
Fire Protection Basis of Design Engineering Evaluation Report

**Tesoro Savage Vancouver
Energy Distribution Terminal
Port of Vancouver, Washington**

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Poole Fire Protection

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Basis of Design
Fire Protection

Poole Fire Protection

Chapter 1 - Introduction

This document has been developed to support the Fire Protection (FP) and Fire Alarm (FA) series drawings. The intent is to establish the requirements that drive the necessary fire protection features needed for the Tesoro Savage Vancouver Energy Distribution Terminal (Terminal) facility to be compliant with code. This Basis of Design does not address construction and egress requirements or life safety features. For further information on the life safety features please refer to the *Life Safety Basis of Design Engineering Evaluation Report*. For further information on construction and egress requirements and other life safety features please refer to the *Life Safety Analysis Report*.

Chapter 2 - Project Summary

The Terminal is located at the Port of Vancouver in the City of Vancouver, Washington. This facility is being designed and constructed to unload multiple grades of crude oil from railcars, then pump the crude oil to storage tanks in the tank Storage area east of Far West Steel and then later pump the crude oil from the storage tanks to the transport vessels at the Marine Terminal Area. The project has been broken down into five separate and distinct areas: 1) Area 200 – Unloading and Office; 2) Area 300 – Storage Area; 3) Area 400 – Marine Terminal; 4) Area 500 – Transfer Pipelines; and 5) Area 600 – West Boiler. Below is a brief description of each area.

Area 200 – Unloading and Office

The Rail Off Loading Area currently includes two unloading tracks for light crude oil with the potential of adding a third track for unloading heavy crude oil. The unloading tracks will be located inside an unloading building. Each unloading track will accommodate 30 cars for a total length of approximately 1,800 feet. The unloading building will be approximately 1,850 feet long and 90 feet wide to accommodate the length of these unloading tracks and the unloading operations.

The building has a complete metal roof, while the walls will only consist of seven metal wall panels spaced along the south side of the building. These seven metal wall panels will be spaced at locations corresponding with E-houses, the fire pump/foam skid building, and other appurtenances that are to be located on the south side of the building. The remainder of the wall area on the building will be open. Within the building there will be two elevated walkways running the length of the building used in the unloading process, and five crossover egress walkways providing access to the north and south sides of the building spaced approximately every 357 feet. There will be three rail tracks running east to west, two trenches (approximately 9 foot wide by 5 foot deep) accommodating the piping system that is used to transport the crude oil to the pump basins (located between the tracks), and 10 pump basins (5 for the south trench and 5 for the north trench), which will be spaced every 355 feet that house the transfer pumps. These transfer pumps will be used to pump the crude oil out of the Unloading Building to the Tank Storage. The Unloading Building will be completely protected by a fire detection and sprinkler system.

Access stairs will be provided between the railcars which will enable workers performing any unloading operations at the track level to exit up the stairs to the elevated crossovers and over the railcars to reach an exterior exit from the Railcar Unloading Building.

Other structures located in the Rail Offloading Area include control room/E-houses and the fire pump/foam skid building.

The Office Area contains the Office Building and two change rooms. The Office Building and East Change Room are located approximately 225 feet to the North of the Unloading Building. These buildings consist of modular office trailers that are pre-built off site and placed at their specific location on the job site. The West Change Room will be constructed in the future and has not been designed yet but will be similar to the East Change Room. The Office Building and change rooms will not be provided with an automatic suppression system.

Area 300 – Storage

The Storage area is currently being planned for the construction of four crude oil storage tanks with the potential of two more tanks in the future. The storage tanks will have a nominal storage capacity of 380,000 barrels (15,960,000 gallons) each and they will be approximately 50 feet tall with a diameter of 240 feet. All tanks will be located inside a perimeter dike capable to contain 110% of the volume of the largest tank plus the anticipated precipitation from a 24 hour, 100 year storm. The tanks will be positioned so that the distance between each tank is 120 feet in any direction. The distance from the tank to the dike varies from a minimum distance of approximately 33 feet to a maximum of 150 feet.

Other structures located in the Storage area will include a Pump Basin for the pumps that will be used to transfer the crude from the tank storage area to the vessels at Berth 13. A Storage Building, a control room/E-house, and a Fire Pump and Foam Building.

Area 400 – Marine Terminal

The Marine Terminal Area will consist of Berths 13 and 14. Crude oil will be pumped from the Storage Area in a 36-inch pipe to Berth 13. The berth will be able to accommodate vessels with a capacity of up to 380,000 barrels, with loading rates of up to 32,000 barrels per hour. Safety measures include automatic shutoff valves, a return and stripping line for the crude to return back to the storage tanks, a marine vapor combustion unit, floating booms and manual fire protection features.

Berth 14 will be used for storage of and access to the boat that will be used to deploy the boom in the water around the ship. There are no other crude unloading operations planned for Berth 14. Safety measures include manual fire protection features.

Other structures located at the Marine Terminal Area will include a control room/E-house,, vapor blower staging unit, Fire Pump and Foam Building, and a dock safety unit.

Area 500 – Transfer Pipelines

The transfer pipelines consists of the pipeline runs between the area 200 Unloading Building and the area 300 Storage Area and between the Storage Area and area 400 Marine Terminal. Depending on the location of the piping runs, the number of pipes varies from 1 ea 36 inch pipe and 1 ea 6 inch pipe to 3 ea 24 inch pipes, 1 ea 36 inch pipe, and 1 ea 6 inch pipe. The transfer pipelines are mainly aboveground and on supports. Where required to avoid interferences or cross over rail track, the pipeline does go underground and is encased in a secondary containment pipe.

Area 600 – West Boiler

The West Boiler area contains a boiler building that will be utilized to generate steam to heat the heavy crude in the heated crude unloading operations inside the Unloading Building at area 200. Other than the E-house, no other buildings will be located on the area 600 site. The west boiler building will not include an automatic fire suppression system.

Water Flow Information

Currently the site has existing city water mains provided from both the City of Vancouver and the Port of Vancouver. Two tests were performed on May 30, 2013 on fire hydrants at the Storage Area and Marine Terminal Area on the City of Vancouver water distribution system. They yielded the following results: for the Storage Area – Static Pressure = 84 psi, Residual Pressure = 63 psi, Flow = 2,005 gpm and for the Marine Terminal Area – Static Pressure = 81 psi, Residual Pressure = 62 psi, Flow = 2,127 gpm. Based on other information provided by the city, water supply at the Railcar Unloading Building consists of a Static Pressure = 50 psi, Residual Pressure = 20 psi, Flow = 2,500 gpm. The City of Vancouver water distribution system will supply water to the fire hydrants on the South side of the Railcar Unloading Building as well as the fire pump that feeds the suppression systems inside the Railcar Unloading Building. The City of Vancouver water distribution system will supply water to the fire pump, which in return will supply water to the suppression systems on the tanks, and the fire hydrants around the dike at the Storage Area. The City of Vancouver water supply at the Marine Terminal Area will supply the fire pump that feeds the elevator monitor nozzles equipment to the dock.

Chapter 3 - Applicable Design Criteria

The following codes and standards are applicable for this project:

- NFPA 10, *Standard for Portable Fire Extinguishers*, 2010
- NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2010
- NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010
- NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2012
- NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2011
- NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2010 Edition
- NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2010
- NFPA 30, *Flammable and Combustible Liquids Code*, 2012 Edition
- NFPA 70, *National Electrical Code*, 2011
- NFPA 72, *National Fire Alarm and Signaling Code*, 2010
- NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves*, 2011 Edition
- International Building Code, 2012
- International Fire Code, 2012
- Factory Mutual Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*, April 2011
- Factory Mutual Data Sheet 3-0, *Hydraulic of Fire Protection Systems*, March 2010
- Factory Mutual Data Sheet 3-26, *Fire Protection Water Demand for Nonstorage Sprinklered Properties*, July 2011
- FMDS 4-0, *Special Protection Systems*, April 2012
- FMDS 4-7N, *Low Expansion Foam Systems*, September 2010, (Interim Revision January 2013)
- Factory Mutual Data Sheet 4-12, *Foam-Water Sprinkler Systems*, October 2011
- Factory Mutual Data Sheet 5-40, *Fire Alarm Systems*, September 2007
- Factory Mutual Data Sheet 5-48, *Automatic Fire Detection*, January 2011
- Factory Mutual Data Sheet 7-32, *Ignitable Liquid Operations*, April 2012
- Factory Mutual Data Sheet 7-88, *Flammable Liquid Storage Tanks*, October 2011

Chapter 4 - Site Information

4.1 Spill Containment

Area 200 – Railcar Unloading Building Area

Adequate floor drainage will be provided in accordance with FM DS 7-32. Track pans will be installed under the railcar to capture spillage from the unloading operation of the railcar. These track pans drain to the closed pipe header piping system within the containment trench. This drain pipe is discharged to containment tanks. If a leak exceeds the capacity of the track pans and drain pipe, the oil will overflow onto the solid surface around the tracks and into the pipe trench. Spills are not expected to discharge into the trench, unless there is a major catastrophic event.

Area 300 – Storage Area

The tank dike will surround all six tanks and will be able to contain 110% of the largest tank plus precipitation from a 24 hour, 100 year storm. The dike will have an impervious liner system to prevent leakage. In addition to the main dike, additional dikes sized at 10% of the tank will contain each individual tank.

Area 400 – Marine Terminal Area

During loading, vessels will be partially encircled by temporary floating booms to contain any accidental releases of crude oil and prevent it from migrating downstream. These booms will be placed around the vessel by a small skiff before any loading begins. A fence-type floating boom may be placed between the berth and the shoreline in place of the floating boom. This would remain in place and would not require placement by the skiff during each vessel call.

4.2 Electrical Hazard Classification

A complete electrical hazard classification analysis has been performed for the project areas. This hazard classification has been performed by Intermountain Consumer Professional Engineers, Inc. The drawings of the hazard classification areas were utilized in the design process. The electrical classification impacts the type and classification of devices and circuitry to be used for each area.

Chapter 5 - Water Supply Evaluation

5.1 Adequacy

The current available water supply will be supplied from the on-site dedicated fire water gridded distribution system. It is been discussed and confirmed that the on-site system water supply available from the City of Vancouver to the Port of Vancouver project is more than adequate to meet the demand of the manual fire operations and the automatic fire suppression system. The City of Vancouver system is accessible at all project site locations and has been deemed reliable, therefore the City of Vancouver water supply will be the water service used in the design of this project.

5.2 Arrangement

Area 200 – Railcar Unloading Building Area

The fire hydrants at the Railcar Unloading Building will be supplied by the City of Vancouver water distribution system as well as the connection to Fire Pump and Foam Building.

Area 300 – Storage Area

The City of Vancouver water distribution system will supply the Fire Pump and Foam Building. At the Storage Area, the fire hydrant/monitor system will be supplied from the site specific fire pump for design parameter purposes.

Area 400 – Marine Terminal Area

The fire pump at the Marine Terminal Area will serve all appurtenances on the dock, any site fire hydrants will be served from the on-site City of Vancouver water distribution system

5.3 Hydrant Flow Testing Results

The results of a flow test performed by the City of Vancouver on May 30, 2013 on fire hydrants on the dedicated fire water distribution system, in the immediate area of the new Railcar Unloading Building, Storage Area and Marine Terminal Area yielded the following results.

Area 200 – Railcar Unloading Building Area

Static Pressure = 50 psi, Residual Pressure = 20 psi, Flow = 2,500 gpm.

Area 300 – Storage Area

Static Pressure = 84 psi, Residual Pressure = 63 psi, Flow = 2,005 gpm

Area 400 – Marine Terminal Area

Static Pressure = 81 psi, Residual Pressure = 62 psi, Flow = 2,127 gpm

5.4 Backflow Prevention

A backflow prevention assembly will be provided for each area, upstream of the fire pump since the water for the Railcar Unloading Building, Storage Area, and Marine Terminal Area are supplied from a potable source. Due to the design including foam, reduced pressure backflow prevention assembly is required and will be provided.

Chapter 6 - Suppression Systems

6.1 Sprinkler Systems, Monitors, Foam Suppression Systems and Fire Hydrants

6.1.1 General

All foam products used in fire protection related operations will be of an environmentally friendly type.

Area 200 – Railcar Unloading Building Area

Fire hydrants will be added on the south side of the structure spaced at every 300 feet. The hydrants will be located on the south side of the track that is located south of the Railcar Unloading Building. Procedures will be in place for cooperation with those companies using the tracks to the south of the unloading building to allow access to the unloading building from the hydrants.

A closed-head foam-water pre-action sprinkler system will be installed inside the Railcar Unloading Building at the roof level, under walkways (as required by code) and in the pump basin areas. The structure will be divided in to five zones, each zone will be activated either manually from the foam manual release stations or automatically from the linear heat detection that will be installed at the roof level and at the pump basin level for that associated zone. The pump pits are located in the center of each zone respectively between the tracks. Note that this system is a closed-head pre-action foam-water system; therefore, foam-water solution will only be discharged once the fire is large enough to activate the linear heat detection, trip the valve and then activate the sprinklers above the fire. Foam will be used to control and extinguish the crude oil pool fire and will also provide cooling to the railcars and any adjacent equipment or building elements.

A closed-head wet-pipe sprinkler system will be provided for the Fire Pump and Foam Building in accordance with NFPA 20, Section 4.12.1.1.2.

Area 300 – Storage Area

An automatic fixed foam system will be placed inside each tank to protect the seal area of the internal floating roof. This system will be a pre-action system activated by the linear heat detection system installed at the foam dam of the floating roof or by the manual foam release stations associated with that tank.

In addition, fire hydrants will be located on the dike spaced every 300 feet along with two fire hydrants located inside the dike area near the intersection of the intermediate dikes. Each hydrant will be equipped with a monitor nozzle and foam eductor capable of reaching the neighboring tank of the one in incident. The flow of water from these monitor nozzles are provided to create a cooling effect on the tank wall. The foam eductor provided on each monitor nozzles will allow the hydrant to spray a foam water solution and control a small pool fire within the dike area. A predetermined size of foam concentrate stored in bucket, pale or other portable device will be kept in the Fire Pump and Foam Building. When the need arises for its use, such as a small spill or rubbish fire, the foam concentrate will be taken to the appropriate fire hydrant and the hose placed in the bucket. The nozzle will draw the foam in at the manufacturer determined proportioning rate to achieve the desired concentration.

A monitor nozzle supplied with foam-water from the Fire Pump and Foam Building will be located near the crude oil pump basin with the primary purpose of providing manual fire suppression to the pump basin.

A closed-head wet-pipe sprinkler system will be provided for the Fire Pump and Foam Building in accordance with NFPA 20, Section 4.12.1.1.2.

Area 400 – Marine Terminal Area

Two remote controlled elevated monitor nozzles will be provided on the dock for firefighting purposes. The monitor nozzles will be supplied from the Fire Pump and Foam Building with foam-water. Activation of the foam-water monitor nozzles will be by manual foam release stations. The controller for the nozzles will be located in the E-house, located shore side.

A closed-head wet-pipe sprinkler system will be provided for the Fire Pump and Foam Building in accordance with NFPA 20, Section 4.12.1.1.2.

6.1.2 Fire Protection Design

Area 200 – Railcar Unloading Building Area

The foam-water sprinkler system will be designed with a density of 0.3 gpm/sq.ft. over a demand area of 4,000 sq.ft. with a supplemental hose stream of 500 gpm per FM DS 7-32, 2.4.8.1, totaling a flow of approximately 1,896 gpm. This design takes into account that there will be no spilling of ignitable liquids where the release point is above three feet in accordance with FM DS 7-32, 2.4.8.1.C(3). The structure will be divided into 5 separate and equally sized zones/systems. The city water supply will be supplemented with a preliminarily sized 2,000 gpm dedicated fire pump rated for 125 psi. System activation will include the system over the fire incident, along with the system(s) adjacent to the target system. Note that this system is a pre-action system so foam-water solution will not discharge from the system until each sprinkler receives sufficient heat to activate, at which time the foam-water solution will be discharged. Automatic activation will be provided through linear heat detection, and manual activation will be activated from the manual release stations. The system piping will be dry until the

system is tripped by the activation of the linear detection system or a manual release station.

A combination Fire Pump and Foam Building will be provided to house the required equipment. The Fire Pump and Foam Building will be separated from the remainder of the Railcar Unloading Building with a minimum of 1 hour fire resistive construction and will be fully protected with an automatic wet-pipe sprinkler system per NFPA 20, 4.12.1.1.2. Foam concentrate storage will be sized for a duration of 10 minutes (FM DS 7-32, 2.4.8.1). A fire pump test header will be provided, which will also double as a backflow preventer test connection.

The fire pump installation will be in accordance with NFPA 20, and will be provided with a flow meter on a recirculation line piped back to the pump suction line. An approved reduced pressure backflow prevention assembly will be installed on the suction side of the pump as required by the City of Vancouver.

Area 300 – Storage Area

The suppression systems to be provided for the Storage Area will include automatic fixed foam system for the seal around the foam dam and fire hydrants with monitor nozzles for exposure protection around the perimeter on the dike. The fire water supply network will be supplied by the City of Vancouver's water distribution system. The city's water distribution system will be supplemented by a fire pump. All fire suppression equipment for the Storage Area will be supplied from the fire pump. The preliminary pump size will be 2,500 gpm at a rated pressure of 125 psi. A combination Fire Pump and Foam Building is to be provided. Minimum flow to two monitor nozzles for exposure protection is 750 gpm at 50 psi each (FM DS 7-88, 2.3.3) and 1,250 gpm at 50 psi for the tank involved in fire.

The internal floating roof tank will be protected by a Type II Discharge Outlet (i.e. foam chamber) which delivers foam onto the burning liquid at the seal area of the foam dam. The foam makers will be supplied from piping that loops the exterior of the tank at the top which in turn will have one supply from the fire pump. These will be single interlocked pre-action systems with automatic activation provided through linear heat detection and manual activation through the foam release stations. The floating roofs will have a 12-inch tall foam dam 12 inches from the shell wall.

The monitor nozzle for the crude oil pump basin will be capable of providing a 3% foam application to the pump basin area. Utilizing the same criteria as for the dock below, based on similar operations, a flow demand of 750 gpm will be required at the monitor nozzle.

Area 400 – Marine Terminal Area

There is an existing manual fire suppression system at the dock loading area. This will be removed and replaced with a new fire main supply line. The fire main will be supplied from a fire pump located in the combination fire pump/foam building shore side. The preliminary pump size will be 2,000 gpm at a rated pressure of 125 psi. The

monitor nozzles will be located at an elevation of ten feet above the dock to prevent obstructions from blocking the effective reach of the nozzle. Each nozzle will be designed to flow 750 gpm for a total demand of 1,500 gpm with a 500 gpm hose allowance for the fire department shore side, taking into consideration the recommendations of NFPA 30, Appendix 29.3.28.

Spacing of the monitor nozzles takes into account the limited space available on the dock. The monitor nozzles will be strategically located, taking into consideration the spacing requirements of NFPA 307, Section 7.2.

6.2 Underground Piping Systems

6.2.1 General

This section only applies to underground fire water piping at the Storage Area, all other underground fire water piping is covered and to be coordinated with the civil engineer. A fire water loop will be installed at the Storage Area per the requirements of NFPA 24, *Installation of Private Service Mains and their Appurtenances*. Fire main sizing will be based on flow velocity limitations not to exceed 15 feet-per-second (fps). Thrust blocks or restraint joints will be provided at all underground fittings where applicable in accordance with NFPA 24.

6.3 Automatic Sprinkler Systems

6.3.1 General

This section covers automatic sprinkler systems of both the foam-water and wet-pipe type. A closed-head foam-water pre-action sprinkler system will be provided in the Railcar Unloading Building. Closed head wet-pipe sprinkler systems will be provided in all the Fire Pump and Foam Buildings at each site.

According to the International Building Code, the E-houses, the Operations/Change Trailer, and Boiler Building(s) do not require a sprinkler system to be installed. Fire extinguishers will be provided and appropriately sized and located in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*.

6.3.2 Design

The piping for the closed-head foam-water sprinkler system will be calculated per the hydraulic calculation requirements in NFPA 13. The hazard classification will be consistent with FM DS 7-32.

6.3.3 System Risers

The foam-water suppression system risers will consist of a foam proportioner and a single-interlock pre-action valve, as well as a strainer and supervised control valves on all water, foam concentrate piping, and foam bladder tank. The fire protection lead-in shall be provided and coordinated with the civil drawings.

6.3.4 Sprinklers

All sprinklers will be:

- corrosion resistant
- quick-response
- glass bulb type
- temperature ratings in accordance with NFPA 13 and Factory Mutual Data Sheets

Maximum sprinkler coverage for the unloading building will comply with the limitations of FM DS 7-32, 2.4.2.1 (100 ft²). Other areas that fall outside of FM DS 7-32 shall comply with FM DS 3-26.

Guards will be provided where sprinklers are installed in areas where subject to mechanical damage.

6.3.5 Aboveground Piping and Components

All new sprinkler system piping materials and components will comply with the requirements of NFPA 13.

All sprinkler piping 2-1/2 inches and larger will be Schedule 10, all sprinkler piping 2 inches and smaller will be Schedule 40. Pipe exposed to the elements will be black steel painted. Pipe located under a structure and not directly exposed to the elements are allowed to be galvanized.

Because the on-site maximum supply pressure is not expected to exceed 175 psi, high pressure components will not be provided.

Since the seismic design category for a structure/roof is calculated to be seismic design category E, seismic restraints for the sprinkler system will be provided.

Hangers will be spaced on sprinkler system piping in accordance with Chapter 9 of NFPA 13.

All valves controlling water supply to the sprinkler system will be FM approved and rated for the maximum expected working pressure. All valves controlling flow to the sprinklers, including the foam concentrate piping will be provided with an electronic tamper switch connected to the respective structure fire alarm system.

6.3.6 Detection and Activation

The foam-water sprinkler system will be activated when the linear heat detection (discussed below) signals a fire or when a manual release station has been activated. The linear heat detection cables will be installed at the roof level, connected to the sprinkler piping and at the pump level in the near vicinity of the pump (typically connected to the pump or motor framing). Manual release stations will be provided at

the base of the stairs or ladders and also at grade all egress points out of the structure. Upon either activation, the respective pre-action suppression valve for that zone will be tripped and the closed-head foam water pre-action sprinkler system will be flooded/filled with foam-water solution. Also, the zones on either side of the zone activated will also be flooded/filled with foam-water solution. Upon the operation of a sprinkler the foam-water solution will begin discharging to control the fire.

6.4 Automatic Fixed Foam System

6.4.1 General

This section is only applicable to the crude oil storage tanks. An automatic fixed foam-water system will be provided for the crude oil tanks. Each tank will be supplied from a separate riser.

6.4.2 Design

The piping for the automatic fixed foam system will be calculated per the hydraulic calculation requirements in NFPA 13. The hazard classification will be consistent with FM DS 7-88.

6.4.3 System Risers

The system risers will consist of a foam proportioner and a single-interlock pre-action valve, as well as strainers and supervised control valves on all water, foam concentrate piping, and foam bladder tank. The fire protection lead-in shall be provided and coordinated with the civil drawings.

6.4.4 Aboveground Piping and Components

All new sprinkler system piping materials and components will comply with the requirements of NFPA 13.

All sprinkler piping 2-1/2 inches and larger will be Schedule 10, all sprinkler piping 2 inches and smaller will be Schedule 40. Pipe exposed to the elements will be painted black steel. Foam concentrate piping will be black steel.

Since the seismic design category for a structure/roof is calculated to be seismic design category E, seismic restraints for the sprinkler system will be provided.

Hangers/piping supports will be spaced on sprinkler system piping in accordance with Chapter 9 of NFPA 13.

All valves controlling water supply to the sprinkler system will be FM Approved and rated for the maximum expected working pressure. All valves controlling flow to the sprinklers, including the foam concentrate piping will be provided with an electronic tamper switch connected to the fire alarm system.

6.4.5 Detection and Activation

The automatic fixed foam system will be activated when the linear heat detection (discussed below) signals a fire or when a manual release station has been activated. The linear heat detection cables will be installed inside the tank around the seal on the internal floating roof. Manual release stations will be provided at the base of the stairs, at the top of the dike at the nearest hydrant, and at the Fire Pump and Foam Building. Upon either activation, the pre-action suppression valve will be tripped and the automatic fixed foam system will be flooded/filled with foam-water solution and begin applying foam to the seal area.

6.5 Monitor Nozzles

6.5.1 General

Monitor nozzles mounted to fire hydrants will be located on the dike at the Storage Area. Remote control elevated monitor nozzles will be provided on the dock at the dock loading area.

6.5.2 Design

The piping for the automatic fixed foam system will be calculated per the hydraulic calculation requirements in NFPA 13. The hazard classification will be consistent with FM DS 7-88 for the Storage Area and NFPA 30 for the Marine Terminal Area.

6.5.3 System Risers

The system riser for the Storage Area fire hydrant monitor nozzles will consist of a supervised control valve. The system riser for the monitor nozzles on the dock will consist of a foam proportioner and a single-interlock pre-action valve, as well as strainers and supervised control valves on all water, foam concentrate piping, and foam bladder tank. The fire protection lead-in for both areas shall be provided and coordinated with the civil drawings.

6.5.4 Aboveground Piping and Components

All new sprinkler system piping materials and components will comply with the requirements of NFPA 13 and NFPA 24.

All sprinkler piping 2-1/2 inches and larger will be Schedule 10, all sprinkler piping 2 inches and smaller will be Schedule 40. Pipe exposed to the elements will be painted black steel. Foam concentrate piping will be black steel.

Since the seismic design category for a structure/roof is calculated to be seismic design category E, seismic restraints for the sprinkler system will be provided.

Hangers/piping supports will be spaced on sprinkler system piping in accordance with Chapter 9 of NFPA 13.

All valves controlling water supply to the sprinkler system will be FM Approved and rated for the maximum expected working pressure. All valves controlling flow to the sprinklers, including the foam concentrate piping will be provided with an electronic tamper switch connected to the fire alarm system.

6.5.5 Underground Piping and Components

Shall be consistent with Section 5.2 above.

6.5.6 Detection and Activation

The monitor nozzles at the Storage Area will activate when the hand wheel on the top of the fire hydrant is operated and water is allowed to flow. The drop in pressure will activate the start of the fire pump increasing the pressure to achieve the designed flow.

The monitor nozzles on the dock will activate when a manual release station has been activated. Manual release stations will be provided strategically on the dock and shore side on the Fire Pump and Foam Building. Upon activation, the pre-action suppression valve will be tripped and the automatic fixed foam system will be flooded/filled with foam-water solution and begin flowing foam through the remote controlled elevated monitor nozzles.

Chapter 7 - Fire Pumps

7.1 General

Fire pumps will be required to supplement the city water supply at all locations; the Railcar Unloading Building, the Storage Area, and the Marine Terminal Area. The fire pumps will be diesel driven as power is not considered to be reliable and there are no plans for the project to have backup power. The fire pumps will be located in a skid enclosure that will also contain the fire suppression system risers as well as fire alarm equipment. The Fire Pump and Foam Building will be completely sprinklered and separated from any other occupancies/structures as required by NFPA 20.

The Storage Area Fire Pump and Foam Building will also include a jockey pump to maintain pressure of the underground piping around the dike. The jockey pump is only meant to maintain pressure to account for thermal expansion and small fluctuations in pressure. Upon the opening of a fire hydrant the pressure would reduce at a significant enough rate that the jockey pump would not be able to compensate, allowing the fire pump to activate as designed.

As discussed in the sections above the pump sizes will be:

- Railcar Unloading Building Area – 2000 gpm at 125 psi
- Storage Area – 2500 gpm at 125 psi
- Marine Terminal Area – 2000 gpm at 125 psi

Chapter 8 - Fire Alarm System

8.1 General

Each site will receive its own fire alarm system control panel that will independently transmit back to a supervising station. The control panel and user interface will be located in the control room/E-house facility at each site (E-house 3 for Area 200). The fire alarm systems will be designed and installed per NFPA 70 and NFPA 72. The panel in the fire pump/skid enclosure will be connected to the main fire alarm panel in the E-house at each location.

H₂S and LEL detection will be provided in the pump pits at both the Railcar Unloading Building and the pump basin at the Storage Area. In addition, O₂ monitoring is being provided for the pump pits located in the Railcar Unloading Building. This monitoring will detect when oxygen levels are below the allowable limits for exposure and provide notification that entrance to the pump pits is not allowed without the appropriate personal protective equipment.

H₂S and LEL detection is also provided strategically in the Railcar Unloading Building at every unloading station.

8.2 Fire Alarm Panel Reporting Capability

Each fire alarm panel will be FM Approved and will be provided with a way to directly communicate to the control operations HMI, the panel will also be provided with a method to transmit/communicate all alarm signals to a supervising station. The Railcar Unloading Building area, Storage Area, and Marine Terminal Area will each independently transmit their panel signals to the supervising station.

8.3 Circuits

The Notification Appliance Circuits will be Class B, the Signaling Line Circuits will be Class B, and Initiation Device Circuits will be Class B. All of these circuits will be supervised by the fire alarm control panel as required by NFPA 72. All circuits in electrically classified areas will be intrinsically safe or installed to meet the classification of the area.

8.4 Initiating Devices

A fire alarm signal will be initiated by the following devices:

- Linear Heat Detection – located at the top of the Railcar Unloading Building room (on or near the sprinkler pipe), at a lower elevation near the pumps themselves, and in the crude oil storage tanks. The linear detection located is intended to activate/trip the pre-action systems to discharge foam solution.
- Foam System Manual Release Stations – located at the base and at the top of the stairs of the Railcar Unloading Building, at every egress point of the Railcar Unloading Building, at the base of the stairs on the tanks at the

Storage Area, at the top of the dike near the closest hydrant for each tank, and on a bank of release stations located at the foam/pump house.

- Waterflow Switches – located on the suppression system risers.
- Manual Pull Stations – surface mounted, located within 5 feet of an exit or near the fire alarm control panel in the E-house facilities.
- Smoke Detectors – located above each fire alarm control panel as required by the spacing requirements of NFPA 72.
- Gas Detection – H₂S, LEL, and O₂ gas detection will be provided in the pump pits of the Railcar Unloading Building. H₂S and LEL detection will be provided at each unloading station in the Railcar Unloading Building near grade. H₂S and LEL detection will be provided in the pump basin at the Storage Area. These gas detectors will be connected to the fire alarm system so they can be monitored.

A supervisory signal will be initiated by the following devices:

- Tamper Switches – provided at each control valve capable of controlling water to the sprinklers and on the valves for the foam concentrate piping.
- Fire Pump Systems – all of the required supervisory signals as required by NFPA 20 will be monitored by the fire alarm system.

8.5 Notification Appliances

An audible and visual device will be located on the exterior of the foam/pump houses, exterior Railcar Unloading Building, on the exterior of the control room/E-house facility and along the unloading rack area (the 1,800 feet long work area). The exterior fire alarm audible devices will be weatherproof devices and will be provided at each unloading work station.

The tone of the gas audible device will be different from that of the fire alarm tone which will be a three-pulse temporal pattern as required by NFPA 72. In addition, all gas notification devices will be equipped with a strobe that, upon detection of high gas, will activate the strobes in the zone that it was detected in only. This serves as a warning notification to avoid this area due to a detection of high gas.

Chapter 9 - Conclusion

This Basis of Design / Engineering Evaluation (Fire Protection Engineering Analysis) has been prepared by John W. Poole, III a Washington licensed Fire Protection Engineer. Mr. Poole will also be serving as the Fire Protection Engineer of Record for the project and will review and PE stamp all design drawings, calculation and material submittals and witness system acceptance testing.

Fire System Operation Description

Vancouver Energy
Vancouver, Washington

Submitted: February 22, 2014
FINAL

Poole Fire Protection

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Chapter 1 - Introduction

This document has been developed at the request of Tesoro Savage Petroleum Terminal LLC (the Applicant) to provide a high level overview of the Fire Protection (FP) and Fire Alarm (FA) systems and equipment proposed for Vancouver Energy (Facility). This document describes: the conditions which activate or trip the respective fire safety systems; what alarms or signals are transmitted; the anticipated result of the system; and site water supply.

Chapter 2 - Facility & Area Overview

2.1 Facility Overview

The Facility is located at the Port of Vancouver in the City of Vancouver, Washington. This Facility will unload crude oil from railcars, pump the crude oil to storage tanks and then pump the crude oil from the storage tanks to the transport vessels at the Marine Terminal Area. The Facility has been broken down into five separate and distinct areas: 1) Area 200 – Unloading and Office; 2) Area 300 – Storage; 3) Area 400 – Marine Terminal; 4) Area 500 – Transfer Pipelines; and 5) Area 600 – West Boiler. Below is a brief description of each area.

2.2 Area 200 – Unloading and Office

The rail unloading facilities will include three tracks and associated equipment for unloading of crude oil. The unloading tracks will be located inside a structure. Each unloading track will accommodate 30 cars for a total length of approximately 1,800 feet. The structure will be approximately 1,850 feet long and 90 feet wide to accommodate the length of these unloading tracks and the unloading operations.

The structure has a complete metal roof, while the walls will only consist of seven metal wall panels spaced along the south side of the structure. These seven metal wall panels will be spaced at locations corresponding with E-houses, the fire pump/foam skid building, and other appurtenances that are to be located on the south side of the structure. The remainder of the wall area on the structure will be open. Within the structure there will be two elevated walkways running the length of the structure used in the unloading process, and five crossover egress walkways providing access to the north and south sides of the structure spaced approximately every 357 feet. There will be three rail tracks running east to west, two trenches (approximately 7- 9 foot wide by 5 foot deep) accommodating the piping system that is used to transport the crude oil to the pump basins (located between the tracks), and 10 pump basins (5 per trench), which will be spaced approximately every 355 feet that house the transfer pumps. These transfer pumps will be used to pump the crude oil from Area 200 to the storage tanks in Area 300. The structure will be completely protected by a fire detection and sprinkler system.

Access stairs will be provided between the railcars which will enable workers performing any unloading operations at the track level to exit up the stairs to the elevated crossovers and over the railcars to reach an exterior exit from the structure.

Other structures located in the Area 200 include control room/E-houses and the fire pump/foam skid building.

The Facility will require three approximately 3,400-square-foot office buildings to house administrative functions, lockers, restrooms, and other employee support facilities. These buildings will be located approximately 225 feet to the North of the rail unloading structure. These buildings consist of modular office trailers that are pre-built off site and placed at their specific location on the job site. The Office Building and change rooms will not be provided with an automatic suppression system.

