Instructor Guide

Topic: Water Shuttle Operations

Teaching and Learning Domain: Cognitive

Time Required: 2 hours

Materials: Appropriate visuals and chalkboard or easel pad

References: IFSTA Pumping Apparatus Driver/Operator (1st ed.), Chapter 14

Motivation: The ability to move water from the source to the fire scene in a rural firegfighting operation is vital to the successful outcome of the incident.

Student Performance Objective (SPO): Given information from discussion, handouts, and reading materials, describe and recognize the proper methods of establishing a water shuttle drafting operation, operating controls and appliances.

Enabling Objectives (EO):

EO 1-1-1 Identify the apparatus requirements for a water shuttle. (NFPA 1002 (1998), 8-2.1, 8-2.2, 8-2.3)

EO 1-1-2 Identify the requirements for setting up a water shuttle operation. (NFPA 1002 (1998), 8-2.1, 8-2.2, 8-2.3)

EO 1-1-3 Describe the fill site operations for a water shuttle. (NFPA 1002 (1998), 8-2.1, 8-2.2, 8-2.3)

EO 1-1-4 Describe the dump site operations for a water shuttle. (NFPA 1002 (1998), 8-2.1, 8-2.2, 8-2.3)

EO 1-1-5 Describe how to evaluate tanker performance in a water shuttle operation. (NFPA 1002 (1998), 8-2.1, 8-2.2, 8-2.3)

Overview:

- Water Shuttle Apparatus
- Setting Up a Water Shuttle
- Fill Site Operations
- Dump Site Operations
- Evaluating Tanker Performance

I. WATER SHUTTLE APPARATUS (EO 1-1-1)

A. Introduction

1. Water shuttle operations used to supply water to emergency scenes far from water supply source where relay pumping not practical

2. Water shuttles involve process in which tankers deliver water to emergency

scene, travel to filling site, reload with water, and return to emergency scene to dump again

3. Water shuttle operations rely on constant movement of apparatus between emergency scene and water supply source

4. Two primary types of apparatus required to operate effective water shuttle operation: pumpers and tankers

B. Pumpers

1. Effective water shuttle operation requires at least two pumpers to be successful

2. One pumper positions at water supply source and used to fill empty tankers at fill site

3. Depending on number of tankers in shuttle and capacity of water supply source, more than one fill site or fill site pumper used to allow two or more tankers to be filled simultaneously

4. Second pumper located at or near emergency scene and used to draft water from portable water tanks at dump site

5. Depending on dump site proximity to emergency scene, dump site pumper can be attack pumper or simply relay water to another pumper supplying attack lines

6. Fill site pumpers should have minimum pump capacity of 1,000 gpm

C. Tankers

1. Department must choose size of tank for apparatus based on local water requirements, road conditions, and bridge weight restrictions

2. Tankers with water tanks less than 2,500 gallons and quick unloading times most efficient tankers for use in water shuttle operations

3. If existing tank being retrofitted to add large diameter, direct tank discharge valve, follow manufacturer's instructions to ensure that tank not structurally damaged as result of installation

4. Two primary ways to increase efficiency of water shuttle operations to decrease amount of time required to fill and amount of time to unload tankers

5. All other parts of water shuttle such as response time and travel time between dump and fill sites fairly constants

6. Attempting to make up time during road travel dangerous

7. Tankers that use 3-inch supply lines for filling should have at least two external fill connections piped directly to tank

8. If LDH used, one fill connection to tank adequate

9. Depending on apparatus design or preference, direct tank fill inlet(s) designed so tank filled either from bottom or top

10. Most tanker water tanks less than 6 feet tall, back pressure created by nearly full tank on bottom fill inlet less than 3 psi

11. Although NFPA 1901 only requires one large discharge, highly recommended each tanker equipped with at least three; one discharge water from rear of apparatus and one on each side

12. Two types of large tank discharges used on tankers: gravity dumps and jet-assisted dumps

    a. Gravity dumps rely on nature's gravitational pull to empty water from tank

    b. Gravity dumps employ 8-inch or larger round or square piping with valve that extends to exterior of apparatus

    c. On outside of apparatus may be extension of dump piping that assists in directing water into portable tank

    d. Actual valve on gravity dump designed to be opened manually from discharge location or remotely from cab of apparatus

    e. Remotely operated valves pneumatically, electrically, or hydraulically actuated

    f. Remote controlled dump valves increase safety of operation by reducing chance of someone being pinched between apparatus and portable tank

    g. Jet dumps employ use of small diameter in-line discharge inserted into piping of large tank discharge

    h. Discharge supplied by fire pump on apparatus

    i. In-line discharge creates venturi effect that increases water flow through large tank discharge

    j. Four primary disadvantages associated with jet dumps:

