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| GP 03-02-03 | Fire Water Systems | December 2004 |
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# Fire Water Systems

## GP 03-02-03

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### Scope

[I] This Global Practice (GP) covers the design and installation of fire water systems.

[I] An asterisk (\*) indicates that additional information is required. If a job is contracted, this additional information is furnished in the Job Specification.

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## 1. Required References

[I] This Section lists Practices and Standards that are generically referenced and assumed to be a part of this document. Unless otherwise specified herein, use the latest edition.

### 1.1. Global Practices–ExxonMobil Engineering Practices

|                             |                                                         |
|-----------------------------|---------------------------------------------------------|
| <a href="#">GP 03-09-01</a> | Winterizing and Protection Against Ambient Temperatures |
| <a href="#">GP 03-10-01</a> | Piping Selection and Design Criteria                    |
| <a href="#">GP 03-10-03</a> | Cement Lined Pipe and Fittings                          |

### 1.2. AWWA–American Water Works Association

|           |                          |
|-----------|--------------------------|
| AWWA C502 | Dry-Barrel Fire Hydrants |
|-----------|--------------------------|

### 1.3. NFPA–National Fire Protection Association

|         |                                                                                    |
|---------|------------------------------------------------------------------------------------|
| NFPA 12 | Standard on Carbon Dioxide Extinguishing Systems (National Fire Codes, vol. 1)     |
| NFPA 15 | Standard for Water Spray Fixed Systems for Fire Protection                         |
| NFPA 22 | Standard for Water Tanks for Private Fire Protection (National Fire Codes, vol. 1) |

### 1.4. NSF International (National Sanitation Foundation)

|         |                                                   |
|---------|---------------------------------------------------|
| NSF 61E | Drinking Water System Components - Health Effects |
|---------|---------------------------------------------------|

## 2. Additional Requirements

- [I] The standards specified for use with this GP, as well as equipment descriptions given herein, apply to equipment and installation in the U.S. and in countries with no comparable standards. Where compliance with any code or standard by a local jurisdiction is mandatory, the requirements prescribed therein shall also be met.
- \* [S] Fire hose couplings selected for a particular plant location shall be compatible with mutual aid and local fire protection facilities. All fire protection equipment hydrants, monitors, hose reels, fire main block valves, etc., shall be consistent with other plant fire protection facilities and shall be approved by the plant Fire Chief.

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## 3. System Design

### 3.1. Design Basis

- 1) \* [S] Design conditions, water supply and rates, piping sizes, materials of construction, and type of hydrant couplings shall be specified. The fire water system design pressure and design temperature shall comply with the requirements in [GP 03-10-01](#).
- 2) \* [S] The system layout shall be specified, including the general location and number of pumps, hydrants, monitors, hose reels, deluge sprays, block and flushing valves. The final layout and location of equipment and facilities shall be approved by the Owner's Engineer.
- 3) [S] Connections for permanent use of fire water other than for fire protection are not permitted, except for supply of water to flare seal drums.
- 4) \*[S] Underground carbon steel piping and above ground portions of carbon steel piping that pass through a dike or dike sleeve shall be protected against external corrosion using a Single Coat Single Wrap or Double Coat Double Wrap protective coating system as specified.
- 5) \* [S] Fire main materials shall be suitable for plant fire water, and shall be designed to reduce sediment buildup. Piping approved for underground fire water piping systems identified in the General ExxonMobil Materials Specification (GEMS) Class Index are listed in Table 1. The selection and use of underground fire water piping materials in this table, or the use of reinforced plastic pipe (RTRP Grades) or Fiber Reinforced Plastic (FRP) for underground fire water systems, shall require the approval of the Owner's Engineer and the plant Fire Chief.

