



## FOAM SYSTEMS APPLICATION CASE STUDY

*Medium Expansion Foam  
for Fire Protection  
and Vapor Suppression*

### Overview

Chemical solvents are stored at a majority of industrial plant sites. The type of chemical, how much of it is stored, and how it is stored are critical issues to the plant safety manager and the fire protection designer.



When a flammable liquid solvent is stored in a tank, it is typically surrounded by a containment area (dike) that is protected by an AFFF Foam System per NFPA 11 guidelines. The AFFF Foam System is designed to deliver foam, at a given application rate and time, into the dike area to suppress a flammable liquid fire. However, in many instances, the solvent being stored can also be classified as a hazardous fuming compound, which has the potential to release toxic vapors when exposed to the atmosphere by means of spill or tank leak. For this type of application, the foam system must also be designed for vapor suppression. Finally, this same chemical/flammable liquid may be classified as a water miscible fuel, thus requiring an alcohol-resistant foam agent. This is where a fixed medium-expansion foam system using ANSULITE® 3x3 Low Viscosity Foam Agent is ideal.

## Application/Design Criteria

Ansul has supplied AFFF foam systems to protect various types of hazardous fuming compounds including oleum and chlorosulfuric acids. This particular case study will focus on the protection of tank dike areas storing Trichlorosilane (TCS), a chemical often used in the manufacture of computer chips. It is hazardous and will emit toxic vapors when exposed to the atmosphere. Thus, the AFFF Foam System had to be designed for both fire protection and vapor suppression.

The Ansul foam system was installed by Grinnell Fire Protection of Portland, Oregon for the Mitsubishi Silicon America facility in Salem, Oregon. The project required the protection of five separate dike areas ranging from 75-360 square feet (7.0-33.4 m<sup>2</sup>). The areas protected were defined as TCS Fill Station - 200 sq. ft. (18.6 m<sup>2</sup>), TCS Doghouse - 360 sq. ft. (33.4 m<sup>2</sup>), TCS Containment Pool - 250 sq. ft. (23.2 m<sup>2</sup>), TCS Day Tank Room - 144 sq. ft. (13.4 m<sup>2</sup>), and the TCS Trench Pool - 75 sq. ft. (7.0 m<sup>2</sup>). The AFFF Foam System was designed in accordance with NFPA 11 - *Standard for Low-Expansion Foam* and NFPA 11A - *Standard for Medium- and High-Expansion Foam Systems*.

The key design criteria specified that...

- The expanded foam application rate shall generate a foam blanket over the entire hazard area of not less than 2 ft. (610 mm) in depth within 2 minutes.
- The central foam concentrate proportioning system shall be of the balanced pressure type.
- Foam concentrate quantity shall be based on 3% proportioning for a foam discharge duration of 12 minutes. Foam concentrate bladder tank shall be sized to handle two separate discharges at the design rate plus an allowance for testing and expansion.
- Foam liquid shall be ANSULITE® 3x3 Low Viscosity AFFF.
- Foam discharge device/nozzle shall be able to produce medium-expansion foam having an expansion ratio of approximately 50:1 and constructed of stainless steel (such as the Ansul KR-M model nozzle).

## Medium-Expansion Foam

Medium-expansion foam is an aggregation of bubbles resulting from the mechanical expansion of a foam solution by air or other gases with a foam-to-solution volume ratio ranging from 20:1 to 200:1. Medium-expansion foam can be used on solid fuel and liquid fires when some degree of in-depth and three-dimensional coverage is necessary - or where rapid vapor suppression is required. It is effective both indoors and outdoors and produces far more foam using less water than with low-expansion foam systems.

Popular discharge devices used to make medium-expansion foam are the Ansul KR-M medium-expansion nozzles. These nozzles are compact, lightweight and can be used as hand-line nozzles or in fixed pipe systems. The KR-M series nozzles are made of corrosion-resistant materials and supplied with built-in shut-off valves. There is also a dual-expansion version that can produce either low or medium expansion foam. The nozzle operates at a minimum pressure of 45 psi (3.1 bar) and has a designed flow rate of 60 gpm (227 Lpm) for model KR-M2 or 120 gpm (454 Lpm) for model KR-M4, both based on 100 psi (6.9 bar) to the nozzle inlet.

ANSULITE® 3x3 Low Viscosity Alcohol-Resistant AFFF Concentrate is specially formulated and UL listed for use with both hydrocarbon and polar solvent (water miscible) fuels. The foam concentrate has a dramatically reduced viscosity as compared to other listed polar-solvent type AFFF concentrates on the market. This reduced viscosity enhances performance in all types of foam proportioning equipment and through devices such as the KR-M nozzles.

## Project Scope

Based on the design criteria, dike dimensions, stored TCS in each area, and calculated application rates; it was determined that the Fill Station and Doghouse would each have two medium-expansion nozzles while the Containment Pool, Day Tank Room and Trench Pool would each have a single KR-M nozzle. The AFFF foam system would have a single bladder tank leading to five branches that would each have a proportioner/ratio controller, concentrate control valve, and deluge valve dedicated to each TCS Station described above. The system would be controlled by an Ansul-supplied control panel and flame detection system.

The Ansul Foam System Scope of Supply was as follows:

- 1 - Vertical Bladder Tank, 400 Gallon (1514 L)
- 5 - Threaded Proportioners, 2"
- 5 - Hydraulically Actuated Ball Valves, 1-1/2"
- 5 - Concentrate Isolation Ball Valves, 1-1/2"
- 5 - Swing Check Valves, 1-1/2"
- 1 - Water Inlet Ball Valve, 2"
- 7 - Medium-Expansion Nozzles, KR-M2
- 8 - ANSULITE® 3x3 Low Viscosity AFFF Concentrate, 55 gal. (208 L) Drums
- 1 - AUTOPULSE® IQ-301 Control Panel and Flame Detection System

## Conclusion

Both the sprinkler contractor and plant safety department were impressed with the layout of the system, easy installation, fast response and fill time, and foam quality.

The noted advantages of such a system include:

- Using one system/nozzle to produce both a foam blanket for fire protection and a medium-expansion foam for vapor suppression.
- Using one foam agent to protect a water miscible flammable liquid and suppress toxic vapors from this same stored solvent.
- Less water is required for medium-expansion foam, causing less chemical disturbance and contamination.
- Fast response and dike fill-time.
- The KR-M nozzles can be supported off the top of the concrete containment dike, eliminating the need for openings and seals through the containment walls.
- Safe, reliable, easy installation with a single bladder tank; no electrical requirements for the foam equipment.

*If you have any questions concerning a stored chemical at your facility and the design of a foam system, please call Ansul Technical Services at 800-862-6785 or 715-735-7411. See our Web Site at [www.ansul.com](http://www.ansul.com).*



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