ANY YEARS AGO, WHEN I FIRST STARTED IN THE fire service, 2½-inch hose was prominent in our apparatus hosebeds, which were divided equally between 1½- and 2½-inch hose. During my first assignment in Harlem with the Fire Department of New York (FDNY), old-time nozzlemen would evaluate the situation at hand and then stretch the appropriate sized handline, no questions asked! Over the years, the fire service slowly evolved to using 1¾-inch hose for attack (which took up less space on our apparatus), and the 2½-inch hose was pushed to the side. In the ensuing years, FDNY's (late) Lieutenant Andrew A. Fredericks highlighted the need for 2½-inch attack lines for situations that require large volumes of water, such as the initial attack at structural fires.

In many instances, larger streams are also needed where flammable liquids are present, but we still see fire departments stretch 1¾-inch hose and deploy portable foam eductors and five-gallon pails of foam concentrate. But is this adequate to respond to a major tank truck spill that requires large amounts of foam to extinguish? Let's take a hypothetical situation that could happen anywhere in the country.

TANK TRUCK SPILL
A tank truck carrying 6,000 gallons of gasoline overturns on a Sunday afternoon on the embankment adjacent to the local big-box discount store. The parking lot is empty but the tanker's contents spill down the embankment and into the lot, and an ignition source ignites the vapors. Six thousand gallons of product at a ½-inch depth covers an approximate surface area of nearly 20,000 square feet. Using a standard formula, surface area x application rate, will give us the flows required for foam solution in gallons per minute (gpm). In this case, the application rate if using aqueous film-forming foam (AFFF) would be 0.10 gpm per square foot of surface area, according to National Fire Protection Association (NFPA) 11, Standard for Low-, Medium-, and High-Expansion Foam (2010 ed.). Using the formula above, our requirements would be:

\[
20,000 \text{ square feet} \times 0.10 \text{ gpm} = 2,000 \text{ gpm of foam solution}
\]

The next question: How much of that is water and how much is foam concentrate? What kind of concentrate does your department use—1% x 3% or 3% x 6%? If using a 1% x 3% concentrate, you would mix at a 1% ratio for hydrocarbons—one gallon of foam concentrate to 99 gallons of water for every 100 gallons of foam solution. With a 3% x 6% concentrate, you would use a 3% ratio for hydrocarbons, or three gallons of foam concentrate mixed with 97 gallons of water for every 100 gallons of foam solution. You would need a 15-minute minimum discharge time to apply the foam to the fire.

Calculating at a 1% mixture for the above scenario, we would need 20 gallons of concentrate per minute for a total of 300 gallons of concentrate. A 3% mixture would require 60 gallons per minute for a total of 900 gallons of concentrate. Remember, these are the minimum amounts! More will be needed to prevent reflash.

For alcohol products, NFPA 11 states that we should consult the manufacturer's product literature for the minimum application rate. Major foam manufacturers require a minimum application rate for alcohols of 0.10 to 0.16 gpm/sq.ft. These application rates, coupled with the requirement that we use either 3% (for 1% x 3% concentrates) or 6% (for 3% x 6% concentrates), change our numbers considerably. At a rate of 0.10 gpm/sq.ft., we would still only need to flow 2,000 gpm, but our foam percentage will increase. At a 0.13-gpm application rate, we would now need to flow 2,600 gpm of foam/water solution for 15
INDUSTRIAL-STRENGTH EQUIPMENT

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quality, service & dependability ... guaranteed
from another source or from foam tankers. You must develop and practice standard operating procedures for these operations.

If you cannot stage your foam supplies close to the point of attack, there are alternatives. You can pump foam solution from greater distances than previously envisioned using devices such as the portable around-the-pump proportioner (photo 2). This device is designed to turn any pumper into a foam-producing device. These units will proportion 3% foam solution up to 1,500 gpm and a 1% solution up to 4,000 gpm. These devices are unique in that they are completely water-driven; there are no pumps to maintain. These devices can work against hydrant pressure of up to 50 pounds per square inch (psi) with only 150-psi inlet pressure.

As water passes through the around-the-pump proportioner, it picks up foam concentrate to form a rich water/foam solution, which is then passed back to the auxiliary intake of the supplying pumper or to the auxiliary intake of another pumper. Once inside the pumpers, everything pumped from that point is a foam solution. Hose lengths leaving the device can be as long as 1,700 feet, depending on the hose diameter (2½ or three inch) and the intake pressure at the pumper. Once in the fire pump, foam solution can then be pumped to appliances or other pumpers (relay) using standard hydraulic calculations. This water/foam solution can be pumped to nozzles, which will then aerate the solution on discharge, forming a foam blanket when it reaches the target. Using nozzles as previously mentioned, your discharge device can be positioned at least 250 feet away from the target, using distance to protect your personnel.
Because of the need to maintain constant intake pressure on the fire pump when using an around-the-pump proportioner, a portable pressure-reducing valve (photo 3) is recommended on the pump supply line. These devices eliminate the need for pump operator intervention to adjust intake gate valves because of suction pressure fluctuations as a result of changes in pump discharge flow. These devices will keep pump intake pressures constant and below those which would affect the efficient operation of an around-the-pump proportioner.