**Table 1: Underground Fire Water Piping Materials**

| NPS   | SCH/RTG | Description                                                | Notes                                                                                                                                                                                |
|-------|---------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4-24  | 350     | Ductile Iron, Cement Lined, Restrained Joint, CL-350       | Pipe is supplied externally coated. In addition, pipe is placed in loose polyethylene sleeve at installation to retard graphitic corrosion.                                          |
| 1/2-2 | 80      | Carbon Steel, Galvanized, Seamless                         | All underground steel components shall be coated. Coating requirements shall be specified on design drawings.<br><br>Corrosion allowance for carbon steel pipe is 0.063 in. (1.6 mm) |
| 1/2-2 | 80      | Carbon Steel, Galvanized, Welded                           |                                                                                                                                                                                      |
| 2-24  | CL 200  | High Density Polyethylene, FM Approved, Seamless, Extruded | With approval of the Owner's Engineer, class (or SDR) requirements may be modified for specific applications.                                                                        |
| 3-24  | Std     | Carbon Steel, Welded, ERW, Cement Lined                    | Cement lining shall be per <a href="#">GP 03-10-03</a> for underground pipe and components, excluding valves.                                                                        |



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|------|-----|--------------------------------------------|--|
| 3-24 | Std | Carbon Steel,<br>Seamless, Cement<br>Lined |  |
|------|-----|--------------------------------------------|--|

- 6) [S] For pipe, tube, or fittings in fire water spray systems, use materials consistent with [GP 03-10-01](#) and NFPA 15. Deviations shall require approval by the Owner's Engineer and the plant Fire Chief.

### 3.2. Water Supply

- 1) [S] When the fire water source can provide an unlimited supply of water (i.e., seawater, lake water, or river water) and the system is designed to directly provide fire water to the grid, there are no requirements for fire water storage.

Where the fire water supply from a given source is limited:

- Fire water storage shall be furnished, with a capacity equal to 6 hrs supply at specified design flow rates, independent of other plant process water usage; and
  - The fire water source shall be sufficient to supply water at half the specified maximum demand on a continuous basis.
  - For lube plants, terminals, and warehouses, the fire water system supply and design shall conform to the requirements of NFPA 22.
- 2) [S] A backflow preventer is required where fire water is supplied from a potable water source or any municipal source. A break tank shall be used when required by local regulation as the means of positively preventing contamination. This tank will be provided with an internal coating in accordance with NSF 61E.
- 3) \*[S] Provision shall be made for the addition of approved biological additives to the fire water system where biological fouling may occur.
- 4) [S] Multiple fire water sources shall be provided to the fire water system for:
- Onshore process facilities with a maximum flow demand greater than 6000 U.S. gpm (22.7 m<sup>3</sup>/min). In this situation, the different fire water sources shall be located to minimize the potential that more than one fire water source can be affected by a single fire or explosion event.
  - Onshore facilities where environmental conditions (tides, seasonal water level fluctuations, etc.) affect the availability or quality of the primary natural water source (e.g., loss of water to a pump suction, fouling from water in the fire water source piping)

### 3.3. Pumps and Drivers

- 1) [S] A minimum of two fire water pumps, each sized for at least 50 percent of the system design capacity, shall be required for all installations except those with a maximum flow demand of 1500 U.S. gpm (5.68 m<sup>3</sup>/min) or less. Design shall include the following:
- Each pump shall be designed for at least 125 psig (860 kPag) discharge pressure at rated capacity and good for continuous service. The pressure rise at shutoff shall not exceed 20 percent, and at 150 percent of rated capacity the head shall not be less than 65 percent of rated head.
  - System pressure shall be controlled at the pump discharge by a pressure controller, bypassing excess flow back to the source of supply.

