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Designing of Hydrant Installation in Processing Unit Warehouse and Tank Farm Area

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***Abstract*— Hydrant installation deals with the set of procedures with detailed study of the fire protection system in Petroleum Refinery & thus judging the risk present in these industries, hence forth giving preferences to safety measures for controlling and reducing the associated risk. It covers the theoretical and numerical aspects also.**

***Index Terms*— Hydrants, Hydrant Flow Rate, Pump capacity, Hydrant types, Water Monitor, Landing Valve, Floating Roof Tank**

I. INTRODUCTION

Indeed though petroleum refineries are generally located in remote areas, experience shows that domestic artificial units come up in close propinquity with the passage of time. Hence these installations which store large volume of ignitable accoutrements, pose trouble to surroundings as well, in addition to their own safety. Similar conditions thus, bear the preface of in- erected fire protection installations. It's impracticable and prohibitively expensive to design fire protection installations to control disastrous fires. Usual demand of a good system is to help extremities from developing into major trouble to the installations and surroundings. Petroleum refineries turn crude canvas into a variety of intermediate forms that are also used in a wide range of products from asphalt to plastics. All products begin by much the same way with the distillation, or vaporization, of crude. Distillation begins when crude canvas boils; factors within crude condense at different rates and so are uprooted at progressive points along a time/ temperature. Lighter, high- value products-propane, butanes, gasoline, spurt energy — condense at lower temperatures while heavier composites bear high temperatures or a special birth system to be converted into similar products as diesel energies, heavy energy canvas, and asphalts. The factors of distillated crude vary according to the make-up of the raw crude, with some batches containing large quantities of sulfur, for illustration, while others may be bituminous and full of heavier composites.

II. FIRE HYDRANT

Fire Pipings, videlicet, stand post type, conforming to IS 9081975 and underground type conforming to IS 909 1975 should behanded. For use in artificial establishment, only stand post type pipings should be handed. Hydrant outlet and stopcock‘for-the underground type line and faucets for the stage post type line should be located as near the ground position as possible. The top of the outlet or spindle of the stopcock should be at a depth not exceeding0.3m. Ordinary manhole covers of cast iron or corroborated concrete shouldn't be used to cover underground pipings or the faucets of the stage post type pipings. They should be covered only by hinge cast iron covers as specified in IS 39501979 with letters‘FH’embossed on them. In case of diligence of high hazard order, the pipings should be installed at every 30 m piecemeal along erecting line and the line outlet should be single or double line with provision of wharf faucets. For moderate hazard where the single line is use, it should be installed at every 45 m piecemeal. In case of any portion which has multiple hazards, the applicable portion should be covered according to the provision given for advanced hazard. Further the pressure available at hydraulically most remote line shouldn't be lower than3.5 kgf/ cms for light moderate hazard. In case of high hazard the‘hydrant system

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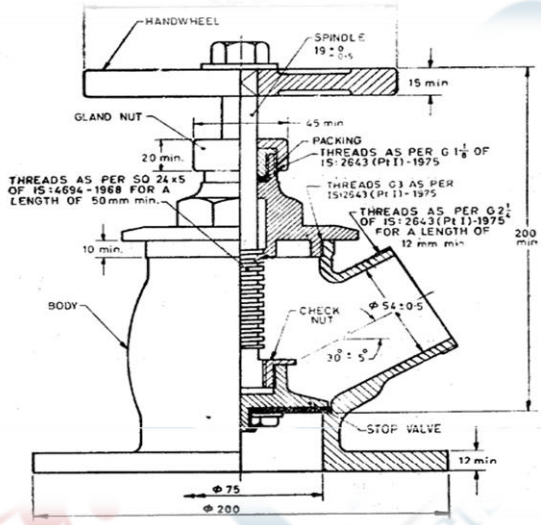
should be so designed that when half the aggregate pumping capacity is being discharged at the hydraulically most remote point and other half in the most vulnerable area enroute a minimal pressure of5.25 kg/ ems is available at the remote point.

III. TYPES OF FIRE HYDRANT

Single headed landing valve – This single headed valve are use to drawn the water from the fire mains and used for fire fighting in different place with the help of expertise firemen.



The landing valve assembly consists of valve, instantaneous female outlet and blank caps for TYPE A. The tolerance where not specified shall be ± 0.5mm.The diameter of the flange shall match with the respective diameter of the pipe that is 75 mm and 100 mm respectively. Water shall be discharged through the valve assembly and its flow shall be measured using flow meter or V-notch. The flow shall be not less than 900 litres per minute at 0.7 MN/m' (7 kgf/m²) for type A.

Double headed landing valve – This landing valve is also work same as single headed landing valve but with two outlets that are fixed with instantaneous female coupling with blank caps. Dimensions of the component parts that is hand wheel, spindle and other attachments are same as single headed landing valve. Water shall be discharged through the valve assembly and its flow shall be measured using a flow meter or V-notch. The flow shall be not less than 1800 liters' per minute at 0.7 MN/m' (7 kgf/m²) for type B.

