Marsh

Marsh Specialty

Fire pre-plans

Risk engineering position paper

Contents

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Background

The potential for major fires in any installation that handles large quantities of hydrocarbon products is self-evident. There have been numerous large damaging fires over the years and these include tank fires which involve massive product losses and process unit fires which cause major plant damage and process interruption.

2

Objective

The objective of this position paper is to define the standards that would be expected of a very good level of fire pre-plans in the oil, gas, and petrochemical industry. These standards are also reflected in the Marsh energy risk ranking criteria. They can be used to support and define risk improvement recommendations and also to provide detailed advice to clients seeking to improve their fire protection and emergency response systems.

3

Scope

The scope of this position paper includes the description and purpose, the ownership and development, and the format and content of fire pre-plans. It is applicable to any facility handling hydrocarbons and toxic materials.

4

General principles

Plants are normally designed, built, and operated to avoid fires by controlling the basic causes; loss of containment and ignition. They are also provided with detection and alarm systems to promote early response and intervention. Finally, there are passive and active fire protection facilities, and emergency response systems and resources, to be used as a final barrier to prevent or minimise the consequences.

A fire pre-plan is a scenario based plan, specific to a particular process area or equipment item. All fire pre-plans should be referenced in the site emergency response plan. They should describe how the fire protection and emergency response systems are to be used in specific fire case scenarios. Fire pre-plans should take into account the nature and likely effects of the fire scenario, the materials involved (process materials and plant construction materials), the surrounding environment, including plant layout, any special hazards pertaining to that area, and the resources available.

Fire pre-plans should be used to assess the resources required. They should be used for regular training and drills, and reviewed and updated after each event. Fire protection systems and emergency response resources (equipment and personnel) are generally designed to cope with the greatest demand they are likely to face. At a given site, the controlling scenario is generally referred to as the fire case. Whilst a lot of attention is paid to this as it underpins the basic design requirements of the central fire protection systems, there are other cases that need also to be studied to ensure the site is prepared for a range of eventualities.

5

Specific requirements

5.1 Policy and procedure

The Health, Safety and Environment Management System (HSE-MS) should include the procedure for the development and application of fire pre-plans. A copy of the fire pre-plans should be included in the emergency procedures manual for the site. Fire pre-plans should be managed in the same way as all other controlled documents.

Corporate standards for fire pre-plans should be available to member sites.

5.2 Ownership and development

Fire pre-plans should be owned by the emergency response organisation at the site. There should be input from all involved and affected groups and disciplines, particularly the operations teams. Where the external/ local fire brigade plays a significant part in the emergency response, they should be familiar with the fire pre-plans.

Specific evacuation plans, muster points, headcount, etc. should be covered under a separate procedure in the site emergency response plans.

By definition, a fire pre-plan is a "desk-top" derived plan, with additional input from exercise and incident feedback. The pre-plan is best developed by a team effort. Team members should include:

- Person responsible for site tactical emergency response team e.g. fire chief/fire engineer.
- Person responsible for first-line response e.g. shift supervisor.
- Operations representative - area specific.
- Firefighting team representative.
- Risk engineer.
- Safety officer.

The pre-plan should be seen as an evaluation of the type of response required for typical scenarios. In the event of an actual incident, the pre-plan should be seen as a guide and would need to be adjusted to suit local factors, e.g. weather conditions, actual process conditions. The fire preplan acts as an aide-memoire in crisis situations where rational thinking time could be limited. The development of a fire pre-plan may also highlight where there may be deficiencies in response capability or particular problems with the subject scenario.

Scenarios to be documented should be as comprehensive as time and resource allows. Good starting points are events typically highlighted in a safety case, or by highlevel unit assessment looking at other property damage events.