1) Fire pump engaged before dumping water from tank which adds time to dumping operation

2) Time saved by increased flow from tank negated by additional time needed to put dump in operation

3) Water still discharged if pump not operating, but will be considerably lower rate than if dump valve designed for gravity dumping

4) Increase cost of purchasing apparatus

13. Regardless of methods used to fill and dump tankers, important that water tank equipped with adequate tank vents

    a. Failure to have adequate venting during quick-filling operations result in dramatic pressure failure of tank

    b. Failure to have adequate venting during dumping operations result in suction effect that collapses tank

    c. Driver must make sure vents completely open when filling and dumping taking place

    d. From safety standpoint, remote controlled vent hatches preferable to manual ones as they eliminate fall hazard associated with climbing on top of apparatus

II. SETTING UP A WATER SHUTTLE (EO 1-1-2)

A. Introduction

1. Success or failure of water shuttle hinges on several crucial decisions made at very beginning of incident

    a. Location of dump site

    b. Location of fill site

    c. Route of travel for tankers between dump and fill sites

2. Preferable that decisions made in pre-incident planning for target hazards and geographical areas within each jurisdiction

3. Pre-incident plan contain best fill site, alternative fill sites, dump site, and

desired route of travel for shuttle apparatus

4. By determining in pre-incident planning, IC or water supply officer does not have to make decisions under emergency conditions

5. Insurance Services Office (ISO) gives extra rating credit to jurisdictions that have automatic aid agreements for water shuttle operations

B. Selecting Dump Site Location

1. Location of dump site in close proximity to incident scene

2. Front and center of incident not always best location for dump site

    a. Example when fire scene located down narrow lane, driveway, or dead-end street

    b. Advantageous to locate dump site at intersection where lane, driveway, or dead-end street meets thoroughfare

    c. Dump site pumper relays water to attack pumper located at fire scene

3. Even when fire scene located on through street, front of fire scene blocked by early arriving apparatus

4. Because committed hoselines or aerial devices, not practical to reposition trucks to provide through access for water shuttle

5. Dump site established at intersection close to scene, with dump site pumper supplying water to attack apparatus at scene

6. Large parking lots near fire scene make excellent dump sites

C. Selecting Fill Site Location

1. Department should have knowledge of appropriate fill sites in jurisdiction before incident occurs

2. Drivers and officers should have good knowledge of water system hydrants, dry hydrants, and suitable drafting locations within response district

3. When need to establish water shuttle occurs, IC or water supply officer selects closest suitable water supply source to scene

4. Closest suitable water supply source not necessarily be actual closest water supply source

5. For reasons of travel safety or water flow requirements, sometimes better to establish fill site at location somewhat farther from dump site than closest source

    a. For example, suppose incident calls for water shuttle to provide flow of 750 gpm for extended period of time

    b. Two closest water supply sources to dump site are 250 gpm rural water system hydrant 1 mile from scene and well-maintained dry hydrant supplied from large lake 2 miles away

    c. Probably better to establish fill site at dry hydrant

    d. Extra mile driven in each direction made up by time saved in filling tanks

    e. When possible, select fill site capable of supplying at least 1,000 gpm

6. Best fill and dump sites are those in which tankers drive straight in from one direction, fill or dump, and proceed straight out other end

7. If maneuvering unavoidable, remember always easier to maneuver apparatus before tank filled than after

8. On large-scale water shuttle operations, advantageous to use multiple fill and dump sites

9. May require two completely separate shuttle operations to supply each end of incident

D. Selecting Route of Travel

1. Route of travel for shuttle operation should take both safety and operational efficiency into consideration

2. Circular route of travel considered to be optimum method for conducting water shuttle operation

3. Method eliminates possibility of large trucks needing to pass each other on narrow, rural roads

4. When using circular pattern, direction of travel for each leg not particularly important unless substantial hill or grade on one or both of legs

5. Most desirable to have full tankers travel downhill and empty ones travel uphill

6. Roadways used during shuttle operations closed to traffic other than emergency

vehicles

7. Apparatus traveling back and forth on same road cause lot of confusion for public on same road and drivers in shuttle must exercise additional caution

8. Other safety issues considered when selecting route of travel

    a. Narrow roads-problems posed include difficulty passing other vehicles and possibility of getting apparatus tires off road surface and causing collision

    b. Long driveways-often require tight maneuvering of apparatus

        1) Improper coordination results in apparatus approaching each other from opposite directions

        2) Could result in serious accident

        3) Rigs forced to back out because of inability to pass other rigs

    c. Blind curves and intersections-vehicles may cross centerline and enter path of another vehicle

