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Technical Letter
No. 1110-3-481 31 March 1997

Engineering and Design
CONTAINMENT AND DISPOSAL OF
AQUEOUS FILM-FORMING FOAM SOLUTION

1. Purpose. This letter provides design guidance for containment and disposal of aqueous film-forming foam (AFFF) discharges from AFFF fire extinguishing systems.

2. Applicability. This letter applies to all HQUSACE elements and USACE commands having military construction and design responsibility. This ETL has been coordinated with the Air Force.

3. Background.

a. AFFF fire suppression systems are typically provided in aircraft hangars. AFFF systems have superior fire extinguishing capability and can effectively control a flammable or combustible liquid fire. This type of protection is necessary to protect valuable, mission-essential aircraft and hangar facilities.

b. A concern of AFFF systems is the discharge of AFFF foam solution. In large volumes, AFFF foam can be harmful to the environment. AFFF solution should not be allowed to flow untreated into the ecosystem, or into the sewage systems in large quantities. The primary concern is discharge from unwanted activations and from periodic testing.

c. Except for this technical letter, there is little information on this subject and no specific design guidance that provide a reasonable approach to handling AFFF discharges.

4. Guidance.

a. Containment systems will be provided for all fixed AFFF fire extinguishing systems. Containment systems will be designed to contain the most probable worst case AFFF discharge. The most probable worse case AFFF discharge is defined as the maximum discharge likely to occur in a non-catastrophic event. The most probable worst case is different for open fire extinguishing systems and for closed fire extinguishing systems.

b. AFFF discharges associated with major fires are not considered the most probable worst case for two reasons. First, a major fire would be considered a catastrophic event. Second, an occurrence of a major fire in a well protected hangar is not considered a probable event. In the event of a fire, a AFFF fire suppression system would control the fire and would not produce significant amounts of AFFF.

c. It should be noted that significantly less AFFF discharge would be produced in a protected hangar than that produced if a fire occurred in an unprotected hangar. To fight a fire in an unprotected hangar, significantly larger amount of AFFF would be applied by the fire department hose streams. A fire in an unprotected hangar could cause considerable environmental harm.

d. Open Fire Extinguishing Systems. Open systems are oscillating and fixed nozzle systems, as well as deluge sprinkler systems which discharge foam by activation of detectors or manual release stations. These systems have open nozzles and sprinkler heads. The worst case for an open system is an accidental discharge, and the fire department responding and shutting off the system. Containment will be designed to hold a minimum of 10-minutes of full system flow. This capacity should be increased if longer fire department response times are anticipated.

e. Closed Fire Extinguishing Systems. Closed systems are systems which have no open orifices. In order for these systems to discharge, there must be a fire that produces sufficient heat to fuse a sprinkler head. Such systems are overhead wet-pipe sprinkler and pre-action sprinkler systems. For these systems, the worst case is defined as the discharge that occurs from periodic testing. Containment systems will be designed to hold 3-minute test flows of each system.

f. Detailed information on AFFF and more specific design guidance are provided in Appendix A.

5. Action. The guidance included in this technical letter and in Appendix A will be used for the planning, design and construction of new facilities with AFFF fire extinguishing system protection.

6. Implementation. This technical letter will have immediate application, as defined in paragraph c, ER 1110-345-100.

FOR THE COMMANDER:

KISUK CHEUNG, P.E.
Chief, Engineering Division
Directorate of Military Programs

1 Appendix
App A - Containment and Disposal of Aqueous Film-Forming Foam AFFF Solution

APPENDIX A
CONTAINMENT AND DISPOSAL OF AQUEOUS FILM-FORMING FOAM (AFFF) SOLUTION

TABLE OF CONTENTS

CONTAINMENT AND DISPOSAL OF AQUEOUS FILM-FORMING FOAM (AFFF) SOLUTION

1. SCOPE

This engineering instruction provides engineering and design guidance on containment systems and disposal requirements for aqueous film-forming foam (AFFF) solution. AFFF solution addressed by this technical letter are produced from AFFF fire suppression systems. In DoD facilities, AFFF fire suppression systems are installed primarily in aircraft hangars. Potential discharges of large amount of AFFF have environmental concerns and impact that must be considered in the design of these systems. The guidance in this instruction does not prohibit utilization of other engineering methods that meet the intent of this document and achieve equal or better results.