5.3 Fire preplan portfolio

A comprehensive portfolio of fire pre-plans should include:

- A fire pre-plan for each major storage tank and each bund area (although these can often be combined for identical tanks in a single local area).
- A fire pre-plan for each pressurised storage vessel and containment area, including protection of the run-off and impounding area, and key steps to avoid a boiling liquid expanding vapor explosion (BLEVE).
- A fire pre-plan for refrigerated storage tanks including protection of the run-off and impounding area.
- A fire pre-plan for each berth at the marine terminal.
- A fire pre-plan for each rail and truck loading gantry.
- A fire pre-plan for each defined “fire area” of the unit e.g. as limited by layout/drainage where this is practical/ meaningful. At least the two or three most severe fire cases for each process unit should be defined.
- Any other specific cases that are equivalent to one of the above.

5.4 Format and content

The plans are best represented on easy-reference A3 size documents, using a standard layout. Data should be included on the diagrams where possible. Lengthy narrative should be avoided and reference should be made to supporting documentation.

The pre-plans should include the following:

Section	Description
Header	Date, revision, author, and approver.
Incident description	Unit/section/equipment item/scenario.
Equipment and contents description	• Size: Volume, diameter, height or length. • Contents: Quantity, chemical description, and properties, e.g. flash point, auto ignition temperature. • Toxic risk: including carcinogens such as Benzene and Asbestos explosion risk, e.g. Vapor Cloud Explosions (VCE), BLEVE, detonation. • Environmental impact and odour risk. • Boil - over risk. • Dispersion and cloud characteristics. • Equipment and other units also at risk. • Third party locations at risk.
Special hazards	• Location of radioactive instrumentation elements. • Location of electrical equipment with polychlorinated biphenyl (PCB). • Location of equipment with water reactive chemicals. • High pressure gas cylinders.
Operations response	• Key operations response actions, e.g. shutdown, depressurisation and isolation, evacuations, remote activation of deluge/monitors etc. • Where possible the number of key actions should be limited to around five to avoid excessive detail; they should also take into account the nature of the emergency e.g. it may be necessary to shut down a pump with a leaking seal from the switch house rather than the local stop/start button.
Tactical emergency response	• Key tactical emergency response actions, e.g. activation of fixed protection if not automatic, deployment, and position of mobile equipment, target areas for firewater and foam (cooling/ extinguishment/precautionary). • Where possible the number of key actions should be limited to around five to avoid excessive detail.
Protection of adjacent equipment	• Identification of other key equipment and hazard arising. • Cooling requirements developed from radiation studies. • Unit/section/equipment item/scenario.
Required manpower	• Level of initial response, e.g. shift first-line response, site brigade, local authority brigade, mutual aid partners. • Minimum initial response numbers. • Approach direction for various response teams, including entry point for non-site response, relative to specific and detailed wind/ weather conditions.

Section	Description
Required equipment	• Fixed equipment response, show equipment type and capacity, i.e. deluge (water, foam or chemical), foam to tank seals, monitors should also include deluge capacity, foam/chemical capacity and type. Mobile equipment response, show equipment type and capacity, i.e. deluge (water, foam or chemical), foam to tank seals and monitors, and hydrants should also include deluge capacity, foam/chemical capacity and type. • Response required from local authority brigade and mutual aid partners as appropriate. • Limitations, e.g. quantity of site available fire fighting consumables and sources of back-up. • Limitations, e.g. volume of surrounding bunds and estimate of when full if not being drained. • Limitations, e.g. blocked routes due to equipment congestion.
Firewater runoff	• Route and destination of runoff. • Location of runoff interceptors and control points (e.g. penstocks).
Diagrams	• Scenario plot plan showing position of fixed equipment including activation panels or valve stations and likely position of mobile equipment, hydrants, monitors, valve stations, water curtain provision, cooling provision, staging areas taking wind direction into account. • Radiation contour diagram for human and equipment exposure. • BLEVE profile, consequence, and radiation contour diagram. • Dispersion and toxicity diagram.
Maximum foam and water requirements	• For major fire cases only – i.e. those that are likely to test the capacity of the systems or define stocks to be accessible; and those that are likely to require special equipment, specific system configurations or supply arrangements to be set up early in the response plan. • Assess the maximum quantities of foam and firewater required to control and extinguish the fire. This should be based on likely duration and intensity, and the attack strategy.