        1) Blind intersections pose extreme danger when driver cannot see oncoming cross traffic

        2) Reverse also true when drivers of civilian vehicles cannot see oncoming apparatus

        3) When possible, use police officers to control flow of traffic at dangerous intersections along shuttle route

    d. Winding roads-require concentration on part of driver; one slight slip in attention level can result in collision

    e. Steep grades-both uphill and downhill can cause problems for driver

        1) Uphill grades slow shuttle operation and cause excessive wear on vehicle

        2) Driving on downhill grades also dangerous

        3) Brake fade can result in driver being unable to slow or stop vehicle at bottom of hill

    f. Inclement weather conditions-roads not cleared of ice, snow, standing water, mud, or storm debris avoided

9. Water Shuttles in IMS

    a. When setting up water shuttle operation, important to understand how the shuttle fits into overall command structure of incident operations

    b. Many departments find most effective to view water shuttle operation and fireground operation as two independent operations, both supervised by one IC

    c. IC personally directs fire fighting operations and creates water supply group or sector to handle water shuttle operation

10. When water supply group/sector established, IC must select person in charge of group/sector

    a. Person known as water supply offcer

    b. Of all apparatus in water shuttle, only supervisor communicates directly with IC

    c. If IC chooses to activate operations section of IMS, water supply officer reports to operations section chief

11. Jurisdictions that have multiple radio frequencies available find it helpful to switch water shuttle operation to different channel

    a. Reduces radio clutter and confusion

    b. When supervisor needs to communicate with IC or operations chief, simply switches to frequency

    c. Person selected water supply officer should have experience in pumper and tanker operations, shuttle operations, and IM

12. Once water supply officer appointed and plan for water shuttle operation formulated, supervisor should appoint individuals in charge of fill site and dump site

    a. May be driver or company officer stationed locations

    b. Persons assigned positions would have radio designations “fill site” and “dump site.”

    c. Individuals in charge of fill and dump sites in constant communication with each other and supervisor

13. Supervisor should monitor water demand at dump site closely and anticipate problems

    a. IC in close contact with water supply officer in event conditions or tactics demand significant change in amount of water used

    b. Water supply officer can adjust resources to meet demand

14. When significant amount of water required, may be necessary to establish two or more independent water shuttle operations

    a. Separate fill and dump sites for each water shuttle

    b. Tankers assigned to specific leg of operation and remain in pattern

    c. When two or more shuttles required, necessary to establish water supply branch

    d. Person in charge called water supply branch director

    e. Each individual shuttle operation has supervisor

III. FILL SITE OPERATIONS (EO 1-1-3)

A. Introduction

1. Purpose of fill site operation to reload tankers as expediently as possible

2. Water supply officer should select best method for particular incident being handled

B. Positioning Fill Site Pumper

1. Water supplies for shuttle operation come from either fire hydrant or static water supply source

2. Recommend pumper used to fill tankers at all fill site operations

3. Using separate pumper to provide water supply maximizes flow from hydrant and eliminates need for tanker to deploy drafting equipment at static source in order to fill tank

4. Use of pumper adds high degree of safety by controlling movement of water

5. Driver must determine best position for drafting or hydrant connection that allows maximum access for tankers to be filled

a. Pump panel located so driver can view both source and fill operations

b. Apparatus with side-mount pump panels have pump panel away from water with intake and discharge hoses on opposite side, allowing driver to view tanker filling operations

c. Front- and rear-mounted pumps require apparatus positioned in manner that does not obstructs driver's view of tanker filling operation

d. Each tanker filled at minimum rate of 1,000 gpm

6. When positioning at hydrant, driver should connect large diameter intake hose between pump intake and steamer connection on hydrant

    a. If hydrant on particularly strong main, 3-inch lines also connected between 2½-inch hydrant outlet(s) and auxiliary intake(s) on pump

    b. Maximizes amount of water pumper able to flow to tanker being filled

7. When positioning at draft, seek spot that requires minimum amount of lift or hard intake hose

    a. Maximizes amount of water supplied to tanker

    b. Number of discharge lines to tanker fill spot can be increased or lengthened

    c. Fill site pumper not necessarily located directly next to tankers being filled

8. Static water supply sources completely inaccessible to pumpers

    a. In these cases, two or more high-volume portable pumps used to relay water to fill site pumper if less than 100 feet between source and pumper

    b. Fill site pumper may receive water from portable pump(s) in two primary ways

        2) First to hook discharge hose(s) from portable pump(s) directly into pumper's intake connection(s)

        3) Second method involves setting up portable water tank next to fill site pumper

