Active Wet Fire Protection System: Installation of Sprinkler Systems for The Living Quarter Building Module in Offshore Platforms

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Living Quarter Building Module (LQBM)

This article will explain the design requirements of a sprinkler piping system for the proper functioning of the Living Quarter Building Module (LQBM) on an offshore platform. The LQ module project is a grassroot green field project where new facilities are installed on a central processing platform. The module consists of facilities for living, kitchen, dining, laundry, storage and recreation, etc for a certain number of personnel.

Office areas, a library and a conference room are also part of the LQ module which will have services like electrical & telecom services, HVAC system, plumbing & sanitary services, F&G detection system and fire suppression system.

DESIGN DESCRIPTION

The LQBM usually will be divided into few levels. The concept is the same as designing a multi-storey building. Each level will have different requirements as per client's standard and its own fire suppression system. Examples of the details are:

Level 1 (Elevation reference level +35.30m) – Firewater hose reel & clean agent system.

Level 2 (Elevation reference level +41.50m) – Firewater hose reel & clean agent system.

Level 3 (Elevation reference level +49.50m) – Firewater hose reel & sprinkler system.

Level 4 (Elevation reference level +54.00m) – Firewater hose reel & sprinkler system.

Roof level below helideck (Elevation reference level +58.50m) – Firewater and foam hose reel & deluge spray system.

Fire Zones

Helideck level (Elevation reference level +63.20m) – Fire water and foam hose reel, firewater monitor & dry chemical powder skid system.

On the other hand, the firewater system for the central processing platform is based on the basis outlined in the total firewater demand calculation. The firewater system is supplied with firewater (seawater) by the firewater pumps. Normally, the firewater pumps used are the vertical shaft turbine type or submersible centrifugal type. Acceptable firewater pump drivers are diesel engines, natural gas engines and electric motors. The pump must be able to supply adequate pressure and flow to the most demanding area, hydraulically. The firewater ring main pressure is maintained at certain pressure minimum by utility water lift pump.

The system is designed to provide sufficient water based on the maximum demand of the controlling deluge zones. The discharge pipe from the firewater pump is connected to a ring main. The ring main is valved into segments so that failure of any segment or maintenance can be carried out without any loss in fire fighting capability.

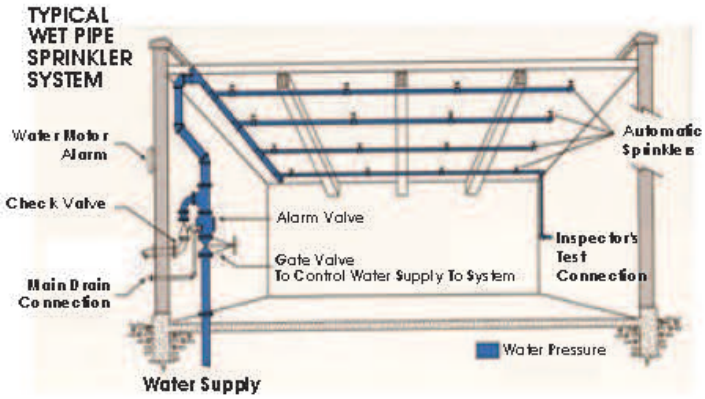
EXAMPLE OF FIRE ZONES IN THE OFFSHORE PLATFORMS

- Fire Zone 1 – Jacket Level and Cellar Deck
- Fire Zone 2 – Middle Deck
- Fire Zone 3 – Upper Deck
- Fire Zone 4 – Below Helideck Roof Level
- Fire Zone 5 – Living Quarters Building Module
- Fire Zone 6 – Helideck
- Fire Zone 7 – Crane Cabin

**** Design Criteria & Parameters***

The firewater sprinkler system for the LQBM is designed as per NFPA 13. The accommodation areas are classified as light hazard occupancy except for the galley, preparation, laundry machine, line handling and store areas which are classified as ordinary hazard occupancies (Group 1). The system components of the LQBM sprinkler system consist of piping, fittings, valves and support system. Piping material for sprinkler system will be covered under the pipe material specification.

This system uses a wet pipe system since the temperature is maintained above freezing point. Water storage tanks are not provided. In case of fire, sea water will be sucked up by the firewater pump for use.



Typical Wet Pipe Sprinkler System

SYSTEM DESCRIPTION

Sprinkler System: The LQBM sprinkler system consists of a seawater supply system providing adequate pressure and flow rate to a water distribution piping system to which the sprinklers are connected. Activating the sprinkler system will result in a localised water spray due to the melting of the sprinkler frangible bulb in the heat caused by a fire outbreak. The sprinkler frangible bulb is intended to result in a severe sudden reduction of the heat release rate of the fire, followed quickly by complete extinguishment, prior to manual intervention.

