Integrated Compressed Air Foam Systems for Fixed Piping Networks

ICAF Case Study Series:

Protection of Underground Mining Diesel Fuel Storage

Doc. FM-072M-0-241 A

May 2006

ICAF® Compressed Air Foam Systems

Overview

Underground shaft mines using diesel-powered equipment will often use underground diesel storage areas to facilitate refueling operations of the equipment. Adit-type mines in the Western United-States initially locate the refueling facility at the surface and as the active mining workings progress from the adit portal(s), the refueling is moved underground.

As noted in NFPA-122 - Standard for Fire Prevention & Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities, many underground diesel fuel storage areas are commonly protected by a fixed water sprinkler system, and this application is even approved by the federal Mine Safety & Health Administration (MSHA).

It should be noted however that the consensus of the NFPA-122 Committee is that a fixed water sprinkler system actually represents a significant safety hazard ! According to the NFPA Fire protection Handbook, water sprinklers can be used on diesel fuel for control, but not for extinguishment.

In a report dated 1985 (The health and Safety Implications of the Use of Diesel-Powered Equipment in Underground Mines), MSHA concludes that "water spray or fog usually will not extinguish diesel fuel fires".

Obviously in an underground mine, fire control is not sufficient and is even dangerous. Fire extinguishment is essential for the following reasons:

1) As long as the fire burns, even while it appears to be controlled and not growing, toxic smoke and gases are produced that can endanger the mine personnel.

2) According to the NFPA Fire Protection Handbook, failure of containers by overpressure when exposed to fire is the main hazard of close-container flammable and combustible liquid storage.

3) Even if a fire is deemed controlled, it can cause container failure, producing a fire so intense that the sprinkler system is unable to control it, much less extinguishing it.

4) Water sprays are not effective in extinguishing pressure fires, running fuel fires, and obstructed spill fires, all of which can occur in a diesel refueling area.

5) Water supplies are limited in many underground mines. Fire control should therefore be considered temporary, because the fire will grow immediately to full intensity when the water supply is depleted.

6) Because the vapor pressure of diesel fuel increases with elevation due to reduced barometric pressure, even fuels without flash point-reducing additives can become flammable, depending on the altitude at which they are used. This reduction in flash point could result in reclassification of the diesel fuel to a Class IC flammable liquid.

There is no consensus in the literature and industry practice about the effectiveness of fixed water sprays in controlling and extinguishing fires involving Class IC liquids. Although industry practice strongly favors the use of fixed water sprays for such applications, available literature and research results clearly indicate they are ineffective !

Water spray sprinkler systems installed for the protection of diesel fuel storage areas might not be effective in suppression, even if they do provide good control by cooling; foam-water systems can provide suppression.

Problems with the use of traditional technologies

The large quantity of water delivered by spray type sprinkler system or even foam-water systems will often be a problem. A pond or other large body of water, an industrial process water system or large water tankers will be needed and should last for the duration of the fire fighting effort while personnel should be trained for their operation.

The cost associated to the piping distribution system to bring the water down in the mine shaft also has to be factored in.

On larger installation, water quantity and pressure can also become an issue, mandating the installation of expensive fire pumps.

Design with ICAF

With the advent of FireFlex Systems ICAF Integrated Compressed Air Foam systems for fixed piping networks, a solution is now available to the designer, providing better fire suppression capabilities with only 25% of the water requirements of foam-water systems!

This new FM Approved AFFF foam system is designed using NFPA-11 TIA #05-1. Compressed Air Foam (CAF) only requires a design density of 0.04 gallons of foam solution per minute, per square feet (1.6 Lpm/sq.m.) of floor area.

And at this reduced water requirement, ICAF systems still manage to provide better suppression capability than traditional systems. Furthermore, 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%!

Using FireFlex Systems FM Approved ICAF Design Manual, the designer will locate a grid of nozzles to cover the risk area. Additional nozzles may need to be installed directly at the refueling equipment and careful evaluation of the various hazards should be made to determine if they are required.

Project Scope of Work

A typical ICAF System installation with its grid of discharge nozzles will be installed at the ceiling level. The balanced flow piping required by ICAF Systems is also much simpler to install and of smaller diameter than the equivalent foam-water system, reducing overall costs.

Special considerations need to be given to the nozzle layout for this kind of hazard since configurations vary widely for each project. Some refueling stations will also have spill catch basin to collect and recycle the diesel oil and protection will have to be extended to those also.

The ICAF System itself also has a small footprint and can even be skid mounted for more flexibility. The foam concentrate is stored in a non-pressurized tank of the appropriate capacity and does not use bladders or complicated inductors and trims. The entire foam trim is actually factory-built in a user-friendly cabinet !

A skid mounted bank of high pressure compressed air cylinders is supplied to provide the pressure to the system so the existing water pressure can be used to feed the system.

The ICAF system requires so little water that even if the local water supply was inexistent, as is often the case in remote locations, the problem could be easily resolved by installing a water reservoir of appropriate capacity that will be pressurized on system activation. The system would then be completely stand-alone and this critical installation would be adequately protected.

Conclusions

Fire protection designers now have an additional weapon in their arsenal of fire combat tools. The ICAF technology is emerging as an vastly superior solution for protection of underground mining diesel refueling stations, diesel storage and other similar hazards.

With ICAF Systems, mine owners can now better protect their investment while achieving quick and total fire suppression in case of accidental fires.

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.

ICAF® Compressed Air Foam Systems

FireFlex Systems Inc.
1935 Lionel-Bertrand Blvd.
Boisbriand, QC, Canada J7H 1N8
T: 450-437-3473 Toll free: (866) 347-3353
Fax: (450) 437-1930

For additional information about ICAF Systems, please visit our web site at: **http://www.fireflex.com**