2.3 Area 300 – Storage

Six above ground storage tanks will be constructed in Area 300. The storage tanks will have a nominal storage capacity of 380,000 barrels (15,960,000 gallons) each and they will be approximately 50 feet tall with a diameter of 240 feet. All tanks will be located inside a perimeter dike capable to contain 110% of the volume of the largest tank plus the anticipated precipitation from a 24 hour, 100 year storm. The tanks will be positioned so that the distance between each tank is 120 feet in any direction. The distance from the tank to the dike varies from a minimum distance of approximately 33 feet to a maximum of 150 feet.

Other structures located in the Area 300 will include a Pump Basin for the pumps that will be used to transfer the crude from the tank storage area to the vessels at Berth 13. A Storage Building, a control room/E-house, and a Fire Pump and Foam Building will also be located in Area 300.

2.4 Area 400 – Marine Terminal

The Marine Terminal Area will consist of berths 13 and 14. Crude oil will be pumped from the Storage Area in a 36-inch pipe to Berth 13. The berth will be able to accommodate vessels with varying capacities, with loading rates of up to 32,000 barrels per hour. Safety measures include automatic shutoff valves, a return and stripping line for the crude to return back to the storage tanks, a marine vapor combustion unit, floating booms and manual fire protection features.

Berth 14 will be used for storage of and access to a skiff that will be used to deploy a fence boom in the water around the ship. There are no crude loading operations planned for Berth 14. Safety measures include manual fire protection features.

Other structures located at the Marine Terminal Area will include a control room/E-house, vapor blower staging unit, Fire Pump and Foam Building, and a dock safety unit.

2.5 Area 500 – Transfer Pipelines

The transfer pipelines consist of the pipeline runs between Area 200 Unloading and Office and Area 300 Storage and between Area 300 and Area 400 Marine Terminal. The transfer pipelines will be mainly constructed aboveground and on supports. Where road or rail crossings occur and in other areas of limited space, the piping would be located underground or raised above the ground in accordance with standard American Railway Engineering and Maintenance-of-Way Association (AREMA) clearances.

2.6 Area 600 – West Boiler

The West Boiler area contains a boiler building that will house equipment utilized to generate steam to heat heavier crudes to assist with unloading operations inside the unloading structure at Area 200. Other than the E-house, no other buildings will be located on the Area 600 site. The west boiler building will not include an automatic fire suppression system.

Chapter 3 - Applicable Design Criteria

Below is a list of codes and standards are applicable for this Facility and have been used or referenced as it relates to the fire protection and safety features related to this Facility. There may be other Codes and Standards referenced or utilized, but these are the ones that have been used or referenced for the fire protection aspects of the Facility:

- ANSI Z358.1, *Standard for Emergency Eyewashes and Shower Equipment*, 2009
- API 2021 – *Management of Atmospheric Storage Tank Fires*
- API 2030 – *Application of Fixed Water Spray Systems for Fire protection in the Petroleum Industry*
- API STD 2610 - *Design, Construction, Operation, Maintenance, and Inspection of Terminal and Tank Facilities*
- Factory Mutual Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*, April 2011
- Factory Mutual Data Sheet 3-0, *Hydraulic of Fire Protection Systems*, March 2010
- Factory Mutual Data Sheet 3-26, *Fire Protection Water Demand for Nonstorage Sprinklered Properties*, July 2011
- FMDS 4-0, *Special Protection Systems*, April 2012
- FMDS 4-7N, *Low Expansion Foam Systems*, September 2010, (Interim Revision January 2013)
- Factory Mutual Data Sheet 4-12, *Foam-Water Sprinkler Systems*, October 2011
- Factory Mutual Data Sheet 5-40, *Fire Alarm Systems*, September 2007
- Factory Mutual Data Sheet 5-48, *Automatic Fire Detection*, January 2011

- Factory Mutual Data Sheet 7-32, *Ignitable Liquid Operations*, April 2012
- Factory Mutual Data Sheet 7-88, *Flammable Liquid Storage Tanks*, October 2011
- *International Building Code*, 2012
- *International Fire Code*, 2012
- *International Safety Guide for Oil Tankers and Terminals (ISGOTT)*, Fifth Edition
- NFPA 10, *Standard for Portable Fire Extinguishers*, 2010
- NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2010
- NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010
- NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2012
- NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2011
- NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2010 Edition
- NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2010
- NFPA 30, *Flammable and Combustible Liquids Code*, 2012 Edition
- NFPA 70, *National Electrical Code*, 2011
- NFPA 72, *National Fire Alarm and Signaling Code*, 2010
- NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves*, 2011 Edition

Chapter 4 - Site Water Supply

4.1 Water Supply Overview

Currently the site has existing water mains provided from both the City of Vancouver and the Port of Vancouver. Two tests were performed on May 30, 2013 on fire hydrants at Area 300 - Storage and Area 400 - Marine Terminal on the City of Vancouver water distribution system. They yielded the following flow test results:

Area 300 - Storage:

Static Pressure = 84 psi
 Residual Pressure = 63 psi
 Flow = 2,005 gpm

Area 400 - Marine Terminal:

Static Pressure = 81 psi
 Residual Pressure = 62 psi

Flow = 2,127 gpm

Based on the information provided by the City of Vancouver, below is the available water supply for the Area 200 rail unloading structure:

Static Pressure = 50 psi

Residual Pressure = 20 psi

Flow = 2,500 gpm

The City of Vancouver water distribution system will supply water to the fire hydrants on the South side of the rail unloading structure as well as the fire pump that feeds the suppression systems inside the Rail unloading structure.

Additionally, the City of Vancouver water distribution system will supply water to the fire pump, which in return will supply water to the suppression systems on the tanks, and the fire hydrants around the dike at the Storage Area.

The City of Vancouver water supply at the Marine Terminal Area will supply the fire pump that feeds the elevator monitor nozzles equipment to the dock.

4.2 Adequacy

The current available water supply will be supplied from the on-site dedicated fire water gridded distribution system. It is been discussed and confirmed that the on-site system water supply available from the City of Vancouver to the Facility is more than adequate to meet the demand of the manual fire operations and the automatic fire suppression system. The City of Vancouver system is accessible at all Facility site locations and has been deemed reliable; therefore, the City of Vancouver water supply will be the water service used in the design of this Facility, not the Port of Vancouver water supply.

4.3 Arrangement of Fire Hydrants and Water Supply

4.3.1 Area 200 – Unloading and Office

Fire hydrants will be provided on the south side of the Rail unloading structure spaced at every 300 feet accessible fire department apparatus. The fire hydrants will be supplied by the City of Vancouver water distribution system.

The hydrants will be located on the south side of the track that is located south of the Rail unloading structure. Procedures will be in place for cooperation with those companies using the tracks to the south of the unloading building to allow access to the unloading building from the hydrants

The fire pump supplying water to the automatic fire suppression systems in the Rail unloading structure is supplied from the City of Vancouver water distribution system. The fire pump is located in the Fire Pump/Foam Building immediately adjacent to the Rail unloading structure.

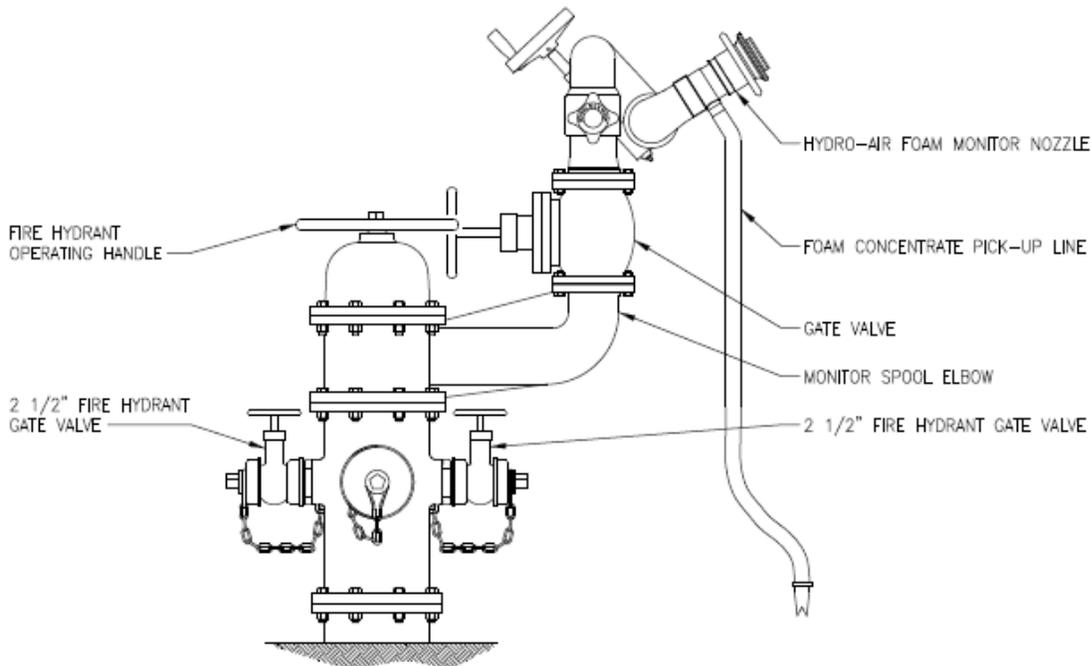
4.3.2 Area 300 – Storage

Fire hydrants will be provided for fire department use around the perimeter of Area 300 - Storage accessible by fire department apparatus. The fire hydrants will be located on the dike spaced every 300 feet, with two fire hydrants located inside the dike area near the intersection of the intermediate dikes. These fire hydrants will be supplied from the fire pump for the storage area and will include a monitor nozzle that can be used to cool the tanks, reduce fire exposure and also be used to apply the self-healing biodegradable foam.

Each hydrant will be equipped with a monitor nozzle and foam eductor and pick-up line that can be placed in a bucket, pale or other portable device of foam concentrate, which through a venture effect, will draw foam concentrate from the pale/container to generate a foam solution (see figure below).

The flow of water from these monitor nozzles are provided to create a cooling effect on the tank wall. The foam eductor provided on each monitor nozzles will allow the hydrant to spray a foam water solution and control a small pool fire within the dike area. A predetermined size of foam concentrate stored in bucket, pale or other portable device will be kept in the Fire Pump / Foam Building. When the need arises for its use, such as a small spill or rubbish fire, the foam concentrate will be taken to the appropriate fire hydrant and the hose placed in the bucket, pale or other portable device. The nozzle will draw the foam in at the manufacturer determined proportioning rate to achieve the desired concentration of foam/water solution.

Additionally, an elevated monitor nozzle supplied with foam-water from the Fire Pump / Foam Building will be located near the crude oil pump basin with the primary purpose of providing manual fire suppression to the pump basin. This monitor nozzle for the crude oil pump basin will be capable of providing a 3% foam application to the pump basin area. Utilizing a flow rate of 750 gpm will provide coverage of the crude oil pump basin.



The City of Vancouver water distribution system will supply water to the fire pump being provided to supply water to the automatic fire suppression systems for the storage tanks and to the fire hydrant/monitor system around the perimeter of the storage area. The fire pump is located in the Fire Pump/Foam Building immediately west of the storage tanks along the edge of the dike.

4.3.3 Area 400 – Marine Terminal

A fire hydrant will be provided for fire department use near Area 400 - Marine Terminal. The on-site City of Vancouver water distribution system will supply water to the fire hydrant and the fire pump for this area to support the fire protection systems at the Marine Terminal area. The fire pump will be located in the Fire Pump/Foam Building immediately adjacent to the Marine Terminal area.

4.4 Cross-Connection Control

A backflow prevention assembly will be on the water supply for each of the above described areas upstream of the fire pump to protect the potable water distribution system. Due to the design including foam, reduced pressure backflow prevention assemblies will be utilized.

Chapter 5 - Fire Pumps

5.1 General Overview

Fire pumps will be required to supplement the city water supply at all locations; the rail unloading structure, the Area 300 - Storage, and Area 400 - Marine Terminal. The fire pumps will be diesel driven, as power is not considered to be reliable per the definition

in NFPA 20, and there are no plans for the Facility to have backup power. The fire pumps will be located in a skid enclosure that will also contain the fire suppression system risers as well as fire alarm equipment. The Fire Pump / Foam Buildings will be completely sprinklered and separated from any other occupancies/structures as required by NFPA 20 to help ensure the reliability of the fire protection systems and fire pumps.

The fire pumps will be set up to automatically start upon a drop in pressure downstream of the fire pump system. The pressure drop will be monitored to a pressure switch in the each fire pump controller. Once the pressure switch reached the predetermine setting, as signal will be sent from the fire pump controller to the diesel engine to automatically start the engine/pump. The fire pump will boost the pressure and flow rate in the respective system to provide the required flow rate and pressure to the respective fire suppression system.

Upon the opening of a fire hydrant around Area 300 - Storage, or the tripping of one of the fire suppression systems (sprinkler or foam system) the pressure would reduce requiring the respective fire pump at the respective area to activate increasing the pressure in the fire protection system to provide adequate fire flow (pressure and flow rate) to meet the demand of the respective system.

The Area 300 - Storage Fire Pump and Foam Building will also include a jockey pump to maintain pressure of the underground piping around the dike. The jockey pump is only meant to maintain pressure to account for thermal expansion, minor leaking in the underground piping and small fluctuations in pressure, having a flow rate of 5 – 10 gpm.

Below are the sizes of the fire pumps to be provided for each respective area:

- Area 200 Unloading and Office– 2000 gpm at 125 psi
- Area 300 Storage– 2500 gpm at 125 psi
- Area 400 Marine Terminal– 2000 gpm at 125 psi

Chapter 6 - Fire Suppression Systems

6.1 Sprinkler Systems, Monitors, and Foam Suppression Systems

6.1.1 Use of Foam Fire Suppression Agents

The best method of controlling a flammable or combustible liquid fire is through the use for foam fire extinguishing agents. The current plan is to use a self-healing biodegradable foam manufactured by Solberg which is an environmentally friendly product. Further discussion regarding environmental impact can be found in NFPA 11, Annex F.

The Harmonized Offshore Chemical Notification Format (HOCNF) applies to all chemicals used in connection with offshore exploration and production activities in the OSPAR maritime area. OSPAR is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Union,

cooperate to protect the marine environment of the North-East Atlantic. This program includes any chemical that can be discharged into a river and ultimately find its way into the North Sea.

The raw materials used in the Solberg self-healing biodegradable foam have been evaluated to the HCNOF and is the only foam to date that has gone through this evaluation. This evaluation, which determines the impact of products discharged into marine and freshwater environments, concluded that the Solberg self-healing biodegradable foam is acceptable for use in the North Sea and in areas that discharge into the North Sea. As well, the German Institute of Hygiene has found the Solberg self-healing biodegradable foam to be of low impact upon discharge to the environment. It should be noted that fluorinated foam products will not achieve those listings because of the persistence of the fluorine molecule.

Furthermore, Solberg self-healing biodegradable foam is permitted by the Norwegian Government to allow runoff directly into the Fjords of the North Sea. This is not permitted with fluorinated surfactant based foam products.

However, it is important and the goal to minimize any release of foam into the river or the waterway. If large amounts of surfactants are released they can cause a fish kill. This can be true of any surfactant and is not limited to fire fighting foam.

6.1.2 Area 200 – Unloading and Office

A closed-head foam-water pre-action sprinkler system will be installed inside the rail unloading structure at the roof level, under walkways (as required by code) and in the pump basin areas. The structure will be divided in to five zones, each zone will be activated either manually from the foam manual release stations or automatically from the linear heat detection that will be installed at the roof level and at the pump basin level for that associated zone. The pump basins are located in the center of each zone respectively between the tracks. Note that this system is a closed-head pre-action foam-water system; therefore, foam-water solution will only be discharged once the fire is large enough to activate the linear heat detection, trip the valve and then activate the sprinklers above the fire. Foam will be used to control and extinguish the crude oil pool fire and will also provide cooling to the railcars and any adjacent equipment or building elements.

A closed-head wet-pipe sprinkler system (water only, no foam) will be provided for the Fire Pump / Foam Building in accordance with NFPA 20, Section 4.12.1.1.2. The wet-pipe system contain water under pressure, therefore, when a fire starts and grows large enough to trip a sprinkler at the ceiling/room a sprinkler or sprinklers are expected to control the fire.

The closed-head foam-water pre-action sprinkler system and the closed-head wet-pipe sprinkler system will be pressurized by the City of Vancouver water distribution system and fire pump; therefore, when either system activates, and pressure drops on the

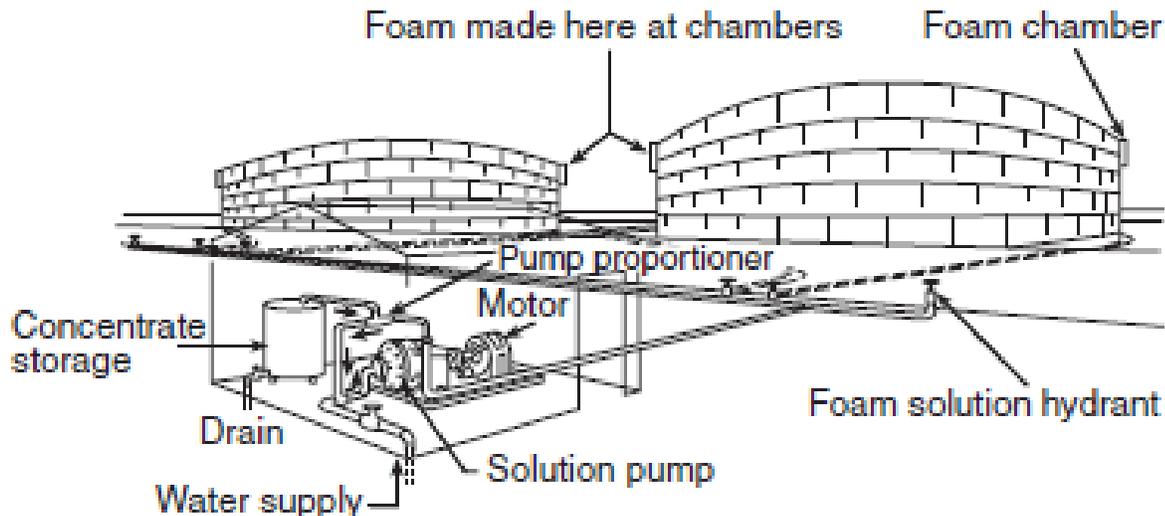
downstream side of the fire pump, the fire pump will start and supplying adequate pressure to the system to control or extinguish the fire.

6.1.3 Area 300 – Storage Area

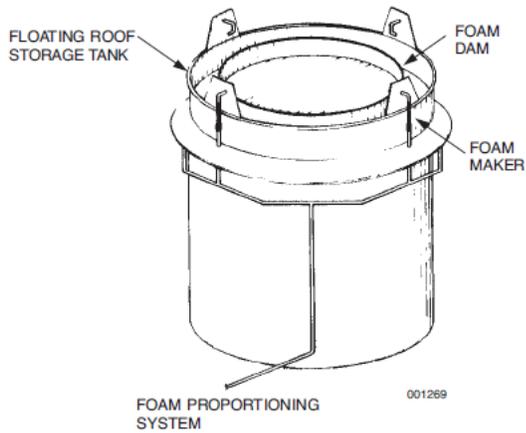
An automatic fixed foam system will be provided for each storage tank to protect the seal area of the internal floating roof. This system will be a Pre-Action Foam System activated by the linear heat detection system installed at the foam dam of the floating roof or by the manual foam release stations associated with each respective tank. See the figures below to reflect the typical configuration and installation of the foam maker on the tank. The linear heat detection cable located around the foam dam will be connected to the fire alarm system (see Chapter 7 for details on the fire alarm and linear detection system). The pre-action valve and foam concentrate tank will be located in the Fire Pump / Foam Building.

The internal floating roof tank will be protected by a Type II Discharge Outlet (i.e. foam chamber) which delivers foam onto the burning liquid at the seal area of the foam dam. The foam makers will be supplied from piping that loops the exterior of the tank at the top which in turn will have one supply from the fire pump. These will be single interlocked pre-action systems with automatic activation provided through linear heat detection and manual activation through the foam release stations. The floating roofs will have a 12- to 18-inch tall foam dam approximately 12 inches from the shell wall.

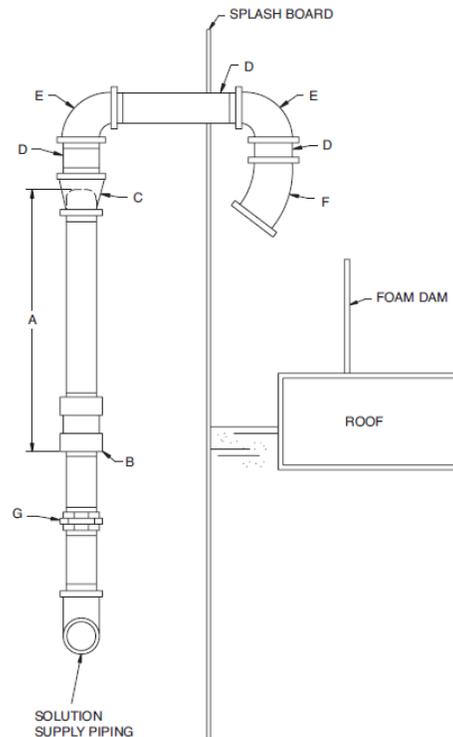
These automatic fixed foam systems are specifically designed to control a fire inside the tank. The Solberg self-healing biodegradable foam will be discharged inside the tank at the seal/foam dam area and provide a blanket of foam on top of the liquid at the floating roof. This blanket of foam is expected to limit the oxygen and extinguish the fire.



Typical Storage Tank Protection



Typical Floating Roof Tank Foam Maker Installation



A closed-head wet-pipe sprinkler system (water only, no foam) will be provided for the Fire Pump / Foam Building in accordance with NFPA 20, Section 4.12.1.1.2. The wet-pipe system contain water under pressure, therefore, when a fire starts and grows large enough to trip a sprinkler at the ceiling/room a sprinkler or sprinklers are expected to control the fire.

6.1.4 Area 400 – Marine Terminal Area

Two remote controlled elevated monitor nozzles will be provided on the dock for firefighting purposes. The monitor nozzles will be supplied from a Pre-Action Foam System located in the Fire Pump / Foam Building. Activation of the foam-water monitor nozzles will be by manual foam release stations located in the E-house and throughout Area 400 - Marine Terminal. The controller for the nozzles will be located in the E-house, located shore side.

A closed-head wet-pipe sprinkler system (water only, no foam) will be provided for the Fire Pump / Foam Building in accordance with NFPA 20, Section 4.12.1.1.2. The wet-pipe system contain water under pressure, therefore, when a fire starts and grows large enough to trip a sprinkler at the ceiling/room a sprinkler or sprinklers are expected to control the fire.

Chapter 7 - Fire Alarm System

7.1 Fire Alarm System Overview

Each area will receive its own fire alarm system control panel that will independently transmit back to a supervising station. The control panel and user interface will be located in the control room/E-house facility at each site (E-house 3 for Area 200). The fire alarm panel in the fire pump/skid enclosure will be connected to the main fire alarm panel in the E-house at each location.

H₂S and LEL detection will be provided in the pump basins at both the rail unloading structure and the pump basin at Area 300 - Storage. In addition, O₂ monitoring is being provided for the pump basins located in the rail unloading structure. This monitoring will detect when oxygen levels are below the allowable limits for exposure and provide notification that entrance to the pump basins is not allowed without the appropriate personal protective equipment.

H₂S and LEL detection is also provided strategically in the rail unloading structure near every unloading station.

7.2 Fire Alarm Panel Reporting Capability

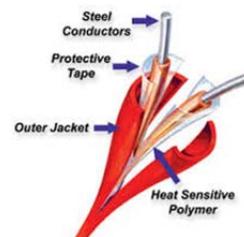
Each fire alarm panel will be FM Approved and will be provided with a way to directly communicate to the control operations HMI (human-machine interface); the panel will also be provided with a method to transmit/communicate all alarm signals to a supervising station. The rail unloading structure area, Area 300 - Storage, and Area 400 - Marine Terminal will each independently transmit their panel signals to the supervising station.

7.3 Initiating Devices

A fire alarm signal will be initiated by the following devices as explained in this section. Each of the initiating devices will be connected to the respective area fire alarm system control panel. The fire alarm panel will then acknowledge the alarm signal and initiate the sequence of operation commensurate for the respective alarm signal. The linear heat detection and manual release stations will activate the respective fire suppression system. All alarm signals will also initiate the audible and visual alarm, transmit the alarm signal to the supervising station and shut down the transfer operation, with all crude oil transfer valves closing in 30 seconds.

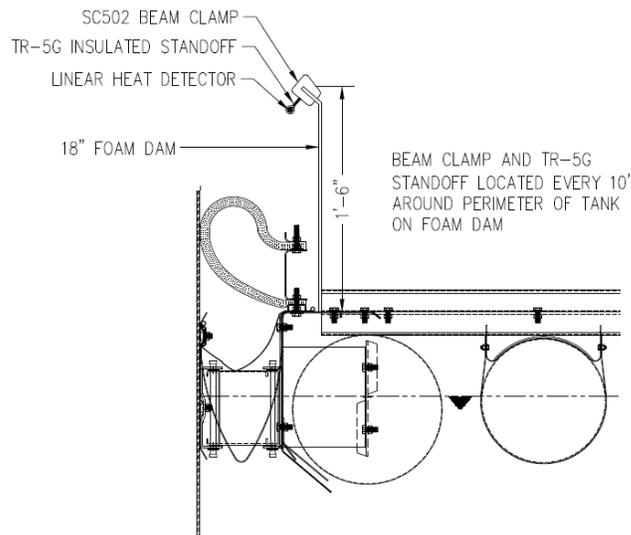
7.3.1 Linear Heat Detection

Linear Heat Detection is a line-type form of fixed temperature heat detection that will detect the heat from the fire anywhere along its entire length of cable. This proprietary cable is available in a range of temperature ratings in order to accommodate varying types of conditions or environments.



The outer jacket of the cable is specifically chosen for the environment and conditions where it will be installed. The linear detection cable is a combination of advanced polymer and digital technologies that can detect heat conditions anywhere along the length of the cable. The cable is comprised of two tri-metallic conductors individually insulated with a heat sensitive polymer outer layer/tape and engineered to break down at specific fixed temperatures. This allows the twisted conductors to make contact and initiate a fire alarm condition at the control panel without any calibration for changes in the ambient temperature. Nor is it required that a specific length be heated in order to initiate a fire alarm, adding to the versatility of this unique product.

The linear detection to be used for this Facility will have a 190°F temperature rating. The linear detection cable will be located at the top of the rail unloading structure (on or near the sprinkler pipe), at a lower elevation near the pumps themselves, and on the foam dam of the crude oil storage tanks. The linear detection is intended to activate/trip the pre-action foam systems which in return will discharge foam solution to control or extinguish the fire.



7.3.2 Foam System Manual Release Stations

The manual foam release stations will be located at the base and at the top of the stairs of the rail unloading structure, at every egress point of the rail unloading structure, at the base of the stairs on the tanks at Area 300 - Storage, at the top of the dike near the closest hydrant for each tank, and on a bank of release stations located at the foam/pump house.



These manual release stations when manually activated will send an alarm signal to the fire alarm panel, which in return will activate the respective foam fire suppression system, activate the audible and visual alarms and transmit the alarm signal to the supervising station.

7.3.3 Waterflow Switches

The wet-pipe sprinkler systems will be provided with a vane-type waterflow switch and the pre-action systems will be provided with a pressure-type waterflow switch. Each of these switches is designed to alarm upon the flow of water in the respective system.

If the vane-type waterflow switch, installed in the wet-pipe sprinkler system, is activated from the flow of water in the sprinkler system then an alarm signal will be sent to the fire alarm panel, which in return will activate the audible and visual alarms and transmit the alarm signal to the supervising station. Activation of the wet-pipe sprinkler system is caused by the heat from the fire activating one of the sprinklers on the system.



If the pressure-type waterflow switch, installed in the pre-action system, is activated from the flow of water in the foam system then an alarm signal will be sent to the fire alarm panel, which in return will activate the audible and visual alarms and transmit the alarm signal to the supervising station. Activation of the pre-action foam system is caused by the activation of either the linear heat detection system or the manual foam release station on the system.



7.3.4 Manual Pull Stations

The manual pull stations will be surface mounted, and typically located within 5 feet of every egress point and near the fire alarm control panel in the rail unloading structure, and be provided at every exit from the Fire Pump / Foam Buildings and E-Houses for Area 200 Unloading and Office, Area 300 Storage and Area 400 Marine Terminal.

These manual pull stations, when manually activated, will send an alarm signal to the fire alarm panel, activate the audible and visual alarms and transmit the alarm signal to the supervising station.



7.3.5 Smoke Detectors

Smoke detection for this Facility is only provided above the fire alarm panels as required by NFPA 72, Section 10.4.4. The smoke detector above the fire alarm panel is intended to provide protection for the control unit/panel.

These smoke detectors, when activated by smoke, will send an alarm signal to the fire alarm panel, activate the audible and visual alarms and transmit the alarm signal to the supervising station.



7.3.6 Gas Detection

H₂S, LEL, and O₂ gas detection will be provided in the pump basins of the rail unloading structure. H₂S and LEL detection will be provided near each unloading station in the rail unloading structure near grade. H₂S and LEL detection will be provided in the pump basin at Area 300 - Storage. These gas detectors will be connected to the fire alarm system so they can be monitored.

Upon activation of any gas detector a signal will be sent to the fire alarm panel, which will then activate the gas detection alarm, which will be a different signal from the fire alarm audible and visual signals, and then transmit a signal to the supervising station.

7.3.7 Valve Tamper Switches

All water supply control valves that provide water to the fire suppression systems or foam concentrate to the fire suppression systems will be provided with an electronic tamper switch.



These electronic tamper switches will be connected to the building fire alarm system. Whenever one of the valves with an electronic tamper switch is moved from its off-normal position, a supervisory signal will be sent to the supervising station and an audible signal will also sound at the fire alarm panel to notify personnel.

7.4 Fire Alarm Notification Appliances

An audible and visual device will be located on the exterior of the foam/pump houses, exterior rail unloading structure, on the exterior of the control room/E-house facility and along the unloading rack area (the 1,800 feet long work area) for the rail unloading structure. The exterior fire alarm audible devices will be weatherproof devices and will be provided at each unloading work station.

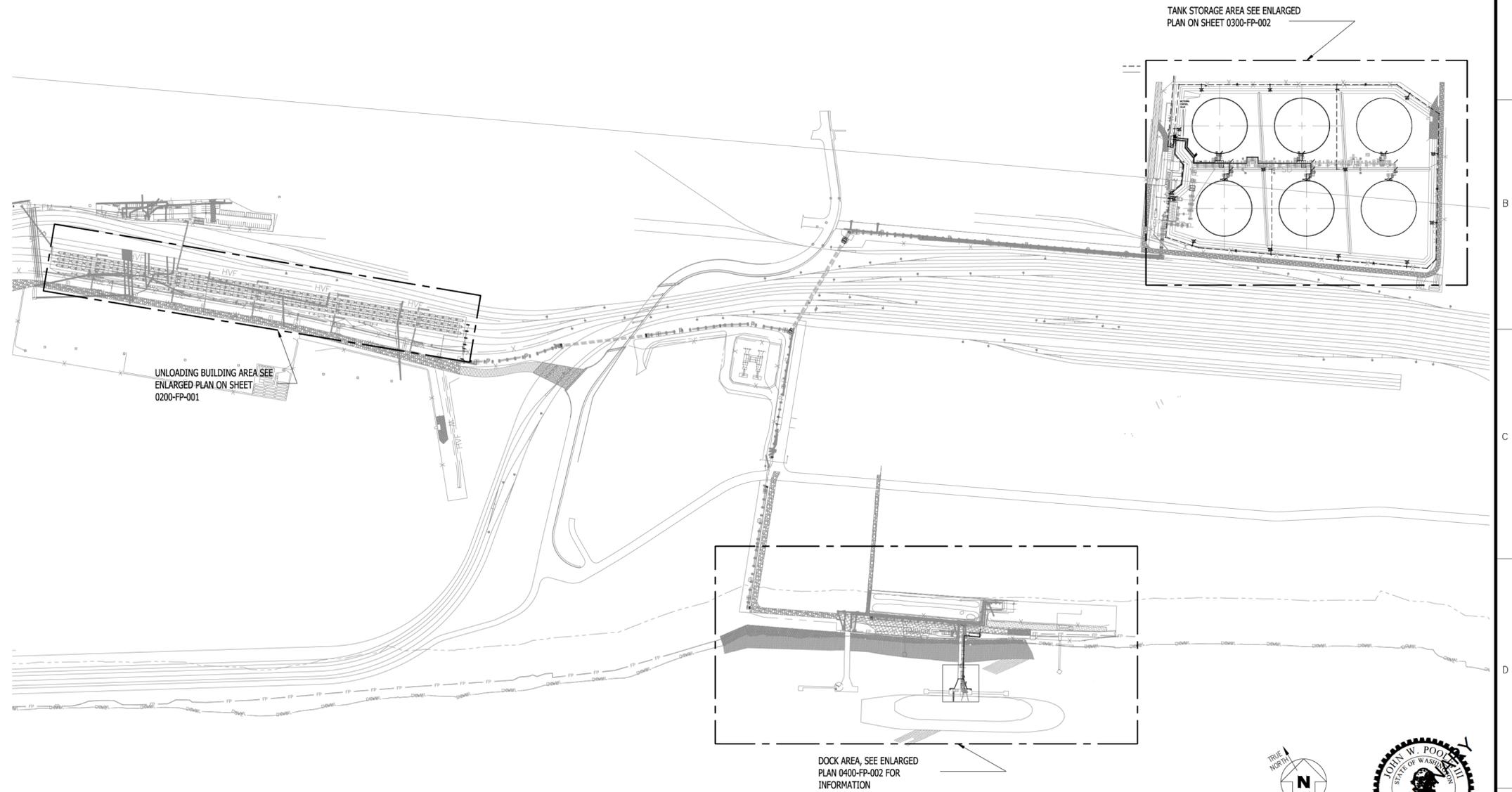
The tone of the gas audible device will be different from that of the fire alarm tone which will be a three-pulse temporal pattern as required by NFPA 72. In addition, all gas notification devices will be equipped with a strobe that, upon detection of high gas, will activate the strobes in the zone that it was detected in only. This serves as a warning notification to avoid this area due to a detection of high gas.

Chapter 8 - Conclusion

This Fire System Operation Description has been prepared by John W. Poole, III a Washington licensed Fire Protection Engineer. Mr. Poole will also be serving as the Fire Protection Engineer of Record for the Facility.