2. INTRODUCTION AND BACKGROUND

Fire suppression systems using AFFF foam solutions are often installed in facilities containing flammable or combustible liquids because of the rapid and efficient fire extinguishing capability of foam. Within the Department of Defense, the primary application of AFFF foam fire suppression systems is in facilities housing fueled aircraft. Although various types of fire fighting foams are available, AFFF is used almost exclusively in fixed fire suppression systems. AFFF provides superior fire extinguishing capability in controlling flammable liquid fuel spill fires. However, discharges from AFFF systems often pose problems relative to collection and disposal, problems not inherent with plain water sprinkler systems. AFFF systems especially those with open orifices have been susceptible to false or unwanted releases, usually caused by system malfunction or human error. Such releases have resulted in the discharge of large amount of foam solution during a single occurrence. Such unplanned discharges can present problems to facility users. Previously, no detailed guidance addressing the collection and disposal of AFFF solution discharges has been issued. The intent of this Engineer Technical Letter (ETL) is to provide such guidance to facility and system designers.

3. AQUEOUS FILM-FORMING FOAM (AFFF)

AFFF is a completely synthetic foam consisting of combinations of fluorochemical and hydrocarbon surfactants combined with high boiling point solvents and water. The surfactants alter the surface properties of water in such a way that a thin aqueous film can spread on a hydrocarbon fuel even though the aqueous film is more dense than the fuel.

3.1 **Military Specification**

Aqueous Film-Forming Foam (AFFF) concentrate used in DoD facilities must be "MIL-SPEC" foam conforming to MIL-F-24385. MIL-SPEC foam is recognized in the fire protection community for its high level of fire extinguishment and burnback performance. In addition to fire extinguishment and burnback requirements, the MIL-F-24385 provides for important chemical and physical properties not specified by other standards. "MIL-SPEC" AFFF concentrate is the standard by which others are measured. Other commercially available AFFF concentrates are simply not comparable to those conforming to MIL-F-24385.

3.2 **Dilution**

AFFF foam solutions are produced by diluting AFFF concentrates with water through the use of a proportioning device. The dilution ratio for 3% type concentrate, the most commonly used, is 33.3 to 1. Similarly, dilution ratios of 16.7 to 1 and 100 to 1 are used for 6% type and 1%, respectively. The concentration of chemicals in the foam solution does not vary significantly with the percentage type of AFFF. In other words, the chemical content of a 1% concentrate is roughly six times that of a 6% concentrate and three times that of a 3% concentrate.

3.3 **Fluorochemical Surfactants**

Fluorochemical surfactants are essential ingredients in AFFF concentrate. No other known class of materials has the capability of producing aqueous solutions of sufficiently low surface tension to permit the formation of an aqueous film on hydrocarbon fuels. This low surface tension allows the aqueous film to spread over and seal the surface of the fuel, extinguishing the flames and preventing the flammable liquids from evaporating. No other type of surfactant can do this as effectively as a fluorochemical surfactant. Fire fighting agents containing fluorochemical surfactants can extinguish flammable liquid fires more quickly using lesser amounts of agent than fire fighting agents not containing fluorochemical surfactants. A drawback to fluorochemical surfactants is that they can move with water in aquatic systems and leach through soil. Whereas a readily degradable compound will break down as it leaches through soil, fluorochemical surfactants will not. If allowed to soak into the ground, fluorochemical surfactants may eventually reach groundwater or flow out of the ground into surface water and cause foaming and other undesirable effects.