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- c) \* An averaging-type Pitot tube installation shall be provided to permit testing of each fire water pump's capacity. The instrument shall be located in the bypass piping (pump discharge to source of supply), or, if specified, in the main fire water grid piping. Alternative arrangements are acceptable subject to approval by the Owner's Engineer.
  - d) If the fire water pump shutoff pressure exceeds the fire water system design pressure, a pressure relief valve discharging to the fire water source shall be provided.
  - e) For installations having three or more fire water pumps, each pump shall be sized for not less than the system design capacity divided by the number of pumps, unless the Owner's Engineer otherwise specifies or approves.
- 2) \* [S] Drivers—where only one pump is installed as permitted by Section 3.3, Item (1), it shall be electric motor driven unless otherwise specified, or the Owner's Engineer otherwise approves. When two or more pumps are installed:
- a) At least one fire water pump shall be electric motor driven.
  - b) At least one fire water pump shall be diesel engine driven. A fuel tank with capacity for 6 hrs of continuous operation at full load shall be provided for the diesel engine driven pump. A steam turbine driven pump may be used in lieu of a diesel engine driven pump with the approval of the Owner's Engineer and the plant Fire Chief.
  - c) Additional pumps, if any, may be electric motor diesel engine or steam turbine driven. Choice of driver for additional pumps shall be based on overall reliability considerations.
  - d) A remote start button for at least one main fire water pump shall be located in the main control house.
- 3) [S] Continuous positive pump suction shall be provided. Priming devices are not acceptable. Deep well pumps shall be used where positive pump suction is not available.
- 4) [S] Suction screens shall be provided where foreign material may be present that could plug the suction line or pumps. Either traveling or double removable screens, cleanable with the pump in service, shall be used.
- 5) \* [S] The fire water system shall be continuously pressurized from a supply source having a minimum capacity of 300 U.S. gpm (1.13 m<sup>3</sup>/min) at 100 psig (690 kPag) pressure (when the main fire water pumps are not in use) by one of the following means, as specified:
- a) A separate electric motor driven pressurizing pump, manifolded in parallel with the main fire water pumps.
  - b) A jumpover connection from the plant cooling water or process water systems, provided that the water is free of oil and emulsion breaking/anti-foaming compounds.
- A low pressure cut-in with alarm shall be provided to start one of the main fire water pumps at a specified pressure. Such alarm shall be located in the main control house.

### 3.4. Booster Pumps

- 1) [S] Booster pumps (used to augment fire water system pressure for special fire protection systems such as spray systems, as required) shall take suction from the fire water system. Where the downstream pressure buildup may exceed the system design rating, a pressure relief valve that discharges to a safe location shall be provided.

Conditions requiring booster pumps are:

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- a) Extended fire water systems, where hydrant pressure may be insufficient to provide required flow.
  - b) Elevated structures within process unit areas where fire water system pressure may be insufficient to provide required flow.
- 2) \* [S] Drivers for booster pumps shall be either electric motors or diesel engines. Use of steam turbines shall be with approval of the Owner's Engineer and the plant Fire Chief.

### 3.5. Piping Layout

- 1) [S] The fire water system shall be looped around process units and other areas to be protected, except for installations with a maximum flow demand of 1500 U.S. gpm (5.68 m<sup>3</sup>/min) or less, for which a single feed distribution system is acceptable. The Owner's Engineer and the plant Fire Chief shall approve the layout of the fire water system. Block valves shall be provided so that in the event of any piping failure:
  - a) No more than 1000 ft (300 m) of pipe containing hydrants, hose reels, monitors or sprays can be lost.
  - b) The piping to not more than two adjacent sides of any process block can be lost.
- 2) \* [S] Fire water mains in freezing climates (Climatic Zones B, C, and D, as defined per [GP 03-09-01](#)) shall be installed a minimum of 1 ft (300 mm) below the frost line. Fire water connections to monitors, hose reels, sprays, etc., in freezing climates shall be designed to eliminate water from freezing in the connections and incorporate winterization features by design.

[S] Fire water piping within process unit areas, except for branches to hose reels and to elevated monitors, shall be underground and buried sufficiently deep to protect against mechanical damage. Any aboveground section within process units shall be minimized in length.

- 4) [S] Fire water piping within process unit areas that feed any combination of more than two monitors, hose reels, hydrants, or sprays, shall be connected to two separate sections of the fire main, and shall be separated by a valve in the main. Lines to hose reels and monitors shall be valved at each end where they connect to the main.

Branches to aboveground systems (elevated monitors, spray systems, etc.) located in exposed areas (such as within a process block) shall be valved at the fire main. Such branches shall be capable of being opened and isolated from a safe location.

However, short sections of aboveground pipe [less than 50 ft (15 m) long and not more than 4 in. (100 mm) size] that feed a single hose reel or monitor need not be valved at the fire water main takeoff.

- 5) \* [S] Fire water piping to marine terminals shall be protected from direct exposure to a fire on the water by installing the lines above the pier deck. Where it is necessary to locate the lines below deck, they shall be fireproofed.

In freezing climates (Climatic Zones B, C, and D, as defined per [GP 03-09-01](#)) marine terminal fire water lines shall be heat traced and insulated. A minimum of four valved hose connections (international hose connections) shall be provided to permit fireboats to pump into the main fire water system, at an Owner specified location.

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