4) Discharge line(s) from portable pump(s) used to fill portable tank

5) Fill site pumper drafts water from tank to fill incoming water tankers

9. Regardless of whether hydrant or static source used small discharge line within view of driver continuously flowed from fill site pumper

    a. Ensures loss of prime does not occur during drafting operations

    b. When operating at hydrant, ensures pump overheating does not occur when discharge lines not being flowed to fill tankers

    c. When operating from static supply, discharge line should return water to source

C. Fill Site Layout

1. Once fill site pumper positioned at water supply source, lay out remainder of hose and appliances needed to operate at fill site

2. Assume that each tanker has two-inch direct tank fill connections or one LDH direct tank fill connection on rear of vehicle

3. First thing is where tanker driver parks tanker when it arrives at fill site

    a. Positioned so minimum of hose required from fill site pumper

    b. Ideal fill position one that allows driver to enter from one direction and exit from another without need to turn or back up

    c. Position should allow room for empty tankers to line up and wait to be filled without creating traffic hazard

4. Once exact fill spot established, traffic cone or similar marker used to denote stopping point for tanker driver

    a. Cone positioned on side of road or at safe spot in parking lot

    b. Tanker driver instructed to pull vehicle adjacent to cone at point where driver's side door window opposite cone

    c. Allows fill hose to be located at rear of vehicle

    d. Reduces need to move hoselines back and forth when vehicles arrive

5. If tankers being filled have two 2½-inch direct tank fill connections, two 3-inch

hoselines laid to approximate location of rear of tanker when parked for filling

a. Each hoseline should have gate valve installed between last section and second to last section of hose

b. Valves used to open lines once connected to tanker for filling

6. Jurisdictions prefer to equip inlets on direct tank fill connections with Storz couplings

a. Couplings speed connection of hose to apparatus

b. If apparatus equipped with Storz connections, may be necessary to install Storz adapters on end of hoses used to fill tankers

c. Main point that apparatus operating in shuttle should use same type of connection so adjustments not need to be made each time different apparatus filled

7. If the tankers being filled have LDH direct tank intakes, only necessary to lay one LDH from fill site pumper to fill location

a. If large in-line gate valve not available for LDH, may be possible to place LDH manifold between last two sections of hose to act as gate valve

b. If no gate valve or manifold available, best to open and close LDH fill lines at pump panel of fill site pumper

8. If some tankers to be filled have 2½-inch intakes and others have LDH intakes, necessary to lay out hose easy to connect to either

a. Best method for accomplishing to lay one LDH to area near fill site

b. Connect manifold to LDH line

c. One LDH and two 3-inch connected from manifold

d. Gate valves on manifold then used to operate whichever lines being used

e. Manifold supervised by radio-equipped firefighter familiar with water movement and preferably by pump operator

D. Top Fill Methods

1. Previous method for laying out fill site considered to be efficient under most circumstances

a. In some jurisdictions, more common to fill tanker through fill or vent opening on top of apparatus

b. Accomplished using either fixed or portable filling equipment

c. If fixed equipment used, fill site limited to location

2. One method of top filling uses permanent or portable overhead pipes used at static water supply source

    a. Portable fill pipes made of PVC or other lightweight material

    b. Fixed overhead pipes constructed of any suitable material

    c. Devices operated by placing one end of fill pipe in static source

    d. Pumper discharges into in-line jet within fill pipe

    e. Creates high flow rate through fill pipe

    f. In-line jets pumped at 150 psi and provide 700 to 800 gpm through 4-inch pipe

    g. Larger diameter piping provides additional flow

    h. Devices advantageous when tankers have no other way of being filled other than through top opening

    i. More efficient use of pumper supplying in-line jet to simply draft from site and pump directly into tankers

3. Another method of overhead pipes uses permanent or portable manifolds

    a. Permanent pipes located adjacent to water source and fed by fill site pumper

    b. Water sources may be hydrants or static supply source

    c. With devices, fill site pumper connects between water supply and fill pipe to provide overhead water when tanker positioned beneath fill opening

    d. If water supply source reliable one, high fill rates accomplished through devices

    e. May take some jockeying to get tank opening positioned directly beneath fill spout

4. Filling tanker through top with portable fill device or open hose butt not recommended due to reaction of hoseline

E. Operating Fill Site

1. Once fill site pumper connected to water supply source and appropriate hose and equipment laid out, fill site operations may begin

    a. Recommended that fill site pumper remain in gear with tanker fill lines charged at all times

    b. Booster line or dump line be flowed to prevent loss of prime or pump overheating