3.4 **Biodegradability**

Biodegradability is a measure of the breakdown of chemicals by bacteria in the same liquid environment. Bacteria use certain chemicals as food, i.e., oxidizable carbon sources as well as dissolved oxygen in the wastewater as it goes through its metabolic life cycle. The biodegradability of a material is typically determined by comparing the Chemical Oxygen Demand (COD) of the material with it Biological Oxygen Demand (BOD). The COD is determined by measuring the amount of a chemical oxidant which is required to completely oxidize a known quantity of the material. The BOD is determined by preparing a dilute solution of a known quantity of the material, inoculating the solution with a culture of bacteria from a sewage treatment plant and measuring the oxygen uptake of the solution for a fixed period of time. Results for both COD and BOD are reported in milligrams of oxygen per liter (mg/l). It is generally accepted that materials with a BOD/COD ratio greater than 0.5 are biodegradable. Actual data reported in AFFF manufacturer's literature shows ratios ranging from 0.60 to 0.99, thereby qualifying AFFF solutions as being biodegradable.

3.5 **Toxicity**

AFFF solutions are reported to have a low degree of fish toxicity, and varies widely with species. It has also been reported that AFFF solution falls into the U.S. Fish and Wildlife Service "*Relatively Harmless*" category and the USEPA "*Practically Non-Toxic*" category for even the most sensitive species. There is no published data on the phytotoxicity of AFFF solutions, but there have been no published reports of plant kills resulting from AFFF solution discharges.

3.6 **General Concern**

Even though AFFF solution is technically considered biodegradable and practically non-toxic, the major concern is the large volume of solution that can be produced from hangar fire protection systems. If AFFF discharge is not contained and controlled, relatively large volumes of AFFF discharge can flow into the environment and have a negative impact to the environment, as well as produce bad side effects, such as foaming. Because AFFF is biodegradable, the breakdown of AFFF by bacteria consumes oxygen. If enough AFFF is discharged. It can deprive aquatic life of oxygen and cause fish kills. If allowed to enter the sewage treatment facilities in relatively large volumes, AFFF foam can disrupt the treatment process.

4. AFFF FIRE SUPPRESSION SYSTEMS

The potential for, and magnitude of a foam system discharge from a fixed fire suppression system largely depends upon the type of system installed in the facility. Systems using "open" discharge devices such as nozzle systems and deluge sprinkler systems, are activated by a electronic control systems employing detectors, manual release stations, and other types of alarm initiating devices. Thus, "open systems" are susceptible to unwanted discharges caused by false activation of flame and heat detectors, power surges, physical damage, and accidental activation of manual release stations. Closed systems, on the other hand, are activated by the heat from a fire and are not prone to false discharge.

4.1 Open Fire Extinguishing Systems

Open fire extinguishing systems have open orifices and consist of monitor nozzle systems or overhead deluge sprinkler systems. To activate, they require the operation of a detection system or manual release station.

4.1.1 Nozzle Systems

Fire suppression systems utilizing fixed or oscillating nozzles are provided in hangar which house large aircraft or aircraft of strategic importance. They are designed for rapid application of foam and are susceptible to unwanted releases of foam solution. Depending upon the size of the hangar and aircraft being protected, nozzle systems can be designed to produce discharges of thousands of gallons per minute of foam solution.

4.1.2 Deluge Sprinkler Systems

In terms of discharge potential, deluge sprinkler systems are comparable to nozzle systems. Both employ open discharge devices, all of which flow upon system activation. Deluge sprinkler systems are typically provided in large hangars in the private sector. However, applicable Army, Air Force and Navy criteria mandate the use of closed-head, not deluge systems, in order to avoid clean-up associated with unwanted discharges.

4.2 **Closed Fire Extinguishing Systems**

Closed fire protection systems are basically overhead wet pipe or preaction sprinkler systems and have closed-head sprinklers. This is in contrast with open-head or deluge sprinkler systems in which all sprinkler heads are open and discharge upon system activation. An inherent feature of the closed fire extinguishing systems is that each individual sprinkler head must be actuated by the heat of a fire before it will begin discharging. Closed-head sprinkler systems, whether wet-pipe or preaction, are not susceptible to false discharges due to system malfunction or inadvertent actuation. Their inherent safeguard against "false dumps" makes closed head systems the preferred system for most DoD hangar facilities.