GENERAL NOTES

1. THESE DRAWINGS ARE CONCEPTUAL IN NATURE AND ARE ONLY MEANT TO SHOW THE DESIGN INTENT. FULL SHOP DRAWINGS WILL BE DEVELOPED AT A LATER DATE IN ACCORDANCE WITH APPLICABLE CODES AND STANDARDS AND DESIGNED BY A LICENSED FPE.
2. DESIGN, MATERIAL AND INSTALLATION FOR FIRE SUPPRESSION SYSTEMS WILL CONFORM TO NFPA 11 (2010), NFPA 13 (2010), NFPA 16 (2010), NFPA 20 (2010), FM DS 1-11, FM DS 2-0, FM DS 2-8, FM DS 3-7, FM DS 3-26, FM DS 4-12, FM DS 7-32, FM DS 7-88, AS WELL AS STATE AND LOCAL CODES.
3. FIRE SUPPRESSION EQUIPMENT INCLUDES, BUT IS NOT LIMITED TO, THE FOLLOWING:
 - i. PROVIDE SKID MOUNTED ENCLOSURES FOR FIRE PROTECTION EQUIPMENT FOR AREAS 200, 300 AND 400. THESE SKIDS SHALL INCLUDE DIESEL DRIVEN FIRE PUMPS, RISERS AND TRIM, FOAM STORAGE TANK, DIESEL STORAGE TANK, BACKFLOW PREVENTER, AND ALL NECESSARY VALVES AND FITTINGS.
 - ii. FIRE HYDRANTS, FOR AREA 200 ONLY, WILL BE SPACED EVERY 300 FEET ALONG THE SOUTH SIDE OF THE RAILCAR UNLOADING BUILDING AND SHALL BE SUPPLIED BY THE CITY OF VANCOUVER WATER SUPPLY.
 - iii. FIRE HYDRANTS, FOR AREA 300 ONLY, EQUIPPED WITH MONITORS AND FOAM EDUCTING NOZZLES WILL BE SPACED SO THAT EVERY CRUDE OIL STORAGE TANK CAN BE REACHED BY TWO HYDRANTS, BUT SHALL NOT BE SPACED GREATER THAN 300 FEET AND SHALL BE SUPPLIED BY THE AREA 300 FIRE PUMP.
 - iv. TWO ELEVATED MONITOR NOZZLES WILL BE PLACED ON THE DOCK, FOR AREA 400 ONLY, CAPABLE OF PRODUCING 750 GPM FROM EACH NOZZLE. THE ELEVATED MONITOR NOZZLES WILL BE REMOTE CONTROLLED AND OPERATED FROM THE E-HOUSE SHORESIDE.
4. FIRE WATER AND FOAM WATER PIPING LOCATED UNDER A SHELTER CAN BE ASTM A53 SCHEDULE 40 GALVANIZED WITH MALLEABLE IRON GALVANIZED FITTINGS. PIPING COMPLETELY EXPOSED TO THE ELEMENTS SHALL BE BLACK STEEL, AND PAINTED TO PROTECT AGAINST CORROSION.
5. ALL FOAM CONCENTRATE PIPING SHALL BE ASTM A53 SCHEDULE 40 BLACK STEEL WITH CAST IRON BLACK FITTINGS.
6. ALL NEW ABOVEGROUND PIPING SHALL BE HYDROSTATICALLY TESTED PER NFPA 13 (2010).
7. ALL UNDERGROUND PIPING SHALL BE FLUSHED AND HYDROSTATICALLY TESTED IN ACCORDANCE WITH NFPA 24 (2010).
8. ALL PIPING SHALL BE SEISMICALLY BRACED IN ACCORDANCE WITH FM DS 2-8, APPLICABLE DESIGN SUPPORT DOCUMENTS SHALL BE SUBMITTED FOR REVIEW.
9. FIRE SUPPRESSION DESIGN CRITERIA SHALL BE AS FOLLOWS:
 - iw. THE RAILCAR UNLOADING BUILDING WILL BE PROTECTED WITH FIVE SINGLE INTERLOCK PRE-ACTION 3% FOAM-WATER SPRINKLER SYSTEMS. THE DESIGN DENSITY SHALL BE 0.30 GPM OVER 4,000 SQUARE FEET WITH A HOSE ALLOWANCE OF 6500 GPM. THERE WILL BE APPROXIMATELY 600 GALLONS OF 3% FOAM CONCENTRATE REQUIRED AT AREA 200.
 - ii. THE TANK STORAGE AREA WILL BE PROTECTED WITH A FIRE WATER MAIN LOOP FOLLOWING THE BERM. THIS MAIN WILL SUPPLY HYDRANTS EQUIPPED WITH MONITOR NOZZLES WITH FOAM EDUCATORS CAPABLE OF REACHING THE CRUDE OIL STORAGE TANKS. IN ADDITION, THE CRUDE OIL STORAGE TANKS WILL BE EQUIPPED WITH A 3% FOAM-WATER SINGLE INTERLOCK PREACTION SUPPRESSION SYSTEMS TO PROTECT THE SEAL AREA AGAINST FIRES. TWO ADDITIONAL RISER OUTLETS SHALL BE PROVIDED, EQUIPPED WITH A VALVE AND CAP, FOR THE FUTURE ADDITION OF TWO MORE CRUDE OIL STORAGE TANKS. THERE WILL BE APPROXIMATELY 300 GALLONS OF 3% FOAM CONCENTRATE REQUIRED AT AREA 300.
 - iii. THE DOCK AREA WILL BE PROTECTED BY TWO ELEVATED MONITOR NOZZLES, REMOTELY OPERATED, CAPABLE OF PRODUCING 750 GPM. THESE MONITOR NOZZLES WILL BE SUPPLIED BY A 3% FOAM-WATER SINGLE INTERLOCK PREACTION SUPPRESSION SYSTEM. THERE WILL BE APPROXIMATELY 1,500 GALLONS OF 3% FOAM CONCENTRATE REQUIRED AT AREA 400.



1 OVERALL SITE FIRE PROTECTION PLAN
 0100-FP-001 SCALE: 1" = 250'

PRELIMINARY, NOT FOR CONSTRUCTION

E	07-14-14		CSWSEDJWP
D	01-31-14	PRELIMINARY BID SET	CSWSEDJWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	CSWSEDJWP
B	07-04-13	CONCEPTUAL FOR REVIEW	CSWSEDJWP
NO.	DATE	REVISION	BY [C] [D] [APP]



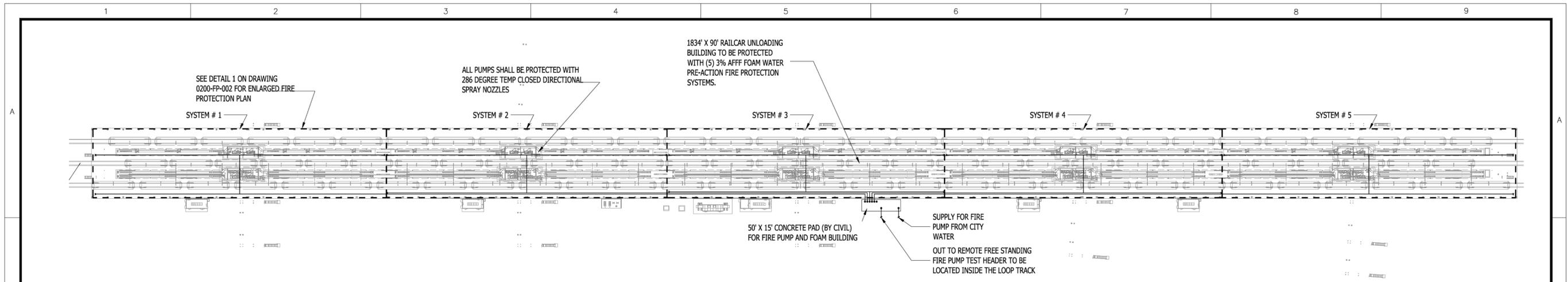
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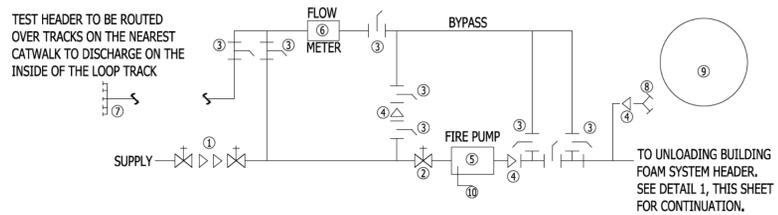
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: OVERALL AREA
 FIRE PROTECTION

DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0100-FP-001				1	1 E

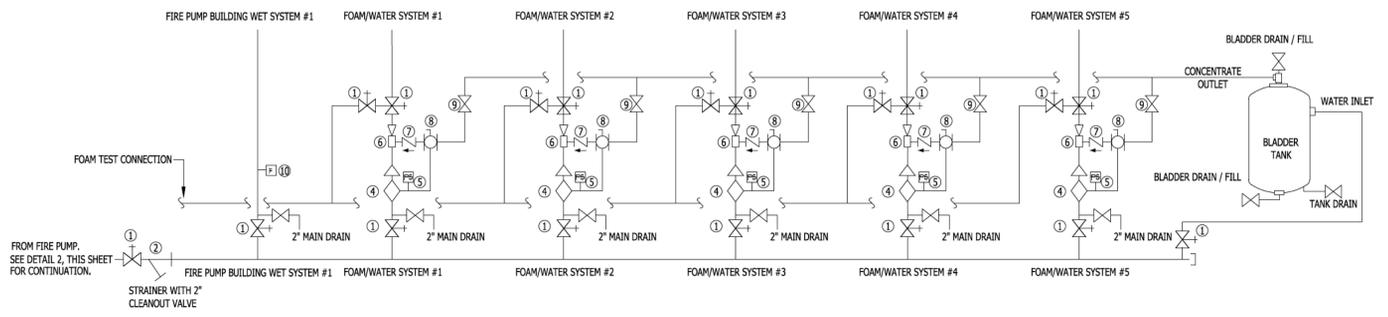


3 OVERALL UNLOADING BUILDING FIRE PROTECTION PLAN
0200-FP-001 SCALE: 1" = 60'



- LEGEND**
1. RPZ BACKFLOW PREVENTOR WITH TAMPER SWITCHES
 2. O.S.&Y. VALVE WITH TAMPER SWITCH
 3. BUTTERFLY VALVE WITH TAMPER SWITCH
 4. CHECK VALVE
 5. DIESEL FIRE PUMP
 6. FLOW METER
 7. REMOTE TEST HEADER
 8. FIRE DEPARTMENT CONNECTION
 9. DOUBLE WALL DIESEL FUEL TANK (INCLUDED IN DIESEL FIRE PUMP SKID ENCLOSURE)
 10. COOLANT LINE DISCHARGE

2 UNLOADING BUILDING FIRE PROTECTION FIRE PUMP DIAGRAM
0200-FP-001 SCALE: NTS



- LEGEND**
1. CONTROL VALVE WITH TAMPER SWITCH
 2. BASKET STRAINER WITH 2" BLOW DOWN VALVE
 3. BUTTERFLY VALVE WITH TAMPER
 4. DELUGE VALVE WITH ELECTRIC RELEASE TRIM AND 1/2" 24 VOLT RELEASING SOLENOID
 5. ALARM PRESSURE SWITCH WITH TWO SETS OF CONTACTS
 6. 3% FOAM BETWEEN THE FLANGE PROPORTIONER
 7. SWING CHECK VALVE
 8. HYDRAULIC CONCENTRATE CONTROL VALVE
 9. FOAM CONCENTRATE ISOLATION BALL VALVE WITH TAMPER SWITCH
 10. FLOW SWITCH



1 UNLOADING BUILDING FIRE PROTECTION RISER DIAGRAM
0200-FP-001 SCALE: NTS

PRELIMINARY, NOT FOR CONSTRUCTION

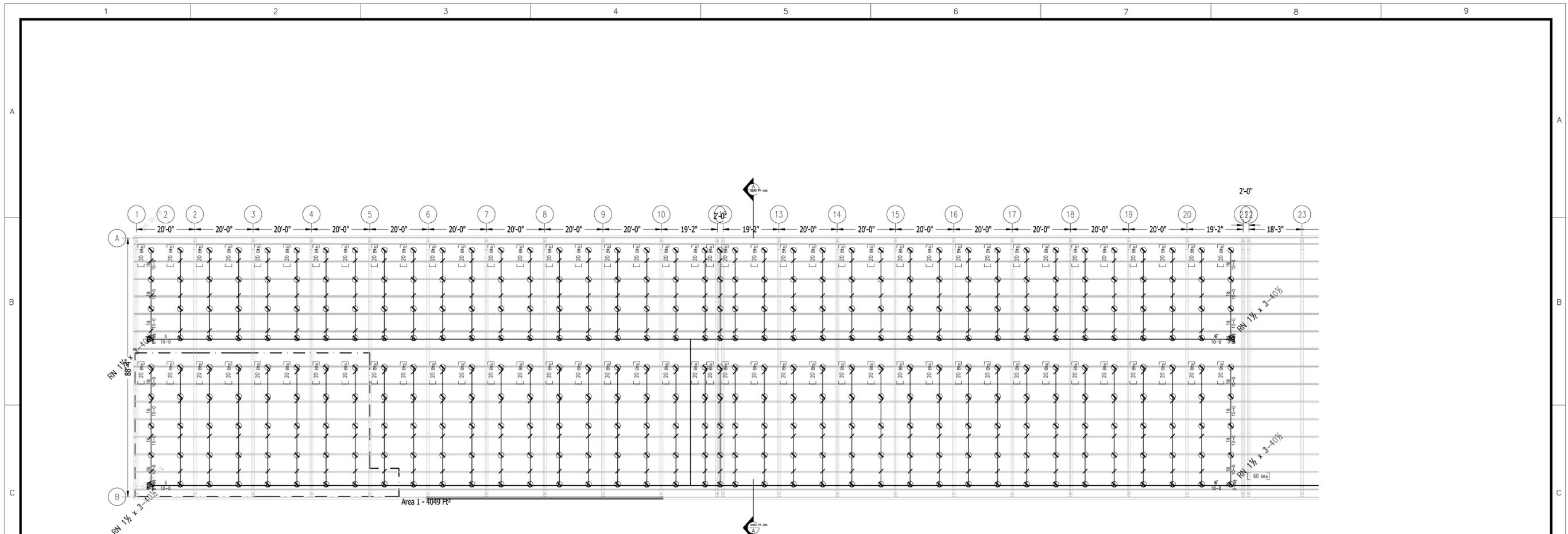
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C	10-25-13	90% PRELIMINARY FOR REVIEW			
B	07-04-13	CONCEPTUAL FOR REVIEW			



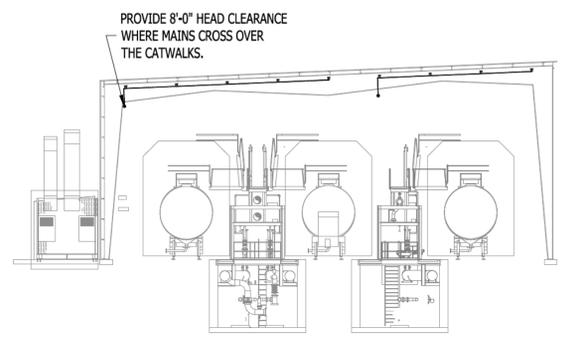
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PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON
DESCRIPTION: UNLOADING BUILDING AREA
FIRE PROTECTION

DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0200-FP-001				1	1 E



1 TYPICAL UNLOADING BUILDING FIRE PROTECTION PLAN
 0200-FP-002 SCALE: 1/16" = 1'-0"



A UNLOADING BUILDING FIRE PROTECTION SECTION A
 0200-FP-002 SCALE: 1/16" = 1'-0"



PRELIMINARY, NOT FOR CONSTRUCTION

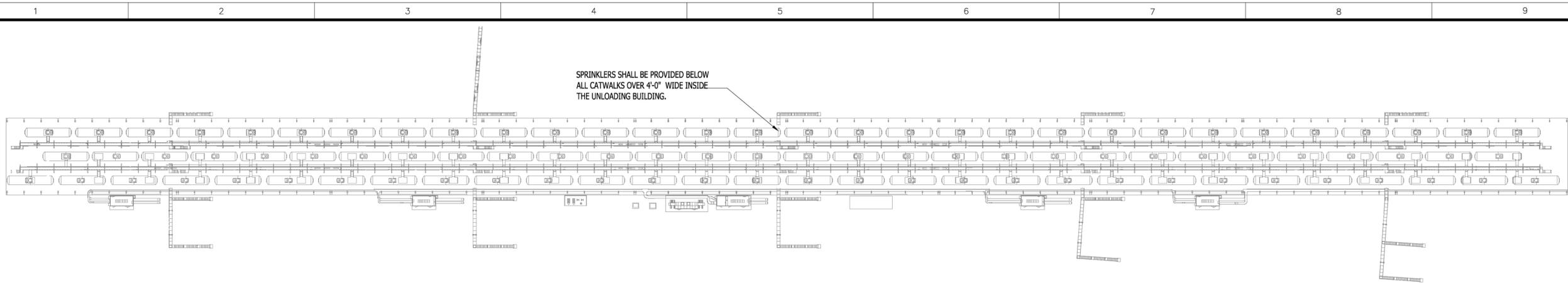
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B	07-04-13	CONCEPTUAL FOR REVIEW			



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PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON
 DESCRIPTION: UNLOADING BUILDING AREA
 FIRE PROTECTION

DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0200-FP-002				1	1 E



1 OVERALL UNLOADING BUILDING FIRE PROTECTION PLAN AT CATWALKS
 0200-FP-003 SCALE: 1" = 60'



PRELIMINARY, NOT FOR CONSTRUCTION

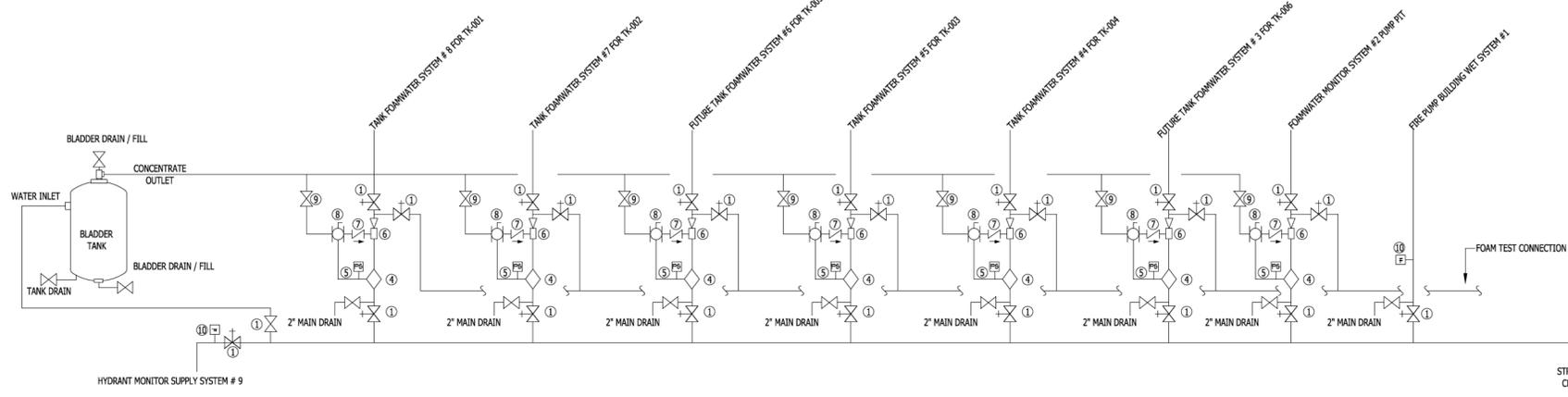
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D	01-31-14	PRELIMINARY BID SET			CSWSEDJWP
C	10-25-13	90% PRELIMINARY FOR REVIEW			CSWSEDJWP
B	07-04-13	CONCEPTUAL FOR REVIEW			CSWSEDJWP



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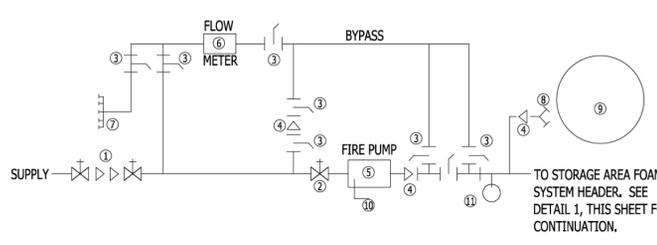
PROJECT:	TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL PORT OF VANCOUVER, WASHINGTON
DESCRIPTION:	UNLOADING BUILDING AREA FIRE PROTECTION

DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0200-FP-003				1/1	E



- LEGEND**
- CONTROL VALVE WITH TAMPER SWITCH
 - BASKET STRAINER WITH 2" BLOW DOWN VALVE
 - BUTTERFLY VALVE WITH TAMPER
 - DELUGE VALVE WITH ELECTRIC RELEASE TRIM AND 1/2" 24 VOLT RELEASING SOLENOID
 - ALARM PRESSURE SWITCH WITH TWO SETS OF CONTACTS
 - 3% FOAM BETWEEN THE FLANGE PROPORTIONER
 - SWING CHECK VALVE
 - HYDRAULIC CONCENTRATE CONTROL VALVE
 - CONCENTRATE ISOLATION BALL VALVE WITH TAMPER SWITCH
 - FLOW SWITCH

1 STORAGE AREA FIRE PROTECTION RISER DIAGRAM
 0300-FP-001 SCALE: NTS



- LEGEND**
- RPZ BACKFLOW PREVENTOR WITH TAMPER SWITCHES
 - O.S.&V. VALVE WITH TAMPER SWITCH
 - BUTTERFLY VALVE WITH TAMPER SWITCH
 - CHECK VALVE
 - DIESEL FIRE PUMP
 - FLOW METER
 - TEST HEADER
 - FIRE DEPARTMENT CONNECTION
 - DOUBLE WALL DIESEL FUEL TANK (INCLUDED IN DIESEL FIRE PUMP SKID ENCLOSURE)
 - COOLANT LINE DISCHARGE
 - PRESSURE MAINTENANCE JOCKEY PUMP

2 STORAGE AREA FIRE PROTECTION FIRE PUMP DIAGRAM
 0300-FP-001 SCALE: NTS



PRELIMINARY, NOT FOR CONSTRUCTION

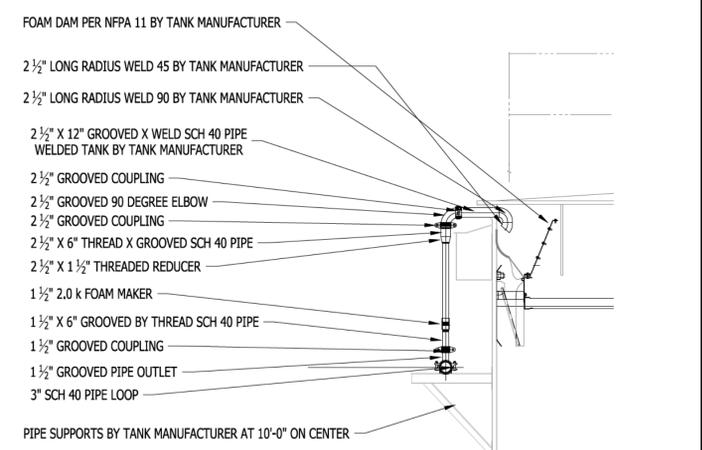
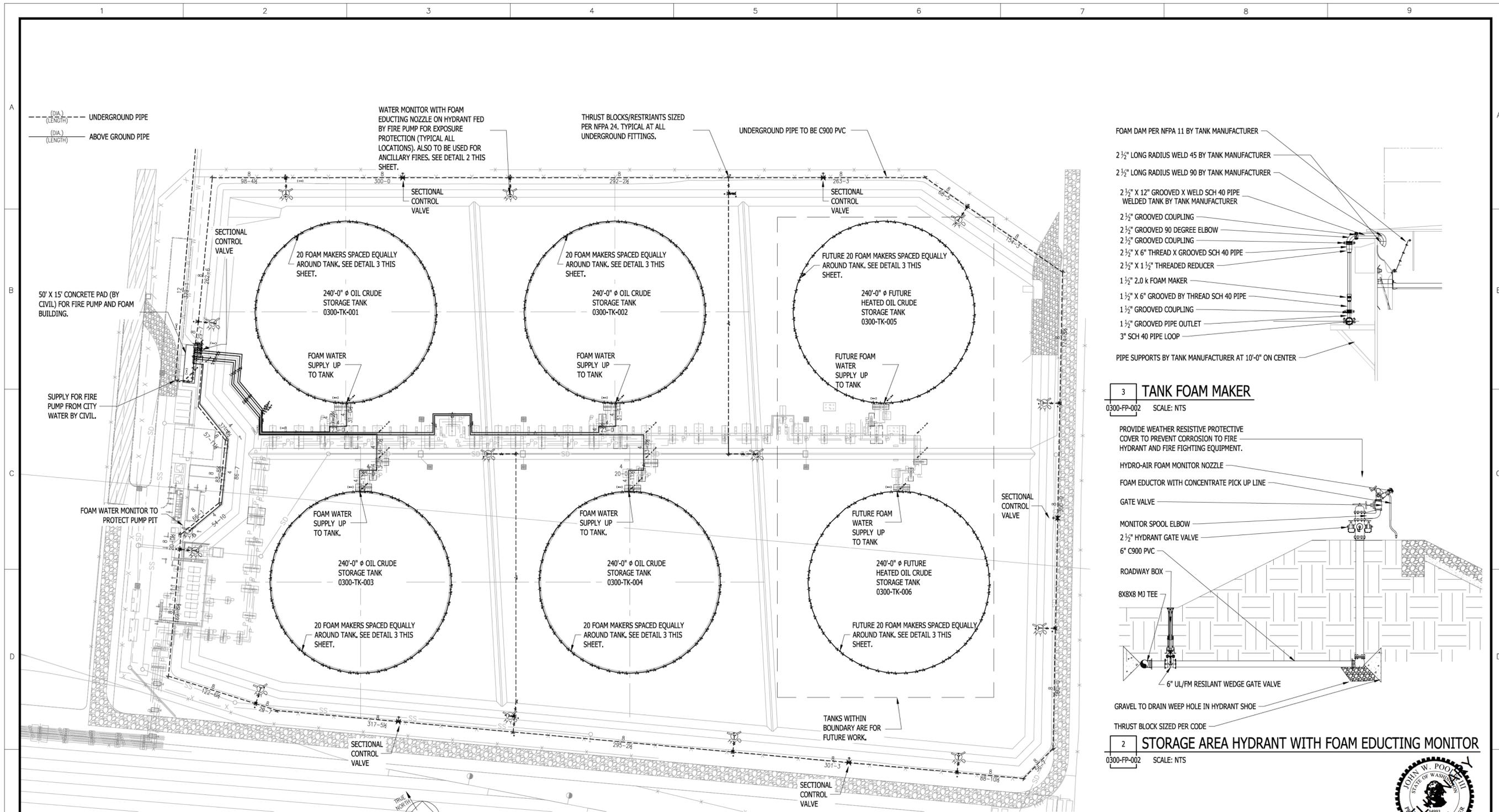
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D	01-31-14	PRELIMINARY BID SET			CSWSEDJWP
C	10-25-13	90% PRELIMINARY FOR REVIEW			CSWSEDJWP
B	07-04-13	CONCEPTUAL FOR REVIEW			CSWSEDJWP



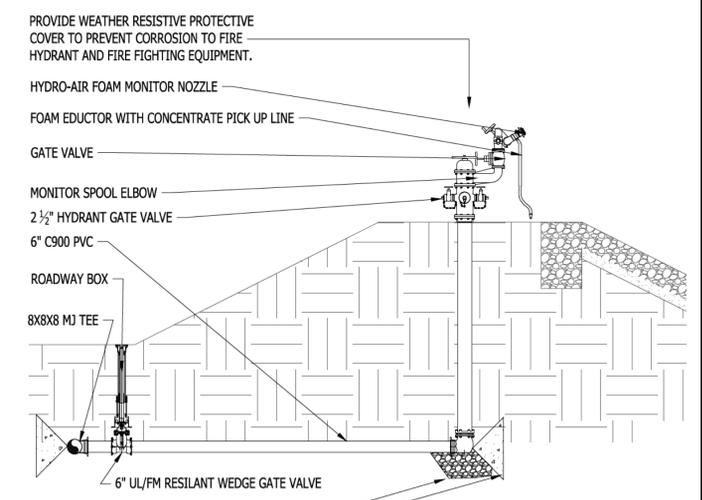
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PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON
 DESCRIPTION: STORAGE AREA FIRE PROTECTION

DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0300-FP-001				1	1 E



3 TANK FOAM MAKER
0300-FP-002 SCALE: NTS



2 STORAGE AREA HYDRANT WITH FOAM EDUCTING MONITOR
0300-FP-002 SCALE: NTS

1 STORAGE AREA ENLARGED FIRE PROTECTION PLAN
0300-FP-002 SCALE: 1"=60'



PRELIMINARY, NOT FOR CONSTRUCTION



E	07-14-14		CSWSEDJWP
D	01-31-14	PRELIMINARY BID SET	CSWSEDJWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	CSWSEDJWP
B	07-04-13	CONCEPTUAL FOR REVIEW	CSWSEDJWP
NO.	DATE	REVISION	BY [C/K'D] APP

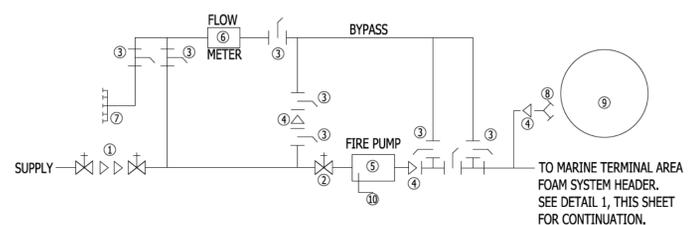


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PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: STORAGE AREA FIRE PROTECTION

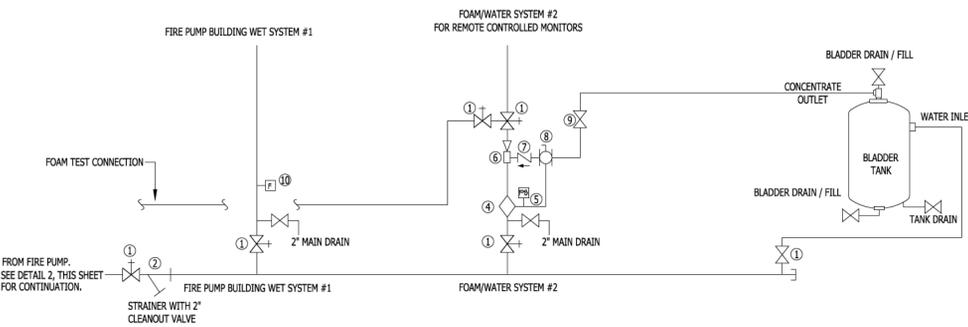
DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0300-FP-002				1	1 E



LEGEND

- 1. RPZ BACKFLOW PREVENTOR WITH TAMPER SWITCHES
- 2. O.S.&Y. VALVE WITH TAMPER SWITCH
- 3. BUTTERFLY VALVE WITH TAMPER SWITCH
- 4. CHECK VALVE
- 5. DIESEL FIRE PUMP
- 6. FLOW METER
- 7. TEST HEADER
- 8. FIRE DEPARTMENT CONNECTION
- 9. DOUBLE WALL DIESEL FUEL TANK (INCLUDED IN DIESEL FIRE PUMP SKID ENCLOSURE)
- 10. COOLANT LINE DISCHARGE

2 MARINE TERMINAL AREA FIRE PROTECTION FIRE PUMP DIAGRAM
0400-FP-001 SCALE: NTS



LEGEND

- 1. CONTROL VALVE WITH TAMPER SWITCH
- 2. BASKET STRAINER WITH 2" BLOW DOWN VALVE
- 3. BUTTERFLY VALVE WITH TAMPER
- 4. DELUGE VALVE WITH ELECTRIC RELEASE TRIM AND 1/2" 24 VOLT RELEASING SOLENOID
- 5. ALARM PRESSURE SWITCH WITH TWO SETS OF CONTACTS
- 6. 3% FOAM BETWEEN THE FLANGE PROPORTIONER
- 7. SWING CHECK VALVE
- 8. HYDRAULIC CONCENTRATE CONTROL VALVE
- 9. CONCENTRATE ISOLATION BALL VALVE WITH TAMPER SWITCH
- 10. WATERFLOW SWITCH

1 MARINE TERMINAL AREA FIRE PROTECTION RISER DIAGRAM
0400-FP-001 SCALE: NTS



PRELIMINARY, NOT FOR CONSTRUCTION

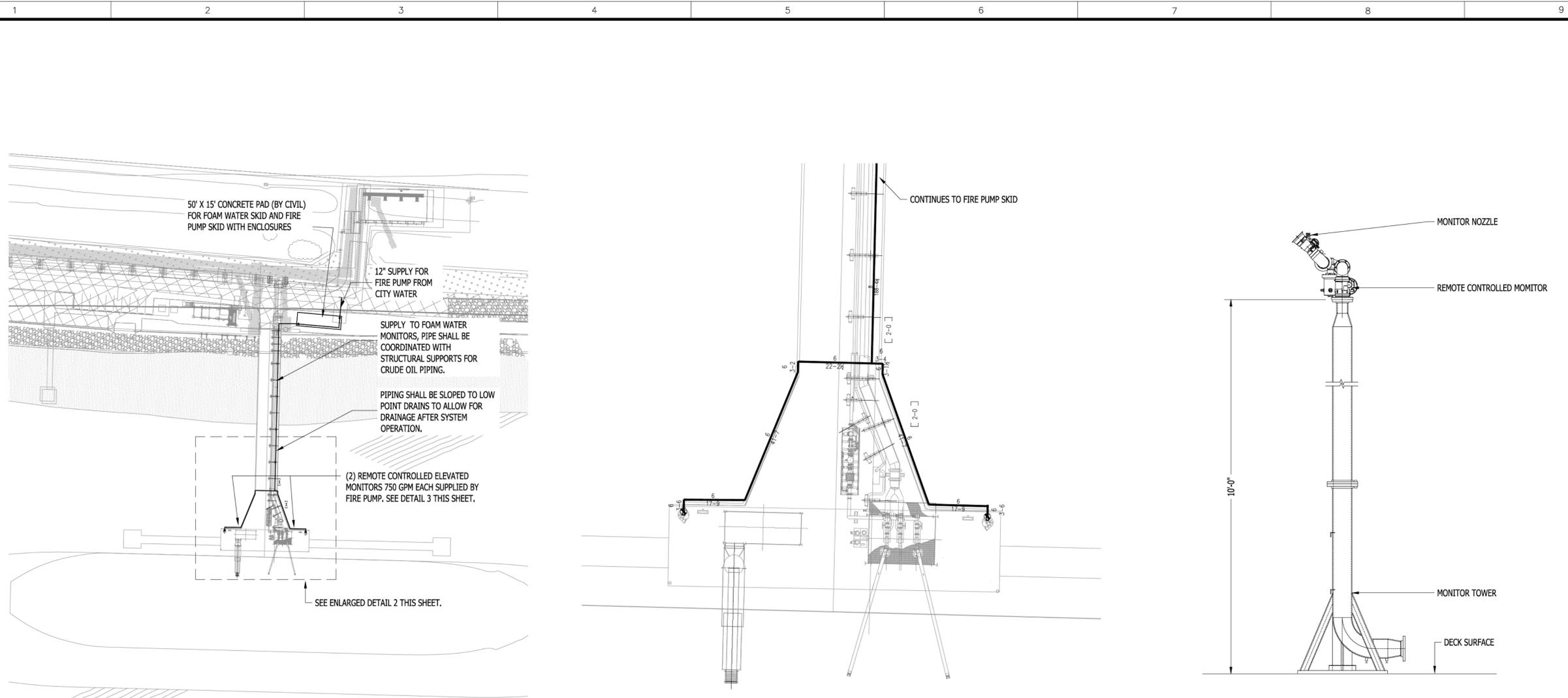
NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14				CSWSEDJWP
D	01-31-14	PRELIMINARY BID SET			CSWSEDJWP
C	10-25-13	90% PRELIMINARY FOR REVIEW			CSWSEDJWP
B	07-04-13	CONCEPTUAL FOR REVIEW			CSWSEDJWP