5.5 Drills

There should be regular drills by the emergency response team in conjunction with the operations teams to maintain their familiarity with the pre-plans and also to test that the information and response steps within them is valid.

5.6 Distribution

The fire pre-plans should be distributed as follows:

- Master copies of all fire pre-plans to be retained electronically.
- Controlled copies of all fire pre-plans to be kept in site emergency manual.
- Controlled copies of area-specific fire pre-plans to be kept in area emergency procedure manual.
- Controlled (laminated) copies of all fre pre-plans to be kept on emergency response vehicles.

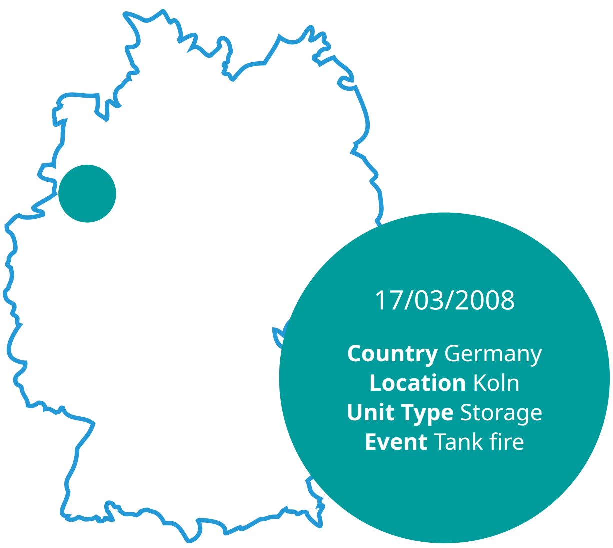
6 Reference to industry losses

Description

Gasoline layer built up on top of 270 ft diameter floating roof tank due to heavy rain. Fire started by lightning, producing full surface tank fire. Emergency services set up fire fighting equipment, and once in place, the fire was extinguished in 65 minutes.

Position paper comment

This incident is the largest tank fire ever extinguished. It illustrates the benefits of fire pre-plans.



Description

An ethylene release from a major pipeline ignited to form a jet fire, which impinged on an adjacent Acrylonitrile storage tank. A major tank fire ensued which took 9 hours to extinguish, during which a number of fire tenders were in attendance with the deployment of 1,180 fire fighters. The flames had a devastating impact on the tank's concrete wall, causing cracks and causing the stability of the whole tank to be in question. Note that the original jet fire took 5 hours to extinguish. There was no active fire protection available in the area, and no specific emergency plans for this scenario. The total cost (property damage, plus business interruption) was around Euro 53 million.

Position paper comment

With clear scenario plans in place, the effects of this major fire could have been greatly reduced.