5. **DESIGN GUIDANCE**

5.1 **Most Probable Worst Case**

a. Containment systems will be designed to contain the most probable worst case AFFF discharge. The most probable worse case AFFF discharge is the maximum discharge likely to occur in a non-catastrophic event. Most probable worst cases are different for closed fire extinguishing systems and for open extinguishing systems.

b. Foam discharges associated with major fires are not considered the most probable worst case event for two reasons. First, a major fire in a hangar would be considered a catastrophic event. It is impractical to design a containment system for a catastrophic event due to the infinite number of variables associated with such an event. Secondly, an occurrence of a major fire in a well protected hangar is not considered a probable event. In an event of a fire, an installed AFFF fire suppression system would control the fire and would not produce significant amounts of AFFF.

c. It should be also noted that significantly less AFFF discharge would be produced in a protected hangar, than would be produced if a fire occurred in an unprotected hangar. To fight a fire in a unprotected hangar, a much larger amount of AFFF would be applied by the fire department hose streams. The fire in an unprotected hangar would pose a significant environmental impact.

d. Open Fire Extinguishing Systems. Open systems are oscillating and fixed nozzle systems, as well as deluge sprinkler systems which discharge foam by activation of detectors or manual release stations. These systems have open orifices. The worst case for open systems is an accidental discharge, and the fire department responding and shutting off the system. Containment will be designed to hold a minimum of 10-minutes of full system flow. This capacity should be increased if longer fire department response times are anticipated.

e. Closed Fire Extinguishing Systems. Closed systems are systems which have no open orifices. In order for these systems to discharge, there must be a fire that produces sufficient heat to fuse sprinkler heads. Such systems are overhead wet-pipe sprinkler systems and pre-action sprinkler systems. For these systems, the worst case is defined as the discharge that occurs from periodic testing. Containment systems will be designed to hold 3-minute test flows of each system and to facilitate required periodic flow testing.

5.2 **Containment System Capacity**

The minimum capacity of any containment system should be adequate to handle anticipated maximum flows. For open fire extinguishing systems, the capacity should be based upon the one event that can produce the largest single discharge amount from an inadvertent activation. For closed fire extinguishing systems, the anticipated flow is that produced during acceptance and periodic system testing.

5.2.1 Discharge From Open Systems

Containment capacity must consider both inadvertent discharges from open discharge devices, e.g., nozzle systems, as well as discharges from testing of all system proportioners. Capacity should be based on a discharge duration of 10 minutes due to inadvertent discharge from open discharge devices. For example, assume an aircraft hangar has three closed-head sprinkler systems, each with a design flow rate of 2,400 gpm, and a nozzle system with a total calculated flow rate of 2,200 gpm. The required containment capacity for an anticipated 10-minute inadvertent discharge of the nozzles would be 22,000 gallons. A 22,000 gallon capacity containment system would be more than adequate to handle a 3-minute test flow of 7,200 gallons of foam solution from a single proportioner. In actuality, the containment system could handle the test flows from three of the four closed-head sprinkler systems. The ten minute duration for inadvertent flows may be modified, if the designer determines that the emergency response to shut the AFFF systems would either take more or less time than 10 minutes.

5.2.2 Discharge From Closed Systems

Containment capacity for closed systems is based upon testing requirements only. The design and sizing of the containment system will be affected by a number of factors, including the system design, and number, size and location of AFFF proportioners. Each proportioner must be tested individually. As a minimum, the containment system should be sized to contain the test flow of foam solution from the system proportioner with the greatest design flow rate for a minimum of three minutes. For example, assume that an aircraft hangar has four closed-head sprinkler systems (no nozzles), each with a separate proportioner. Assume also that the greatest flow rate is 2,500 gpm. A 3-minute test should produce at least 7,500 gallons of foam solution, which would be the minimum capacity of the containment system. In this example, the 7,500 gallon containment system would have to be emptied between each test. Designing to the minimum in this case does not facilitate system testing. It is preferable to size the containment to handle test flows for all four systems, or for at least half the systems. Designing for only one system being tested would greatly lengthen the testing period.