Fire Water Pumping System: The sprinkler system uses firewater (seawater) from the central processing platform firewater ring main. The firewater ring main pressure is maintained at the required pressure minimally by the pumps. Firewater pumps should be located to minimise possibility of damage in the event of fire. It should be isolated as far as practical, from external fuel and ignition source.

The capacity of the pump is based on overall fire water demand calculation. In the case of fire at the platform, LQBM and/or when the ring main pressure drops, the first firewater pump will start. Incase it fails to startand/or if the pressure continues to drop, the second firewater pump will start automatically.

Sizing of fire water pump:

Design basis: Firewater pumps are designed as per NFPA 20, API STD 610 and API RP 14G.

Case example:

a) In order to determine the fire water demand, the platform will be segregated into the following zones:

Vertical Turbine Pumps

Fire zone 1 : Jacket Level and Cellar Deck
Fire zone 2 : Middle Deck
Fire zone 3 : Upper Deck
Fire zone 4 : Below Helideck Roof Level
Fire zone 5 : Living Quarter Building Module
Fire zone 6 : Helideck (Not governing)
Fire zone 7 : Crane Cabin (Not applicable)

b) The fire water pump capacity is based on largest deluge system plus two hose streams.
c) Deluge is considered for the equipment in fire zones 1, 2, 3 and 4.
d) The estimated deluge capacity equals to deluge rate (litres/min/m2) x equipment area + design margin.

DESIGN CALCULATION

Design Basis & Assumption: The design basis and assumption for LQBM sprinkler system are based on NFPA 13. The type of sprinkler system is wet pipe sprinkler system which provides fixed fire protection using piping filled with pressurised water supply from a dependable source at all times which would be the fire water pumps. Sprinklers are provided in all areas except for specific sections as according to the client's requirements, such as locker room, internal stairway, distribution board room, radio room, freezer room and common toilet.

Examples of LQBM accommodation areas to be provided with sprinkler system are:

Level A	Level B
Gymnasium & Game Room	Cabins
Offices	Infirmary
Recreation Lounge	Dr Cabin
Dining Hall	Library
Internal Corridors	Arrival Lounge
Cabins	Safety Briefing Room
Conference Room	Store Room
TV Room	Water Heater Room
Print Room	Internal Corridors

Accommodation areas are classified as light hazard occupancies. The basis of classification is whereby the quantity and combustibility of contents is low and fires with relatively low rates of heat release are expected.

However, areas such as the galley, dry store, preparation, laundry machine room, linen handling and linen storeroom, are classified as ordinary hazard occupancies (OH1).

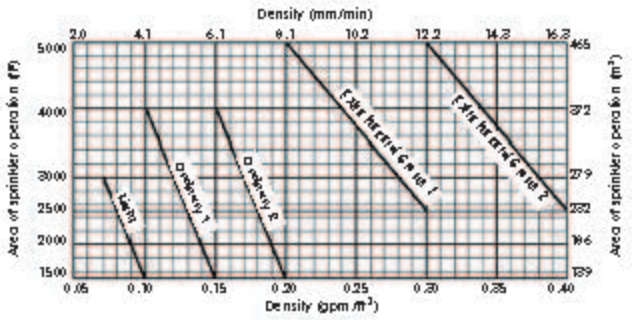
Sprinkler K-factor and Firewater Demand For LQBM: The proportionality constant K factor is estimated with an initial sprinkler upstream pressure and the flow rate per sprinkler, Q as per following formula:

$$K = Q / (p)^{1/2}$$

The flow rate through the sprinkles for the design area as per the selected K factor shall be calculated which gives the total firewater demand.

Nominal K-factor (gpm/(psi)$^{1/2}$)	K-factor Range (gpm/(psi)$^{1/2}$)	K-factor Range (dm^3/min/(kPa)$^{1/2}$)	Percent of Nominal K-5.6 Discharge	Thread Type
1.4	1.3-1.5	1.9-2.2	25	1/2 in. NPT
1.9	1.8-2.0	2.6-2.9	33.3	1/2 in. NPT
2.8	2.6-2.9	3.8-4.2	50	1/2 in. NPT
4.2	4.0-4.4	5.9-6.4	75	1/2 in. NPT
5.6	5.3-5.8	7.6-8.4	100	1/2 in. NPT
8.0	7.4-8.2	10.7-11.8	140	3/4 in. NPT
				or
				1/2 in. NPT
11.2	11.0-11.5	15.9-16.6	200	1/2 in. NPT
				or
				3/4 in. NPT
14.0	13.5-14.5	19.5-20.9	250	3/4 in. NPT
16.8	16.0-17.6	23.1-25.4	300	3/4 in. NPT
19.6	18.6-20.6	27.2-30.1	350	1 in. NPT
22.4	21.3-23.5	31.1-34.3	400	1 in. NPT
25.2	23.9-26.5	34.9-38.7	450	1 in. NPT
28.0	26.6-29.4	38.9-43.0	500	1 in. NPT

Full Hydraulic Calculation Of The NFPA 13 Sprinkler Design: The sprinkler system installed is designed using the area and density approach. The use of LQBM and the contents are analysed and the level of fire hazard must be determined.