Reference to industry standards

7

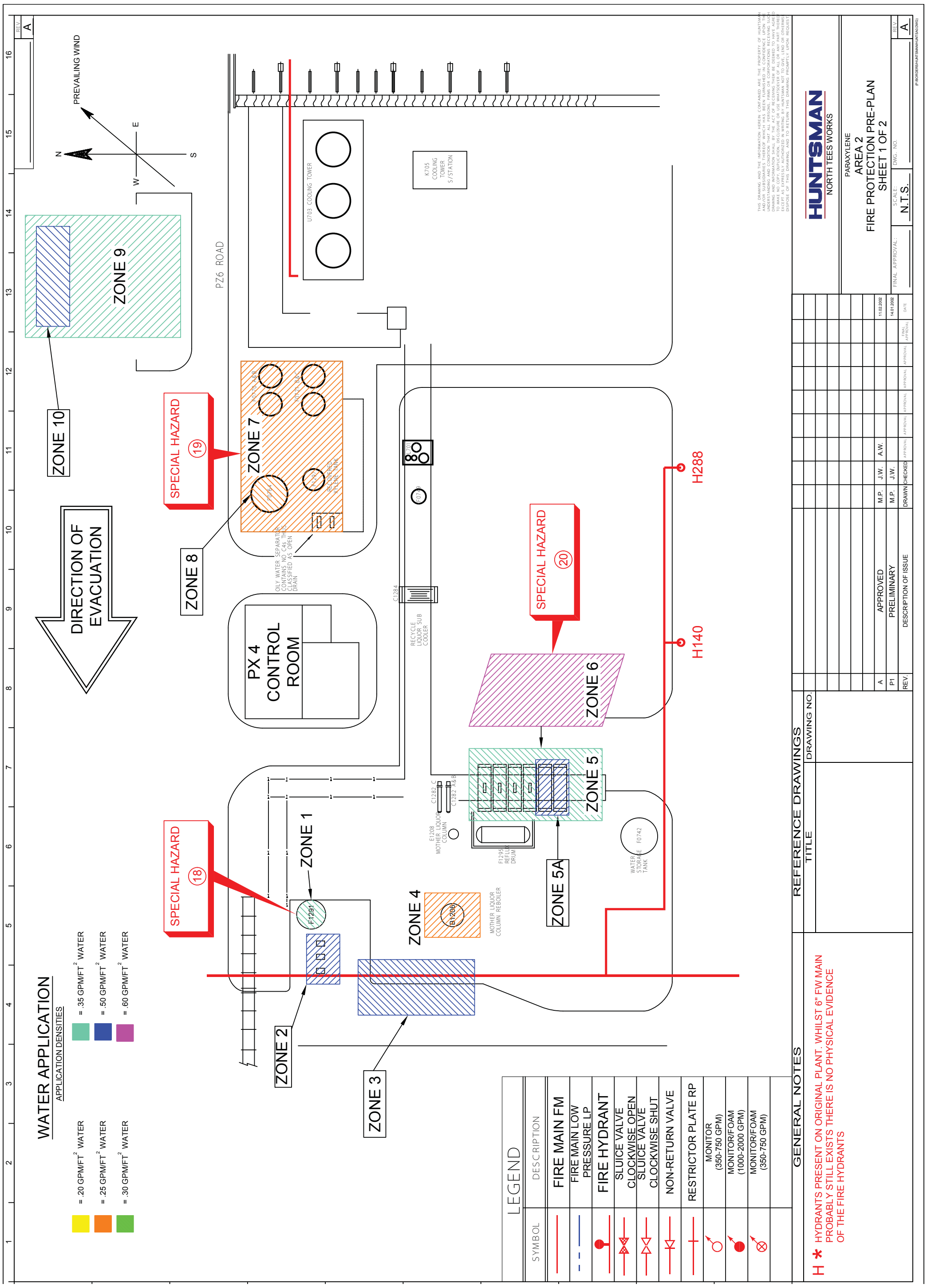
API RP 2001 Fire Protection in Refineries.