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PROJECT:	TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL PORT OF VANCOUVER, WASHINGTON		
DESIGNER:	C. WILSON	START DATE:	06/19/2013
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE
DESCRIPTION:	MARINE TERMINAL AREA FIRE PROTECTION		

SCALE:	AS-NOTED
PROJECT MANAGER:	S. DURFLINGER
CHECKED:	S. DURFLINGER
APPROVED:	J. POOLE
SIZE:	24x36
DRAWING NUMBER:	0400-FP-001
SHEET:	1/1
REV.	E



1 MARINE TERMINAL AREA FIRE PROTECTION PLAN
 0400-FP-002 SCALE: 1"=60'



2 MARINE TERMINAL AREA ENLARGED FIRE PROTECTION PLAN
 0400-FP-002 SCALE: 1/16"=1'-0"

3 REMOTE CONTROLLED ELEVATED MONITOR
 0400-FP-002 SCALE: 1/2" = 1'-0"



PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14				
D	01-31-14	PRELIMINARY BID SET			
C	10-25-13	90% PRELIMINARY FOR REVIEW			
B	07-04-13	CONCEPTUAL FOR REVIEW			



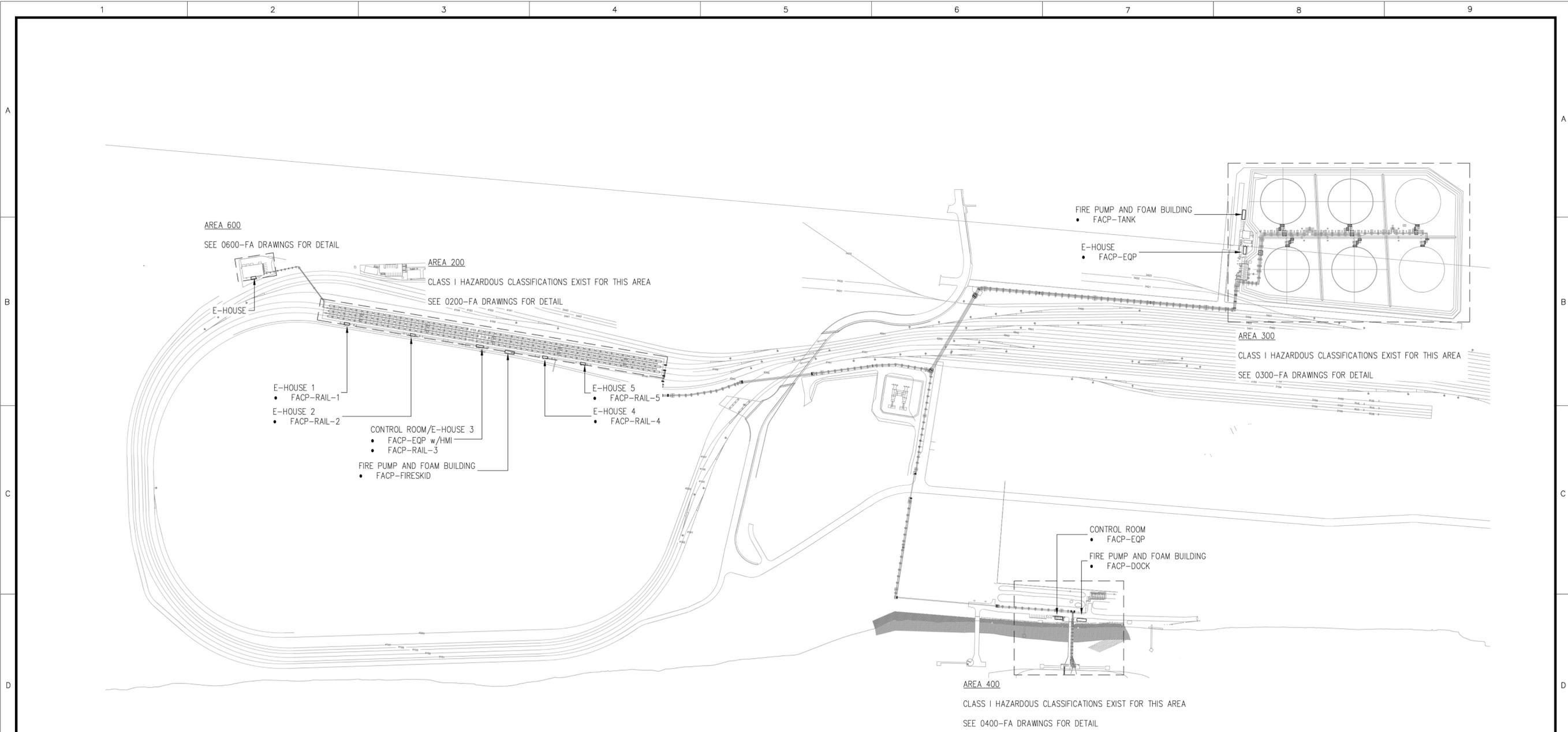
TESORO SAVAGE

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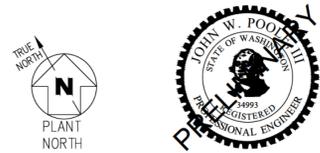
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

PROJECT:	TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL PORT OF VANCOUVER, WASHINGTON		
DESCRIPTION:	MARINE TERMINAL AREA FIRE PROTECTION		

DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0400-FP-002				1	1 E



1 OVERALL SITE PLAN
0100-FA-001 SCALE: NONE



PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP



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CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: OVERALL AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlw	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlw	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durlfänger
CHECKED:	S. Durlfänger	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0100-FA-001				1	1

ELECTRICAL NOTES

- FIRE & GAS ALARM SYSTEM SHALL BE INSTALLED AND TESTED IN STRICT ACCORDANCE WITH NFPA 72 (2010), NATIONAL FIRE ALARM CODE, FM DS 5-48, FM DS 5-49, FM DS 5-40, AS WELL AS STATE AND LOCAL BUILDING CODES AND STANDARDS.
- FIRE & GAS ALARM CONDUCTORS AND CABLES SHALL BE INSTALLED IN STRICT ACCORDANCE WITH NFPA 70 (2011) NATIONAL ELECTRICAL CODE AND SPECIFICALLY WITH ARTICLES 760, 770 AND 800, WHERE APPLICABLE. OPTICAL FIBER CABLES SHALL BE PROTECTED AGAINST MECHANICAL INJURY IN ACCORDANCE WITH ARTICLE 760.
- FIRE & GAS ALARM CONDUCTORS AND CABLES SHALL BE INSTALLED IN A NEAT AND WORKMAN LIKE MANNER. CONDUCTORS AND CABLES SHALL BE SUPPORTED BY THE BUILDING STRUCTURE IN SUCH A MANNER THAT THE CABLE WILL NOT BE DAMAGED BY NORMAL BUILDING USE.
- THE INSTALLING CONTRACTOR MUST PROVIDE THE FIRE ALARM CONTRACTOR WITH ACCURATE MARKED UP DRAWINGS SHOWING ALL JUNCTION BOXES, TERMINAL CABINETS, DEVICE LOCATIONS, WIRE ROUTING, ETC. FOR THE USE IN MAKING OF "RECORD DRAWINGS".
- CONDUIT ROUTING AND CONDUIT SIZE SHALL BE DETERMINED BY THE INSTALLING CONTRACTOR IN CONJUNCTION WITH NFPA 70 AND INDICATED ON THE RECORD DRAWINGS. CONDUIT FILL SHALL NOT EXCEED 40%.
- MAIN FACP WILL BE SUPPLIED FROM CKT: IN PANEL .
- DEVICE POLARITY MUST BE OBSERVED ON ALL DC CIRCUITS (LON, 4-20mA, IDC, NAC, AND AUXILIARY POWER).
- ALL INITIATING, NOTIFICATION, & RELEASE CIRCUIT WIRING MUST BE SUPERVISED.
- ALL WIRING, INCLUDING SHIELDS, MUST BE DRY AND FREE OF SHORTS AND GROUNDS.
- INITIATING DEVICES SHALL BE SUPPORTED INDEPENDENTLY OF THEIR ATTACHMENT TO FIRE ALARM CIRCUIT CONDUCTORS.
- ALL FIRE & GAS ALARM CIRCUITS SHALL BE IDENTIFIED AT TERMINAL AND JUNCTION LOCATIONS IN A MANNER THAT WILL PREVENT UNINTENTIONAL INTERFERENCE WITH THE LOCAL OPERATING NETWORK (LON) DURING TESTING AND SERVICING IN ACCORDANCE WITH NEC ARTICLE 760-10.
- SMOKE DETECTORS SHALL BE MOUNTED IN ACCORDANCE WITH NFPA 72. DETECTORS SHALL NOT BE LOCATED IN DIRECT AIR FLOW NOR CLOSER THAN 3 FEET FROM AN AIR DIFFUSER OR RETURN AIR OPENING.
- DETECTORS SHALL NOT BE INSTALLED UNTIL AFTER THE CONSTRUCTION CLEAN UP OF ALL TRADES IS COMPLETED AND FINAL.
- ALL FIRE & GAS ALARM DEVICES MUST BE INSTALLED IN AN PROPER BACK BOX. NO DEVICE SHALL BE INSTALLED WITH OUT A BACK BOX.
- POWER-LIMITED FIRE ALARM CIRCUIT CONDUCTORS AND CABLES SHALL BE INSTALLED AS FOLLOWS: (NEC ARTICLE 760 -71)
 - IN RACEWAY OR EXPOSED ON THE SURFACE OF CEILING AND SIDE WALLS OR "FISHED" IN CONCEALED SPACES. CABLE SPLICES OR TERMINATIONS SHALL BE MADE IN LISTED FITTINGS, BOXES, ENCLOSURES, FIRE ALARM DEVICES OR UTILIZATION EQUIPMENT. WHERE INSTALLED EXPOSED, CABLES SHALL BE ADEQUATELY SUPPORTED AND INSTALLED IN SUCH A WAY THAT MAXIMUM PROTECTION AGAINST PHYSICAL DAMAGE IS AFFORDED BY BUILDING CONSTRUCTION SUCH AS BASEBOARDS, DOOR FRAMES, LEDGES, ETC. WHERE LOCATED WITH IN 7 FEET OF THE FLOOR CABLES SHALL BE SECURELY FASTENED IN AN APPROVED MANNER AT INTERVAL OF NOT MORE THAN 18 INCHES.
 - IN METAL RACEWAYS OR RIGID NON METALLIC CONDUIT WHERE PASSING THROUGH A FLOOR OR WALL TO A HEIGHT OF 7 FEET ABOVE THE FLOOR UNLESS ADEQUATE PROTECTION CAN BE AFFORDED BY BUILDING CONSTRUCTION SUCH AS DETAILED IN 15.1 ABOVE OR UNLESS AN EQUIVALENT SOLID GUARD IS PROVIDED.
 - IN RIGID METAL CONDUIT, RIGID NON-METALLIC CONDUIT, INTERMEDIATED METAL CONDUIT, OR ELECTRICAL METALLIC TUBING WHERE INSTALLED IN HOIST WAYS. (EXCEPTION: AS PROVIDED IN NEC SECTION 620-71 FOR ELEVATORS AND SIMILAR EQUIPMENT).
- ALL DEVICES SHALL BE LABELED WITH THEIR ADDRESS AND CIRCUIT NUMBER.
- POWER-LIMITED CIRCUIT CABLES AND CONDUCTORS SHALL NOT BE PLACED IN ANY CABLE, CABLE TRAY, COMPARTMENT, ENCLOSURE, OUTLET BOX, RACEWAY, OR SIMILAR FITTING WITH CONDUCTORS OF ELECTRIC LIGHT, POWER CLASS 1 NON POWER LIMITED FIRE ALARM CIRCUIT CONDUCTORS, OR MEDIUM POWER NET-POWER BOARD BAND COMMUNICATIONS CIRCUITS IN ACCORDANCE WITH NEC ARTICLE 760.
- POWER LIMITED CIRCUIT CONDUCTORS SHALL NOT BE STRAPPED, TAPED OR ATTACHED BY ANY MEANS TO THE EXTERIOR OF ANY CONDUIT OR OTHER RACEWAY AS A MEANS OF SUPPORT.
- INITIATING DEVICE CIRCUITS (IDC) AND NOTIFICATION APPLIANCE CIRCUITS (NAC) ARE TWO WIRE CLASS "B". NO T-TAPPING IS ALLOWED ON EITHER OF THESE CIRCUITS.
- LOCAL OPERATING NETWORK (LON) CIRCUITS ARE TWO WIRE CLASS "X". NO T-TAPPING IS ALLOWED ON THESE CIRCUITS.
- AUXILIARY POWER CIRCUITS ARE TWO WIRE CIRCUITS THAT CAN BE T-TAPPED AS REQUIRED.
- OPENINGS AROUND ELECTRICAL PENETRATIONS THROUGH FIRE-RESISTANT / RATED WALLS, PARTITIONS, FLOORS, OR CEILINGS SHALL BE FIRE STOPPED USING APPROVED METHODS TO MAINTAIN THE FIRE RESISTANCE RATING.
- ALL DEVICES WITHIN AN ELECTRICALLY CLASSIFIED HAZARDOUS LOCATION SHALL BE PROVIDED WITH ENCLOSURES IDENTIFIED FOR THE APPROPRIATE CLASS AND DIVISION OF WHICH THEY ARE LOCATED.

GENERAL NOTES:

- THESE DRAWINGS ARE CONCEPTUAL IN NATURE AND ARE ONLY MEANT TO SHOW THE DESIGN INTENT. FULL SHOP DRAWINGS WILL BE DEVELOPED BY INSTALLER IN ACCORDANCE WITH APPLICABLE CODES AND STANDARDS AND DESIGNED BY LICENSED F.P.E.
- ALL TESTING OF THE FIRE ALARM AND GAS DETECTION SYSTEMS AND EQUIPMENT TO COMPLY WITH THE APPLICABLE CODES AND STANDARDS.
- THE EQUIPMENT PLACEMENT AND COVERAGE SHOWN ON THIS DRAWING IS FOR DIAGRAMMATIC PURPOSES ONLY. THE ENGINEER RESPONSIBLE FOR THE INSTALLATION SHALL DECIDE EXACT LOCATIONS FOR EQUIPMENT "ON-SITE".
- ALL EQUIPMENT TO BE INSTALLED SHALL BE IN ACCORDANCE WITH LOCAL, STATE AND OTHER APPLICABLE CODES AND STANDARDS, OR AS REQUIRED BY THE "AHJ".
- ALL WIRING AND PRODUCT SETTINGS SHALL BE IN ACCORDANCE WITH LOCAL, STATE AND OTHER APPLICABLE CODES AND STANDARDS, OR AS REQUIRED BY THE "AHJ".
- ALL SYSTEM OPERATIONS ARE TO BE TESTED AND VERIFIED IN ACCORDANCE WITH THE SEQUENCE OF EVENTS MATRIX. SYSTEM TESTING MUST BE DOCUMENTED ON APPROVED FORMS PRIOR TO TURN OVER TO CUSTOMER.

DETECTION SYSTEM SPECIFIC NOTES:

- LON COMMUNICATION CABLES MUST BE IN METALLIC GROUNDED CONDUIT WHEN CROSSING OR CLOSER THAN 12" TO NON COMMUNICATION CABLES.
- OBSERVE POLARITY WHEN WIRING LON COMMUNICATIONS NETWORK. "A" SIDE OF COM 1 SHALL CONNECT TO NEXT DEVICE "A" SIDE COM2. "B" SIDE OF COM1 SHALL CONNECT TO NEXT DEVICE "B" SIDE COM2. SHIELDS OF LON CABLE TO BE CONNECTED TO SHIELD TERMINAL AT EACH DEVICE.
- EACH LON DEVICE IS TO BE GROUNDED. EACH FACP CABINET AND BACK PLANE IS TO BE EARTH GROUNDED.
- ALL LON DEVICES MUST BE ADDRESSED BEFORE SYSTEM POWER UP.
- ALL WIRING MUST BE CHECKED FOR GROUNDS AND SHORTS PRIOR TO SYSTEM POWER BEING APPLIED.

PROTECTOWIRE (LHD) NOTES:

- STRAIN RELIEF CONNECTORS SHALL BE INSTALLED IN ALL JUNCTION BOXES WHERE THE LHD ENTERS OR EXITS THE ENCLOSURE IN ORDER TO MAINTAIN DUST AND MOISTURE TYPE CONDITIONS.
- LHD MUST BE INSTALLED IN ONE CONTINUOUS RUN WITHOUT TAPS OR BRANCHES TO COMPLY WITH LOCATION AND SPACING REQUIREMENTS.
- LHD SHALL NOT HAVE ANY BENDS OF LESS THAN 3 INCHES IN DIAMETER, ANY BEND TIGHTER THAN 3 INCHES WILL RESULT IN DAMAGING THE CABLE.
- POSITION STANDOFF EVERY 10' OR AS NEEDED FOR QUALITY INSTALLATION. POSITION 15" FROM CORNERS.
- WHERE EYEBOLTS ARE UTILIZED TO MOUNT OR SUPPORT LHD, RUBBER INSULATING GROMMETS SHALL BE USED.

ABBREVIATION LEGEND:

- LON - LOCAL OPERATING NETWORK
- IDC - INITIATING DEVICE CIRCUIT
- NAC - NOTIFICATION APPLIANCE CIRCUIT
- FACP- FIRE ALARM CONTROL PANEL
- LHD - LINEAR HEAT DETECTOR
- HMI - HUMAN MACHINE INTERFACE
- TBD - TO BE DETERMINED
- TYP - TYPICAL

SYMBOL LEGEND

- DRY CONTACT RELAY OUTPUT
- LINEAR HEAT DETECTOR W/ TEMP RATING
- GAS DETECTOR
- STROBE
- HORN/STROBE
- HORN
- FOAM RELEASE MANUAL STATION
- LOW AIR SWITCH
- TAMPER SWITCH
- FOAM FLOW/WATERFLOW SWITCH
- RELEASING SOLENOID
- SMOKE DETECTOR - PHOTOELECTRIC
- MANUAL ALARM STATION
- ROOM TEMPERATURE SWITCH
- LHD ZONE BOX
- LHD END-OF-LINE BOX

NO.	DATE	REVISION	BY	CK'D	APP
E	07-14-14				JCPSEDJWP
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C	10-25-13	90% PRELIMINARY FOR REVIEW			JCPSEDJWP
B	08-04-13	CONCEPTUAL FOR REVIEW			JCPSEDJWP



PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: OVERALL AREA
FIRE & GAS DETECTION AND ALARM

DESIGN: J. Pahlow START DATE: 06/19/2013 SCALE: As-Noted

DRAWN: J. Pahlow PRINT DATE: 01/31/2014 PROJECT MANAGER: S. Durflinger

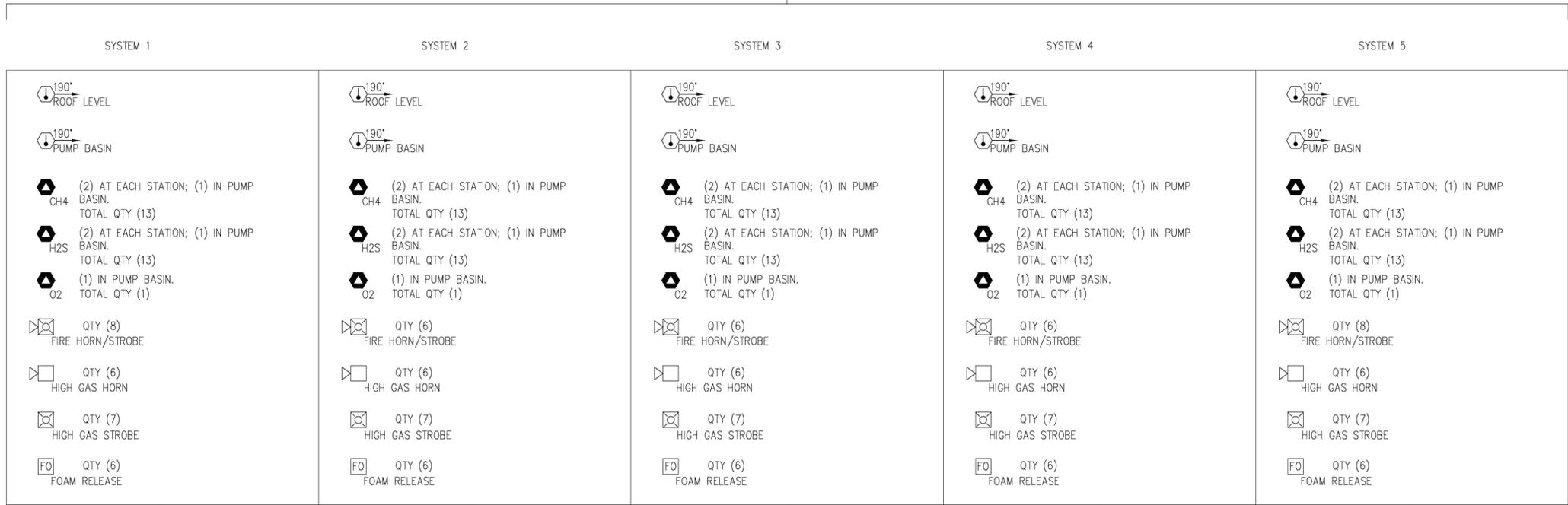
CHECKED: S. Durflinger APPROVED: J. Poole SIZE: 24x36

DRAWING NUMBER: 0100-FA-002 SHEET: 1/1 REV.:

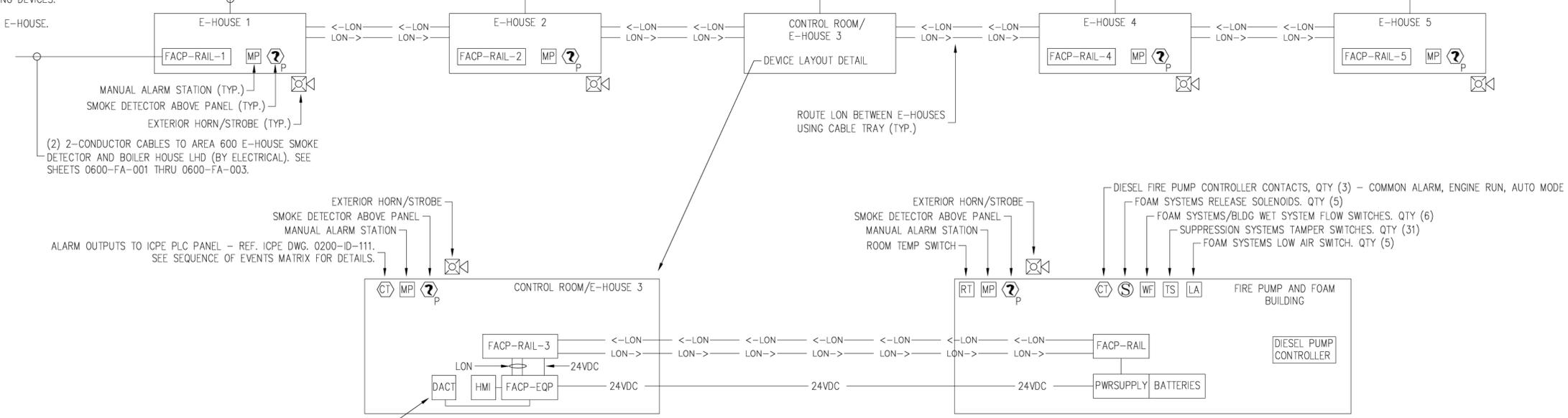
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UNLOADING BUILDING WITH (5) FOAM WATER SPRINKLER ZONES
SEE DRAWING 0200-FA-003 FOR DEVICE LAYOUT



CLASS B INITIATING, NOTIFICATION;
4-20mA CIRCUITS TO RAIL
UNLOADING BUILDING DEVICES.
IN CABLE TRAY.



(2) 2-CONDUCTOR CABLES TO AREA 600 E-HOUSE SMOKE DETECTOR AND BOILER HOUSE LHD (BY ELECTRICAL). SEE SHEETS 0600-FA-001 THRU 0600-FA-003.

ALARM OUTPUTS TO ICPE PLC PANEL - REF. ICPE DWG. 0200-ID-111. SEE SEQUENCE OF EVENTS MATRIX FOR DETAILS.

DIGITAL ALARM COMMUNICATOR TRANSMITTER:
FOR SUPERVISING STATION REPORTING.
(2) SEPARATE PHONE LINES, EACH WITH ITS OWN PHONE NUMBER, CONNECTED DIRECTLY TO THE PUBLIC SWITCHED TELEPHONE SYSTEM REQUIRED (BY OTHERS)

1 UNLOADING BUILDING PRELIMINARY DEVICE LOCATIONS
0200-FA-001 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

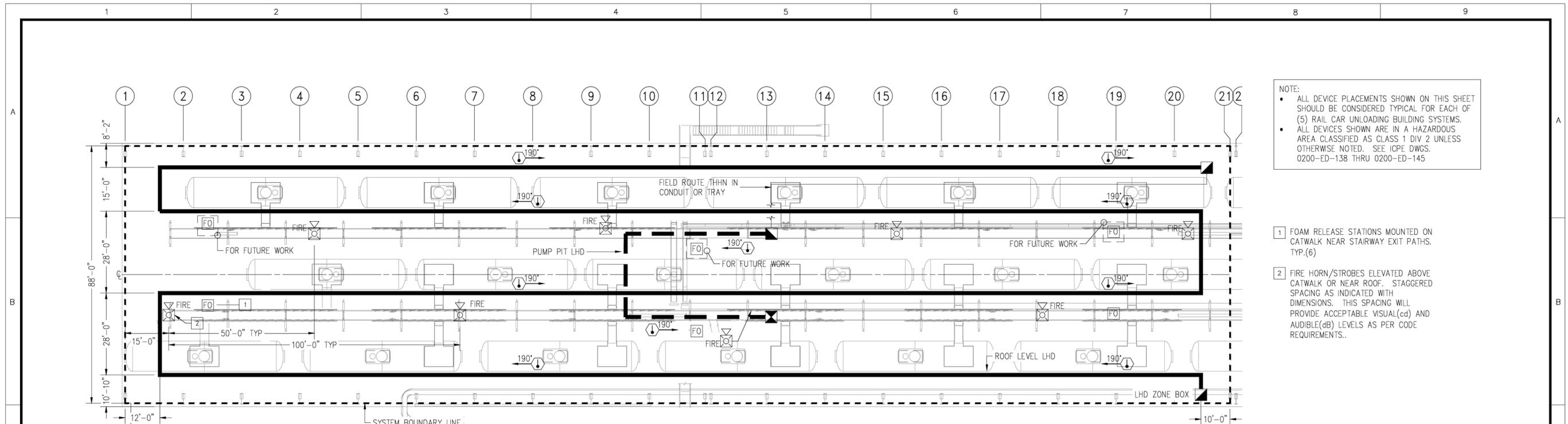
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NO.	DATE	REVISION	BY



PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON
DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pahlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pahlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durlfingler
CHECKED:	S. Durlfingler	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0200-FA-001				1	1

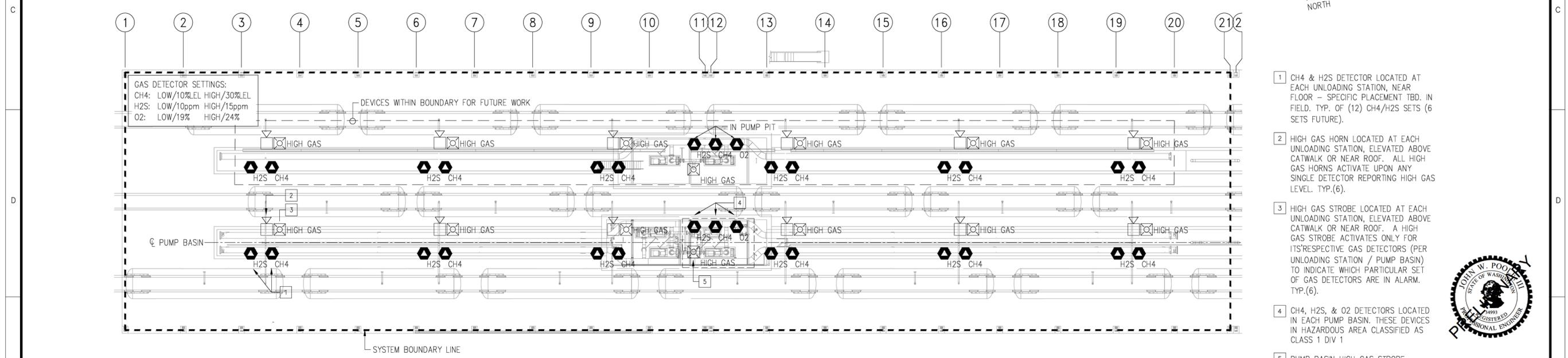




1 TYPICAL UNLOADING BUILDING FIRE DETECTION & ALARM DEVICE LAYOUT
 0200-FA-003 SCALE: 1/16" = 1'-0"

NOTE:
 • ALL DEVICE PLACEMENTS SHOWN ON THIS SHEET SHOULD BE CONSIDERED TYPICAL FOR EACH OF (5) RAIL CAR UNLOADING BUILDING SYSTEMS.
 • ALL DEVICES SHOWN ARE IN A HAZARDOUS AREA CLASSIFIED AS CLASS 1 DIV 2 UNLESS OTHERWISE NOTED. SEE ICPE DWGS. 0200-ED-138 THRU 0200-ED-145

- 1 FOAM RELEASE STATIONS MOUNTED ON CATWALK NEAR STAIRWAY EXIT PATHS. TYP.(6)
- 2 FIRE HORN/STROBES ELEVATED ABOVE CATWALK OR NEAR ROOF. STAGGERED SPACING AS INDICATED WITH DIMENSIONS. THIS SPACING WILL PROVIDE ACCEPTABLE VISUAL(cd) AND AUDIBLE(dB) LEVELS AS PER CODE REQUIREMENTS..