2. Firefighter assigned to handle each tanker fill line laid out

    a. Firefighters referred to as make and break personnel

    b. Primary responsibilities to make fill connection when tanker arrives and disconnect hose(s) when tank full

    c. Personnel remain with lines until other firefighters replace them

3. When tanker reaches fill site, driver should cautiously pull into filling position until driver's door parallel to traffic cone laid out as stop marker

    a. Make and break personnel should be off to side of fill site as apparatus approaches

    b. When apparatus comes to complete stop, make and break personnel connect fill hose(s) to direct tank fill intake(s)

    c. Once hose connected, intake valve(s) opened

    d. Make and break personnel return to gate valve(s) or manifold on fill hose(s) and slowly open valve(s) to start water flowing

    e. Remain at gate valve or manifold until tanker full

4. While filling taking place, tanker driver should remain in cab of apparatus

    a. Ensure that apparatus immediately driven away once tank full and hose connections broken

    b. Any tankers that arrive in area of fill site while tanker being filled should

stage safe distance back

c. As tanker driver sees first tanker leaving fill site area, next one in line may cautiously proceed into fill spot

5. If fill site has sufficient room, second set of fill lines laid from fill site pumper for second tanker

    a. While one tanker being filled, second tanker pulled into position and connected to fill lines

    b. When first tanker full and lines shut down, lines to second tanker opened to begin immediate filling

    c. When first tanker drives away from fill site, next tanker in line pulled into spot and readied to fill

    d. Unless fill site pumper connected to high flow hydrant, not recommended that more than one tanker be filled at same time

6. Once water tank completely full, make and break personnel should slowly close valve(s) on gate valve or manifold

    a. Should proceed to connection at direct tank fill inlet and operate bleeder valve to relieve pressure on line(s)

    b. Once pressure relieved, hoses disconnected and pulled off to side of fill site

    c. Tankers should only move in and out of position when signaled by designated person

7. Make and break personnel or fill site officer should monitor ground conditions around fill site as operations proceed

    a. Inevitable that significant amount of water spilled in area

    b. During freezing conditions, ice may form

    c. If road not paved, may begin to become soft

    d. May become necessary to adjust location of fill site for both operational and safety reasons

F. Shutting Down Fill Site

1. Previous procedure followed until IC determines water shuttle operation no longer

necessary

a. Once decision made, fill site should remain in operation until all tankers participating in shuffle refilled

b. Jurisdictions prefer to fill tankers before they return to quarters

c. Exception to rule if fill site being supplied by static water source

d. May be more desirable to wait until tanker can get to hydrant for filling

e. Recommended apparatus farthest from scene be released first

2. Once all tankers refilled, fill site pumper and equipment shut down and prepared to return to service

IV. DUMP SITE OPERATIONS (EO 1-1-4)

A. Introduction

1. Dump site located close to incident and goa1 to provide continuous source of water supply to apparatus attacking incident

2. Variety of methods used to run dump site, as well as variety of methods employed to discharge water from tanker

B. Dump Site Operational Methods

1. In direct pumping method, tanker pumps water from tank directly into attack pumper

a. Method typically accomplished by having attack pumper lay out supply line that ends in location easily accessible to tankers approaching scene

b. When tanker arrives at dump site, supply hose connected to discharge of tanker

c. Contents of tank pumped to attack pumper

d. Siamese placed at dump site that allows two tankers to pump into supply line

2. Advantage of direct pumping method that it reduces need for tanker to park directly next to attack pumper

3. Disadvantages are many

a. Interruption of flow when tankers disconnecting and connecting

b. Tankers with small capacity pumps not able to supply water to attack pumper at the rate attack pumper discharging water

4. Second method is nurse tanker operation

    a. Involves very large tanker that parks immediately adjacent to attack pumper

    b. Attack pumper supplied by discharge line from pump of nurse tanker or drafts directly from tank of nurse tanker

    c. Departments that use tractor-trailer tankers use them a nurse tanker because highly ineffective as shuttle apparatus in most cases

5. Advantage that nurse tanker so large that fire controlled before need to refill tank

6. Several disadvantages to operation

    a. Tankers required to have sizable fire pump in order to pump loads into nurse tanker

    b. Even with sizable fire pump, dumping time for tanker significantly higher than if able to discharge through dump valve

7. Most efficient way of operating water shuttle to use portable water tanks as dump site water supply source

    a. One or more large portable water tanks positioned in strategically sound location near emergency scene

    b. Once tank(s) positioned, pumper deploys hard intake hose with low-level strainer into one of tanks and prepares to draft water from tank

    c. When first tanker arrives on scene, discharges water into portable tank

    d. Dump site pumper may begin drafting from tank and supplying water to attack pumper

    e. Dump site may be located directly adjacent to scene and attack pumper may draft from portable water tank

