout of the facility also mandated to install the system hardware (foam tank, system trim, etc.) almost 200 feet (60m) from the hazard itself.

With the use of the ICAF System, this was not a problem at all since long pipe lengths between the system and the protected hazard are easily handled and do not represent a design problem due to excessive pressure losses as in foam-water systems. Piping was kept to minimal diameter with no detrimental effect on the system performance.

Should you have questions regarding this application or any other involving flammable liquid hazards, contact FireFlex Systems Inc. Our engineers will work the project with you and find the best layout for your specific application.

For additional information about ICAF Systems, please visit our web site at: www.compressedairfoam.eu

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