2 TYPICAL UNLOADING BUILDING GAS DETECTION AND ALARM DEVICE LAYOUT
 0200-FA-003 SCALE: 1/16" = 1'-0"

- 1 CH4 & H2S DETECTOR LOCATED AT EACH UNLOADING STATION, NEAR FLOOR - SPECIFIC PLACEMENT TBD, IN FIELD. TYP. OF (12) CH4/H2S SETS (6 SETS FUTURE).
- 2 HIGH GAS HORN LOCATED AT EACH UNLOADING STATION, ELEVATED ABOVE CATWALK OR NEAR ROOF. ALL HIGH GAS HORNS ACTIVATE UPON ANY SINGLE DETECTOR REPORTING HIGH GAS LEVEL. TYP.(6).
- 3 HIGH GAS STROBE LOCATED AT EACH UNLOADING STATION, ELEVATED ABOVE CATWALK OR NEAR ROOF. A HIGH GAS STROBE ACTIVATES ONLY FOR ITS RESPECTIVE GAS DETECTORS (PER UNLOADING STATION / PUMP BASIN) TO INDICATE WHICH PARTICULAR SET OF GAS DETECTORS ARE IN ALARM. TYP.(6).
- 4 CH4, H2S, & O2 DETECTORS LOCATED IN EACH PUMP BASIN. THESE DEVICES IN HAZARDOUS AREA CLASSIFIED AS CLASS 1 DIV 1
- 5 PUMP BASIN HIGH GAS STROBE ACTIVATED UPON HIGH GAS ALARM



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CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: UNLOADING BUILDING AREA
 FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pahlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pahlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durlfingler
CHECKED:	S. Durlfingler	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0200-FA-003				1	1

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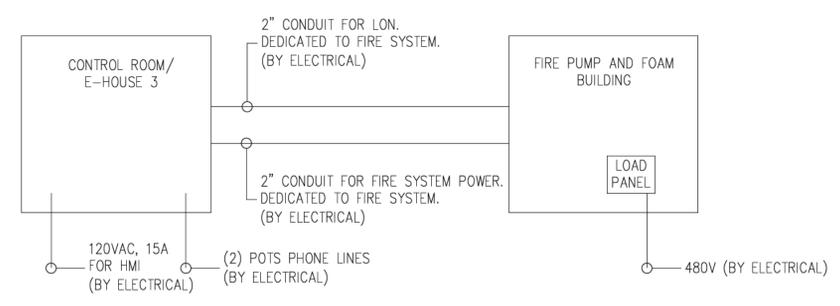
B

C

D

E

————— CONDUIT INSTALLED BY ELECTRICAL
 - - - - - CONDUIT FIELD INSTALLED BY FIRE SYSTEM CONTRACTOR



1 UNLOADING BUILDING PRELIMINARY POWER & UNDERGROUND CONDUIT REQUIREMENTS
 0200-FA-004 SCALE: NONE



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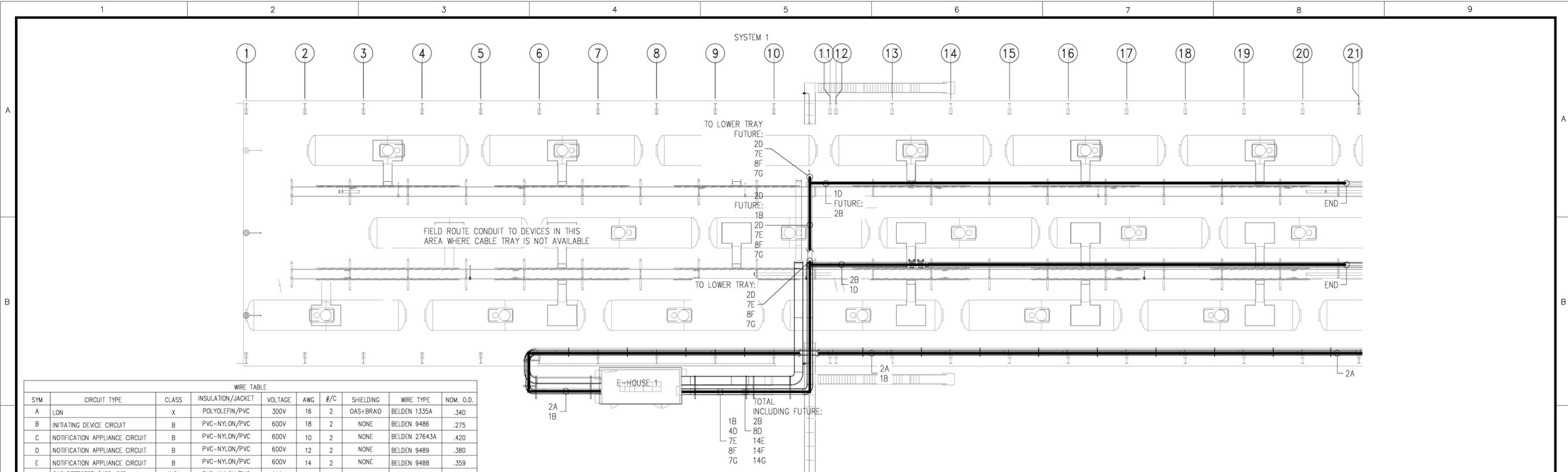
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PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON

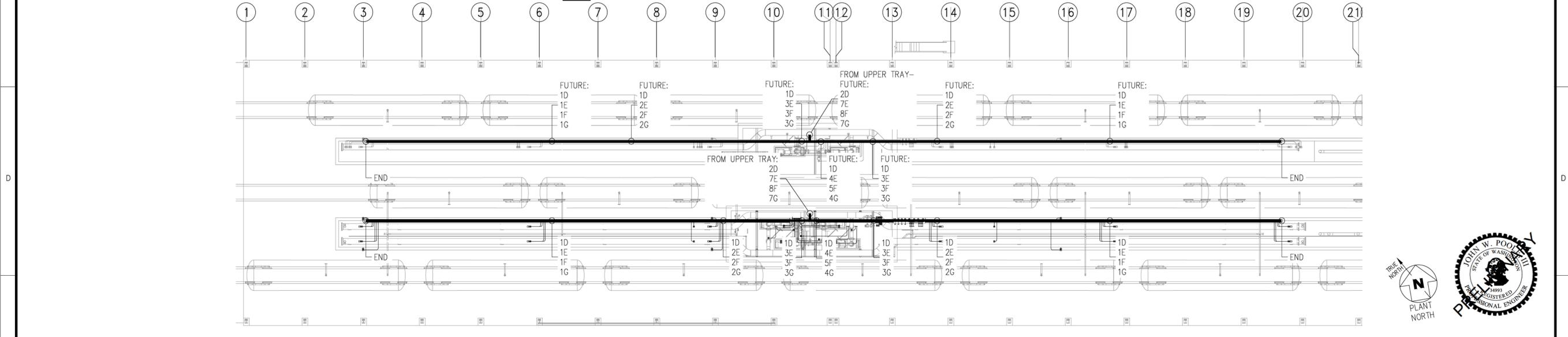
DESCRIPTION: UNLOADING BUILDING AREA
 FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pahlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pahlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durlfingler
CHECKED:	S. Durlfingler	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0200-FA-004				1	1



WIRE TABLE									
SYM	CIRCUIT TYPE	CLASS	INSULATION/JACKET	VOLTAGE	AWG	#/C	SHIELDING	WIRE TYPE	NOM. O.D.
A	LON	X	POLYOLEFIN/PVC	300V	16	2	OAS+BRAID	BELDEN 1335A	.340
B	INITIATING DEVICE CIRCUIT	B	PVC-NYLON/PVC	600V	18	2	NONE	BELDEN 9486	.275
C	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	10	2	NONE	BELDEN 27843A	.420
D	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	12	2	NONE	BELDEN 9489	.380
E	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	14	2	NONE	BELDEN 9488	.359
F	GAS DETECTOR (H2S, O2)	N/A	PVC-NYLON/PVC	600V	14	2	OAS	BELDEN 9343	.358
G	GAS DETECTOR (CH4)	N/A	PVC-NYLON/PVC	600V	14	3	OAS	BELDEN 3081A	.361

1 UNLOADING BUILDING SYSTEM 1 CABLE TRAY ROUTE - EL. 57'-8"
0200-FA-005 SCALE: NONE



2 UNLOADING BUILDING SYSTEM 1 CABLE TRAY ROUTE - EL. 32'-6"
0200-FA-005 SCALE: NONE



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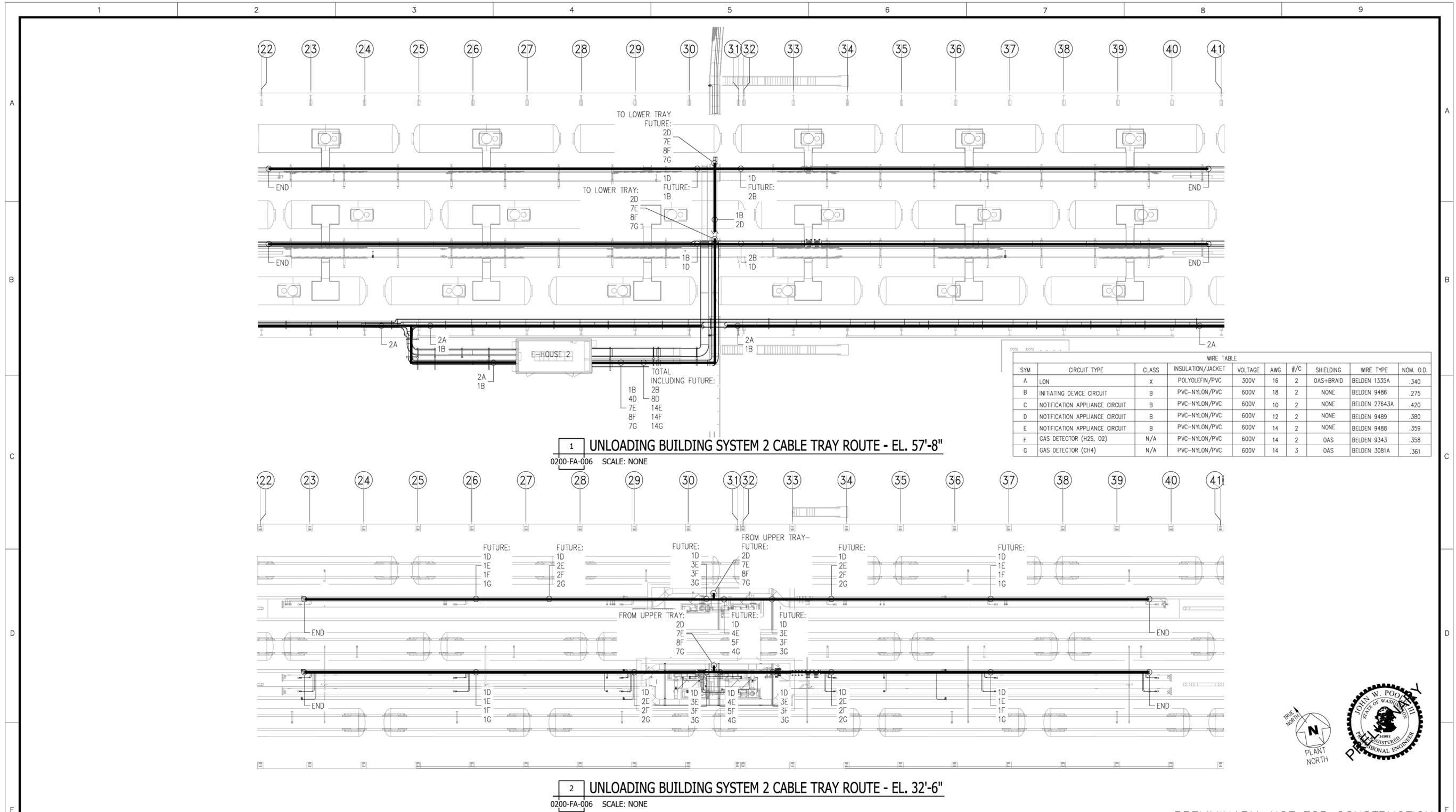


PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

PRELIMINARY, NOT FOR CONSTRUCTION

DESIGN: J. Pahlow	START DATE: 06/19/2013	SCALE: As-Noted
DRAWN: J. Pahlow	PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durlfing
CHECKED: S. Durlfing	APPROVED: J. Poole	SIZE: 24x36
DRAWING NUMBER: 0200-FA-005		SHEET: 1/1
		REV. E



1 UNLOADING BUILDING SYSTEM 2 CABLE TRAY ROUTE - EL. 57'-8"
0200-FA-006 SCALE: NONE

2 UNLOADING BUILDING SYSTEM 2 CABLE TRAY ROUTE - EL. 32'-6"
0200-FA-006 SCALE: NONE



NO.	DATE	REVISION	BY	CHK'D	APP
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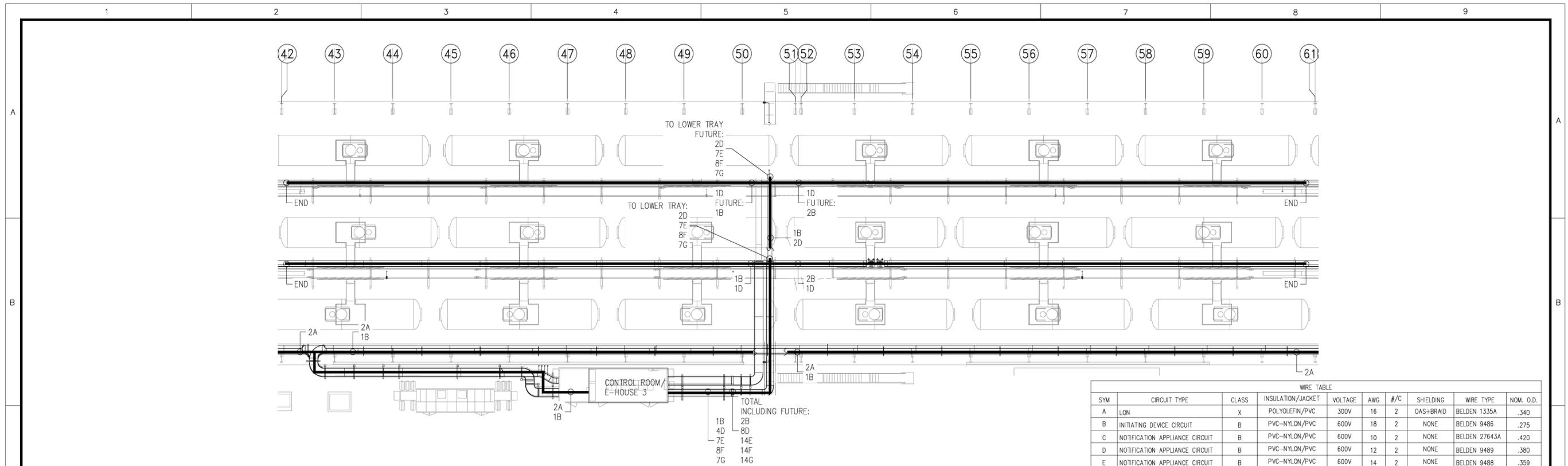
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

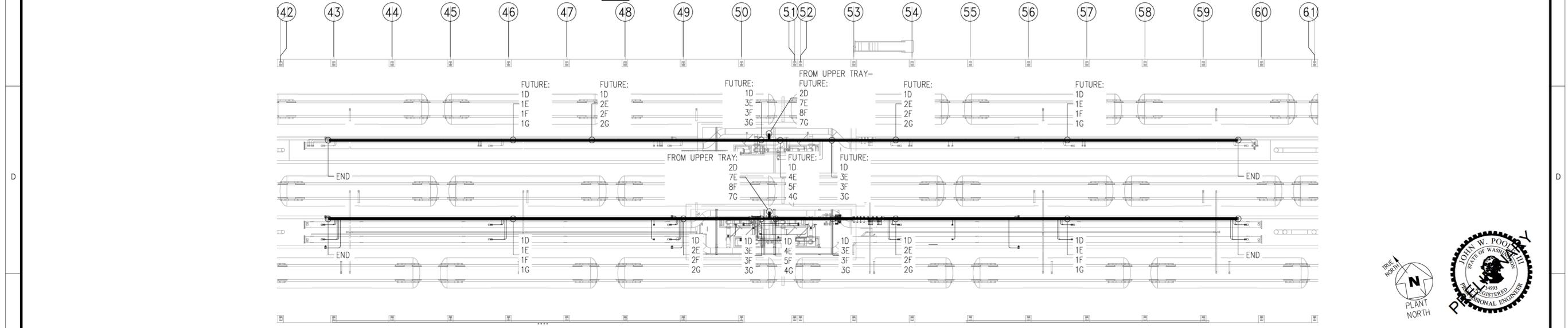
PRELIMINARY, NOT FOR CONSTRUCTION

DESIGN: J. Pahlow	START DATE: 06/19/2013	SCALE: As-Noted
DRAWN: J. Pahlow	PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durlfänger
CHECKED: S. Durlfänger	APPROVED: J. Poole	SIZE: 24x36
DRAWING NUMBER: 0200-FA-006		SHEET: 1
		REV.:



SYM	CIRCUIT TYPE	CLASS	INSULATION/JACKET	VOLTAGE	AWG	#/C	SHIELDING	WIRE TYPE	NOM. O.D.
A	LON	X	POLYOLEFIN/PVC	300V	16	2	OAS+BRAID	BELDEN 1335A	.340
B	INITIATING DEVICE CIRCUIT	B	PVC-NYLON/PVC	600V	18	2	NONE	BELDEN 9486	.275
C	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	10	2	NONE	BELDEN 27643A	.420
D	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	12	2	NONE	BELDEN 9489	.380
E	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	14	2	NONE	BELDEN 9488	.359
F	GAS DETECTOR (H2S, O2)	N/A	PVC-NYLON/PVC	600V	14	2	OAS	BELDEN 9343	.358
G	GAS DETECTOR (CH4)	N/A	PVC-NYLON/PVC	600V	14	3	OAS	BELDEN 3081A	.361

1 UNLOADING BUILDING SYSTEM 3 CABLE TRAY ROUTE - EL. 57'-8"
0200-FA-007 SCALE: NONE



2 UNLOADING BUILDING SYSTEM 3 CABLE TRAY ROUTE - EL. 32'-6"
0200-FA-007 SCALE: NONE



NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP



TESORO SAVAGE

THIS DRAWING CONTAINS PROPRIETARY AND PRIVILEGED INFORMATION OF TESORO SAVAGE PETROLEUM LLC AND SHALL NOT BE DISCLOSED OR USED FOR THE BENEFIT OF OTHERS WITHOUT PRIOR WRITTEN PERMISSION OF THE DRAWING OWNER.

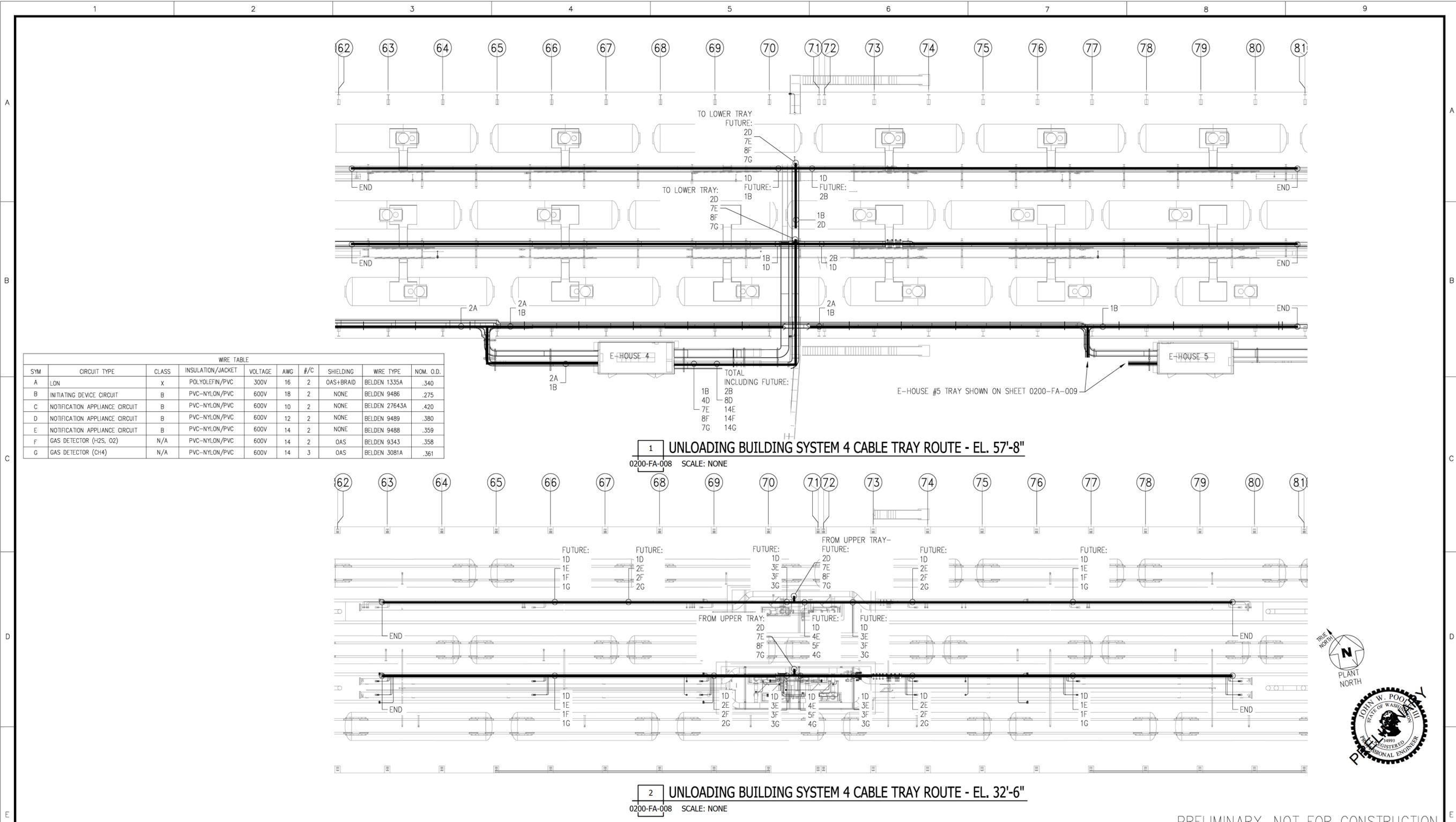
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

PRELIMINARY, NOT FOR CONSTRUCTION

DESIGN: J. Pahlow	START DATE: 06/19/2013	SCALE: As-Noted
DRAWN: J. Pahlow	PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durlfänger
CHECKED: S. Durlfänger	APPROVED: J. Poole	SIZE: 24x36
DRAWING NUMBER: 0200-FA-007		SHEET REV. 1/1 E



WIRE TABLE									
SYM	CIRCUIT TYPE	CLASS	INSULATION/JACKET	VOLTAGE	AWG	#/C	SHIELDING	WIRE TYPE	NOM. O.D.
A	LON	X	POLYOLEFIN/PVC	300V	16	2	OAS+BRAID	BELDEN 1335A	.340
B	INITIATING DEVICE CIRCUIT	B	PVC-NYLON/PVC	600V	18	2	NONE	BELDEN 9486	.275
C	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	10	2	NONE	BELDEN 27643A	.420
D	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	12	2	NONE	BELDEN 9489	.380
E	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	14	2	NONE	BELDEN 9488	.359
F	GAS DETECTOR (H2S, O2)	N/A	PVC-NYLON/PVC	600V	14	2	OAS	BELDEN 9343	.358
G	GAS DETECTOR (CH4)	N/A	PVC-NYLON/PVC	600V	14	3	OAS	BELDEN 3081A	.361

NO.	DATE	REVISION	BY
E	07-14-14		JCP/SED/JWP
D	01-31-14	PRELIMINARY BID SET	JCP/SED/JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP/SED/JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP/SED/JWP
			CK'D APP

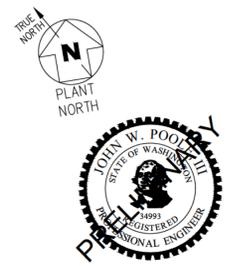


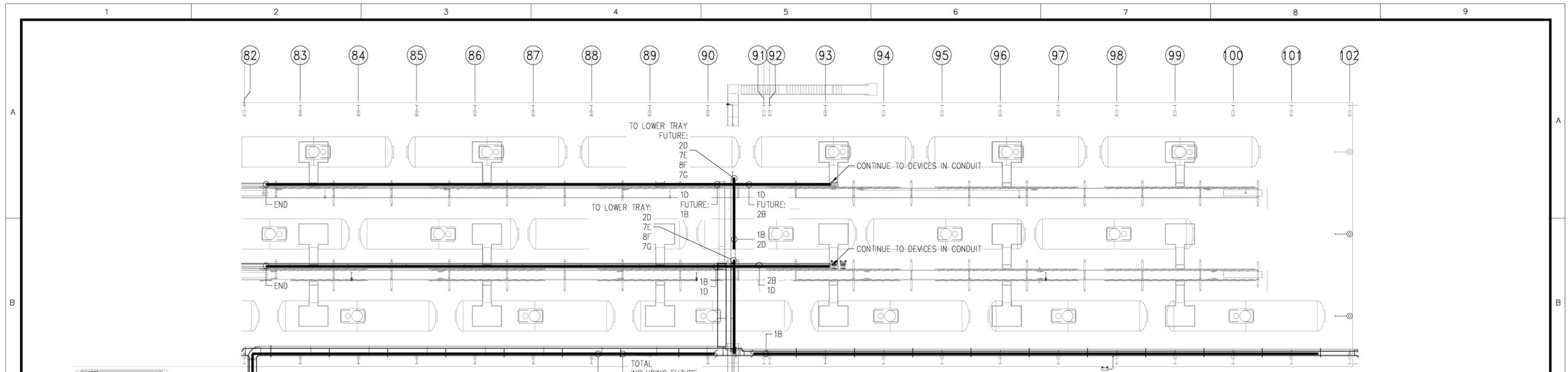
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: UNLOADING BUILDING AREA
 FIRE & GAS DETECTION AND ALARM

PRELIMINARY, NOT FOR CONSTRUCTION

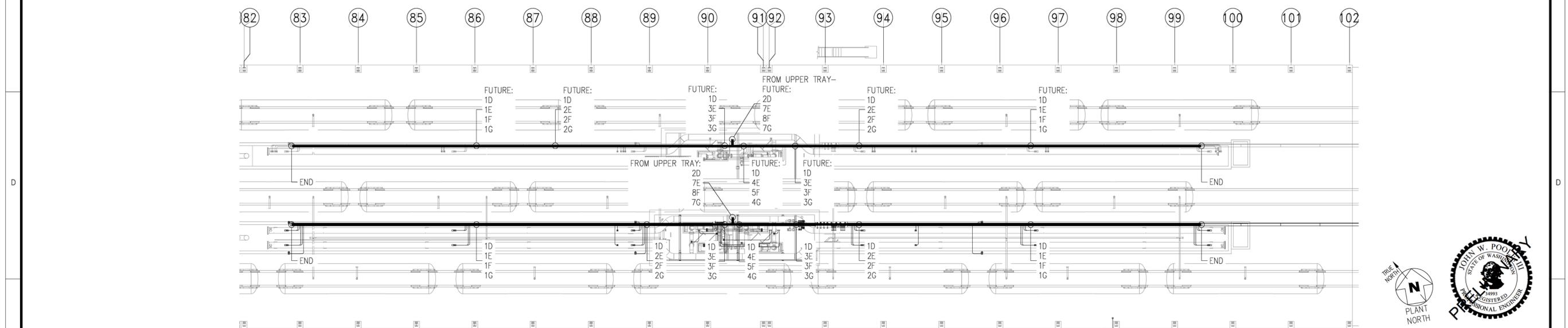
DESIGN: J. Pahlow	START DATE: 06/19/2013	SCALE: As-Noted
DRAWN: J. Pahlow	PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durlfing
CHECKED: S. Durlfing	APPROVED: J. Poole	SIZE: 24x36
DRAWING NUMBER: 0200-FA-008		SHEET: 1/1
		REV.:





1 UNLOADING BUILDING SYSTEM 5 CABLE TRAY ROUTE - EL. 57'-8"
 0200-FA-009 SCALE: NONE

WIRE TABLE										
SYM	CIRCUIT TYPE	CLASS	INSULATION/JACKET	VOLTAGE	AWG	#/C	SHIELDING	WIRE TYPE	NOM. O.D.	
A	LON	X	POLYOLEFIN/PVC	300V	16	2	OAS+BRAID	BELDEN 1335A	.340	
B	INITIATING DEVICE CIRCUIT	B	PVC-NYLON/PVC	600V	18	2	NONE	BELDEN 9486	.275	
C	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	10	2	NONE	BELDEN 27643A	.420	
D	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	12	2	NONE	BELDEN 9489	.380	
E	NOTIFICATION APPLIANCE CIRCUIT	B	PVC-NYLON/PVC	600V	14	2	NONE	BELDEN 9488	.359	
F	GAS DETECTOR (H2S, O2)	N/A	PVC-NYLON/PVC	600V	14	2	OAS	BELDEN 9343	.358	
G	GAS DETECTOR (CH4)	N/A	PVC-NYLON/PVC	600V	14	3	OAS	BELDEN 3081A	.361	



2 UNLOADING BUILDING SYSTEM 5 CABLE TRAY ROUTE - EL. 32'-6"
 0200-FA-009 SCALE: NONE



NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP



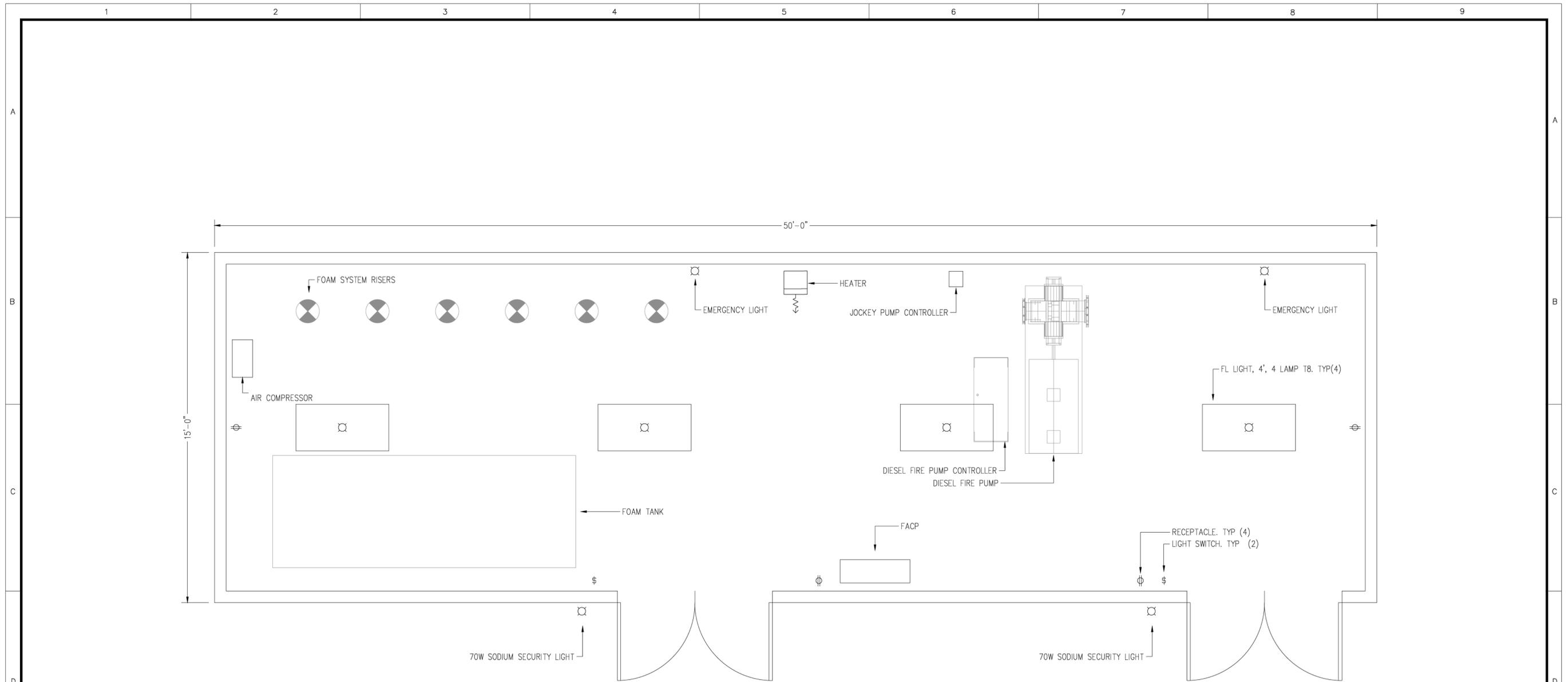
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: UNLOADING BUILDING AREA
 FIRE & GAS DETECTION AND ALARM

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

PRELIMINARY, NOT FOR CONSTRUCTION

DESIGN:	J. Pahlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pahlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durlflinger
CHECKED:	S. Durlflinger	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0200-FA-009				1	E



1 TYPICAL FIRE PUMP AND FOAM BUILDING ELECTRICAL LAYOUT
 0200-FA-010 SCALE: 1/2" = 1'-0"



PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP

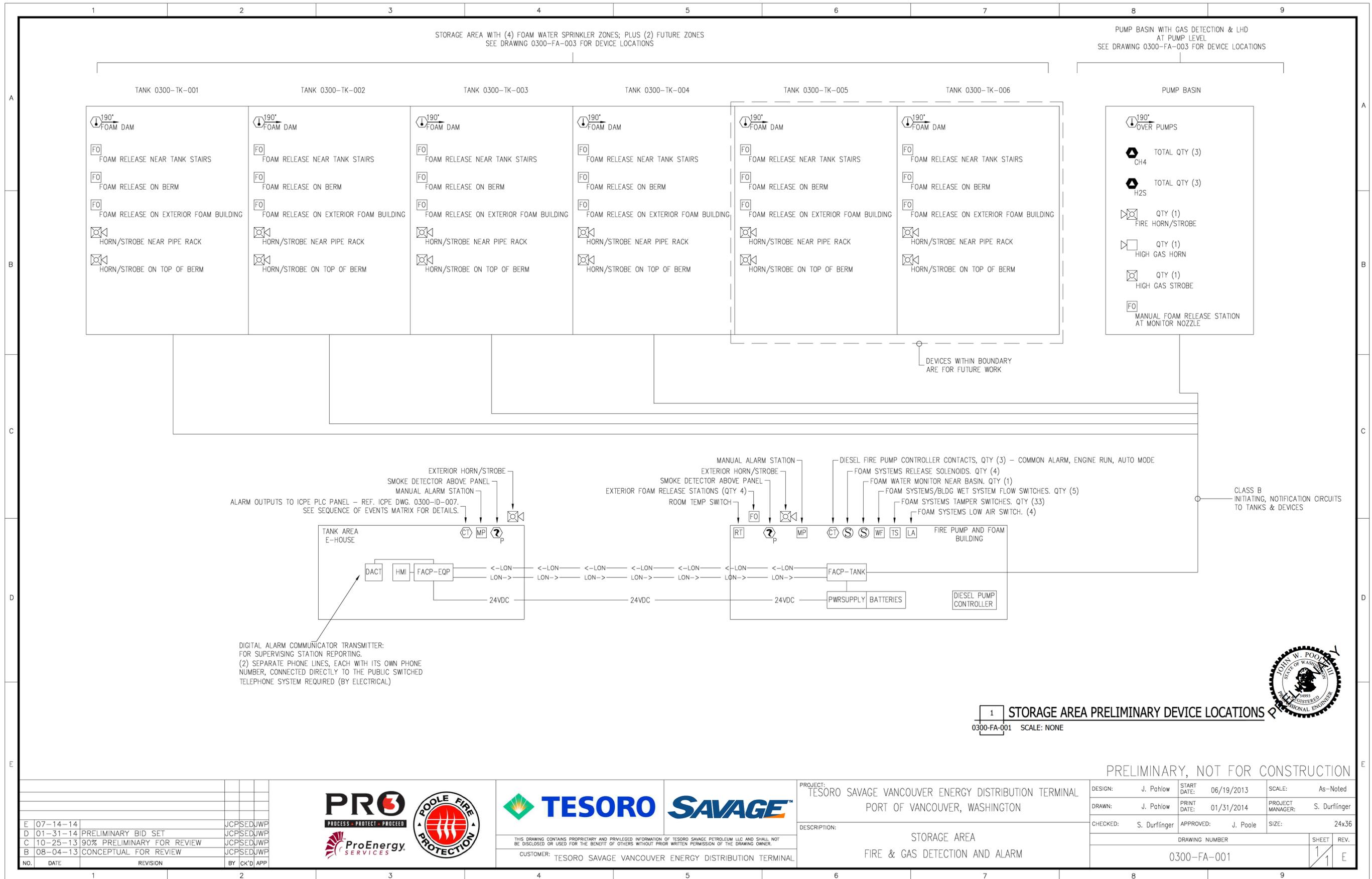


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 CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: UNLOADING BUILDING AREA
 FIRE & GAS DETECTION AND ALARM

DESIGN: J. Pahlow	START DATE: 06/19/2013	SCALE: As-Noted
DRAWN: J. Pahlow	PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durflinger
CHECKED: S. Durflinger	APPROVED: J. Poole	SIZE: 24x36
DRAWING NUMBER: 0200-FA-010		SHEET: 1/1
		REV. E



1 STORAGE AREA PRELIMINARY DEVICE LOCATIONS
0300-FA-001 SCALE: NONE



PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP



PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: STORAGE AREA
FIRE & GAS DETECTION AND ALARM

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

DESIGN: J. Pahlow	START DATE: 06/19/2013	SCALE: As-Noted
DRAWN: J. Pahlow	PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durlfingler
CHECKED: S. Durlfingler	APPROVED: J. Poole	SIZE: 24x36
DRAWING NUMBER: 0300-FA-001		SHEET: 1/1
		REV. E