8. Method does not require shuttle tankers equipped with fire pump as long as adequate-sized direct-tank discharge valve and adequate venting

a. Method easiest of methods to ensure constant supply of water to attack pumper

b. Primary disadvantage is that multiple tank operation requires substantial amount of working space for dump site

9. Tankers may pump water into portable tank (or nurse tanker) through one or more discharges or hoselines

    a. Only done when tanker not equipped with dump valve

    b. Not possible to pump water out of apparatus as fast as dump valve empties tank

    c. Limiting factors are flow capacity of tank to pump lines, pump size, venting capability, and ability to control hoselines at delivery point

    d. In addition to longer time required to empty tank, method requires tanker driver place fire pump in gear before discharging water, and take out of gear before heading back to fill site

10. If method used, some type of mechanical device used to hold hoses discharging into tanks

    a. Commercial or homemade clamps or fill spouts available

    b. Jurisdictions choose to tie section of hard intake hose to portable tank and connect fill lines to it

    c. Any method suitable as long as firefighters not required to manually hold lines

11. Most efficient method of unloading tankers to dump water into portable tanks through gravity or jet dump

    a. Dumping allows tankers to deliver water rapidly and get back on road

    b. Gravity dumps employ large diameter valves and pressure created by height of water column in tank to move water

12. Actual amount of flow through dump valve dependent on design and size of dump valve, baffling in tank, and venting capability of tank

    a. Baffles sufficiently sized openings to allow free water movement at bottom of tank and air movement at top during rapid filling or unloading

b. Most desirable to dump off either side and off rear of the tanker

13. Most efficient method for operating dump site to have tankers dump loads into one or more portable water tanks

14. Simplest form of dump site operation is single portable water tank

    a. Tankers dump water into tank from which dump site pumper drafting

    b. Single portable tank works on fires that require relatively low overall flow rates (less than 300 gpm)

    c. Portable tank and dump site pumper positioned so easy in and out access allowed for tankers dumping into tank

15. Most common style of portable water tank folding type

    a. Tank removed from storage position on apparatus in same manner as ground ladder

    b. Carried to deployment position and unfolded

    c. Portable tank drains tucked inside tank to prevent leakage or dislodging

    d. Some departments choose to place salvage cover on ground beneath where tank deployed

16. Regardless of style of portable water tank used, recommended that tank have capacity at least 500 gallons larger than capacity of tank on apparatus carrying it

17. Dump site pumper should have low-level strainer attached to hard intake hose

    a. Allows continuous drafting ability down to point where only about 2 inches of water left in tank

    b. Low-level strainers designed for use in portable tanks commercially available or homemade

18. Once tank deployed, first tanker may dump water

    a. Dump site spotter or dump site officer should wave and guide tanker into position

    b. Adequate guidance given to assure tanker driver that dump valve properly aligned with tank

c. When tanker in position, dump valve opened, and water flows into portable tank

d. Once level of water in portable tank sufficient for drafting, dump site pumper should prime pump and start water flowing

e. Recommended that dump site pumper flow line back into portable tank to ensure prime not lost when discharge lines shut down

19. Once first tanker emptied contents into portable tank, immediately proceed toward fill site to reload

    a. If space available in portable tank, next tanker brought into position and water dumped into portable tank until filled

    b. If second tanker not able to empty entire load before portable tank full, should remain in position and empty tank when room becomes available

    c. Additional tankers staged and ready to proceed to portable tank as soon as water needed to refill tank

20. Incidents that require flow rates in excess of 300 gpm best served by multiple portable tank dump site operation

    a. Number of portable tanks used at dump site limited only by number of tanks and amount of water transfer equipment available

    b. Most common multiple portable tank operations used range from two to five portable tanks

21. When multiple portable tanks used, each tank positioned so water transferred from one tank to next

    a. Ultimate destination of water in tanks routed into last tank from which dump site pumper drafting water

    b. Basic goal of multiple tank operations to keep final tank in chain full at all times

    c. Water constantly being transferred from preceding tanks in operation to achieve goal

    d. When done, upstream tanks empty first and available for dumping without delay

22. Number of methods for transferring water between tanks

    a. Simplest method to connect two tanks by drain openings

    b. Commercially constructed tanks only have one drain, which limits to two-tank operation

    c. Using two-tank method maintains same level of water in both tanks at all times

23. Most efficient method uses jet siphons to move water from one tank to another

    a. Jet siphon is device attached to section of hard intake hose or piece of PVC or aluminum pipe

    b. Jet siphon has inlet for connection of 1½-inch or larger hose

    c. When jet siphon, hard intake hose, and 1½-inch hose assembled, end with jet siphon placed into tank from which water transferred

    d. Once tank has sufficient amount of water, 1-1/2-inch hose charged

    e. As flow of water begins through hard intake hose, water from portable tank drawn in

    f. Water flows through hard intake hose and into next tank in line

    g. If next tank becomes full, 1-1/2-inch line shut down to stop flow

    h. If apparatus water tank runs dry, pumper not able to supply jet siphon if drafting tank becomes empty and pump prime lost