8

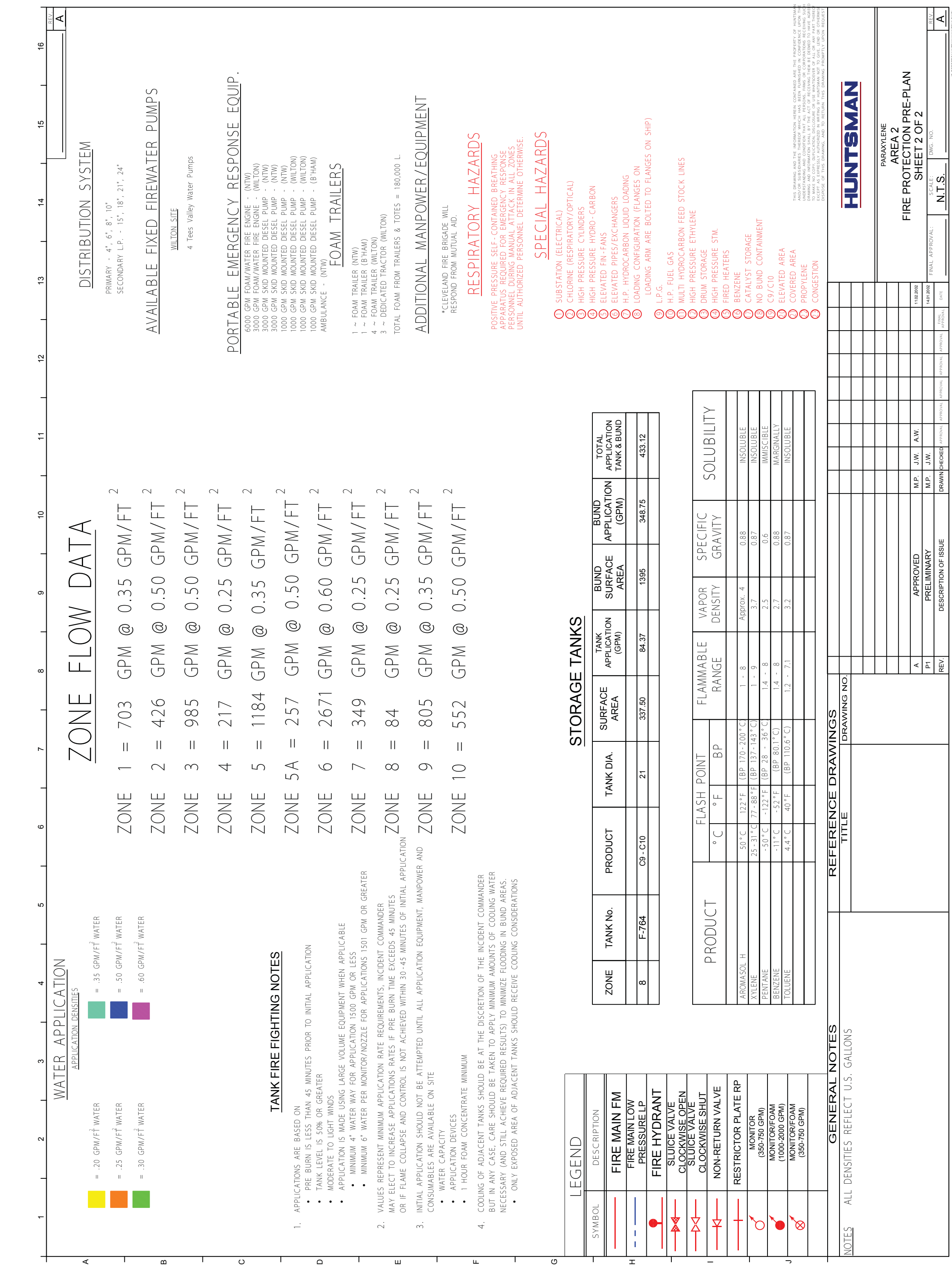
Appendices

APPENDIX A

Example of a fire protection pre-plan



APPENDIX B


WATER APPLICATION
APPLICATION DENSITIES
= .20 GPM/FT² WATER
= .25 GPM/FT² WATER
= .30 GPM/FT² WATER
= .35 GPM/FT² WATER
= .50 GPM/FT² WATER
= .60 GPM/FT² WATER
TANK FIRE FIGHTING NOTES
1. APPLICATIONS ARE BASED ON
• PRE BURN IS LESS THAN 45 MINUTES PRIOR TO INITIAL APPLICATION
• TANK LEVEL IS 50% OR GREATER
• MODERATE TO LIGHT WINDS
• APPLICATION IS MADE USING LARGE VOLUME EQUIPMENT WHEN APPLICABLE
• MINIMUM 4" WATER WAY FOR APPLICATION 1500 GPM OR LESS
• MINIMUM 6" WATER PER MONITOR/NOZZLE FOR APPLICATIONS 1501 GPM OR GREATER
2. VALUES REPRESENT MINIMUM APPLICATION RATE REQUIREMENTS. INCIDENT COMMANDER MAY ELECT TO INCREASE APPLICATIONS RATES IF PRE BURN TIME EXCEEDS 45 MINUTES OR IF FLAME COLLAPSE AND CONTROL IS NOT ACHIEVED WITHIN 30-45 MINUTES OF INITIAL APPLICATION
3. INITIAL APPLICATION SHOULD NOT BE ATTEMPTED UNTIL ALL APPLICATION EQUIPMENT, MANPOWER AND CONSUMABLES ARE AVAILABLE ON SITE
• WATER CAPACITY
• APPLICATION DEVICES
• 1 HOUR FOAM CONCENTRATE MINIMUM
4. COOLING OF ADJACENT TANKS SHOULD BE AT THE DISCRETION OF THE INCIDENT COMMANDER BUT IN ANY CASE, CARE SHOULD BE TAKEN TO APPLY MINIMUM AMOUNTS OF COOLING WATER NECESSARY (AND STILL ACHIEVE REQUIRED RESULTS) TO MINIMIZE FLOODING IN BUND AREAS.
• ONLY EXPOSED AREA OF ADJACENT TANKS SHOULD RECEIVE COOLING CONSIDERATIONS
ZONE FLOW DATA
ZONE 1 = 703 GPM @ 0.35 GPM/FT²
ZONE 2 = 426 GPM @ 0.50 GPM/FT²
ZONE 3 = 985 GPM @ 0.50 GPM/FT²
ZONE 4 = 217 GPM @ 0.25 GPM/FT²
ZONE 5 = 1184 GPM @ 0.35 GPM/FT²
ZONE 5A = 257 GPM @ 0.50 GPM/FT²
ZONE 6 = 2671 GPM @ 0.60 GPM/FT²
ZONE 7 = 349 GPM @ 0.25 GPM/FT²
ZONE 8 = 84 GPM @ 0.25 GPM/FT²
ZONE 9 = 805 GPM @ 0.35 GPM/FT²
ZONE 10 = 552 GPM @ 0.50 GPM/FT²
DISTRIBUTION SYSTEM
PRIMARY - 4", 6", 8", 10"
SECONDARY L.P. - 15", 18", 21", 24"
AVAILABLE FIXED FIREWATER PUMPS
WILTON SITE
4 Tees Valley Water Pumps
PORTABLE EMERGENCY RESPONSE EQUIP.
6000 GPM FOAM/WATER FIRE ENGINE - (NTW)
3000 GPM FOAM/WATER FIRE ENGINE - (WILTON)
3000 GPM SKID MOUNTED DIESEL PUMP - (NTW)