Jet ratio controllers are another method of supplying foam to nozzles (photo 4). These devices use a small amount of water and, through a highly efficient venturi principle, can move foam concentrate from remote storage locations to a matched self-educating nozzle. This all-hydraulic system dramatically simplifies and improves the logistics of moving large quantities of foam concentrate great distances. Foam concentrate is delivered from the jet ratio controller to the nozzle through ordinary fire hose. Depending on the nozzle and hose size, as well as the percentage of foam mixed (1% or 3%), the distance between the foam supply and the nozzle can be as much as 2,500 feet.

**FOAM COOPERATIVES**

It would be impractical to carry as much foam as required for our scenario on our existing apparatus. Many departments...
and regions are forming cooperative agreements and developing foam task forces to assist with the purchase and on-site delivery of needed equipment and resources (foam concentrate). A task force is a group of resources with common communications and a leader that may be preestablished and sent to or formed at an incident. Such departments and regions have purchased foam trailers that contain two 330-gallon foam totes. These trailers may be spread out within a region or stationed at adjoining departments to provide a backup to the initial trailer that responds (photo 5). When paired with an engine or two, personnel, and a supervisor, a task force can be created so that on callout, the incident commander knows exactly what will be arriving on scene. A one-, two-, or three-task force response can be created so that various response scenarios can be preplanned. Typing of the task force can be accomplished to account for different resources that may be included in the task force.

"Industrial-strength" operations do not necessarily mean "industrial" operations; I mean operations that will require large volumes of water or a large commitment of resources. According to Charles Dickenson, the former United States Fire Administration deputy fire administrator, in the end it still comes down to British thermal units (Btus) vs. gpm of water. Without enough water, even at the correct application rates, you will not have enough power to overcome the Btus the fire is generating.

Years ago, the FDNY had the Super Pumper System, which was intended to get enough water to the seat of the fire to
overcome the heat and extinguish the fire. With today's industrial equipment, we can replicate the water volumes the Super Pumper System once supplied. The large-capacity portable monitors in photo 6 are capable of flowing 6,000 and 10,000 gpm, respectively. Large monitors can be mounted in the bed of a support vehicle so you can deploy a less expensive vehicle close to the scene instead of a $500,000 pumper (photo 7). These units can self-educt foam with the proper nozzle. Coupled with a supply of Class A foam, the knockdown and extinguishing capabilities are dramatically increased at large, exterior attack operations. Can you imagine delivering large volumes of water to the seat of the fire in a concentrated pattern? Large-volume pumps flowing as much as 6,000 gpm and hose can provide the necessary water supplies to support these monitors and nozzles (photo 8).

There are endless possibilities for using industrial equipment in municipal applications. Some of today's fire department equipment was originally designed for industrial use. Concrete core cutters used for high-rise firefighting came out of the construction industry. The FDNY Super Pumper concept and equipment originated in the marine industry. Today's pneumatic and hydraulic auto extrication tools originated in the auto body repair industry. The water delivery capabilities of industrial equipment will truly enhance your operations at industrial-strength operations. As Dwight Williams, veteran industrial firefighter, always says, "If you're going to be a bear, then be a grizzly bear." Use the industrial technology and equipment available to you, and truly become the grizzly bear you need to be.

ENDNOTES

CRAIG H. SHELLEY, EFO, CFO, CFPS, a 40-year veteran of the fire service, is the CEO of World Safe International, an international consulting company, and a member of the Williams Fire and Hazard Control team. He has served in volunteer fire/EMS, career municipal, and career industrial fire departments. He served for 26 years with the Fire Department of New York, retiring as the chief of marine operations. Shelley is an adjunct associate professor for the University of Maryland University College, teaching its Managerial Issues in Hazardous Materials and Advanced Fire Administration courses, and also serves as an adjunct associate professor for Charter Oak State College, teaching strategic planning. He previously was a fire protection advisor with a major oil company operating in the Middle East. He has a bachelor of science degree in fire service administration and a master of science degree in executive fire service leadership. He is a co-author of Industrial Fighting for Municipal Firefighters (Fire Engineering, 2007).