24. If only two or three tanks used in conjunction with jet siphon operation, dump site pumper able to supply hoses to jet siphons

    a. Requires more work on part of dump site pumper driver

    b. If four or more tanks connected using jet siphons, advantageous to have second pumper draft from tanks solely to supply some or all jet siphon lines

25. Procedure establishing and running multiple portable tank shuttle operation:

    a. First portable tank deployed in same manner as in single-tank operation section

b. Make sure tank drain on downhill side of tank

c. Dump site pumper driver and crew deploy hard intake hose and strainer into first portable tank

d. First tanker dumps water into first tank

e. Dump site pumper may begin drafting operation

f. Second portable tank set up next to first one

g. Tip-to-tip diamond-shaped arrangement preferred method for arranging tanks

h. If immediately available, use different colored portable tanks to help dump site officer direct apparatus to appropriate tank for dumping

i. Whichever tanks available deployed as quickly as possible

j. Jet siphon equipment assembled

k. End with siphon placed in second portable tank, and discharge end of assembly positioned over edge of first portable tank and secured

l. Next tanker dumps load into second portable tank

m. Once water level sufficient, jet siphon supply hose charged to begin process of transferring water from second tank to first

n. If additional portable tanks desired, each set up and operated as described for second tank

o. Tankers dump into end-most tank that has room for water

p. As apparatus being positioned, dump site officer should advise tanker driver of tank to dump in

q. Dump site pumper driver or jet siphon pumper driver monitor level of water in each tank and adjust siphon lines accordingly

26. Dump site officer monitor ground conditions around dump site as operations proceed

    a. Inevitable that significant amount of water spilled in area

    b. During freezing conditions, ice form

c. If road not paved, may begin to become soft

d. May be necessary to relocate dump site

27. If all portable tanks become empty during operation, dump site pumper may continue to support fireground operations using water in onboard water tank

a. When becomes necessary, firefighters in hazardous positions withdrawn as loss of water to attack lines imminent

b. Once portable tanks refilled, normal operations resume

c. Driver of dump site pumper should refill apparatus water tank as soon as possible

28. Once need for continuous water supply no longer present, dump site operation disbanded

a. Before disassembling operation, good idea to make sure that attack apparatus and dump site pumper have topped off onboard water tanks

b. Once apparatus tanks full, all drafting and water transfer equipment disassembled, cleaned, and stowed

c. Portable tank drains opened to allow remaining water to drain out

d. If lot of sediment or debris left in tank(s), rinse out before stowing on apparatus

29. Any tankers staged in preparation for dumping returned to service or used in any manner IC deems appropriate

V. EVALUATING TANKER PERFORMANCE (EO 1-1-5)

A. For almost as long concept of using apparatus with large tanks to supply water for fire fighting been around, so has debate over size tanker most efficient for application

1. Jurisdictions believe more water tank can carry the better

2. Jurisdictions favor smaller apparatus that can load, unload, and travel back and forth in more expedient manner than can larger apparatus

B. No general rule of thumb or correct answer to question of what size tanker best

1. Tanker performance based on number of factors including loading and unloading

time, vehicle condition, drive-train capabilities, and tank size

2. Possible that large, underpowered tanker not able to supply water as well as smaller, well-designed tanker

C. Possible to assign gpm figure that each tanker capable of supplying over variety of distances

1. Done by analyzing filling time, dumping time, and travel time between dump and fill sites for each tanker

2. Information used in pre-incident planning to determine how many tankers required to provide desired flow rate for target hazard

3. Used by IC or water supply officer at fire for which no pre-incident plan available but desired flow rate determined at scene

D. Two basic methods for developing flow rating for individual tankers

1. First relies solely on actual testing of each tanker under realistic water shuttle conditions

2. Begin with tanker parked in proper position to dump load into portable tank

3. Start clock when dump valve opened

4. Keep clock running as tanker leaves dump site, drives to fill site, and returns to dump site

5. Clock stopped when tanker's dump valve back in proper position to dump next load

6. By dividing amount of water tanker dumped by time round trip took, gpm flow rating assigned to tanker for shuttle of particular distance

b. For example, suppose dump site and fill site located one mile apart

c. 3,000 gallon tanker able to make round trip in 12 minutes

d. Most tankers only actually dump 90 percent of load before heading off to be refilled

e. Flow rating for tanker, over 1 mile shuttle distance, calculated as follows:

$$GPM = \frac{\text{Tank Size}—10\%}{}$$

Trip Time

$$GPM = \frac{3{,}000 - 300}{12 \text{ minutes}}$$

$$GPM = \frac{2{,}700}{12}$$

$$GPM = 225$$

F. What this means is that particular tanker able to supply 225 gpm over 1-mile shuttle route

G. Second method of evaluating tanker performance by using series of formulas originally developed by ISO

1. Formulas used to rate water supply performance of fire departments that protect rural areas

2. Formulas divide shuttle operation into two time elements: travel time and handling time

Travel Time in minutes = 0.65 + (1 .7)(Distance in Miles)