Stand pipe hydrant – A penstock is a type of rigid water pipeline which is erected intomulti-story structures in a perpendicular position, to which fire hoses can be connected, allowing homemade operation of water to the fire. Within structures stovepipes therefore serve the same purpose as fire. This type of line are used in dry line system. A" dry" penstock is a pipe extending into a structure that can be used by the fire department to supply fire fighting water to the innards of the structure. The pipe is fixed and permanently in place with an input generally located near a road or driveway so that a fire machine can supply water to the system. Fire fighters bring hoses in with them and attach them to penstock outlets located along the pipe throughout the structure. Dry stovepipes aren't typically filled with water, the pipes are therefore dry and are so named. When a fire occurs the pipes are" charged", meaning water is introduced into them.

IV. WATER MONITOR

Observers shall be located at strategic locales for protection of cluster of columns, heaters, gassifiers,etc., and where it may not be possible to approach the advanced situations. A minimum of 2 observers shall be handed for the protection of each similar area. Water monitors for protection of heaters shall be installed so that the heater can be insulated from the remainder of the factory in an exigency.

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The observers shouldn't be installed lower than 15 mtrs from dangerous outfit. The demand of observers shall be established grounded on hazard involved and layout considerations. The position of water observers shall not exceed 45 mtrs. from the hazard to be defended. Observers should be painted with luminous color for ease of identification. The size of the water examiner is denoted by its stage post flange confines and is designed for rated discharge capacity of 1 750 I/ min for 63 mm size, 2 580-l/ min for 75 mm size and 4 250-l/ min for 100 mm size at pressure of0.7 MN/ m ² 7 (kgf/ cm ²). The shape of the examiner shall be so designed that it shall allow free inflow of water with minimal disunion loss and maximum stability against snoot response.

V. MATERIAL SPECIFICATION

For Single and double landing valve hydrant - The stopcock body, bonnet, stop stopcock, check nut, immediate womanish outlet and blank cap shall be made either of prime- drum-citation Conforming to Grade LTB-2 of IS 318 1981 or aluminum amalgamation conforming to 19 designation 4225, 4450 and 4600 of IS 617 1975. All aluminum and zinc amalgamation shall be of die casting only.

Zinc-aluminum amalgamation (bobby0.5 to1.5 percent, aluminum10.5 to11.5 percent, magnesium0.015 to0.03 percent and balance zinc) or pristine sword designation 04Cr17NiMOa conforming to IS 6529 1972. All aluminum and zinc amalgamation shall be of die casting only. The stopcock spindle shall be made of brass rod conforming to IS 320 1980 or IS 319 1989 for use with body of prime- drum-citation and of pristine sword conforming to IS 6603 1972 for use with body of aluminum or zinc amalgamation or pristine sword. The hand wheel shall be made of mild sword conforming to IS 1030 1989 or cast iron conforming to IS 210 1978.

Washers, gaskets shall be made of rubber conforming to IS 937 1981 or leather conforming to IS 581 1976. Gland quilting shall be of asbestos thread conforming to IS 4687 1980. The spring shall be of phosphor line conforming to IS 7608 1987 for bobby amalgamation wharf stopcock and pristine sword line conforming to IS 6528 1972 for aluminum amalgamation, zinc amalgamation and pristine sword wharf faucets.

For Stand Pipe Hydrant- The stand-pipe head may be made either of leaded-tin- bronze or aluminum alloy. The stand-pipe may also be made either completely out of aluminum alloy with shaft of aluminum pipe or mild steel pipe (galvanized) with leaded- tin-bronze fittings. While selecting the material for the manufacture of stand-pipes, care shall be taken to avoid juxta-position of dissimilar metals likely to cause electrolytic action. Leaded-Tin-Bronze — Leaded-tin-bronze used for castings and forgings shall conform to Grade II of IS : 318-1962.Aluminum Alloy - Aluminum alloy used for castings and forgings shall conform to IS Designation on 4 450 of IS : 617-1975. Mild Steel Pipes (Galvanized) - Mild steel pipes (galvanized), if used for the stand- pipe shaft, shall conform to IS : 1239 (Part I)-1979. Aluminum Pipe - Aluminum pipe, if used for the stand-type shaft, shall conform to IS : 737-1974.