5.3 **Floor Drainage Systems**

Applicable design criteria for aircraft hangars require floor drainage systems to restrict the spread of fuel in the event of a spill. System configuration and size of drainage piping must also take into consideration the hydraulic demands placed on the system throughout it entire length. This includes the AFFF discharges that could occur in the event of an inadvertent activation of an open fire extinguishing system.

5.4 **Oil-Water Separators**

Oil-water separators are an integral part of hangar drainage systems. They are installed in the hangar drainage system to intercept oil or fuel spilled on the hangar floor before it enters the influent piping to the wastewater treatment plant. Oil in the influent to treatment plants inhibits the treatment process and is never acceptable by the treatment plant authorities above small threshold limits. An oil-water separator is sized for a designated flow rate which is generally based upon the maximum anticipated spill. Flow above the design rate would have the effect of diminishing the effectiveness of the separation process. Separation is based upon providing sufficient detention time to allow the oil, which is lighter than water, to rise to the top of the separator for removal.

In hangar protected with open fire suppression systems, activation of the foam system would result in large quantities of foam solution entering the floor drainage system. If not diverted, such copious amounts of foam solution would become influent to the oil-water separator. Such a large volume of foam solution would overwhelm the capability of the separator designed for much smaller amount of spilled fuel. The likely result would be the accumulation of excessive amounts of foam solution within the facility. To preclude this, automatically-actuated valves are needed in the drainage piping upstream of the oil-water separator to prevent foam solution from entering the separator and to divert flow to a containment system.

6. **CONTAINMENT SYSTEMS**

A system engineered to collect and contain AFFF solution is needed where fixed AFFF fire suppression systems are installed. Numerous types of systems can be used, depending upon the fire protection system, anticipated maximum discharges, size of facility, site conditions, climatic conditions, disposal method, and other factors. Several types of systems are addressed below. However, designers are encouraged to consider other innovative methods and systems as may be deemed appropriate for each specific application.

6.1 **Underground Tanks**

The storage of foam-water solution in underground tanks prior to controlled release or other disposal means is an option which may sometimes be utilized. The tank may, in most cases, be located so gravity flow to the tank can be utilized. The underground tank also does not have to be sized to accommodate rainfall during the retention period. Generally underground tanks for this application are not required to be double-walled or have leak detection. Underground tank can be costly, particularly if the retention system must accommodate a large amount of foam solution. For example, a tank needed for retention of 20,000 gallons of solution would have an approximate diameter of 10 feet and a length of 35 feet. Emptying of the tank could be accomplished by metered pumping to the wastewater treatment plant or by other methods covered in this document.

6.2 **Aboveground Tank With Sump**

6.2.1 For open AFFF systems, this method utilizes a sump pit with a vertical shaft pump or submergible pump which diverts solution to a vertical storage tank. This method is suitable if underground tanks are undesirable or more costly. For open systems, this system may require high volume pumps to pump the discharge up to the above ground tank. These pump requires high maintenance and increase long term facility maintenance costs.

6.2.1 For closed AFFF systems, containment systems receive AFFF only during system testing. The AFFF discharge can be directed to the containment system using hoses connected to a test header. This eliminates the need for sump and pumps and makes aboveground tanks cost effective for closed systems.

6.3 **Earthen Retention Ponds**

Earthen retention ponds may have an advantage where large capacity containment systems are required. A disadvantage is that a large amount of space is generally required. Ponds should be designed to contain the greatest 24-hour rainfall in a 5-year period. Ponds should be lined with an impermeable material in locations where ground or surface water contamination is a potential problem. Liners should be protected from ultraviolet (UV) radiation or be UV resistant. Gravity flow to the pond from drainage piping system is preferred where the topography of the site permits. If relative elevations preclude gravity flow, the discharged solution would have to be pumped to the retention pond. Disposal of the solution from the pond could be by controlled flow to a wastewater treatment plant, solar evaporation or a combination of the two. Valving and piping should be provided to drain off rain water to the sewage treatment plant.

6.4 **Containment Trench**

This method utilizes a lengthy containment trench with steel safety and rain cover which would contain the foam solution until it can be disposed.

6.5 **Additional Capacity For Rainfall**:

When open air AFFF retention ponds or tanks are used, or where areas drained by AFFF drainage system are open to rain fall, the capacity of the storage system shall be increased to accommodate a 5 year - 24 hour maximum rain fall event, in addition to the worst case foam discharge. Because of extremely unlikely event of an AFFF discharge occurring simultaneously with a greater rain event, capacity will not be designed for greater rain fall events. Containment systems for only closed head fire protection systems do not require rain fall allowance since the containment system is only used for system testing.

The odds of system activation occurring in the same period as a 5 year - 24 hour rain event is extremely small. If one assumes one false activation per year, the odds of this activation occurring within 2 days (48 hours) of a 5 year - 24 hour maximum rain event is less than 1 in 333,000. Since the containment is designed to accommodate this unlikely event, designing for greater rainfall is not required.

6.6 No Containment Required

There are geographical areas in the world where no containment system is necessary. They would be in dry climate areas, where there are little or no open water, streams or wetlands and no high ground water table. In these areas, solar evaporation would be a method for disposal of the foam solution.

6.7 Containment For Closed Systems

The containment systems listed above are, for the most part, for containing large discharges that are associated with open systems. Closed system discharges are limited to testing only. Containment requirement for testing are less than that for inadvertent discharges associated with open systems. Testing produces less solution discharge since the flow duration is only three minutes, testing can be planned, and testing can be conducted sequentially on individual systems after the containment system is emptied. Containment could be an impermeable pit or an open concrete vault which could contain the full test flow. It is important that any collection system must be designed to contain the full force of the flow, which is usually from several 2-1/2 inch fire hoses, flowing simultaneously.

7. AFFF DISPOSAL AND TREATMENT OPTIONS

7.1 Discharge To Wastewater Treatment Plants

The most common method of disposing of foam solution is to treat it biologically in a wastewater treatment plant. This is generally accepted as the preferred method of disposal. Where feasible, solution should go directly to the treatment plant via sanitary sewer lines serving the facility. Another method of disposal allowed in some areas is solar evaporation. Disposal of the AFFF solution is a design consideration that be must coordinated with the base or installation officials.

7.1.1 Discharge To Flowing Sewers

AFFF solution should be metered discharge to "flowing sewers" because discharge to an intermittently flowing sewer could cause waste to collect and to be flushed to aeration basins at higher than recommended concentrations. Uncontrolled sewer discharge rates could also result in foam backing out of sewer drains.

7.1.2 **Foaming**

When too much fire fighting foam containing fluorochemical surfactants is discharged to a wastewater treatment system at one time, severe foaming can occur, even at low concentrations. This results in aesthetic concerns in rivers and streams as well as operational problems in sewers and wastewater treatment systems. Therefore, the rate of discharge must be controlled.

7.1.3 **Rate Of Discharge**

It is generally recognized that the concentration of foam solution in the influent reaching a wastewater treatment plant needs to be no greater than 1,700 parts per million (ppm). This degree of dilution is considered sufficient to prevent "shock loading" and foaming which can upset treatment plant operation. As an example, if a discharge is to be made to a 6-million-gallon-per-day treatment plant, the solution could be discharged at a rate of 7 gallons per minute (gpm). Since such a low rate of discharge is apt to be difficult to control, dilution of the foam solution by say 10 to 1, would permit a discharge rate of 70 gpm. In any case, it could take several days or even weeks to dispose of the solution, depending upon the amount of the foam solution release. Since this level of dilution may not apply to all wastewater treatment plants, operators of affected plants should be consulted in advance. Discharge levels of AFFF must be determined well in the early stages of design. In some instances, treatment plant modifications may be necessary, new environmental permits may be needed, or existing permits updated.