1		2		3		4		5		6		7		8		9					
STORAGE AREA SEQUENCE OF EVENTS				INPUT																	
				PANEL FIRE ALARM	X																X
OUTPUT				SOUND PANEL AUDIBLE (FIRE)																	
				SOUND PANEL AUDIBLE (TROUBLE)	X																
E-HOUSE				SOUND PANEL AUDIBLE (SUPERVISORY)		X															
				SOUND PANEL AUDIBLE (LOW GAS)			X														
FIRE PUMP/FOAM BUILDING				SOUND PANEL AUDIBLE (HIGH GAS)			X														
				SILENCE ALL HORN/STROBES				X													
TANKS				SILENCE PANEL				X													
				ACTIVATE EXTERIOR HORN/STROBES					X												
PUMP BASIN				ACTIVATE EXTERIOR HORN/STROBES					X												
				DISPLAY INFO ON HMI						X											
RELAY OUTPUTS TO PLANT PLC				ACTIVATE EXTERIOR HORN/STROBE						X											
				ACTIVATE FIRE HORN/STROBE										X							
GENERAL TROUBLE SIGNAL				ACTIVATE HIGH GAS HORN							X	X									
				ACTIVATE HIGH GAS STROBE											X	X					
GENERAL SUPERVISORY SIGNAL				ACTIVATE SOLENOID - FOAM MONITOR NOZZLE																	
				RELAY OUTPUTS TO PLANT PLC																	
LOW GAS ALARM (CH4 OR H2S)				GENERAL FIRE ALARM SIGNAL																	
				GENERAL TROUBLE SIGNAL																	
HIGH GAS ALARM (G14 OR H2S)				GENERAL SUPERVISORY SIGNAL																	
				LOW GAS ALARM (CH4 OR H2S)																	
DIGITAL ALARM COMMUNICATOR TRANSMITTER				HIGH GAS ALARM (G14 OR H2S)																	
				ALARM OUTPUT TO SUPERVISING STATION																	
FACP-EOP PANEL ANY TROUBLE/FAULT				[SPARE]																	
				ESD1																	
FACP-TANKS PANEL ANY TROUBLE/FAULT				ESD2																	
				DIGITAL ALARM COMMUNICATOR TRANSMITTER																	
FIRE PUMP AND FOAM BLDG				ALARM OUTPUT TO SUPERVISING STATION																	
				FIRE PUMP AND FOAM BLDG																	
FIREPUMP CONTROLLER OUTPUTS				FIRE PUMP AND FOAM BLDG																	
				FIREPUMP CONTROLLER OUTPUTS																	
TAMPER SWITCHES - (QTY 33)				FIREPUMP CONTROLLER OUTPUTS																	
				TAMPER SWITCHES - (QTY 33)																	
FOAM SYSTEMS LOW AIR SWITCH				TAMPER SWITCHES - (QTY 33)																	
				FOAM SYSTEMS LOW AIR SWITCH																	
FOAM WATER FLOW - TANK 1				FOAM SYSTEMS LOW AIR SWITCH																	
				FOAM WATER FLOW - TANK 1																	
FOAM WATER FLOW - TANK 2				FOAM WATER FLOW - TANK 1																	
				FOAM WATER FLOW - TANK 2																	
FOAM WATER FLOW - TANK 3				FOAM WATER FLOW - TANK 2																	
				FOAM WATER FLOW - TANK 3																	
FOAM WATER FLOW - TANK 4				FOAM WATER FLOW - TANK 3																	
				FOAM WATER FLOW - TANK 4																	
MANUAL FOAM RELEASE - TANK 1				FOAM WATER FLOW - TANK 4																	
				MANUAL FOAM RELEASE - TANK 1																	
MANUAL FOAM RELEASE - TANK 2				MANUAL FOAM RELEASE - TANK 1																	
				MANUAL FOAM RELEASE - TANK 2																	
MANUAL FOAM RELEASE - TANK 3				MANUAL FOAM RELEASE - TANK 2																	
				MANUAL FOAM RELEASE - TANK 3																	
MANUAL FOAM RELEASE - TANK 4				MANUAL FOAM RELEASE - TANK 3																	
				MANUAL FOAM RELEASE - TANK 4																	
MANUAL FOAM RELEASE - TANK 5				MANUAL FOAM RELEASE - TANK 4																	
				MANUAL FOAM RELEASE - TANK 5																	
MANUAL FOAM RELEASE - TANK 6				MANUAL FOAM RELEASE - TANK 5																	
				MANUAL FOAM RELEASE - TANK 6																	
BUILDING WET SYSTEM WATERFLOW				MANUAL FOAM RELEASE - TANK 6																	
				BUILDING WET SYSTEM WATERFLOW																	
ROOM LOW TEMP SWITCH				BUILDING WET SYSTEM WATERFLOW																	
				ROOM LOW TEMP SWITCH																	
TANK 1				ROOM LOW TEMP SWITCH																	
				LINEAR HEAT DETECTOR ACTIVE																	
TANK 2				LINEAR HEAT DETECTOR ACTIVE																	
				MANUAL FOAM RELEASE STATION ACTIVE																	
TANK 3				MANUAL FOAM RELEASE STATION ACTIVE																	
				LINEAR HEAT DETECTOR ACTIVE																	
TANK 4				LINEAR HEAT DETECTOR ACTIVE																	
				MANUAL FOAM RELEASE STATION ACTIVE																	
TANK 5				LINEAR HEAT DETECTOR ACTIVE																	
				MANUAL FOAM RELEASE STATION ACTIVE																	
TANK 6				LINEAR HEAT DETECTOR ACTIVE																	
				MANUAL FOAM RELEASE STATION ACTIVE																	
PUMP BASIN				LINEAR HEAT DETECTOR ACTIVE																	
				MONITOR MANUAL FOAM RELEASE STATION ACTIVE																	
CH4 OR H2S DETECTOR LOW ALARM				MONITOR MANUAL FOAM RELEASE STATION ACTIVE																	
				CH4 OR H2S DETECTOR LOW ALARM																	
CH4 OR H2S DETECTOR HIGH ALARM				CH4 OR H2S DETECTOR LOW ALARM																	
				CH4 OR H2S DETECTOR HIGH ALARM																	

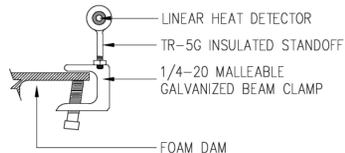
1 STORAGE AREA 300 SEQUENCE OF EVENTS
0300-FA-002 SCALE: NONE



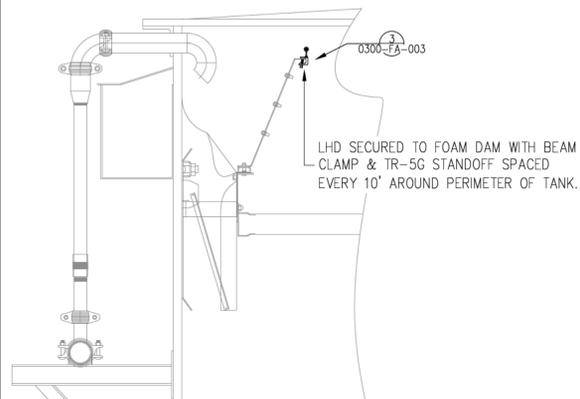
PRELIMINARY, NOT FOR CONSTRUCTION

						PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL PORT OF VANCOUVER, WASHINGTON		DESIGN: J. Pahlow DRAWN: J. Pahlow CHECKED: S. Durlfänger		START DATE: 06/19/2013 PRINT DATE: 01/31/2014 APPROVED: J. Poole		SCALE: As-Noted PROJECT MANAGER: S. Durlfänger SIZE: 24x36	
E 07-14-14 D 01-31-14 C 10-25-13 B 08-04-13		JCPSEDJWP JCPSEDJWP JCPSEDJWP JCPSEDJWP		THIS DRAWING CONTAINS PROPRIETARY AND PRIVILEGED INFORMATION OF TESORO SAVAGE PETROLEUM LLC AND SHALL NOT BE DISCLOSED OR USED FOR THE BENEFIT OF OTHERS WITHOUT PRIOR WRITTEN PERMISSION OF THE DRAWING OWNER. CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL		DESCRIPTION: STORAGE AREA FIRE & GAS DETECTION AND ALARM		DRAWING NUMBER: 0300-FA-002		SHEET: 1 REV: 1		E	

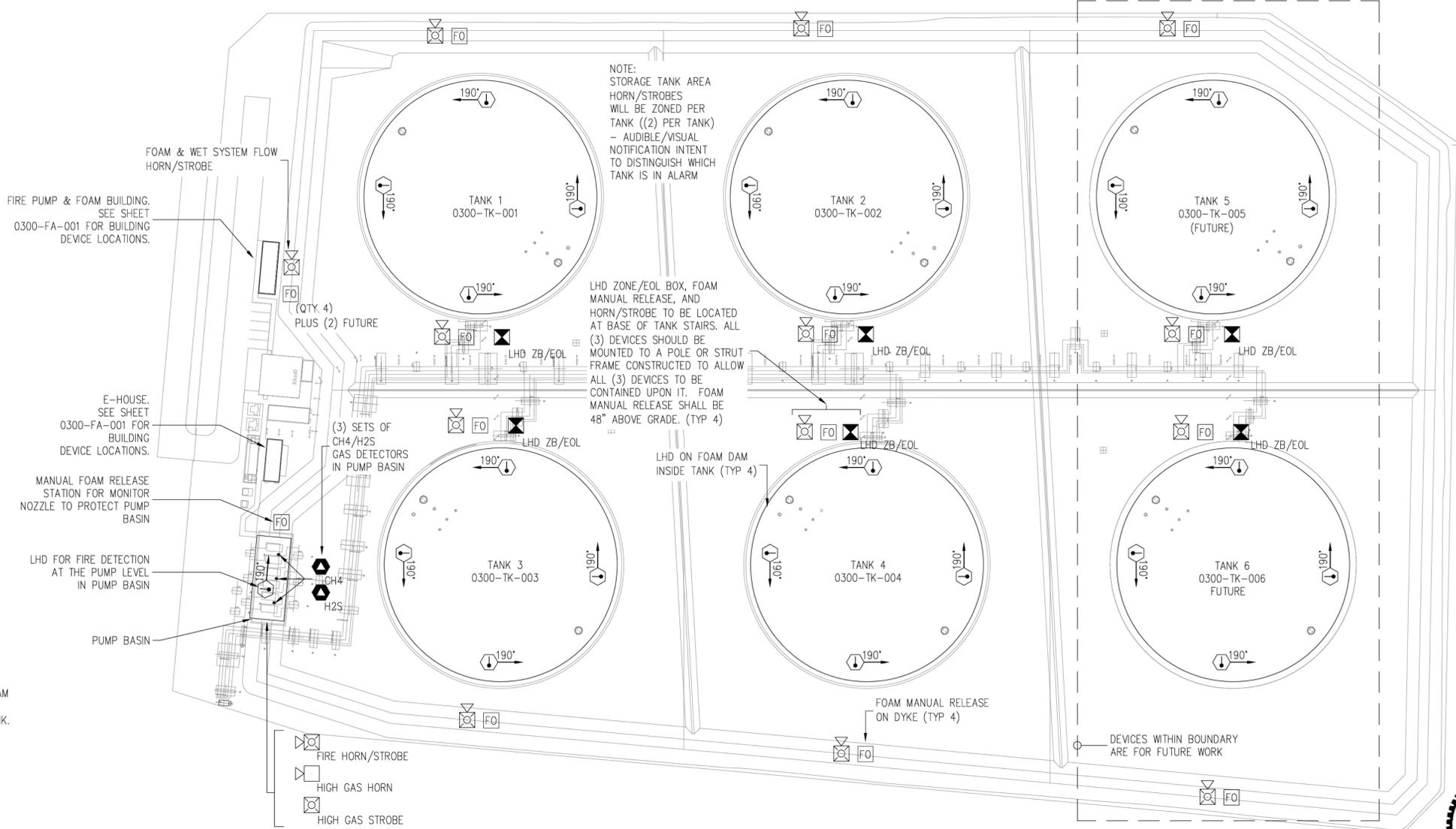
- HAZARDOUS CLASSIFICATION NOTES:
1. DEVICES WITHIN THE FIRE PUMP/FOAM SKID ARE NOT WITHIN A CLASSIFIED AREA.
 2. DEVICES IN E-HOUSE ARE NOT WITHIN A CLASSIFIED AREA.
 3. TANK INTERIOR IS CLASS 1 DIV 1
 4. DEVICES WITHIN PUMP BASIN ARE IN CLASS 1 DIV 1 AREA.
 5. ALL OTHER DEVICES ARE WITHIN A CLASS 2 DIV 2 AREA.
 6. SEE ICPE DWGS. 0300-ED-58 THRU 0300-ED-60.



3 LHD MOUNTING DETAIL
0300-FA-003 SCALE: NONE



2 LHD ON FOAM DAM
0300-FA-003 SCALE: NONE



1 TYPICAL STORAGE AREA DEVICE LOCATIONS
0300-FA-003 SCALE: 1/16" = 1'-0"

NOTE:
STORAGE TANK AREA HORN/STROBES WILL BE ZONED PER TANK ((2) PER TANK) - AUDIBLE/VISUAL NOTIFICATION INTENT TO DISTINGUISH WHICH TANK IS IN ALARM

LHD ZONE/EOL BOX, FOAM MANUAL RELEASE, AND HORN/STROBE TO BE LOCATED AT BASE OF TANK STAIRS. ALL (3) DEVICES SHOULD BE MOUNTED TO A POLE OR STRUT FRAME CONSTRUCTED TO ALLOW ALL (3) DEVICES TO BE CONTAINED UPON IT. FOAM MANUAL RELEASE SHALL BE 48" ABOVE GRADE. (TYP 4)

- FIRE HORN/STROBE
- HIGH GAS HORN
- HIGH GAS STROBE



PRELIMINARY, NOT FOR CONSTRUCTION

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B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP

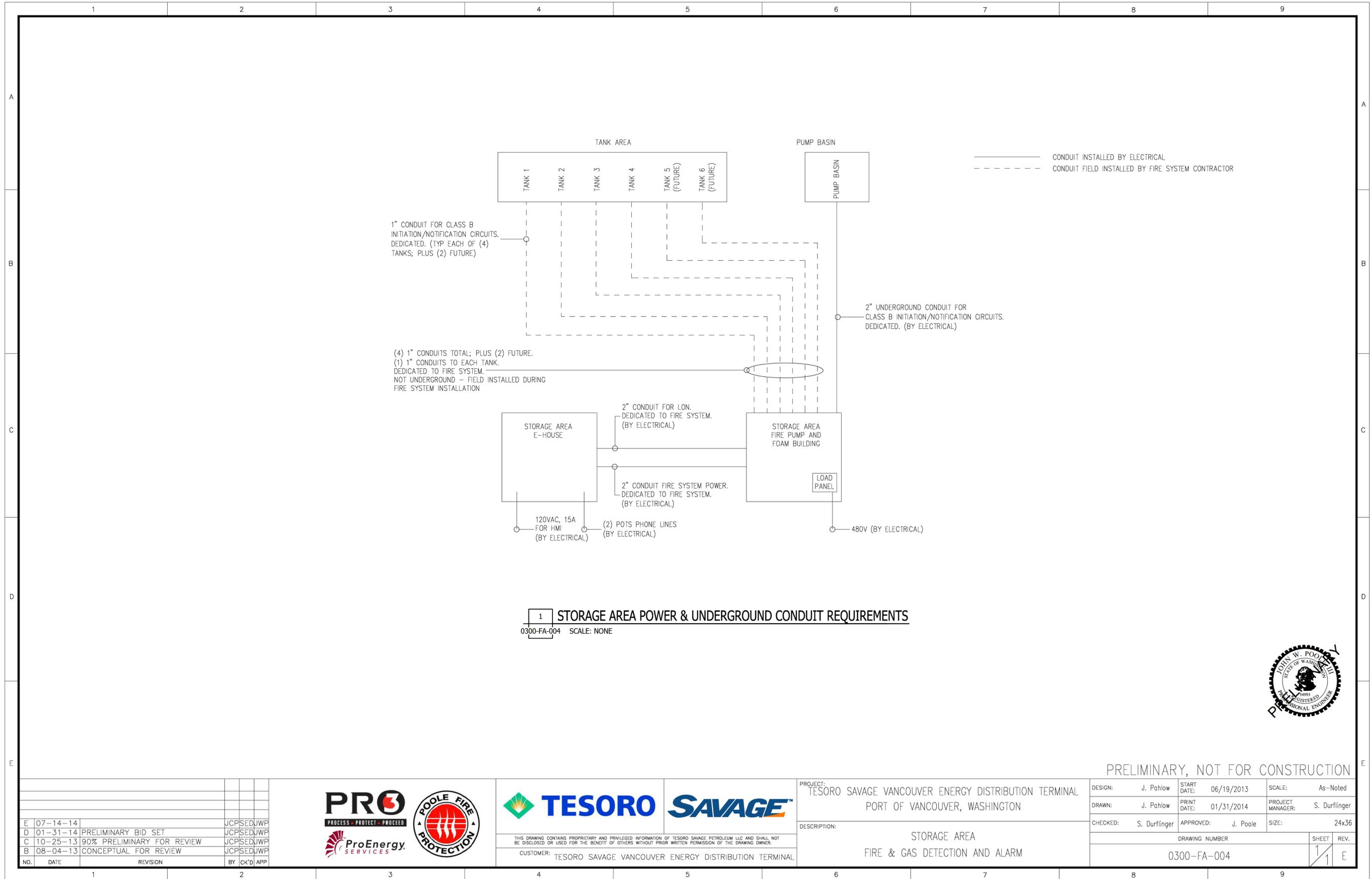


PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: STORAGE AREA
FIRE & GAS DETECTION AND ALARM

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

DESIGN:	J. Pahlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pahlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durlfing
CHECKED:	S. Durlfing	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0300-FA-003				1	E



1 STORAGE AREA POWER & UNDERGROUND CONDUIT REQUIREMENTS
0300-FA-004 SCALE: NONE



PRELIMINARY, NOT FOR CONSTRUCTION

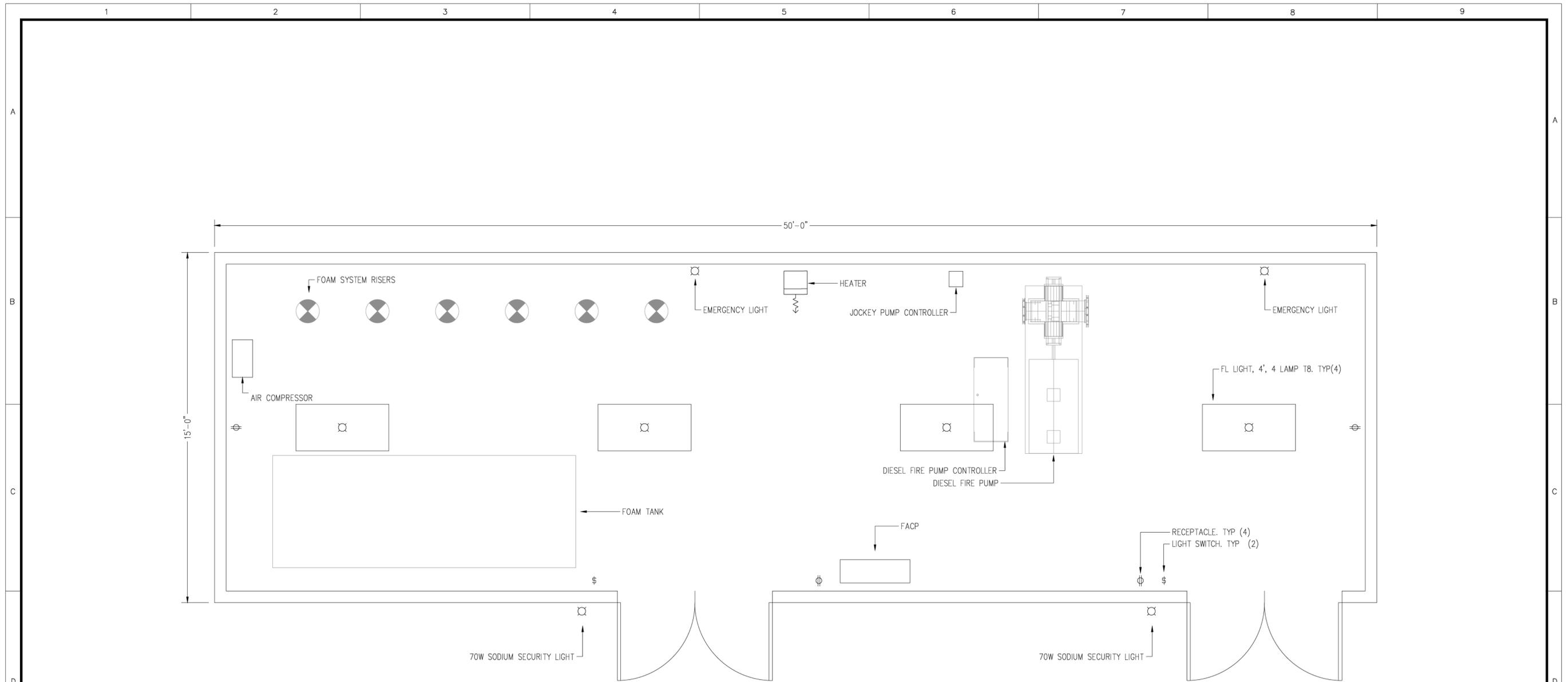
NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
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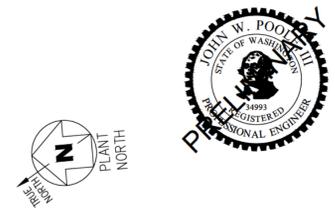
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: STORAGE AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pahlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pahlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durlfänger
CHECKED:	S. Durlfänger	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0300-FA-004				1	1



1 TYPICAL FIRE PUMP AND FOAM BUILDING ELECTRICAL LAYOUT
 0300-FA-005 SCALE: 1/2" = 1'-0"



PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP



PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON
 DESCRIPTION: STORAGE AREA
 FIRE & GAS DETECTION AND ALARM
 CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

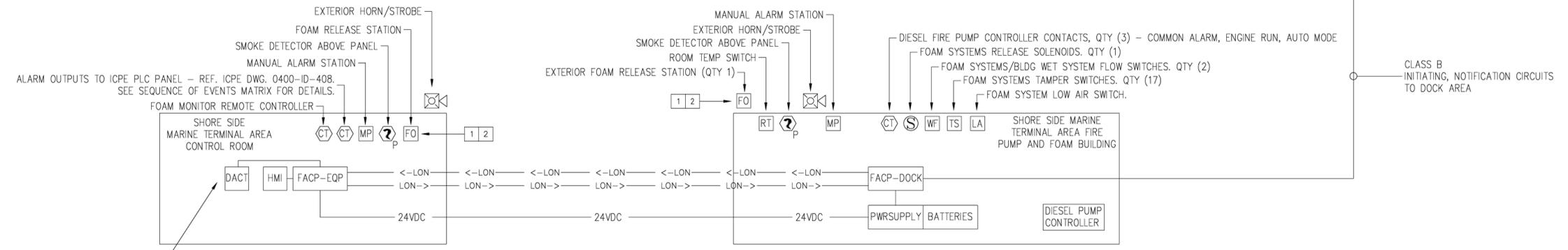
DESIGN: J. Pahlow	START DATE: 06/19/2013	SCALE: As-Noted
DRAWN: J. Pahlow	PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durlfänger
CHECKED: S. Durlfänger	APPROVED: J. Poole	SIZE: 24x36
DRAWING NUMBER: 0300-FA-005		SHEET: 1/1
		REV. E

MARINE TERMINAL AREA WITH (1) FOAM WATER ZONE
SEE DRAWING 0400-FA-003 FOR DEVICE LOCATIONS

MARINE TERMINAL AREA

- FOAM RELEASE SHORE SIDE
- FOAM RELEASE ON UPPER CRANE PLATFORM
- FOAM RELEASES (2) NEAR MONITORS
- FOAM RELEASE NEAR BOTTOM OF TOWER STAIRS
- HORN/STROBE ON UPPER CRANE PLATFORM
- HORN/STROBES (2) ON DOCK LEVEL
- FOAM MONITOR REMOTE CONTROL CONTACTS (2)

- 1 A PROTECTIVE COVER THAT IS REQUIRED TO BE LIFTED TO ACCESS MANUAL FOAM RELEASE SHALL BE USED.
- 2 SIGNAGE SHALL BE PROVIDED LABELING THIS DEVICE AS A FOAM RELEASE STATION FOR REMOTE CONTROLLED ELEVATED MONITOR NOZZLES ON DOCK.



DIGITAL ALARM COMMUNICATOR TRANSMITTER:
FOR SUPERVISING STATION REPORTING.
(2) SEPARATE PHONE LINES, EACH WITH ITS OWN PHONE
NUMBER, CONNECTED DIRECTLY TO THE PUBLIC SWITCHED
TELEPHONE SYSTEM REQUIRED (BY ELECTRICAL)



1 MARINE TERMINAL AREA PRELIMINARY DEVICE LOCATIONS
0400-FA-001 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

						PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL PORT OF VANCOUVER, WASHINGTON		DESIGN: J. Pahlow START DATE: 06/19/2013 SCALE: As-Noted	
		<small>THIS DRAWING CONTAINS PROPRIETARY AND PRIVILEGED INFORMATION OF TESORO SAVAGE PETROLEUM LLC AND SHALL NOT BE DISCLOSED OR USED FOR THE BENEFIT OF OTHERS WITHOUT PRIOR WRITTEN PERMISSION OF THE DRAWING OWNER.</small>		CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL		DESCRIPTION: MARINE TERMINAL AREA FIRE ALARM		DRAWN: J. Pahlow PRINT DATE: 01/31/2014 PROJECT MANAGER: S. Durflinger	
E 07-14-14 D 01-31-14 PRELIMINARY BID SET C 10-25-13 90% PRELIMINARY FOR REVIEW B 08-04-13 CONCEPTUAL FOR REVIEW		JCPSEDJWP JCPSEDJWP JCPSEDJWP JCPSEDJWP		NO. DATE REVISION BY CK'D APP		CHECKED: S. Durflinger APPROVED: J. Poole DRAWING NUMBER: 0400-FA-001		SIZE: 24x36 SHEET: 1/1 REV. E	

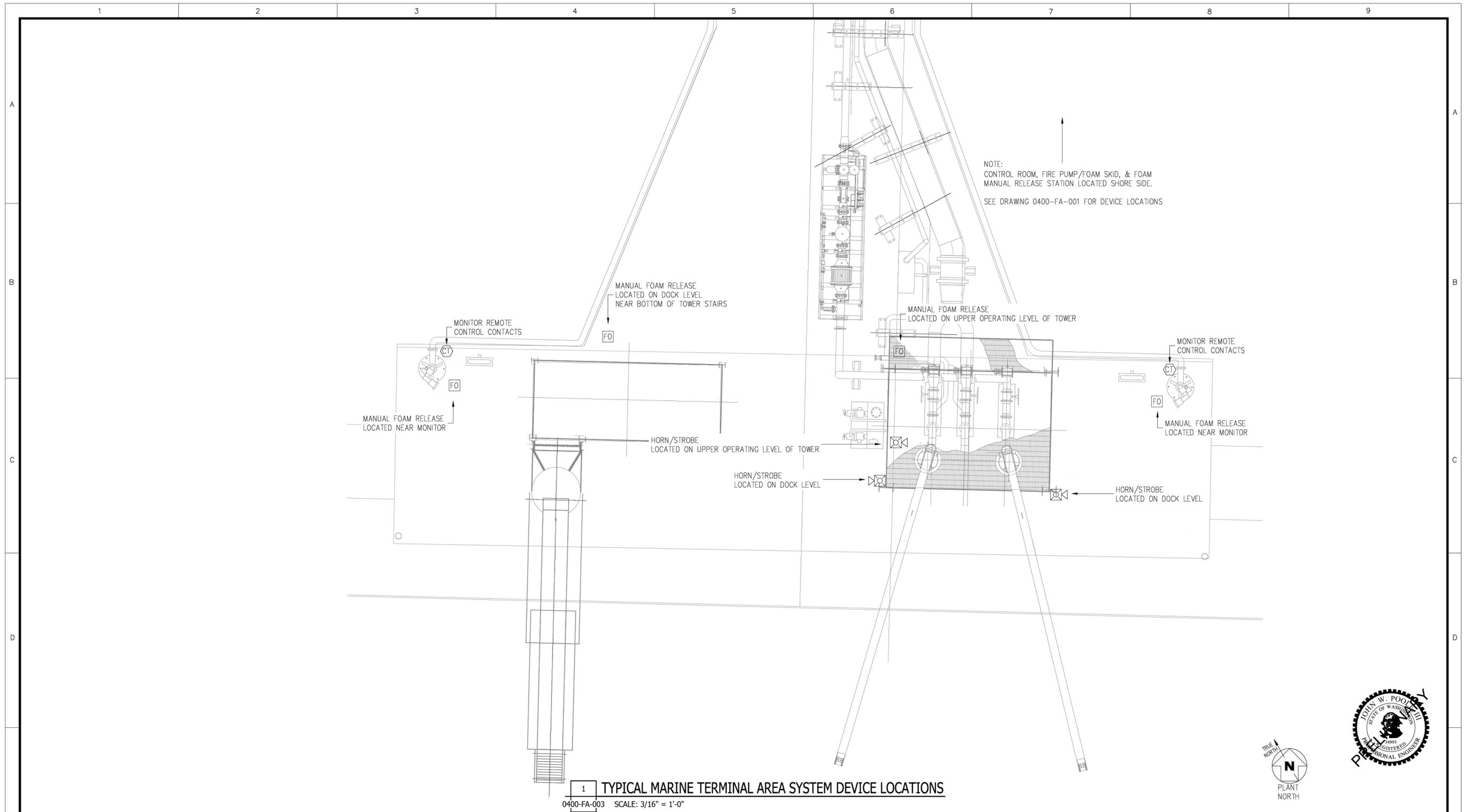
MARINE TERMINAL SEQUENCE OF EVENTS	OUTPUT	SOUND PANEL AUDIBLE (FIRE)	SOUND PANEL AUDIBLE (TROUBLE)	SOUND PANEL AUDIBLE (SUPERVISORY)	SOUND PANEL AUDIBLE (LOW GAS)	SOUND PANEL AUDIBLE (HIGH GAS)	SILENCE ALL HORN/STROBES	SILENCE PANEL	CONTROL ROOM	ACTIVATE EXTERIOR HORN/STROBES	DISPLAY INFO ON HMI	FIRE PUMP/FOAM BUILDING	ACTIVATE EXTERIOR HORN/STROBE	ACTIVATE SOLENOID - FOAM WATER	DOCK AREA	ACTIVATE HORN/STROBES	RELAY OUTPUTS TO PLANT PLC	GENERAL FIRE ALARM SIGNAL	GENERAL TROUBLE SIGNAL	GENERAL SUPERVISORY SIGNAL	{SPARE}	{SPARE}	{SPARE}	ESD1	ESD2	DIGITAL ALARM COMMUNICATOR TRANSMITTER	ALARM OUTPUT TO SUPERVISING STATION
INPUT																											
PANEL FIRE ALARM		X								X							X									X	
PANEL TROUBLE ALARM			X							X								X								X	
PANEL SUPERVISORY ALARM				X						X								X								X	
PANEL SILENCE BUTTON							X																				
PANEL ACKNOWLEDGE BUTTON								X																			
CONTROL ROOM																											
FACP-EQP PANEL ANY TROUBLE/FAULT			X							X								X									
MANUAL ALARM STATION		X								X	X							X									
SMOKE DETECTOR ABOVE PANEL			X							X	X							X									
MANUAL FOAM RELEASE		X								X		X	X		X		X						X	X			
FIRE PUMP AND FOAM BLDG																											
FACP-TANKS PANEL ANY TROUBLE/FAULT			X							X								X									
FIREPUMP CONTROLLER OUTPUTS				X						X								X									
MANUAL ALARM STATION		X								X		X						X									
SMOKE DETECTOR ABOVE PANEL			X							X	X							X									
TAMPER SWITCHES - (QTY 17)				X						X								X									
FOAM SYSTEM LOW AIR SWITCH				X						X								X									
FOAM WATER FLOW		X								X		X			X		X				X		X	X			
MANUAL FOAM RELEASE		X								X		X	X		X		X						X	X			
BUILDING WET SYSTEM WATERFLOW		X								X		X					X										
ROOM LOW TEMP SWITCH				X						X								X									
MARINE TERMINAL AREA																											
MANUAL FOAM RELEASE		X								X		X	X		X		X						X	X			

1 MARINE TERMINAL AREA 400 SEQUENCE OF EVENTS
 0400-FA-002 SCALE: NONE



PRELIMINARY, NOT FOR CONSTRUCTION

						PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL PORT OF VANCOUVER, WASHINGTON		DESIGN: J. Pahlow DRAWN: J. Pahlow CHECKED: S. Durlfänger		START DATE: 06/19/2013 PRINT DATE: 01/31/2014 APPROVED: J. Poole		SCALE: As-Noted PROJECT MANAGER: S. Durlfänger SIZE: 24x36	
E 07-14-14 D 01-31-14 PRELIMINARY BID SET C 10-25-13 90% PRELIMINARY FOR REVIEW B 08-04-13 CONCEPTUAL FOR REVIEW		JCPSEDJWP JCPSEDJWP JCPSEDJWP JCPSEDJWP		THIS DRAWING CONTAINS PROPRIETARY AND PRIVILEGED INFORMATION OF TESORO SAVAGE PETROLEUM LLC AND SHALL NOT BE DISCLOSED OR USED FOR THE BENEFIT OF OTHERS WITHOUT PRIOR WRITTEN PERMISSION OF THE DRAWING OWNER. CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL		DESCRIPTION: MARINE TERMINAL AREA FIRE ALARM		DRAWING NUMBER: 0400-FA-002		SHEET: 1 REV: 1		E	



1 TYPICAL MARINE TERMINAL AREA SYSTEM DEVICE LOCATIONS
0400-FA-003 SCALE: 3/16" = 1'-0"

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NO.	DATE	REVISION	BY	CHK'D	APP
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C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP

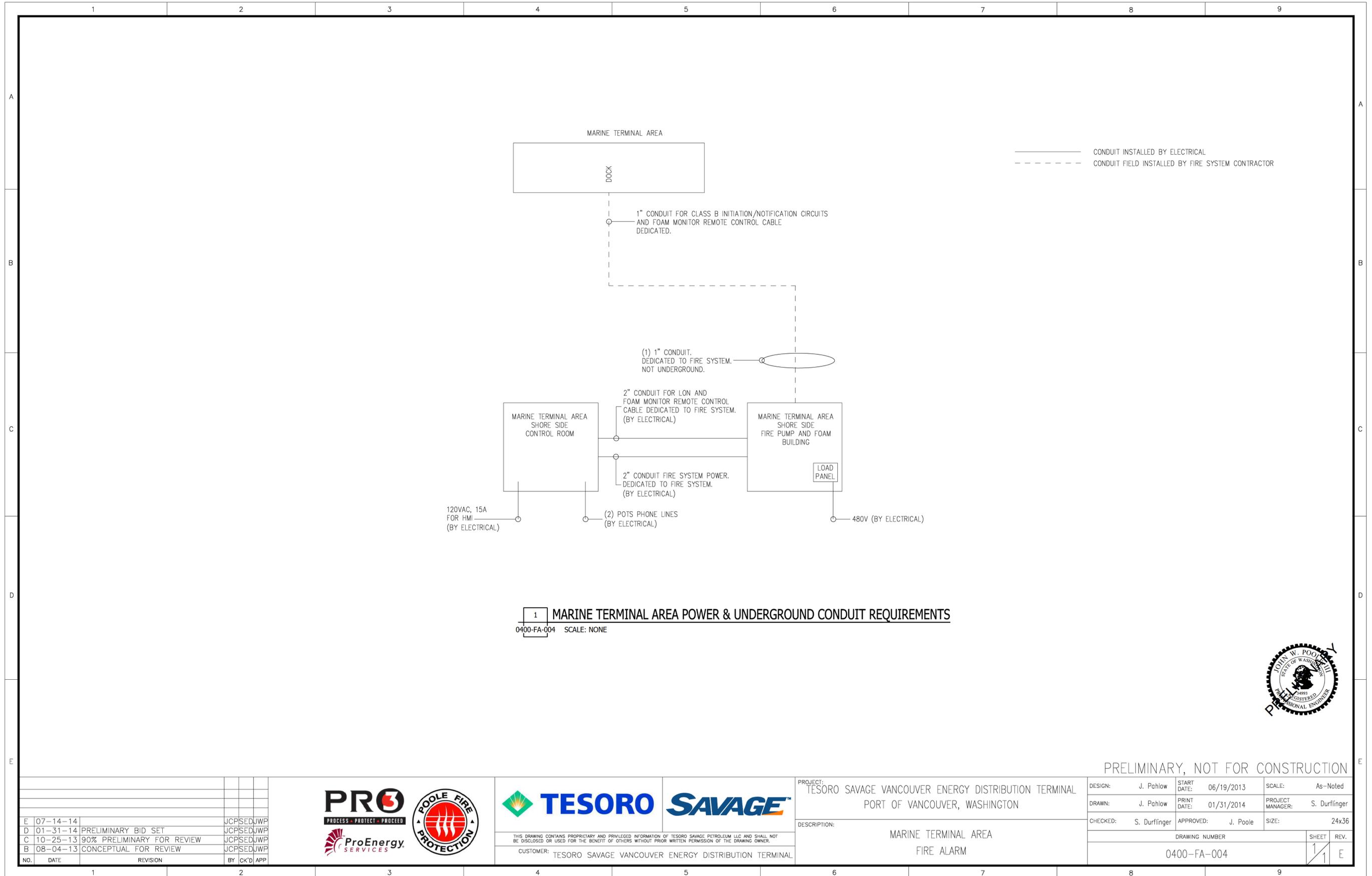


PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: MARINE TERMINAL AREA
FIRE ALARM

DESIGN:	J. Pahlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pahlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durlfänger
CHECKED:	S. Durlfänger	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0400-FA-003				1	1





1 MARINE TERMINAL AREA POWER & UNDERGROUND CONDUIT REQUIREMENTS
 0400-FA-004 SCALE: NONE



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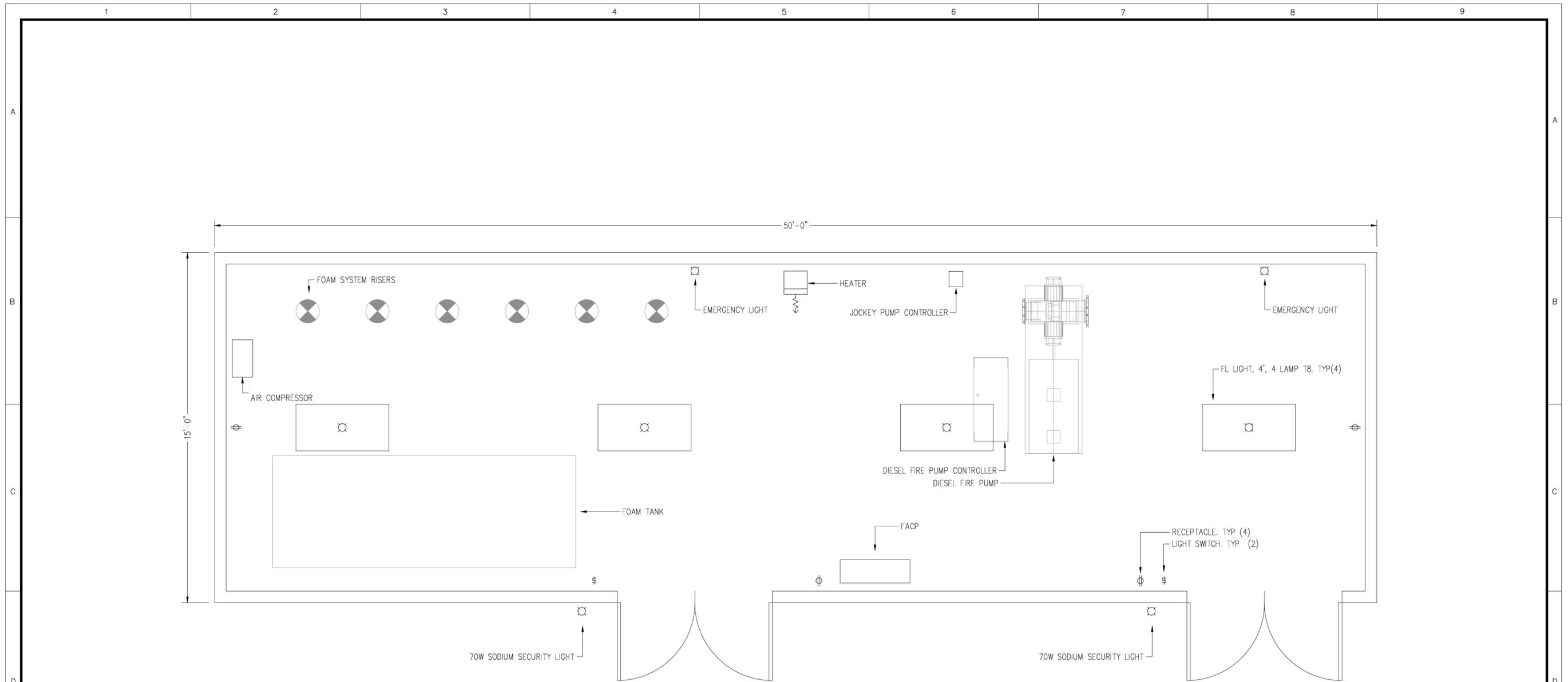
NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
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B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP



PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: MARINE TERMINAL AREA
 FIRE ALARM

DESIGN: J. Pahlow	START DATE: 06/19/2013	SCALE: As-Noted
DRAWN: J. Pahlow	PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durlfing
CHECKED: S. Durlfing	APPROVED: J. Poole	SIZE: 24x36
DRAWING NUMBER: 0400-FA-004		SHEET: 1
		REV. 1 E



1 TYPICAL FIRE PUMP AND FOAM BUILDING ELECTRICAL LAYOUT
 0400-FA-005 SCALE: 1/2" = 1'-0"

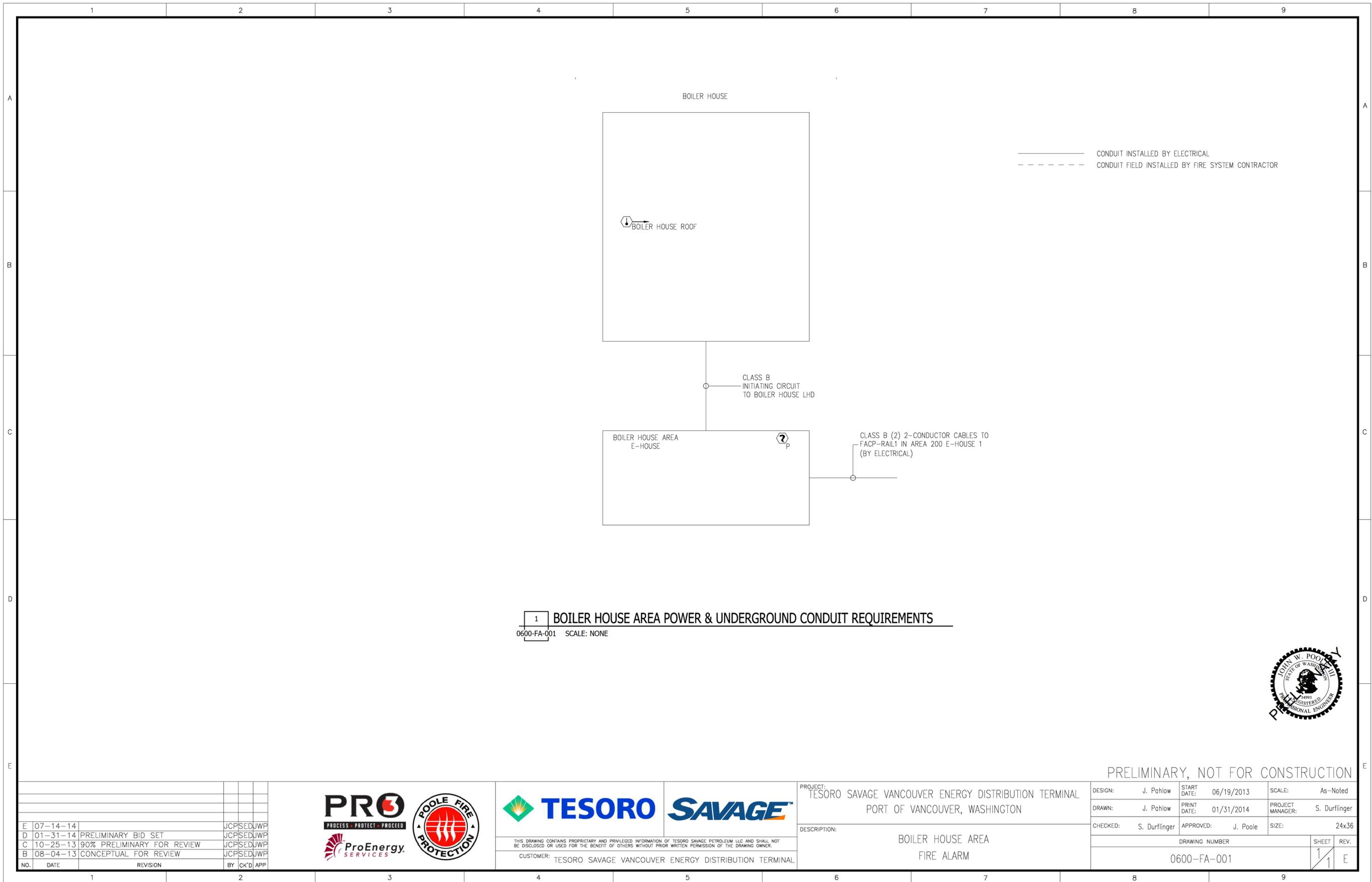


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D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP



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DRAWING NUMBER				SHEET	REV.
0400-FA-005				1	1



1 BOILER HOUSE AREA POWER & UNDERGROUND CONDUIT REQUIREMENTS
 0600-FA-001 SCALE: NONE



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NO.	DATE	REVISION	BY	CHK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	JCP	SED	JWP
B	08-04-13	CONCEPTUAL FOR REVIEW	JCP	SED	JWP



PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
 PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: BOILER HOUSE AREA
 FIRE ALARM

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

DESIGN:	J. Pahlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pahlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0600-FA-001				1	1

SEE AREA 200 SEQUENCE OF EVENTS, SHEET 0200-FA-002
FOR INPUT/OUTPUT EFFECTS OF AREA 600 E-HOUSE AND BOILER BUILDING DETECTION SYSTEM.

1 BOILER BUILDING AREA 600 SEQUENCE OF EVENTS
0600-FA-002 SCALE: NONE



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E		07-14-14		JCP	SED	JWP	DESIGN: J. Pahlow		START DATE: 06/19/2013	SCALE: As-Noted
D		01-31-14		JCP	SED	JWP	DRAWN: J. Pahlow		PRINT DATE: 01/31/2014	PROJECT MANAGER: S. Durlfänger
C		10-25-13		JCP	SED	JWP	CHECKED: S. Durlfänger		APPROVED: J. Poole	SIZE: 24x36
B		08-04-13		JCP	SED	JWP	DRAWING NUMBER		SHEET	REV.
A		1		REVISION		BY	0600-FA-002		1	1



PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: BOILER HOUSE AREA
FIRE ALARM

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

Fire Suppression Hydraulic Analysis

Tesoro Savage Vancouver Energy Distribution Terminal Port of Vancouver, Washington

Submitted: July 14, 2014

Poole Fire Protection

19910 West 161st Street
Olathe, Kansas 66062
www.poolefire.com

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Appendix A – Railcar Unloading Building Calculation

Appendix B – Storage Area Calculation

Appendix C – Marine Terminal Area Calculation

Appendix D – Flow Test Reports

Chapter 1 - Scope

1.1 Purpose

The objective of this report is to define key components and establish design criteria associated with the fire water system, as well as to document preliminary worst-case, but credible, hydraulic demand scenarios for these systems. This report presents basic calculated hydraulic demands for three (3) separate scenarios to address hazard events in the following new facility areas: Area 200 – Unloading and Office Area, Area 300 – Storage Area and Area 400 – Marine Terminal Area, in addition to outlining performance criteria associated with fire water equipment specified for the facility. The report is based on current information available at the time it was developed.

1.2 Code References

Per the direction of the Project Design-Build Team, FM Global is the primary insurance Authority for this project. The City of Vancouver Building Department and Fire Department and the Port Authority are considered as the overall Authority Having Jurisdiction. The versions of the following codes and standards were employed in this analysis:

FM Global Property Loss Prevention Data Sheets (FMDS):

- FMDS 3-0, *Hydraulics for Fire Protection Systems*, March 2010
- Factory Mutual Data Sheet 3-26, *Fire Protection Water Demand for Nonstorage Sprinklered Properties*, July 2011
- FMDS 4-0, *Special Protection Systems*, April 2012
- FMDS 4-7N, *Low Expansion Foam Systems*, September 2010, (Interim Revision January 2013)
- FMDS 4-12, *Foam-Water Sprinkler Systems*, October 2011, (Interim Revision January 2013)
- FMDS 7-32, *Ignitable Liquid Operations*, April 2012
- FMDS 7-88, *Flammable Liquid Storage Tanks*, October 2011

National Fire Protection Codes and Standards:

- NFPA 10, *Standard for Portable Fire Extinguishers*, 2010 Edition
- NFPA 11, *Standard for Low-, Medium-, and High Expansion Foam*, 2010 Edition
- NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010 Edition
- NFPA 15 *Standard for Water Spray Fixed Systems for Fire Protection*, 2012 Edition
- NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2011 Edition
- NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2010 Edition

- NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2010 Edition
- NFPA 30, *Flammable and Combustible Liquids Code*, 2012 Edition
- NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves*, 2011 Edition

Chapter 2 - Existing Project Conditions

2.1 Project Conditions

This project consists of the design and construction of new crude oil unloading and storage facilities at the terminal facility located in the City of Port of Vancouver, Clark County, Washington. This project includes a railcar unloading building, crude oil storage tanks and a dock loading area. Each of the three specific project areas are not at contiguous locations; however, they are in the same general vicinity. There is also crude oil piping that is located above grade that transfers the crude for the unloading area, the storage area, and then from the storage area to the marine terminal area.

2.2 Existing Water Supply

Currently the site has existing city water mains, both from the City of Vancouver and the Port of Vancouver which provides both fire water and potable water for service to the general area. The City of Vancouver water service was chosen to be used in the design since they have water distribution systems available at areas 200, 300 and 400. As well as, their water source is deemed to be reliable. The following data summarizes the capacity of the existing system at each specific location and is based on flow test data provided to Poole Fire Protection from the City of Vancouver and Port of Vancouver (refer to Appendix D):

Railcar Unloading Area

- ❖ Static Pressure: 50 psi
- ❖ Residual pressure: 20 psi
- ❖ Flow: 2,500 gpm
- ❖ Test results are from historical information

Storage Area

- ❖ Static Pressure: 84 psi
- ❖ Residual pressure: 63 psi
- ❖ Flow: 2,005 gpm
- ❖ Data from flow test performed by City of Vancouver on 5-30-2013
- ❖ Test was on the City of Vancouver's water system.
- ❖ On 5-28-13 an additional flow test was conducted by FM Global on the Port of Vancouver's system. These results were not incorporated in our analysis, but are being provided for informational purposes.
 - Static Pressure: 118 psi, Residual Pressure: 70 psi, Flow: 1763 gpm.

Marine Terminal Area

- ❖ Static Pressure: 81 psi
- ❖ Residual pressure: 62 psi
- ❖ Flow: 2,127 gpm
- ❖ From flow test performed by City of Vancouver on 5-30-2013
- ❖ Test was on the City of Vancouver's water system.

2.3 General Assumption(s)

The following general assumptions have been incorporated in this analysis:

- The water supply capacities of existing systems will not be reduced in the future.
- Existing municipal water supply can meet the required duration time for system operation.
- Fire protection water storage/suction tank(s) are not necessary.
- The worst-case crude oil product to be handled at this site has a closed-cup flash point of 94°F.
- Fire detection, releasing devices and alarm system will comply with NFPA 72, 2013 Edition.
- Proper building/tank separations will be provided in accordance with IBC requirements.
- A reserve supply of foam concentrate will be provided on site and be sufficient to replenish the largest concentrate demand.
- Proper fire barriers/walls will be provided where required as required by IBC standard.
- Electrical power to the site is not considered reliable as defined by NFPA 20.
- City water supply has substantial pressure to warrant the installation of a bypass line around the fire pump. This will ensure that some water will always get to the suppression system if the pump is out of service.
- New underground waterlines are of AWWA approved materials.

Chapter 3 - Railcar Unloading Building Area

3.1 Design Scenario and Assumptions

The Railcar Unloading Building is proposed to be protected with a single interlocked closed-head foam-water preaction sprinkler system per FMDS 7-32, Paragraph 2.4.8.1. This system will be supplied from the City of Vancouver water distribution system. The City water supply will be supplemented with a 2,000 gpm fire pump rated for 125 psi. The building which is approximately 90 ft x 1,834 ft, will be protected by five separate systems/zones of equal size. Sprinklers will also be provided below the catwalks and egress walkways as required to meet the intent of NFPA 13. The pump pits located below the open grating between the track in the Railcar Unloading Building will also be provided with sprinklers supplied from the same closed-head foam-water preaction system that serves that respective system/zone of the building. System activation will include the system over the fire incident along with the system(s) adjacent to the target system. Note that this system is a closed-head preaction system so foam-water solution will not discharge from the system until each sprinkler receives sufficient heat to activate, at which time the foam-water solution will be discharged. Automatic activation of the preaction system solenoid valve, allowing water to enter the piping system, will be provided through linear heat detection. The preaction system piping will remain dry (air only) until the fire trips the linear detection system or a manual release system is activated.

A single row of fire hydrants will be provided outside the south side of the building. These hydrants will be spaced at intervals of 300 ft and be supplied from the City of Vancouver water distribution system. The design, installation and testing of the new underground water distribution system, including the hydrants, valves and sprinkler system lead-ins will comply with the requirements of NFPA 24.

A combination foam/pump house will be provided to house the required equipment for the fire suppression systems. This foam/pump house area will be separated from the remainder of the building with a minimum of 1 hour fire resistive construction (fully sprinklered) per NFPA 20, Section 4.12.1.1.2. Foam concentrate storage will be sized for a duration of 10 minutes (FMDS 7-32, Paragraph 2.4.8.1). A test header will be provided, which will also double as a forward flow backflow prevention assembly test connection.

The fire pump design, installation and testing will be in accordance with NFPA 20, and will be provided with a flow meter on a recirculation line piped back to the pump suction line as permitted by NFPA 20. An approved reduced pressure backflow prevention assembly will be installed on the suction side of the fire pump. There will be a total of six risers (five for the unloading structure and one for the foam/pump house). Also housed in the foam/pump house will be the diesel fuel storage tank, unit heater, fire alarm control panel, and foam concentrate storage tank.

Based upon the crude oil product being handled, a flash point of 94°F represents the most flammable product; therefore, a foam proportioning rate of 3% will be provided in a

solution that will be designed to deliver a density of 0.3 gpm/ft² over an operating area of 4,000 ft² and a supplemental exterior hose stream allowance of 500 gpm (FMDS 7-32, Paragraph 2.4.8.1) added at the source prior to the fire pump. From FMDS 4-12, Paragraph 2.3.1.4, the system shall deliver foam-water solution to the four most remote sprinklers within two minutes of sprinkler operation.

The following assumptions were taken into consideration:

- Adequate floor drainage will be provided.
- Potential spill release point is no more than 3 ft above the floor.
- Standard Spray Upright (SSU) sprinklers are to have a flow coefficient (K) of 8.0.
- Sprinklers will have a response characteristic of standard and possess a high temperature rating with each covering a maximum area of 100 ft² per sprinkler.
- A 12" diameter underground lead-in will be provided to supply the fire pump.
- The foam/pump house will be protected with wet pipe sprinkler system.
- A variable rate foam proportioner will be utilized.
- The maximum roof height will not exceed 40 ft. (FMDS 7-32, Table 3)
- Suction pressure is not to reduce below 20 psi.

3.2 Calculations

Preliminary Foam-Water sprinkler system demand (at pump discharge) is 1,390.6 gpm (see Appendix A). An additional 500 gpm hose stream is added at the source to the fire pump.

Pressure loss (at pump discharge) is 151.3 psi including a safety margin (see attached calculations). The total pressure required from the source supply is anticipated to be 32.1 psi.

Foam concentrate calculation, used to size the foam concentrate tank, is based upon a supply driven calculation without the hose stream allowance. This supply driven calculation reflects the worst case scenario and actual operating conditions for an automatic style system, which are governed by the available water supply. Based on this calculation (see Appendix A) the anticipated flow demand is 1,643 gpm. Based on the foam concentration calculation requirements of FM DS 4-12, Section 2.3.6.4.3, 1,643 gpm x 3% concentrate x 10 min. x 15% increase for proportioner, the total foam concentrate required is 567 gallons

3.3 Results Summary

The system foam-water solution demand is 1,390.6 gpm at 151.3 psi at the pump discharge. The estimated pump rating (2,000 gpm at 125 psi) is sufficient. The foam concentrate tank is to be sized to accommodate 567 gallons.

Chapter 4 - Storage Area

4.1 Design Scenario and Assumptions

The Storage Area currently consists of four tanks of 240 ft diameter x 48 ft tall tanks with room for two additional future tanks. All tanks are surrounded by a single large dike, with smaller dikes surrounding each tank. The tanks are fixed roof type with an internal floating roof. The suppression systems to be provided for the Storage Area will include automatic fixed foam system for the seal areas inside the perimeter of each tank and fire hydrants with monitor nozzles with foam eductors for exposure protection around the perimeter of the large diked area.

The fire water supply network will be fed by the City of Vancouver's water distribution system. The City's water distribution system will be supplemented by a diesel driven fire pump. All fire suppression equipment for the Storage Area, including the fire hydrants around the dike, will be supplied from the fire pump. The preliminary pump size will be 2,500 gpm at a rated pressure of 125 psi. A combination foam/pump house will be provided.

A combination foam/pump house will be provided to house the required equipment for the fire suppression systems. No buildings are adjacent to the foam/pump house, therefore separation from other buildings as per NFPA 20, Section 4.12.1.1.2, is not applicable. Foam concentrate storage for the seal protection system inside the tank will be sized for a duration of 10 minutes (FMDS 7-32, Paragraph 2.4.8.1). A test header will be provided, which will also double as a forward flow backflow prevention assembly test connection.

The fire pump design, installation and testing will be in accordance with NFPA 20, and will be provided with a flow meter on a recirculation line piped back to the pump suction line as permitted by NFPA 20. An approved reduced pressure backflow prevention assembly will be installed on the suction side of the fire pump. There will be a total of six risers (five for the unloading structure and one for the foam/pump house). Also housed in the foam/pump house will be the diesel fuel storage tank, unit heater, fire alarm control panel, jockey pump and foam concentrate storage tank.

A fire hydrant water loop around the dike will be installed per the requirements of NFPA 24. Fire main sizing will be based on flow velocity limitations not to exceed 15 feet-per-second (fps). Hydrants with monitor nozzles will be spaced around the main dike area where each tank can be reached with two monitor nozzle streams. The monitors will be spaced and sized so that they are able to reach the tanks at a distance of 200 feet. Minimum flow to two monitor nozzles for exposure protection is 750 gpm at a minimum pressure of 50 psi for each monitor (FMDS 7-88, Paragraph 2.3.3) and 1,250 gpm at a minimum pressure of 50 psi for the tank involved in fire, for a total demand of 2,750 gpm at minimum pressure of 50 psi.

Fixed foam-water fire suppression systems will provide internal tank protection for the seal area around the perimeter for each of the crude oil tanks. Two outlets, each with a valve and cap, will be provided in the pump house to supply the future tanks. These systems will be installed per the requirements of NFPA 11, *Standard for Low-, Medium-, and High Expansion Foam*.

The internal floating roof tanks will be protected by a Type II Discharge Outlet (i.e. foam chamber) which will deliver foam onto the burning liquid at the seal area of the floating roof. The foam makers will be supplied from piping that loops the exterior of the tank at the top, which in turn will have one supply from the fire pump. This foam-water fire suppression system will consist of a single interlocked preaction system, that will be activated by a linear heat detection system, also provided at the seal area of the floating roof or by the manual release stations located at the stair of each respective tank, at the top of the dike near each respective tank or at the foam/pump house.

The pump pit, which is not provided with a roof, located near the foam/pump house at the Storage Area, will be provided with a monitor nozzle that will be supplied by a foam-water system that will be designed to deliver a foam-water solution to the pump pit.

The following assumptions were utilized and includes as part of this analysis:

- Dike areas are of sufficient size and volume for spill containment.
- City of Vancouver water supply can meet the 4 hour duration requirement per FMDS 7-88, Paragraph 2.3.3.
- Tanks have a 12" tall foam dam at 12" from tank shell wall that will be designed as part of the floating roof to contain the foam-water solution.
- The tank system design is based on a minimum of 30 psi at the most remote foam maker.
- Water supply to the fire pump will be from the City of Vancouver system.

4.2 Calculations

Preliminary suppression system demand for the foam-water system for the crude oil storage tank is 3,025 gpm (see Appendix B), the 2,750 gpm for exposure protection is included in this calculation.

Pressure loss (at pump discharge) is 117.3 psi including a safety margin (see Appendix B). The total pressure required from the source supply is anticipated to be 9.75 psi.

Foam concentrate calculation for the tank is based upon a supply driven calculation. This supply driven calculation reflects the worst case scenario and actual operating conditions for an automatic style system, which are governed by the available water supply. Based on this calculation (see Appendix B) the anticipated flow demand for the foam suppression system only is 225 gpm. Based on the foam concentration

calculation requirements of FM DS 4-12, Section 2.3.6.4.3, 225 gpm x 3% concentrate x 10 min. x 15% increase for proportioner, the total foam concentrate required is 78 gallons.

The foam concentrate calculation for the crude oil pump pit is based on the required flow of 750 gpm at a duration for 30 minutes at 3% concentration. This requires a foam concentrate tank size of 675 gallons.

4.3 Results Summary

The system foam-water solution demand is 275 gpm at 109 psi at the discharge of the pump. The total system demand including the exposure protection is 3,025 gpm at 117.3 psi. The estimated pump rating (2,500 gpm at 125 psi) is sufficient. The foam concentrate tank is to be sized to accommodate 675 gal.

Chapter 5 - Marine Terminal Area

5.1 Design Scenario and Assumptions

There is an existing manual fire suppression system at the Marine Terminal Area. This will be removed and replaced with a new fire main supply line. The fire main supply line will be provided from the fire pump located in the combination fire pump/foam house, located shore side. The minimum pump size will be 2,000 gpm at a rated pressure of 125 psi.

Two remote controlled foam-water elevated monitor nozzles will be provided on the dock to cover the Marine Terminal Area. These monitors are not intended to provide coverage or fire suppression for a fire on the vessel. Activation of the monitor nozzles is through manual release stations only. Upon activation, foam-water will flow to both monitor nozzles. The monitor nozzles will be located at an elevation of ten feet above the dock to prevent obstructions from blocking the effective reach of the nozzle. Each nozzle will be designed to flow 750 gpm at a pressure of 100 psi for a total demand of 1,500 gpm with a 500 gpm hose allowance at the source to the fire pump, taking into consideration the recommendations of NFPA 30, Section A. 29.3.28.

Spacing of the monitor nozzles takes into account the limited space available on the dock. The monitor nozzles will be strategically located, taking into consideration the spacing requirements of NFPA 307, Section 7.2.

5.2 Calculations

Preliminary suppression system demand (at pump discharge) is 1,500 gpm (see Appendix C). An additional 500 gpm hose stream is added at the source to the fire pump.

Pressure loss (at pump discharge) is 114.2 psi including a safety margin (see Appendix C). The total pressure required from the source supply is anticipated to be 63.5 psi.

The foam concentrate calculation for the dock is based on the required flow of 1,500 gpm at a duration for 30 minutes at 3% concentration. This requires a foam concentrate tank size of 1,350 gallons which will be rounded up to 1,500 gallons.

5.3 Results Summary

The system foam-water solution demand is 1,500 gpm at 114.2 psi at the pump discharge. The estimated pump rating (2,000 gpm at 125 psi) is sufficient. The foam concentrate tank is to be sized to accommodate 1,500 gallons.

Chapter 6 - Results and Analysis

The largest overall calculated fire water supply flow is established by the crude oil tank storage area fire protection system. The crude oil storage tanks, combined with the hydrants for exposure protection, have the largest suppression system demand of 3,025 gpm at 117.3 psi.

The Marine Terminal Area loading area has the largest requirement for foam concentrate, which is 1,500 gallons, which is driven from the overall duration of flow, which is 30 minutes.

Based on the water supply data provided, the following pumps are recommended:

- 2,000 gpm at 125 psi for the Railcar Unloading Building area
- 2,500 gpm at 125 psi for the Storage Area
- 2,000 gpm at 125 psi for the Marine Terminal Area

The proposed fire pumps will be sufficient to supplement the City of Vancouver's existing water supply in feeding the new fire protection systems.

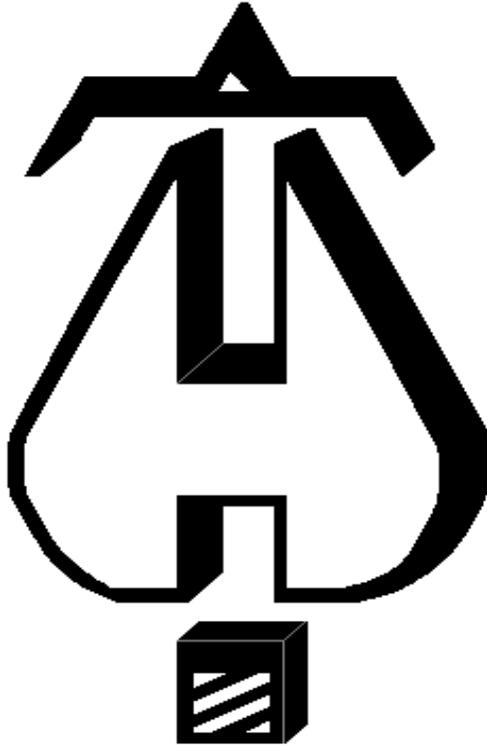
The fire protection systems as described in this report are recommended and will provide an acceptable level of protection at each facility.