Density / Area Curves

The design area is a theoretical area of the LQBM, representing the worst case area in which a fire can occur. The design density is a measurement of how much water per square foot of floor area should be applied to the design area.

After the design area and density of LQBM are determined, a full hydraulic calculation of the sprinkler system is performed to prove that the system can deliver the required amount of water over the required design area. These calculations account for all the pressure that is lost or gained between the water supply source and the sprinklers that would operate in the design area.

The full hydraulic calculation includes pressure losses due to friction inside the piping and losses or gains due

ACTIVE WET FIRE PROTECTION SYSTEM (INSTALLATION OF SPRINKLER SYSTEMS) FOR THE LIVING QUARTER BUILDING MODULE (LQBM) IN THE OFFSHORE PLATFORMS

Free Sprinkler Hydraulics Program [FREESHP] 10:26 06 April 2011 Page 2 of 3
Test only Example from NFPA 13 [775.1L/min@3.072bar]

Start Nodes End	Start Elev. End	Q L/min K-fact q L/min	Size Nom Bore	Fitting reference Eq.len m	Lengths Fitts m Total m	Type C-fact mbar/m	Ptotal Pelev Pfrict	Endbar Velbar Normal	Direct Slope° m/s
100	0.000	775.1		Tee	0.300	CM	3.072	3.016	North
			80 mm	turn 90°	6.006	150	0.000		
101	0.000		75.70	6.006	6.306	8.9	0.056		2.87
101	0.000	775.1		Gate	0.300	CM	3.016	3.009	North
			80 mm	Valve	0.407	150	0.000		
102	0.000		75.70	0.407	0.707	8.9	0.006		2.87
102	0.000	775.1		Elbow	14.400	CM	3.009	2.856	North
			80 mm	90° std	2.799	150	0.000		
103	0.000		75.70	2.799	17.199	8.9	0.153		2.87
103	0.000	775.1		Gate	1.200	S40	2.856	2.721	Up
			80 mm	Valve	0.310	120	0.118		
104	1.200		77.90	0.310	1.510	11.7	0.018		2.71
104	1.200	775.1		Alarm	3.300	S40	2.721	2.330	Up
			80 mm	Valve	2.440	120	0.323		
105	4.500		77.90	2.440	5.740	11.7	0.067		2.71
105	4.500	775.1		Elbow	32.700	S40	2.330	1.922	West
			80 mm	90° std	2.130	120	0.000		
106	4.500		77.90	2.130	34.830	11.7	0.408		2.71
106	4.500	775.1			21.000	S40	1.922	1.214	West
			65 mm		0.000	120	0.000		
107	4.500		62.70		21.000	33.7	0.708		4.18
107	4.500	261.5		Tee	0.300	S40	1.214	1.085	Up
			40 mm	turn 90°	2.440	120	0.029		
108	4.800		40.90	2.440	2.740	36.2	0.099		3.32
108	4.800	261.5		Tee	5.850	S40	1.085	0.785	North
		80.0	40 mm	turn 90°	2.440	120	0.000		
109	4.800	70.9	40.90	2.440	8.290	36.2	0.300	0.785	3.32
109	4.800	190.6			3.900	S40	0.785	0.707	North

Source duty at node 100 = 775.1 L/min @ 3.072 bar at 10:26 06 April 2011

to elevation differences between the source and the discharging sprinklers.

The calculation shall demonstrate that:

a) Minimum sprinkler inlet pressure is met.
b) The proposed set pressure (downstream pressure) of pressure control valve.
c) Firewater pump is sufficient for fire protection in the LQBM.

Sprinkler System Schedules: The sprinkler system consists of piping, fittings, valves and instrument items and uses sea water as the fluid to pressurise the whole system. As seawater is used, suitable materials would be metallic piping such as carbon steel or galvanised carbon steel pipe, stainless steel pipe, copper-nickel pipe and fibreglass piping. Sprinkler nozzle characteristics must also be specified in the design.

1. MOC: Brass with chrome plated (Suitable for Sea Water Treated only).
2. Type: Pendent.
3. Final Finish Body Part: Chrome plated.
4. Sprinkler / Detector Bulb Colour Red (Operate at 68°C)
5. Operation Response: Standard Response
6. K Factor is 5.6
7. Certification: UL / FM Approved
8. Model No.: TY3251
9. Part No.: 57-571-9-155
10. Quantity - 100 Nos
11. P.O NO.OGSP/78000-01851/AJ - Amendment 01. ■