Calculations/Design Procedures Basic Fire Protection Requirements for Hydrocarbon Hazards Offshore Platforms

The primary purpose of this design manual is to present a recommended calculation procedure to determine basic fire protection requirements for hydrocarbon hazards encountered in today's "typical" offshore platforms.

Today's offshore platform operator must be safety and fire conscious, and concerned about minimizing fire losses and operational down time. The requirements, type of equipment and quantity of extinguishing agent for fire control on offshore drilling platforms are dictated by location.

Due to the different kinds of hazards encountered on offshore platforms, it is recommended that two types of extinguishing agents be provided.

Dry Chemical Protection should be provided to extinguish three-dimensional fires, pressure fed fires (both gaseous and liquid) and electrical fires. ***Aqueous Film Forming Foam*** should be provided to extinguish spill and pool fires and to secure and cool liquid hydrocarbon spills. Systems of this type, combining the rapid fire extinguishing capabilities of dry chemical as well as their ability to extinguish three-dimensional fires with the sealing and securing capabilities of an aqueous film forming foam, are of particular importance for protection of flammable liquid hydrocarbon hazards.

DESIGN PARAMETERS

The parameters of sizing fire-extinguishing equipment for any platform should include the following points:

- Flow rate of extinguishing agent
- Minimum flow time of extinguishing agent
- Accessibility of equipment by platform personnel

THESE FACTORS DICTATE

Taking into consideration that offshore platforms normally are designed with two levels. The decks are normally connected by two stairways on opposite sides of the platforms. If a fire breaks out on a level where there are no operating personnel, the fire fighting personnel will have access to the deck from only the two stairways. This dictates the positioning of major fire fighting equipment at the point where the stairways connect to each deck. If operating personnel are on the level where the fire occurs, the first reaction is to run to the stairway. Therefore, the most accessible points for the location of the major fire fighting equipment is the stairway area of each deck.

The flow rate of extinguishing agent from a handline is effectively limited by the amount of reaction force one man can withstand and still maintain accurate control of the discharge nozzle. The maximum flow rate of dry chemical a man can accurately control is 5 to 8 lbs. /sec. The maximum flow rate of AFFF is approximately 60 gpm per hand line using 1" hose.

The maximum flow rate required from a given piece of equipment is the flow rate per handline times the maximum number of handlines which could be used to combat any single fire.

This maximum flow rate should be reviewed as to the maximum flow rate available vs. the potential hazards on that particular deck. (Drip pan size etc.) In review, the following standards should be used: D.C.

(Max area size in sq. ft.)x(.04 lbs./sec./sq. ft.) x (60 sec. flow) = Unit size

Example:

(100 sq. ft.)x (.04 lbs. /sec. /sq. ft.)x
(60 sec. flow) = 240 lbs. Unit Capacity

Taking into consideration that based on a horizontal impinging natural gas pressure fire each 8 lbs. /sec., hand line can extinguish a fire fed at the rate of 8 mm s.c.f.d. This is based on data covering a gas pressure range up to 750 psi. The information is applicable for higher pressures since the primary effect of pressure in this case is an extension in detachment of the flame zone from the gas source.

Due to the complexity of equipment, possible wind

conditions, presence of rapidly heated material (stainless steel tubing etc.), it is recommended that the unit capacity size be calculated by taking the maximum flow rate from the unit times a minimum flow time of one minute.

CALCULATIONS: FOUR-PILE PLATFORM

On a "typical" four-pile platform, there are two stairways on opposite sides of the platform connecting the two decks. At these two locations, position both an AFFF and a dry chemical hose reel. The dry chemical unit, which contains two hose reels, should be mounted on the sub-deck (where it will be least susceptible to damage). If the unit is placed adjacent to a stairway connection, it will be necessary to furnish only one remote reel (via the other stairway) on the sub-deck.

Position two remote reels by each stairway location on the upper deck. There should be five dry chemical hose reels on the platform. (2 on the dry chemical unit and 3 remotes.) The maximum number, which would normally be used at one time, would be three on the lower deck. With a maximum of three 8-lbs. /sec. reels being used at once, a total flow rate from the unit of 24 lbs. /second would be required. Taking a minimum flow time of 1 minute, we calculate the size of the unit to be:

(24 lbs. /sec.) x (60 sec.) = 1,440 lbs. of D.C.