3000 GPM SKID MOUNTED DIESEL PUMP - (NTW)
1000 GPM SKID MOUNTED DIESEL PUMP - (NTW)
1000 GPM SKID MOUNTED DIESEL PUMP - (WILTON)
1000 GPM SKID MOUNTED DIESEL PUMP - (WILTON)
1000 GPM SKID MOUNTED DIESEL PUMP - (B'HAM)
AMBULANCE - (NTW)
FOAM TRAILERS
1 ~ FOAM TRAILER (NTW)
1 ~ FOAM TRAILER (B'HAM)
4 ~ FOAM TRAILER (WILTON)
3 ~ DEDICATED TRACTOR (WILTON)
TOTAL FOAM FROM TRAILERS & TOTES = 180,000 L.
ADDITIONAL MANPOWER/EQUIPMENT
*CLEVELAND FIRE BRIGADE WILL RESPOND FROM MUTUAL AID.
RESPIRATORY HAZARDS
POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS REQUIRED FOR EMERGENCY RESPONSE PERSONNEL DURING MANUAL ATTACK IN ALL ZONES UNTIL AUTHORIZED PERSONNEL DETERMINE OTHERWISE.
SPECIAL HAZARDS
SUBSTATION (ELECTRICAL)
CHLORINE (RESPIRATORY/OPTICAL)
HIGH PRESSURE CYLINDERS
HIGH PRESSURE HYDRO-CARBON
ELEVATED FIN-FANS
ELEVATED PIPES/EXCHANGERS
H.P. HYDROCARBON LIQUID LOADING
LOADING CONFIGURATION (FLANGES ON LOADING ARM ARE BOLTED TO FLANGES ON SHIP)
L.P.G.
H.P. FUEL GAS
MULTI HYDROCARBON FEED STOCK LINES
HIGH PRESSURE ETHYLENE
DRUM STORAGE
HIGH PRESSURE STM.
FIRED HEATERS
BENZENE
CATALYST STORAGE
NO BUND CONTAINMENT
C9/C10
ELEVATED AREA
COVERED AREA
PROPYLENE
CONGESTION
STORAGE TANKS
ZONE | TANK No. | PRODUCT | TANK DIA. | SURFACE AREA | TANK APPLICATION (GPM) | BUND SURFACE AREA | BUND APPLICATION (GPM) | TOTAL APPLICATION TANK & BUND
8 | F-764 | C9 - C10 | 21 | 337.50 | 84.37 | 1395 | 348.75 | 433.12
PRODUCT | FLASH POINT °C | °F | BP | FLAMMABLE RANGE | VAPOR DENSITY | SPECIFIC GRAVITY | SOLUBILITY
AROMASOL H | 50°C | 122°F | (BP 170 - 200°C) | 1 - 8 | Approx. 4 | 0.88 | INSOLUBLE
XYLENE | 25 - 31°C | 77 - 88°F | (BP 137 - 143°C) | 1 - 9 | 3.7 | 0.87 | INSOLUBLE
PENTANE | -50°C | -122°F | (BP 28 - 36°C) | 1.4 - 8 | 2.5 | 0.6 | IMMISCIBLE
BENZENE | -11°C | -52°F | (BP 80.1°C) | 1.4 - 8 | 2.7 | 0.88 | MARGINALLY
TOLUENE | 4.4°C | 40°F | (BP 110.6°C) | 1.2 - 7.1 | 3.2 | 0.87 | INSOLUBLE
LEGEND
SYMBOL | DESCRIPTION
FIRE MAIN FM
FIRE MAIN LOW PRESSURE LP
FIRE HYDRANT
SLUICE VALVE CLOCKWISE OPEN
SLUICE VALVE CLOCKWISE SHUT
NON-RETURN VALVE
RESTRICTOR PLATE RP