H. Formulas include built-in factor for acceleration and deceleration times as tankers leave and approach fill and dump sites

1. Assume average travel speed between fill and dump site of 35 mph

2. If road conditions allow for faster speeds, formula adjusted accordingly

3. Handling time computed as follows:

Handling Time = Fill Site Time + Dump Site Time

I. Fill site time includes time spent maneuvering apparatus into position, make and break times, and actual filling time

1. For sake of calculation, flow rate that fill site pumper supplying established

2. Each jurisdiction has to determine fill rate most likely to achieve

J. Dump site time includes time spent maneuvering apparatus into position and actual dumping time

1. Each tanker dumps load at different rate

2. Dumping time determined by actual testing or supplied by manufacturer

3. NFPA 1901 specifies that tankers should be able to be dumped at minimum of 1,000 gpm

K. ISO allows 90 percent of tankers total tank capacity to be used for calculation

1. 10 percent loss accounts for water spilled or remains in tank after dump valve closed

2. Through testing, many departments found that their tanker actually only dumping 80 percent of load

3. Modifications done to improve performance

L. One of the most accurate ways to measure amount of water left in tank after dumping to weigh apparatus on truck scale when completely full and again after tank dumped

1. Difference in two weights accounts for amount of water actually dumped

2. For example, suppose we wish to know how much water actually dumped from 2,000 gallon tanker

3. After weighing apparatus both times, found to be 14,500 pounds lighter after water dumped

4. Because we know that water weighs 8.34 pounds per gallon, we can determine 1,739 gallons (14,500÷8.34) dumped

5. Would account for 87 percent of capacity of tanker

M. Once travel time and handling time determined, flow rate for tanker calculated using following formula:

$$\text{Tanker Flow Rate} = \frac{\text{Tanker Water Tank Size (in Gallons) - 10\%}}{\text{Travel Time + Handling Time}}$$

Example 1

Determine flow rate for 2,500 gallon tanker shuttling water 3 miles in each direction. Assume fill and dump rates of 1,000 gpm. Also assume that maneuvering and make and break times at each site total 2 minutes.

Travel Time in minutes = 0.65 + (1 .7)(Distance in miles)

Travel Time in minutes = 0.65 + (1 .7)(3 miles)

Travel Time in minutes = 0.65 + 5.1

Travel Time in minutes = 5.75

Handling Time = Fill Site Time + Dump Site Time

Handling Time = (2 min. + [tank size/fill rate]) + (2 min. + [tank size/dump rate])

Handling Time = (2 min. + [2,500/1,000]) + (2 min. + [2,500/1,000])

Handling Time = (2 min. + 2.5 min.) + (2 min. + 2.5 min.)

Handling Time = 4.5 min. + 4.5 min.

Handling Time = 9 minutes

$$\text{Tanker Flow Rate} = \frac{\text{Tanker Water Tank Size (in Gallons) - 10\%}}{\text{Travel Time + Handling Time}}$$

$$\text{Tanker Flow Rate} = \frac{2{,}250 \text{ gallons}}{5.75 + 9}$$

$$\text{Tanker Flow Rate} = \frac{2{,}250 \text{ gallons}}{14.75}$$

Tanker Flow Rate = 153 gpm on a 3 mile relay

While it is not part of the classroom portion of the drill, a department or several departments may want to set up and operate a water shuttle operation to identify areas where improvements can be made in water delivery and to evaluate the efficiency of each tanker in terms of filling, dumping, and overall gpm in relation to the amount of water being carried in the tank. If this is done, keep safety in mind, especially as units are moving at the dump and fill sites and along the shuttle route. A department may want to pursue a better ISO rating for their community based on the ability to maintain a specific fire flow at the "emergency" scene.

REVIEW:

Water Shuttle Operations

- Water Shuttle Apparatus
- Setting Up a Water Shuttle
- Fill Site Operations
- Dump Site Operations
- Evaluating Tanker Performance

REMOTIVATION:

ASSIGNMENT:

EVALUATION: