U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: WATER SUPPLY SYSTEMS FOR AIRCRAFT FIRE AND RESCUE PROTECTION

Date: July 31, 1992
Initiated by: AAS-100

AC No: 150/5220-4B
Change:

1. PURPOSE. This Advisory Circular (AC) provides guidance for the selection of a water source and standards for the design of a distribution system to support aircraft rescue and firefighting (ARFF) service operations on airports.

2. CANCELLATION. AC 150/5220-4A, Water Supply Systems for Aircraft Fire and Rescue Protection, dated 12/11/85, is canceled.

3. APPLICABILITY. Compliance with the standards contained in this AC is mandatory for projects involving federal funding. These standards are recommended for water supply systems intended to support ARFF operations at any airport. This AC does not include water supply systems intended to support airport structural fire protection functions. Guidance for the water requirements for fire protection of airport structural facilities such as airport terminals, aircraft hangers, air cargo terminals, fuel farms, etc., can be found in National Fire Protection Association (NFPA) publication, NFPA 419, Guide for Master Planning Airport Water Supply Systems for Fire Protection.

4. DEFINITIONS.

a. Airport Water Distribution System. A system of water mains, piping, valves, hydrants, pumps, etc., under airport authority for the distribution of pressurized water to support ARFF operations on airports.

b. Listed. Equipment or materials included in a list by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

c. Multi-distribution System. A system consisting of the main potable distribution system and a secondary non-potable backup distribution system.

d. Potable Water. Water, certified by a department of health or other agency having jurisdiction that it has met minimum specifications and is suitable for human consumption.

5. METRIC UNITS. To promote an orderly transition to metric (SI) units, this AC contains both English and SI dimensions. The SI units may not be exact. Pending official change to that system, the English system governs.

6. WATER SOURCES. Water can be acquired from a public (municipal) water system, man-made reservoirs, or natural sources. Public water systems are generally a reliable primary source for ARFF service operations. Man-made reservoirs include a variety of devices such as: gravity tanks, pressure tanks, wells, and in or above ground level reservoirs. Natural sources such as lakes, rivers, and springs may also be accessible to the airport. Whichever water source is chosen, the Airport Master Plan should identify the source as being able to support the present and forecasted water requirements of the ARFF service as well as the domestic water service demands of the airport. When selecting the water source to support an overall airport fire protection program, the following should be considered:

a. Public Water System. Generally a reliable primary water supply source. The disadvantages of this source include: lack of control over water sharing, physical condition of the system, the scheduling of service interruptions, and system component make-up, such as pressure reducing valves or water meters. Also, booster pumps are often required to overcome restricted flows and/or to increase pressure during fire service operations.

b. Man-made Reservoirs.

(1) Elevated gravity tanks provide a dependable delivery of water. However, the need for high pressures and flow rates during fire service operations may restrict their use because of the extra cost of fire pumps or other practical considerations. If employed, their height and location should not constitute an airport hazard. If selected, they shall be properly sized to support the needed flow rates and shall be installed and maintained in accordance with NFPA 22, "Standard on Water Tanks for Private Fire Protection." It should be noted that elevated facilities located on the airport need to be shown on the Airport Layout Plan and be approved by the FAA.

(2) In- or above ground level water reservoirs intended for ARFF support can be located on or off the airport, but should be under the airport operator's control to assure availability. Any reservoir should be divided into approximately equal sections to allow continuous service during routine maintenance, repairs, or expansions to the reservoir. As an additional safeguard, automatic supervision of the water level in the reservoir is recommended. Installation of reservoirs shall also be in accordance with NFPA 22. It should be noted that when man-made reservoirs or natural bodies of open water are located on or near airport property, and will remain uncovered, consideration must be given to the design of the reservoir such that attraction to wildlife is minimized. Designs of the water body should be linear to facilitate covering if wildlife begins to use the collected water.

(3) Wells are subject to recedence. In some areas high volume use results in salt water intrusion. This not only presents increased corrosion problems, it also affects the usefulness of the water for foam production, except for military specification AFFF or other foam concentrates known to be compatible with either fresh- or saltwater. Before placing reliance on well water supplies, local water table trends should be analyzed for potential recedence, contaminants, and saltwater intrusion.

c. Natural Supply Sources. These are usually located beyond the physical control of the airport. Other disadvantages include: the affects of seasonal rain/snow fall variations, new land developments which increase water demands, and possible alterations of the source. In addition, industrial pollutants or other contaminants, may affect the usefulness of the water for foam production and/or cause damage to ARFF vehicles, pumping equipment, and/or the associated water supply distribution network.

7. SOURCE EVALUATION. A viable water source is one that has the capacity to support ARFF water flow requirements. To determine the best water source, analyze the alternatives on the basis of cost-effectiveness and operational requirements. To avoid costly future expansions or corrective measures, the selected source should be able to accommodate current needs as well as projected expansions. The analysis should examine at least the following:

a. Control. Validation of the airport's authority to maintain control over the water source. The concept of "control" should include reliable "access" both in terms of access rights to use the water and to have both the rights and the means to gain physical access with ARFF vehicles. The later could involve easements for vehicle traffic. The arrangements for control/access may be critical in case of normal distribution system failure and vehicle shuttle operations are needed as a backup system.

b. Capacity. Verification of the capacity of the potential source to supply the flow rates and pressures needed to support both normal domestic and industrial obligations and emergency ARFF service demands. If inadequate, plans and procedures to curtail other users during ARFF operations should be considered.

c. Seasonal Moisture Accumulations. An evaluation of the affects of drought, flood, and freezing conditions on the reliability of potential water sources.

d. Future Requirements. An assessment of the potable water requirements of any population centers that may share the source. Consider the increases in population on- and around the airport which may expand significantly over time and develop estimates for increased water demand.

e. Water Quality. Identify any actual and potential water contamination, e.g., chemicals or particulates and assess their affect on ARFF operations.

d. Backup Source. Identify any existing backup source or examine the feasibility of providing a secondary water source to be used in the event of an interruption in the main water supply. This is particularly important when hydrants are the primary source of ARFF vehicle refill. Contingency plans should be developed to provide the necessary water resupply when the hydrant system is inoperative due to scheduled service as well as for unscheduled interruptions.

8. DISTRIBUTION SYSTEM. All of the components for an ARFF water supply system shall meet the requirements of and be installed in accordance with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances". The valves, hydrants, and pumps should be designed to operate as intended at temperature conditions applicable for the geographic region. The installation should include freeze protection, if necessary.

a. Piping Layout. A gridded or a looped water distribution system is preferred over a single water main. The emergency capacity of the system should be based on the ARFF vehicle refill standards discussed in paragraph 9 and any domestic or industrial service that will have concurrent demands. Avoid installing water lines under future sites for airport buildings, maintenance facilities, embankments, or heavy traffic areas such as runways and taxiways. Provide anti-surge components as needed to protect piping from surge and water hammer damage. When feasible, the airport water distribution system should be fed with water at two or more widely separated and isolatible inlets.

b. Valves. Locate valves for optimum control and to limit size of the inoperative area during system checks, repairs, modifications, or expansions.

c. Hydrants. All hydrants installed in support of an ARFF water supply system shall be listed by an approved testing laboratory.

(1) The availability of hydrants in proximity to aprons is highly desirable. Where hydrants are located close to hangers, terminal buildings, and passenger gates, the location shall be identified with a reflective sign at least 15 feet (4.5 M) above their position. Hydrants should be strategically located on loops or grids readily accessible to ARFF vehicles. Optimum hydrant spacing is approximately 300 feet (90 M). Spacing should not be more than 500 feet (150 M) apart along the periphery of aprons which are used for aircraft parking and passenger loading and unloading.

(2) Hydrant station locations should not constitute a hazard to aircraft or ground vehicle movements. This placement should also safeguard hydrants against aircraft or ground service vehicular damage and vandalism.

(3) Hydrants installed along runway shoulders or other strategic locations are intended only as resupply points. They do not replace self-propelled ARFF equipment. Runway or taxiway hydrant systems shall be conspicuously marked, and be of recessed or flush type. Additionally, such systems will need special winter maintenance to insure identification of their positions for inspection, test, maintenance, and emergency use .

d. Fire Service Pumps. Fire service pumps are often needed to boost the normal municipal water system pressure to the levels needed for ARFF emergencies as well as for multi-story airport structures and aircraft hangers. An effective emergency pumping system has the following characteristics:

(1) Fire pumps are installed to conform to NFPA 20, "Standard for the Installation of Centrifugal Fire Pumps."

(2) The number of pumps is adequate to supply the total water demand at the required pressure with the largest individual pump inoperative.

(3) The pump power source is highly reliable, i.e., each pump is individually driven. Avoid the dependence of all pumps driven by a common source, such as a public electric utility. For electric motor driven pumps, a backup engine generator with an automatic transfer device is available in case of an electrical failure.

(4) The pump arrangement allows either manual or automatic operations.

(5) Pressure reducing components are provided to protect domestic piping from surge pressures or water hammer damage.

(6) A regular inspection schedule and a preventive maintenance program is in place.

(7) A strategic arrangement of valves and discharge headers is provided to ensure the continuous availability of water during single or group pump maintenance operations.

(8) Suction lines to all fire pumps from reservoirs are sized to permit full water flow requirements.

(9) The pump house is a detached building of fire resistive construction. Site location does not constitute a hazard to aircraft operations. If pumps are housed within another structure, the pump room is sectioned off by an enclosure having a minimum four-hour fire rating.

(10) Spare pumps are operational and are on-line during emergencies.

9. VEHICLE FILL PERFORMANCE.

a. Vehicle Capacity. In general the water payload of an ARFF vehicle is a function of the airport ARFF index. The latter is based on the longest air carrier passenger aircraft serving the airport. The ability of any ARFF water supply system to efficiently refill these vehicles is a primary consideration in assessing system acceptability.

(1) Airport indices are used to quantify the amount of water and the minimum number of vehicles needed to transport it. The details on the derivation of the ARFF index system are contained in AC 150/5210-6C, "Aircraft Fire and Rescue Facilities and Extinguishing Agents", 1/28/85.

(2) The operational capacity for a given ARFF vehicle is a function of the total water requirements for that airport index and the required number of vehicles needed to transport and apply that quantity of water.

b. Vehicle Tank Fill Connections. The tank fill performance standard for modern ARFF vehicles specifies that the tank fill connections be sized to permit the filling of the water tank in no more than two minutes when the available water supply provided at the tank intake connection is at a pressure of 80 psi (5.5 bar). See AC 150/5220-10A, "Guide Specification for Water/Foam Aircraft Rescue and Firefighting Vehicles", dated 7/3/91. for details.

c. Fill Supply Flow Rate.

(1) To take full advantage of existing vehicle technology, the water system connections designated as ARFF vehicle fill stations should, wherever practical, be sized and have the volume capacity to support that standard.

(2) As an illustration, a 2000 gallon (7,600 l) capacity vehicle would need a minimum flow of 1000 gallons (3,800 l) per minute. Using the individual vehicle fill requirements thus derived, a cost-effective water supply system can be designed for any unique fleet of ARFF vehicles.

10. SYSTEM READINESS.

a. Oversight. Responsibility for assuring proper operation, maintenance, and testing of an ARFF vehicle fill source and the associated distribution system should rest with a single agency or authority. Depending on the actual source, and/or its physical location, that authority could be airport management, a private water company, or the local municipal utilities department.

b. Operational Checks. Periodic testing of subsystem components as well as the total water supply system is essential to both prove the operational readiness of the system and to train new personnel or maintain the currency of those responsible for system operation under emergency conditions. In addition, key ARFF officials should be fully familiar with the operation of any portion of the water supply system under airport jurisdiction. The following schedule of operational checks is recommended:

(1) Initiate and maintain a leak detection program to detect and repair leaks that may develop in any portion of the buried water system that lies near the air operations surfaces. Undetected leaks could result in pavement undermining and subsequent collapse.

(2) Perform a turnover test for both the primary and the spare fire water pumps at least once a week. Conduct full flow tests at least once per year. Run up each internal combustion engine (including any spares) used to drive fire water pumps weekly for at least one-half hour.

(3) Flush test all hydrants annually. Operate all main and subsystem valves in the water supply system through at least one full cycle (open/close/open or close/open/close) at least once annually.

(4) Conduct a daily inspection of all subsystem isolation valves to insure that inadvertent system outages do not go undetected in the event that unauthorized valve closures occur.

(5) Conduct a full flow test immediately after any significant change, modification or repair has been made to the airport ARFF water supply system; or, to any of the major subsystems. This test is needed to insure that the original design parameters have not been degraded or that the anticipated improvements have been attained.

c. System Outage Reporting. Airport management should develope and implement an operating procedure that assures ARFF service notification of any reduction in the ARFF water supply capability, either in pressure or volume.

(1) In the case of an unscheduled interruption, the notification should be immediate and should include information as to the extent or areas of the airport affected, the estimated time to system restoration, and any emergency procedures instituted by the water supply system operator.

(2) For scheduled interruptions due to maintenance or system modifications, notification should, whenever practical, precede the interruption by 24 hours.

(3) The airport ARFF officials should also be notified promptly of system restoration so that appropriate system tests may be conducted.

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