MONITOR (350-750 GPM)
MONITOR/FOAM (1000-2000 GPM)
MONITOR/FOAM (350-750 GPM)
GENERAL NOTES
NOTES
ALL DENSITIES REFLECT U.S. GALLONS
REFERENCE DRAWINGS
TITLE
DRAWING NO
A | APPROVED | M.P. | J.W. | A.W.
P1 | PRELIMINARY | M.P. | J.W.
REV. | DESCRIPTION OF ISSUE | DRAWN | CHECKED | APPROVAL
HUNTSMAN
PARAXYLENE
AREA 2
FIRE PROTECTION PRE-PLAN
SHEET 2 OF 2
SCALE: N.T.S.
DWG. NO.
REV. A

Marsh Risk Engineering

Marsh Risk Engineering has been established for over 25 years and is uniquely qualified to provide risk managers and underwriters with the essential information they need to determine the right limit and scope of cover and the right price.

Each member of the team is a qualified engineer, with practical experience in design, construction, operation, and maintenance across a broad range of oil, gas, and petrochemical risks.

They have all been trained in advanced insurance skills, in the ability to assess and analyse risk, and to communicate effectively and frequently in more than one language.

The goal is to build bridges between risk engineering, insurance and risk management, and between the client and the underwriter. At the same time, the comparative skills of the team permit a benchmarking system which gives a global opinion of the risk, assessed against peer plants world-wide.

From the earliest planning stage to the last operational phase, the engineering services team is able to contribute practical and cost-effective advice, and assistance.

In addition to tailored programmes, the team has a series of core packages, covering everything from managing a major emergency to risk reduction design features, and safe working practices.

Marsh Risk Engineering uses its breadth of expertise, experience, and its practical knowledge and skills to communicate a real understanding of physical risks, your insurance implications and the commercial operating environment.

For further information, please contact your local Marsh office or visit our website at marsh.com

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Marsh

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