The closest size available dry chemical unit would be a 1,500-lb. capacity, which will supply up to 50/70-lbs. /sec. flow if required.

A review of the systems fire extinguishing ability vs. the platform hazards, the extinguishing capabilities are as follows:

Max. Hazard Area
(24 lb. /sec.) x (.04 lb./sec./ft.^{2}) = 600 ft.^{2}

Max. Pressure Fire
(24 lb. /sec.) x (8 mm scfd.) = 24 mm scfd.
(8 lb. /sec.)

Unless a four pilons platform has unusually large hazards, the above system should handle all the pressure and (3) three-dimensional fires that could be expected.

The calculations determine that the system required on four-pile platform consists of the following equipment:

1 - CDC1500 Lb. Capacity DC Unit
3 - Remote Reels with 100' x 1" Hose & Nozzle
3 - Remote Actuators Stations

1 - CPM150 AFFF Unit
4 - Remote Reels with 100' x 1" Hose & Nozzle
3 - Remote Actuators Stations

CALCULATIONS: EIGHT-PILE PLATFORM

On a "typical" eight-pile platform, there are two stairways on opposite sides of the platform. There is a multiple wellhead area separated from the production area by a firewall.

Position both an AFFF and a dry chemical hose reel at the stairway connection points on both decks. In addition, due to the extremely large wellhead hazard area, position an AFFF and a dry chemical reel on the production side of the firewall adjacent to both doors. The dry chemical unit contains two hose reels and should be mounted on the sub-deck if possible. With the unit placed adjacent to a stairway connection it will be necessary to provide only three remote reels on the sub-deck. Position two remote reels on the top deck. The total number of hose reels on the platform will be seven. (2 on the D.C. unit and 5 remote reels).

With a maximum of five reels being used on the lower deck for one fire and allowing a maximum flow rate of 8 lbs. /sec. for each handline, the maximum flow rate from the unit would be 40 lbs. sec. With a minimum flow, time of one min. the size of the required unit is calculated at:

(40 lb. /sec.) x (60 sec.) = 2,400 lbs. of D.C.

The closest available dry chemical unit would be 2,500 lbs. and have a maximum flow rate capacity of 100/125 lbs. /sec. Reviewing the systems fire extinguishing capability vs. the platform hazards we find the following:

Max. Hazard Area
(40 lbs. /sec.) ÷ (.04 lb./sec./ft.^{2}) = 1,000 ft.

(40 lbs. /sec.) (8 mm scfd.) = 40 mm scfd.
(8 lbs. /sec.)

This system should be adequate for hydrocarbon hazards found on most eight-pile platforms. To calculate the AFFF unit size, six hose reels will be required, one by each stairway connection on both decks and one by each fire wall door. With each reel having a flow rate of 60 gpm, the maximum number to be used on any single fire would be the four on the sub-deck. The maximum flow rate

required from the AFFF unit would be (60 gpm) x (4) = 240 gpm. The calculations dictate a unit size of not less than 240-gallon capacity. A 300-gallon capacity unit is to be supplied. The unit will provide a maximum flow rate of 300 gpm.

A review of the fire extinguishing capabilities of the system vs. the platform hazards indicates:

Max. Area:

(__240 gpm.__) x (2.5 min.) = 600 sq.ft.
(.16 gpm. sq. ft.)

Under normal conditions, an eight-pile platform will not have potential spill areas (drip pans etc.) in excess of 600 ft.^{2}**.**

By consolidating the calculations, the system required on an eight pile consists of the following equipment:

1 - CDC2500 Lb. Capacity Dry Chemical Unit
5 - Remote Reels with 150' x 1" Hose & Nozzle
5 - Remote Actuation Stations

1 - CPM300 AFFF Unit
6 - Remote Reels with 150' x1" Hose & Nozzle
5 - Remote Actuation Stations

SPECIAL HAZARDS

Individual platforms could have hazards, which the basic fire protection system should not be required to handle. These hazards should be analyzed for system application completely separate from the rest of the platform. Examples of these hazards are: storage tanks, compressors, and electrical generating rooms. In many cases, the system application on these hazards should involve automatically actuated systems.