For Water Monitor - Examiner shall have the flange of periphery corresponding to stand post that's 63 mm, 75 mm and 100 mm independently. Flanges of advanced size may be used for better hydraulic effectiveness and in that case it shall be welded with the reducer. The reducer shall further be connected to swivel joint which shall be so designed so as to have vertical gyration of 360” in either direction. The swivel joint shall be farther welded with the bend. The bend shall be further connected with another swivel joints having vittles for perpendicular gyration of minimal 125” (80’ overhead and 45” over). The swivel joint shall be farther attached with proper bend to water barrel. The outlet of barrel shall have external vestments conforming to IS 2643 (Part I)-1975 with class A forbearance. The snoot shall be of standard perforation size and conforming to performance conditions. The bay of the snoot shall be handed with external hexagon to grease tightening of snoot. Near the snoot outlet, external thread shall be handed to enable lower snoot tip or fog tip to be connected to the same. Covering medium shall be handed

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to grease the vertical and perpendicular gyration of examiner. This shall be either single handle bar type or worm and worm wheel type. Positive cinches shall be handed for unattended operation. In case of worm and worm wheel geared unit, it shall be tone locking type.Piping material and Design– Piping in the refinery are done in two ways underground piping and above ground piping. The pipe size from the pump house is 30inch after coming to the process unit area it reduces to 28inch. The underground sub branches in processing area are 14inch and the outer area is ringed with 28inch. Similarly in warehouse the water main size is 10 inch and in tank farm area it is ringed with 28inch. Piping shall be listed for fire protection service or shall comply with the standards.

VI. DESIGNIGN CALCULATION

A. Hydrant Calculation –

The total area of the process unit is = 250*110 = 27500m2
The length of the water main ring is = 720m

As per OISD 116 the water main are at a distance of 15 meter and the hydrant and monitor should be at a distance of 30 meter.

Therefore total no of hydrant and monitor = 720/30 = 24

Out of which 16 are double headed landing valve hydrant and 8 are water monitor
The discharge of one double headed landing valve is

=72m3/hr

Therefore for 16 double headed landing valve is = 72x16 =

1152m3/hr

Similarly the discharge of one water monitor is = 144m3/hr

Therefore the discharge of 8 water monitor is = 144x8 =

1152 m3/hr

Total water requirement

Discharge of double headed landing valve+ discharge of water monitor = 1152+1152
= 2304x4

= 9216m3

B. Warehouse Calculation –

The total area of the warehouse = 100x80 = 8000m2
Therefore the length of the water main is = 360m

As per OISD 116 the water main at a distance of 8 meter and

the hydrant distance are at a 30 meter=360/30 = 12

Discharge of one double headed landing valve hydrant is =

72m3/hr

Therefore 12 double headed landing

valve hydrant will discharge =

72x12 = 864m3/hr

Total water requirement = 864x4= 3456m3

C. Calculation For Volume,Dyke Area And Water Main For Fixed Roof (Internal Floating Roof Tank)

Number of tanks = 2
Diameter of each tank = 30 m
Height of each tank = 15 m
Volume of tank = □r2h
= 3.14*15*15*20
=10597m3/hr
=1059700 lit.
Total capacity of tanks = 2*1059700 lit
= 21195000
Dyke area of tank as per OISD 116 the height of dyke wall is 2mtr and maximum depth of liquid in dyke after total spillage is 300mm
So maximum height is = 2-0.2 = 1.8m
Tank volume = Dyke volume
10597 = a3
10597 = 1.8*a2
= 77 m2
Therefore total area of the dyke = length*breadth*height
= 77*77*2
= 11858m3
The length of one side of water main ring = 77*4 = 308 m
As per OISD 116 maximum distance between two hydrant post should not exceed 30 mtr
The total length of water main = 308 m
So total number of hydrant and monitor = 308/30 = 11

By assuming that there are 7 double headed hydrant and 6 water monitor are there
So the discharge of 7 double headed hydrant is = 7*72 = 504m3/hr
Now the discharge of 6 water monitor = 6*144 = 864m3/hr

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Total water requirement of double headed hydrant and water monitor = 504+864

= 1368*4m3/hr

= 5472m3

D. Pump Calculation –

At the time of fire in tank farm area out of 7 double headed landing valve and 4 water monitor, 3 double headed landing valve and 2 water monitor are activated. Therefore the discharge of 3 double headed landing valve is

=3 x 72 = 216m^3/hr

Similarly for 2 water monitor the discharge will be = 2x144m^3/hr= 288m^3/hr

Now in processing unit 16 double headed landing valve and 8 water monitor are there. Out of this 5 double headed landing valve and 4 water monitor are activated. Therefore the discharge of 5 double headed landing valve is

= 5 x 72 = 360 m^3/hr

Similarly for 4 water monitor the discharge will be = 4 x 144 = 576 m^3/hr

Therefore the total water requirement is =216+288+360+576+337 = 1777 m^3/hr

Total capacity of reservoir for 4 hour pumping capacity = 19492m^3

VII. CONCLUSION

The process and operations of Petroleum Refinery are highly hazardous which can cause serious fire and blast accidents. So adequate fire protection and prevention measures should be taken to control and prevent these accidents. To avoid these accidents, proper communication systems, storage tanks mounted with safety accessories, specialized fire fighting techniques should be made and practiced regularly. The fire fighting installations like Hydrants, Sprinkler systems, foam systems, stout metallic chains for providing earthing to the fuel supply lines to avoid the static discharge, lightening arrestors at the top the storage tanks & chimneys.

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