7.2 **Solar Evaporation Pond**

Disposition of AFFF solution through solar evaporation is feasible under certain circumstances. Feasibility of this disposal method is related to the rate of evaporation which depends upon the holding area surface area, the difference in saturation pressures at the air dewpoint and the surface water temperature, wind velocity and the latent heat required to change water to vapor. High humidity present in many locations during the summer has the effect of slowing the rate of evaporation. The ideal location for utilizing solar evaporation as a means for disposing of AFFF solution would be a hot, dry climate with high wind velocities. To facilitate the evaporation process, the holding area would need a relatively large surface area in order to make this a viable option. Ponds should be designed with a shallow depth and large surface area. For example, a pond designed to contain 20,000 gallons of foam solution should have an area of approximately 12,000 square feet and be filled to a depth of approximately three inches. Such a pond of circular configuration would require a diameter of about 120 feet. Assuming the absence of rain, complete evaporation would take about 64 days under calm, damp conditions. But under windy, dry conditions, the 3-inch depth would evaporate in less than one day. It is important to keep in mind that this example is based upon there being no rainfall during the evaporation period. Rainfall must be considered in sizing the pond in the same manner as done for earthen ponds.

7.3 On-site Treatment

Under certain conditions, on site treatment may be the most cost effective disposal method for AFFF wastes. This may involve aerobic digestion, anaerobic digestion, air stripping or other treatment method. Several different methods of on-site AFFF treatment are being developed and may be available in the near future. Permits may be required if the effluent from such treatment systems are discharged to surface waters.

7.4 Truck/Rail Transport to Off-Site Treatment Facility

In certain circumstances, it may be necessary to truck AFFF waste to an off-site treatment facility. This method of disposal is very costly and should only be considered as a last resort.

8. SUMMARY

Aqueous film-forming foam (AFFF) is frequently used in fixed fire suppression systems for combating flammable and combustible liquid fires. Discharges from these systems can produce thousands of gallons of foam-water solution. Unplanned discharges usually occur due to system malfunction or human error. Planned discharges are associated with acceptance and routine testing of these systems. "Open" systems such as deluge sprinkler and nozzle systems are more susceptible to inadvertent AFFF discharges than are closed-head sprinkler systems. Accordingly, foam solution containment requirements for closed system are less than for open systems. Designers need to evaluate various containment and disposal methods appropriate for each situation.

9. DESIGN GUIDANCE SUMMARY

Designs of containment/disposal systems for AFFF discharges should be sized for inadvertent discharges and for testing.

9.1 Open Fire Suppression Systems

a. These systems include monitor nozzles and deluge sprinkler systems.

b. Designs of AFFF containment/disposal systems should be sized to contain the flow from largest single inadvertent discharge for a minimum 10-minute duration. The 10-minute duration should be increased if emergency response time to shut down the system is anticipated to be longer.

c. Designing for a 3-minute test flow is usually not a factor for open systems since testing usually requires less containment than a 10-minute inadvertent discharge.

9.2 Closed Fire Suppression Systems

a. These systems include wet pipe and pre-action sprinkler systems.

b. Design of the AFFF containment/disposal system should be based testing of proportioning systems for a 3-minute duration.

c. To facilitate testing and maintenance, containment systems should be sized for testing all fire suppression systems in the same period. However, containment systems can be sized for testing individual systems separately. Designing for the largest single system would require the containment system to be emptied between tests. This would extend the testing period and increase cost for testing. Sizing the containment for a single system should be coordinated with and accepted by the user.

9.3 Containment Systems

Containment systems for open fire extinguishing systems can consist of underground tanks, aboveground tanks with sump, earthen retention ponds, containment trenches or other systems that will achieve the containment of AFFF discharges from inadvertent releases. For closed systems, containment should be sized to contain flows for required acceptance and periodic testing.

9.4 **AFFF Disposal and Treatment**

The usual method of disposing AFFF solution is through regulated flow to the wastewater treatment plant. Flow rate is dependent upon the size and capacity of the treatment plant, and must not exceed 1700 parts per million at the plant. Other methods such as solar evaporation, on-site treatment and transport to an off-site treatment facility may be utilized based on local conditions. Regardless of what type of disposal arrangement is provided, it is essential that foam solution from system testing and inadvertent discharges be disposed of in an environmentally responsible manner.