APPENDIX A

Railcar Unloading Building Calculation

Hydraulic Analysis
Fire Protection

Poole Fire Protection



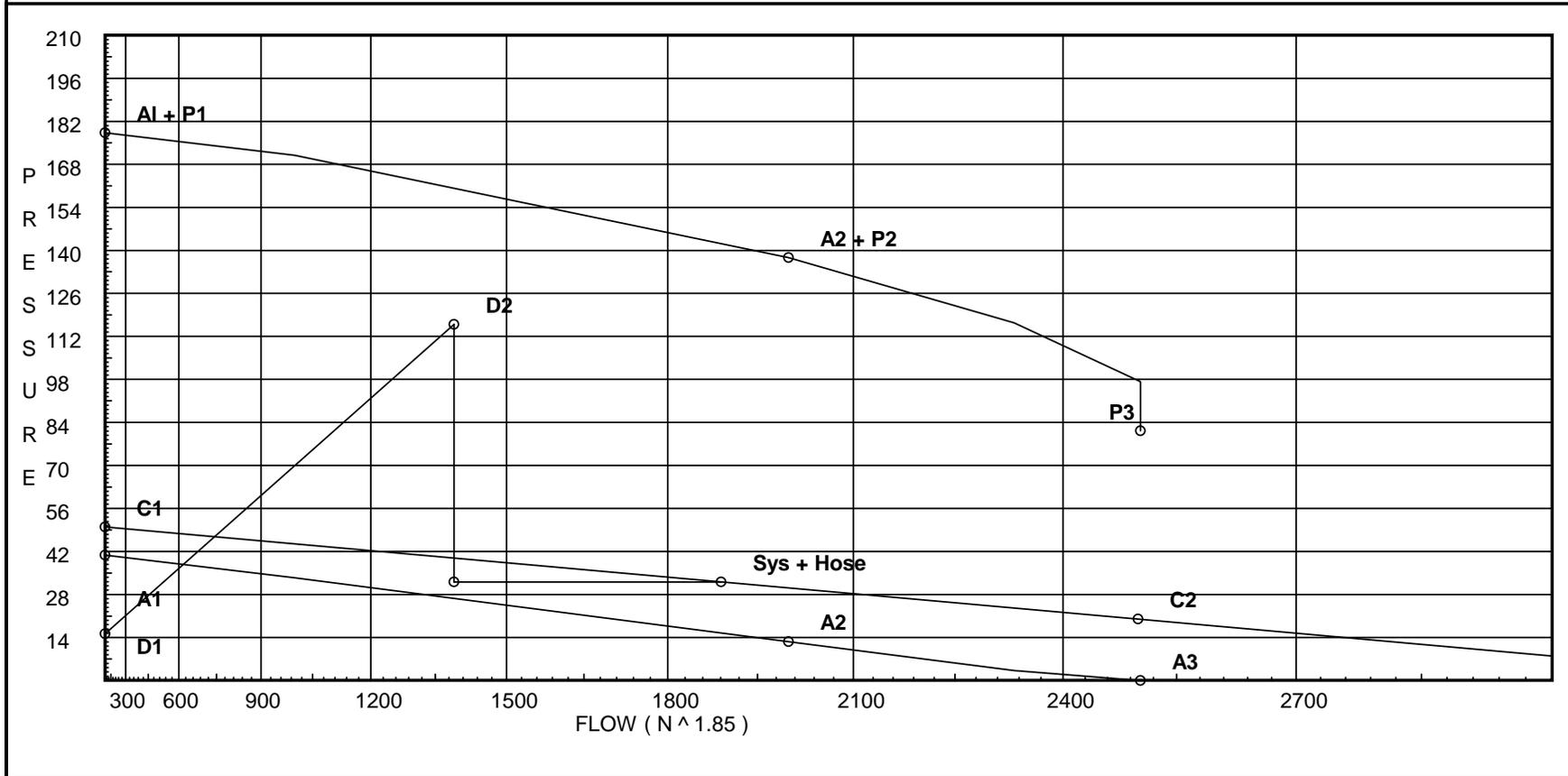
... **Fire Protection by Computer Design**

ProEnergy Services
2001 PorEnergy Blvd
Sedalia, MO 65301
660 829 5100

Job Name : Rail Unloading-R4
Drawing :
Location :
Remote Area :
Contract :
Data File : Rail Unloading-R4 Area .W XF

Water Supply Curve C

City Water Supply: C1 - Static Pressure : 50 C2 - Residual Pressure: 20 C2 - Residual Flow : 2500 City Water Adjusted to Pump Inlet for Pf - Elev - Hose Flow A1 - Adjusted Static: 40.800 A2 - Adj Resid : 12.69 @ 2000 A3 - Adj Resid : 0 @ 2503.18	Pump Data: P1 - Pump Churn Pressure : 137.5 P2 - Pump Rated Pressure : 125 P2 - Pump Rated Flow : 2000 P3 - Pump Pressure @ Max Flow : 81.25 P3 - Pump Max Flow : 2503.18 City Residual Flow @ 0 = 3295.02 City Residual Flow @ 20 = 2500.00 City Water @ 150% of Pump = 19.93 Pump flow terminated at adjusted curve 0 psi	Demand: D1 - Elevation : 15.210 D2 - System Flow : 1390.63 D2 - System Pressure : 115.931 Hose (Demand) : D3 - System Demand : 1390.63 Hose (Adj City) : 500 Safety Margin : 35.369
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Fittings Used Summary

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Fitting Legend		½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24	
Abbrev.	Name																					
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61	61
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13	13
L	NFPA 13 Long Turn Elbow	0.5	1	2	2	2	3	4	5	5	6	8	9	13	16	18	24	27	30	34	40	40
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121	121
Zie	Wilkins 375	Fitting generates a Fixed Loss Based on Flow																				

Units Summary

Diameter Units Inches
 Length Units Feet
 Flow Units US Gallons per Minute
 Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

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SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
PO	See Information on Pump Curve			151.3	1390.63	115.931
TEST	50.0	20	2500.0	32.108	1890.63	32.108

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
101	35.12	8	14.06	30.0	
102	34.7	8	14.59	30.55	
103	34.28	8	16.02	32.02	
104	33.87	8	18.95	34.83	
105	33.45	8	24.1	39.27	
106	30.1		38.51		
107	30.1		38.52		
108	30.1		38.56		
109	30.1		38.66		
110	30.1		38.83		
111	30.1		39.08		
112	30.1		39.43		
113	30.1		39.9		
114	30.1		40.51		
TOR	30.1		95.32		
BOR	1.5		114.23		
118	1.5		114.32		
PO	0.0		115.93		
PI	0.0		17.84		
119	1.5		17.37		
120	-6.0		30.69		
121	-6.0		31.55		
122	-6.0		34.04		
TEST	0.0		32.11		
HOSE	-6.0		-4.14	500.0	
123	33.43		27.82		
124	33.43		27.86		
125	33.43		27.93		
126	33.43		28.06		
127	33.43		28.25		
128	33.43		28.52		
129	33.43		28.87		
130	33.43		38.1		
131	35.12	8	14.07	30.01	
132	34.7	8	14.59	30.56	
133	34.28	8	16.03	32.03	
134	33.87	8	18.96	34.83	
135	33.45	8	24.11	39.28	
136	35.12	8	14.09	30.03	
137	34.7	8	14.61	30.58	
138	34.28	8	16.05	32.05	

Flow Summary - NFPA 2007

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NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
139	33.87	8	18.98	34.85	
140	33.45	8	24.14	39.3	
141	35.12	8	14.13	30.07	
142	34.7	8	14.65	30.62	
143	34.28	8	16.09	32.09	
144	33.87	8	19.03	34.9	
145	33.45	8	24.2	39.36	
146	35.12	8	14.2	30.14	
147	34.7	8	14.72	30.7	
148	34.28	8	16.17	32.17	
149	33.87	8	19.12	34.98	
150	33.45	8	24.31	39.45	
151	35.12	8	14.3	30.25	
152	34.7	8	14.83	30.81	
153	34.28	8	16.28	32.28	
154	33.87	8	19.26	35.1	
155	33.45	8	24.48	39.58	
156	35.12	8	14.45	30.41	
157	34.7	8	14.98	30.96	
158	34.28	8	16.45	32.44	
159	33.87	8	19.44	35.27	
160	33.45	8	24.71	39.77	
161	35.12	8	14.64	30.61	
162	34.7	8	15.18	31.17	
163	34.28	8	16.66	32.65	
164	33.87	8	19.69	35.5	
165	33.45	8	25.02	40.02	
166	33.45	8	37.71	49.13	

EOD

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
101 to 102	35.12 34.7	8.00	30.00 30.0	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0342	14.062 0.182 0.342		Vel = 4.73	
102 to 103	34.7 34.28	8.00	30.55 60.55	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1255	14.586 0.182 1.255		Vel = 9.54	
103 to 104	34.28 33.87	8.00	32.03 92.58	1.5 1.61		0.0 0.0	10.000 0.0	120 0.2750	16.023 0.178 2.750		Vel = 14.59	
104 to 105	33.87 33.45	8.00	34.82 127.4	1.5 1.61		0.0 0.0	10.000 0.0	120 0.4965	18.951 0.182 4.965		Vel = 20.08	
105 to 106	33.45 30.1	8.00	39.28 166.68	1.5 1.61	E T	4.0 8.0 0.0	3.870 12.000 15.870	120 0.8164	24.098 1.451 12.956		Vel = 26.27	
106 to 107	30.1 30.1		0.0 166.68	6 6.065		0.0 0.0	10.000 0.0	120 0.0012	38.505 0.0 0.012		Vel = 1.85	
107 to 108	30.1 30.1		166.70 333.38	6 6.065		0.0 0.0	10.000 0.0	120 0.0047	38.517 0.0 0.047		Vel = 3.70	
108 to 109	30.1 30.1		166.81 500.19	6 6.065		0.0 0.0	10.000 0.0	120 0.0097	38.564 0.0 0.097		Vel = 5.55	
109 to 110	30.1 30.1		167.05 667.24	6 6.065		0.0 0.0	10.000 0.0	120 0.0167	38.661 0.0 0.167		Vel = 7.41	
110 to 111	30.1 30.1		167.43 834.67	6 6.065		0.0 0.0	10.000 0.0	120 0.0251	38.828 0.0 0.251		Vel = 9.27	
111 to 112	30.1 30.1		168.03 1002.7	6 6.065		0.0 0.0	10.000 0.0	120 0.0354	39.079 0.0 0.354		Vel = 11.14	
112 to 113	30.1 30.1		168.85 1171.55	6 6.065		0.0 0.0	10.000 0.0	120 0.0471	39.433 0.0 0.471		Vel = 13.01	
113 to 114	30.1 30.1		169.95 1341.5	6 6.065		0.0 0.0	10.000 0.0	120 0.0606	39.904 0.0 0.606		Vel = 14.90	
114 to TOR	30.1 30.1		49.13 1390.63	6 6.065	2E	28.0 0.0 0.0	818.520 28.000 846.520	120 0.0647	40.510 0.0 54.808		Vel = 15.44	
TOR to BOR	30.1 1.5		0.0 1390.63	8 7.981	T B Eq	35.0 12.0 73.0	28.600 120.000 148.600	120 0.0170	95.318 16.387 2.527		** Fixed Loss = 4 Vel = 8.92	
BOR to 118	1.5 1.5		0.0 1390.63	10 10.02		0.0 0.0	15.000 0.0	120 0.0056	114.232 0.0 0.084		Vel = 5.66	

Final Calculations - Hazen-Williams

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
118 to PO	1.5 0		0.0 1390.63	10 10.02	B S 4E	19.0 55.0 88.0	10.000 162.000 172.000	120 114.316 0.650 0.965			Vel = 5.66
PO			0.0 1390.63					115.931			K Factor = 129.16
System Demand Pressure								115.931			
Safety Margin								35.369			
Continuation Pressure								151.300			
Pressure @ Pump Outlet								151.300			
Pressure From Pump Curve								-133.460			
Pressure @ Pump Inlet								17.840			
PI to 119	0 1.5		0.0 1390.63	10 10.02	E G	22.0 0.0 0.0	10.000 22.000 32.000	120 17.840 -0.650 0.180			Vel = 5.66
119 to 120	1.5 -6		0.0 1390.63	10 10.02	3E G Zie	66.0 5.0 0.0	7.500 71.000 78.500	120 17.370 12.881 0.442			* * Fixed Loss = 9.633 Vel = 5.66
120 to 121	-6 -6		0.0 1390.63	10 10.28	T G 4L	75.336 7.534 96.43	50.000 179.300 229.300	140 30.693 0.0 0.854			Vel = 5.38
121 to 122	-6 -6		500.00 1890.63	12 12.34	E T 2G 6L	42.195 93.767 18.753 168.781	600.000 323.496 923.496	140 31.547 0.0 2.496			Vel = 5.07
122 to TEST	-6 0		0.0 1890.63	16 16.41	6L T 2G	333.719 166.859 32.96	450.000 533.539 983.539	140 34.043 -2.599 0.664			Vel = 2.87
TEST			0.0 1890.63					32.108			K Factor = 333.66
HOSE to 121	-6 -6	H500	500.00 500.0	6 6.16	T	43.037 0.0 0.0	3.500 43.037 46.537	140 -4.138 0.0 0.316			Vel = 5.38
121			0.0 500.00					-3.822			K Factor = 255.76
107 to 123	30.1 33.43		-166.70 -166.7	1.5 1.61	T	8.0 0.0 0.0	3.330 8.000 11.330	120 38.517 -1.442 -9.252			Vel = 26.27
123			0.0 -166.70					27.823			K Factor = -31.60
108 to 124	30.1 33.43		-166.81 -166.81	1.5 1.61	T	8.0 0.0 0.0	3.330 8.000 11.330	120 38.564 -1.442 -9.264			Vel = 26.29
124			0.0 -166.81					27.858			K Factor = -31.60
109 to 125	30.1 33.43		-167.04 -167.04	1.5 1.61	T	8.0 0.0 0.0	3.330 8.000 11.330	120 38.661 -1.442 -9.287			Vel = 26.32

Final Calculations - Hazen-Williams

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
125			0.0 -167.04					27.932		K Factor = -31.61	
110 to 126	30.1 33.43		-167.44	1.5	T 8.0 0.0	3.330 8.000	120	38.828 -1.442		Vel = 26.39	
126			0.0 -167.44					28.058		K Factor = -31.61	
111 to 127	30.1 33.43		-168.03	1.5	T 8.0 0.0	3.330 8.000	120	39.079 -1.442		Vel = 26.48	
127			0.0 -168.03					28.249		K Factor = -31.61	
112 to 128	30.1 33.43		-168.85	1.5	T 8.0 0.0	3.330 8.000	120	39.433 -1.442		Vel = 26.61	
128			0.0 -168.85					28.517		K Factor = -31.62	
113 to 129	30.1 33.43		-169.95	1.5	T 8.0 0.0	3.330 8.000	120	39.904 -1.442		Vel = 26.78	
129			0.0 -169.95					28.874		K Factor = -31.63	
114 to 130	30.1 33.43		-49.12	1.5	T 8.0 0.0	3.330 8.000	120	40.510 -1.442		Vel = 7.74	
130			0.0 -49.12					38.103		K Factor = -7.96	
131 to 132	35.12 34.7	8.00	30.01	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	14.068 0.182 0.342		Vel = 4.73	
132 to 133	34.7 34.28	8.00	30.55	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	14.592 0.182 1.254		Vel = 9.54	
133 to 134	34.28 33.87	8.00	32.03	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	16.028 0.178 2.752		Vel = 14.59	
134 to 135	33.87 33.45	8.00	34.84	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	18.958 0.182 4.967		Vel = 20.08	
135 to 123	33.45 33.43	8.00	39.27	1.5	E 4.0 0.0	0.540 4.000	120	24.107 0.009		Vel = 26.27	
123			0.0 166.70					27.823		K Factor = 31.60	
136 to 137	35.12 34.7	8.00	30.03	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	14.087 0.182 0.342		Vel = 4.73	

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
137 to 138	34.7 34.28	8.00	30.58 60.61	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1256	14.611 0.182 1.256		Vel = 9.55	
138 to 139	34.28 33.87	8.00	32.05 92.66	1.5 1.61		0.0 0.0	10.000 0.0	120 0.2755	16.049 0.178 2.755		Vel = 14.60	
139 to 140	33.87 33.45	8.00	34.85 127.51	1.5 1.61		0.0 0.0	10.000 0.0	120 0.4973	18.982 0.182 4.973		Vel = 20.09	
140 to 124	33.45 33.43	8.00	39.30 166.81	1.5 1.61	E	4.0 0.0	0.540 4.000	120 0.8176	24.137 0.009 3.712		Vel = 26.29	
124			0.0 166.81						27.858		K Factor = 31.60	
141 to 142	35.12 34.7	8.00	30.07 30.07	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0343	14.127 0.182 0.343		Vel = 4.74	
142 to 143	34.7 34.28	8.00	30.62 60.69	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1260	14.652 0.182 1.260		Vel = 9.56	
143 to 144	34.28 33.87	8.00	32.09 92.78	1.5 1.61		0.0 0.0	10.000 0.0	120 0.2762	16.094 0.178 2.762		Vel = 14.62	
144 to 145	33.87 33.45	8.00	34.91 127.69	1.5 1.61		0.0 0.0	10.000 0.0	120 0.4986	19.034 0.182 4.986		Vel = 20.12	
145 to 125	33.45 33.43	8.00	39.35 167.04	1.5 1.61	E	4.0 0.0	0.540 4.000	120 0.8196	24.202 0.009 3.721		Vel = 26.32	
125			0.0 167.04						27.932		K Factor = 31.61	
146 to 147	35.12 34.7	8.00	30.14 30.14	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0345	14.196 0.182 0.345		Vel = 4.75	
147 to 148	34.7 34.28	8.00	30.70 60.84	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1265	14.723 0.182 1.265		Vel = 9.59	
148 to 149	34.28 33.87	8.00	32.17 93.01	1.5 1.61		0.0 0.0	10.000 0.0	120 0.2774	16.170 0.178 2.774		Vel = 14.66	
149 to 150	33.87 33.45	8.00	34.98 127.99	1.5 1.61		0.0 0.0	10.000 0.0	120 0.5008	19.122 0.182 5.008		Vel = 20.17	
150 to 126	33.45 33.43	8.00	39.45 167.44	1.5 1.61	E	4.0 0.0	0.540 4.000	120 0.8231	24.312 0.009 3.737		Vel = 26.39	
126			0.0 167.44						28.058		K Factor = 31.61	

Final Calculations - Hazen-Williams

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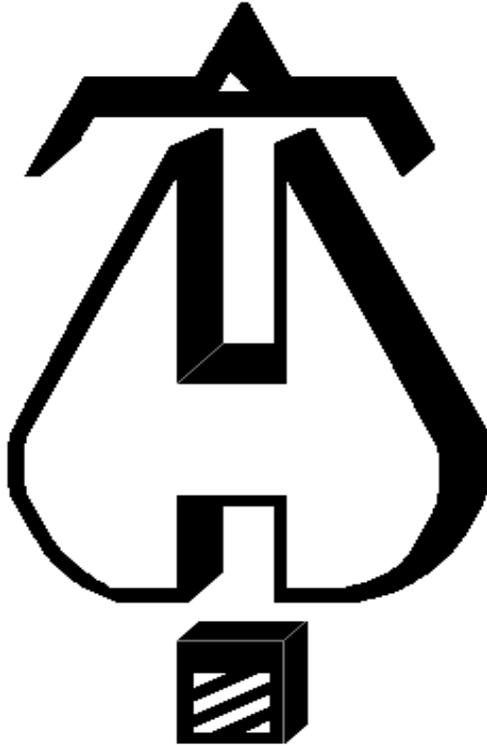
Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
151 to 152	35.12 34.7	8.00	30.25	1.5		0.0	10.000	120	14.300 0.182			
			30.25	1.61		0.0	10.000	0.0347	0.347	Vel =	4.77	
152 to 153	34.7 34.28	8.00	30.81	1.5		0.0	10.000	120	14.829 0.182			
			61.06	1.61		0.0	10.000	0.1274	1.274	Vel =	9.62	
153 to 154	34.28 33.87	8.00	32.28	1.5		0.0	10.000	120	16.285 0.178			
			93.34	1.61		0.0	10.000	0.2792	2.792	Vel =	14.71	
154 to 155	33.87 33.45	8.00	35.11	1.5		0.0	10.000	120	19.255 0.182			
			128.45	1.61		0.0	10.000	0.5041	5.041	Vel =	20.24	
155 to 127	33.45 33.43	8.00	39.58	1.5	E	4.0	0.540	120	24.478 0.009			
			168.03	1.61		0.0	4.540	0.8286	3.762	Vel =	26.48	
127			0.0 168.03						28.249	K Factor =	31.61	
156 to 157	35.12 34.7	8.00	30.41	1.5		0.0	10.000	120	14.446 0.182			
			30.41	1.61		0.0	10.000	0.0350	0.350	Vel =	4.79	
157 to 158	34.7 34.28	8.00	30.96	1.5		0.0	10.000	120	14.978 0.182			
			61.37	1.61		0.0	10.000	0.1286	1.286	Vel =	9.67	
158 to 159	34.28 33.87	8.00	32.44	1.5		0.0	10.000	120	16.446 0.178			
			93.81	1.61		0.0	10.000	0.2818	2.818	Vel =	14.78	
159 to 160	33.87 33.45	8.00	35.27	1.5		0.0	10.000	120	19.442 0.182			
			129.08	1.61		0.0	10.000	0.5088	5.088	Vel =	20.34	
160 to 128	33.45 33.43	8.00	39.77	1.5	E	4.0	0.540	120	24.712 0.009			
			168.85	1.61		0.0	4.540	0.8361	3.796	Vel =	26.61	
128			0.0 168.85						28.517	K Factor =	31.62	
161 to 162	35.12 34.7	8.00	30.61	1.5		0.0	10.000	120	14.640 0.182			
			30.61	1.61		0.0	10.000	0.0355	0.355	Vel =	4.82	
162 to 163	34.7 34.28	8.00	31.17	1.5		0.0	10.000	120	15.177 0.182			
			61.78	1.61		0.0	10.000	0.1302	1.302	Vel =	9.74	
163 to 164	34.28 33.87	8.00	32.65	1.5		0.0	10.000	120	16.661 0.178			
			94.43	1.61		0.0	10.000	0.2853	2.853	Vel =	14.88	
164 to 165	33.87 33.45	8.00	35.50	1.5		0.0	10.000	120	19.692 0.182			
			129.93	1.61		0.0	10.000	0.5149	5.149	Vel =	20.48	
165 to 129	33.45 33.43	8.00	40.02	1.5	E	4.0	0.540	120	25.023 0.009			
			169.95	1.61		0.0	4.540	0.8463	3.842	Vel =	26.78	

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
129			0.0 169.95						28.874		K Factor = 31.63	
166 to 130	33.45 33.43	8.00	49.12	1.5	E	4.0	0.540 4.000	120	37.708 0.009			
			49.12	1.61		0.0	4.540	0.0850	0.386		Vel = 7.74	
130			0.0 49.12						38.103		K Factor = 7.96	



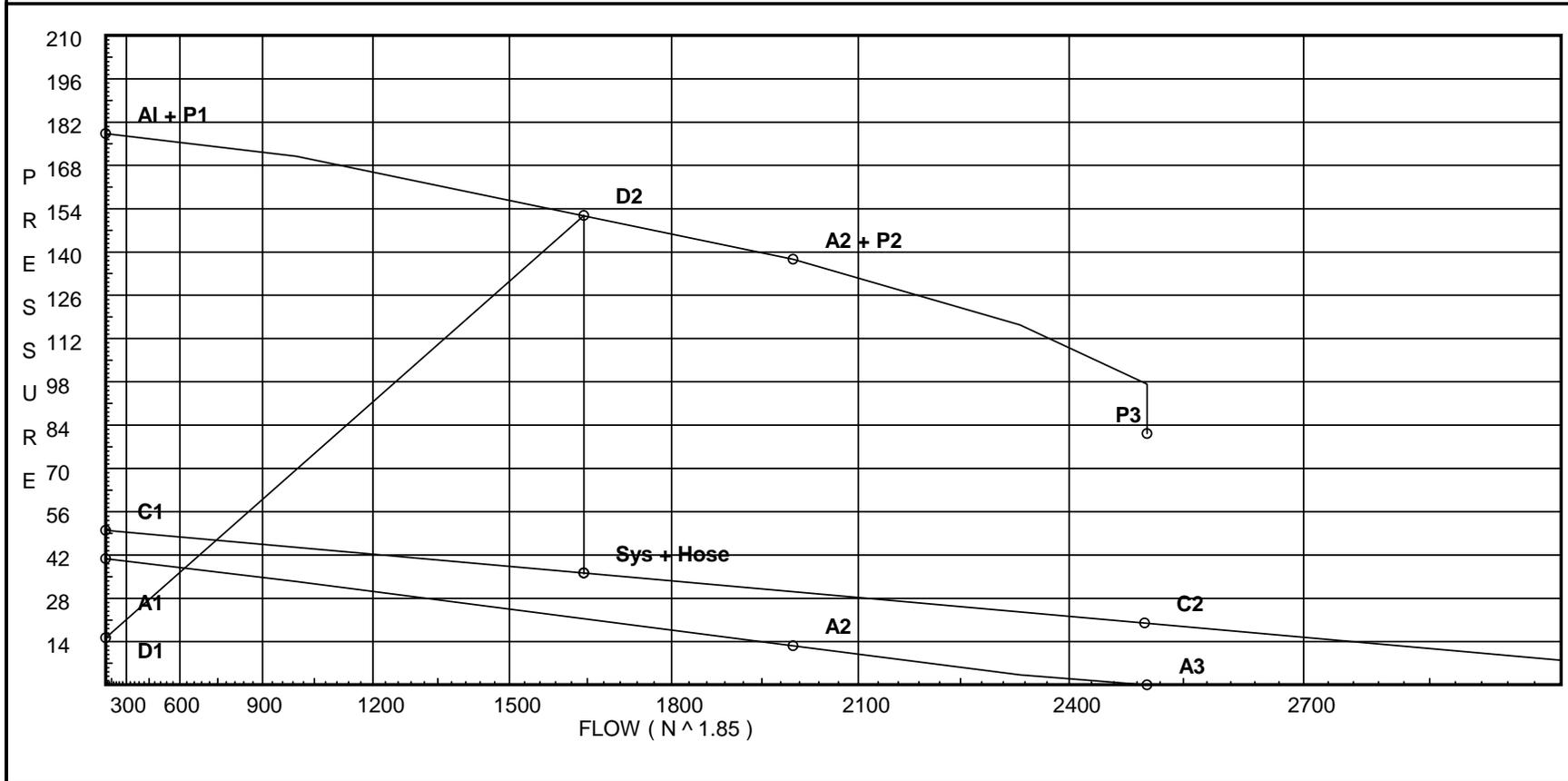
... Fire Protection by Computer Design

ProEnergy Services
2001 PorEnergy Blvd
Sedalia, MO 65301
660 829 5100

Job Name : Rail Unloading-R4
Drawing :
Location :
Remote Area :
Contract :
Data File : Rail Unloading-R4 Area .W XF

Water Supply Curve C

City Water Supply: C1 - Static Pressure : 50 C2 - Residual Pressure: 20 C2 - Residual Flow : 2500 City Water Adjusted to Pump Inlet for Pf - Elev - Hose Flow A1 - Adjusted Static: 40.800 A2 - Adj Resid : 12.69 @ 2000 A3 - Adj Resid : 0 @ 2503.18	Pump Data: P1 - Pump Churn Pressure : 137.5 P2 - Pump Rated Pressure : 125 P2 - Pump Rated Flow : 2000 P3 - Pump Pressure @ Max Flow : 81.25 P3 - Pump Max Flow : 2503.18 City Residual Flow @ 0 = 3295.02 City Residual Flow @ 20 = 2500.00 City Water @ 150% of Pump = 19.93 Pump flow terminated at adjusted curve 0 psi	Demand: D1 - Elevation : 15.210 D2 - System Flow : 1643.59 D2 - System Pressure : 151.764 Hose (Demand) : D3 - System Demand : 1643.59 Safety Margin : 0.004
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Fittings Used Summary

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Fitting Legend		½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
Abbrev.	Name																				
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
L	NFPA 13 Long Turn Elbow	0.5	1	2	2	2	3	4	5	5	6	8	9	13	16	18	24	27	30	34	40
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zie	Wilkins 375	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units Inches
 Length Units Feet
 Flow Units US Gallons per Minute
 Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

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SUPPLY ANALYSIS

Node at Source	Static Pressure	Residual Pressure	Flow	Available Pressure	Total Demand	Required Pressure
PO	See Information on Pump Curve			151.768	1643.59	151.764
TEST	50.0	20	2500.0	36.191	1643.59	36.191

NODE ANALYSIS

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
101	35.12	8	19.87	35.66	
102	34.7	8	20.52	36.24	
103	34.28	8	22.43	37.88	
104	33.87	8	26.37	41.08	
105	33.45	8	33.34	46.2	
106	30.1		52.46		
107	30.1		52.47		
108	30.1		52.54		
109	30.1		52.67		
110	30.1		52.9		
111	30.1		53.24		
112	30.1		53.72		
113	30.1		54.36		
114	30.1		55.19		
TOR	30.1		129.85		
BOR	1.5		149.68		
118	1.5		149.8		
PO	0.0		151.76		
PI	0.0		21.51		
119	1.5		21.1		
120	-6.0		35.19		
121	-6.0		36.35		
122	-6.0		38.28		
TEST	0.0		36.19		
HOSE	-6.0		36.35		
123	33.43		38.42		
124	33.43		38.47		
125	33.43		38.57		
126	33.43		38.74		
127	33.43		39.0		
128	33.43		39.37		
129	33.43		39.86		
130	33.43		52.45		
131	35.12	8	19.87	35.66	
132	34.7	8	20.53	36.25	
133	34.28	8	22.43	37.89	
134	33.87	8	26.38	41.09	
135	33.45	8	33.36	46.2	
136	35.12	8	19.9	35.69	
137	34.7	8	20.55	36.27	
138	34.28	8	22.46	37.92	

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
139	33.87	8	26.42	41.12	
140	33.45	8	33.4	46.23	
141	35.12	8	19.96	35.74	
142	34.7	8	20.61	36.32	
143	34.28	8	22.52	37.97	
144	33.87	8	26.49	41.17	
145	33.45	8	33.49	46.29	
146	35.12	8	20.05	35.82	
147	34.7	8	20.71	36.41	
148	34.28	8	22.63	38.06	
149	33.87	8	26.61	41.27	
150	33.45	8	33.64	46.4	
151	35.12	8	20.2	35.95	
152	34.7	8	20.86	36.53	
153	34.28	8	22.79	38.19	
154	33.87	8	26.79	41.41	
155	33.45	8	33.86	46.55	
156	35.12	8	20.4	36.13	
157	34.7	8	21.06	36.72	
158	34.28	8	23.01	38.38	
159	33.87	8	27.05	41.61	
160	33.45	8	34.19	46.77	
161	35.12	8	20.67	36.37	
162	34.7	8	21.34	36.95	
163	34.28	8	23.31	38.62	
164	33.87	8	27.39	41.87	
165	33.45	8	34.61	47.07	
166	33.45	8	51.92	57.64	

EOD

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
101 to 102	35.12 34.7	8.00	35.66 35.66	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0471	19.867 0.182 0.471		Vel = 5.62	
102 to 103	34.7 34.28	8.00	36.24 71.9	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1723	20.520 0.182 1.723		Vel = 11.33	
103 to 104	34.28 33.87	8.00	37.88 109.78	1.5 1.61		0.0 0.0	10.000 0.0	120 0.3770	22.425 0.178 3.770		Vel = 17.30	
104 to 105	33.87 33.45	8.00	41.08 150.86	1.5 1.61		0.0 0.0	10.000 0.0	120 0.6789	26.373 0.182 6.789		Vel = 23.77	
105 to 106	33.45 30.1	8.00	46.20 197.06	1.5 1.61	E T	4.0 8.0 0.0	3.870 12.000 15.870	120 1.1128	33.344 1.451 17.660		Vel = 31.06	
106 to 107	30.1 30.1		0.0 197.06	6 6.065		0.0 0.0	10.000 0.0	120 0.0018	52.455 0.0 0.018		Vel = 2.19	
107 to 108	30.1 30.1		197.10 394.16	6 6.065		0.0 0.0	10.000 0.0	120 0.0062	52.473 0.0 0.062		Vel = 4.38	
108 to 109	30.1 30.1		197.22 591.38	6 6.065		0.0 0.0	10.000 0.0	120 0.0133	52.535 0.0 0.133		Vel = 6.57	
109 to 110	30.1 30.1		197.49 788.87	6 6.065		0.0 0.0	10.000 0.0	120 0.0227	52.668 0.0 0.227		Vel = 8.76	
110 to 111	30.1 30.1		197.95 986.82	6 6.065		0.0 0.0	10.000 0.0	120 0.0344	52.895 0.0 0.344		Vel = 10.96	
111 to 112	30.1 30.1		198.64 1185.46	6 6.065		0.0 0.0	10.000 0.0	120 0.0481	53.239 0.0 0.481		Vel = 13.16	
112 to 113	30.1 30.1		199.60 1385.06	6 6.065		0.0 0.0	10.000 0.0	120 0.0643	53.720 0.0 0.643		Vel = 15.38	
113 to 114	30.1 30.1		200.89 1585.95	6 6.065		0.0 0.0	10.000 0.0	120 0.0826	54.363 0.0 0.826		Vel = 17.61	
114 to TOR	30.1 30.1		57.64 1643.59	6 6.065	2E	28.0 0.0 0.0	818.520 28.000 846.520	120 0.0882	55.189 0.0 74.666		Vel = 18.25	
TOR to BOR	30.1 1.5		0.0 1643.59	8 7.981	T B Eq	35.0 12.0 73.0	28.600 120.000 148.600	120 0.0232	129.855 16.387 3.442		** Fixed Loss = 4 Vel = 10.54	
BOR to 118	1.5 1.5		0.0 1643.59	10 10.02		0.0 0.0	15.000 0.0	120 0.0077	149.684 0.0 0.115		Vel = 6.69	

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
118 to PO	1.5 0		0.0 1643.59	10 10.02	B S 4E	19.0 55.0 88.0	10.000 162.000 172.000	120 149.799 0.650 1.315			Vel = 6.69
PO			0.0 1643.59					151.764			K Factor = 133.42
System Demand Pressure								151.764			
Safety Margin								0.004			
Continuation Pressure								151.768			
Pressure @ Pump Outlet								151.768			
Pressure From Pump Curve								-130.262			
Pressure @ Pump Inlet								21.505			
PI to 119	0 1.5		0.0 1643.59	10 10.02	E S 4E	22.0 0.0 0.0	10.000 22.000 32.000	120 21.505 -0.650 0.245			Vel = 6.69
119 to 120	1.5 -6		0.0 1643.59	10 10.02	3E G Zie	66.0 5.0 0.0	7.500 71.000 78.500	120 21.100 13.487 0.600			* * Fixed Loss = 10.238 Vel = 6.69
120 to 121	-6 -6		0.0 1643.59	10 10.28	T G 4L	75.336 7.534 96.43	50.000 179.300 229.300	140 35.187 0.0 1.165			Vel = 6.35
121 to 122	-6 -6		0.0 1643.59	12 12.34	E T 2G 6L	42.195 93.767 18.753 168.781	600.000 323.496 923.496	140 36.352 0.0 1.926			Vel = 4.41
122 to TEST	-6 0		0.0 1643.59	16 16.41	6L T 2G	333.719 166.859 32.96	450.000 533.539 983.539	140 38.278 -2.599 0.512			Vel = 2.49
TEST			0.0 1643.59					36.191			K Factor = 273.21
HOSE to 121	-6 -6		0.0 0.0	6 6.16	T	43.037 0.0 0.0	3.500 43.037 46.537	140 36.348 0.0 0.0			Vel = 0
121			0.0 0.0					36.348			K Factor = 0
107 to 123	30.1 33.43		-197.10 -197.1	1.5 1.61	T	8.0 0.0 0.0	3.330 8.000 11.330	120 52.473 -1.442 -12.613			Vel = 31.06
123			0.0 -197.10					38.418			K Factor = -31.80
108 to 124	30.1 33.43		-197.22 -197.22	1.5 1.61	T	8.0 0.0 0.0	3.330 8.000 11.330	120 52.535 -1.442 -12.627			Vel = 31.08
124			0.0 -197.22					38.466			K Factor = -31.80
109 to 125	30.1 33.43		-197.49 -197.49	1.5 1.61	T	8.0 0.0 0.0	3.330 8.000 11.330	120 52.668 -1.442 -12.659			Vel = 31.12

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv. Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
125			0.0 -197.49					38.567		K Factor = -31.80	
110 to 126	30.1 33.43		-197.95	1.5	T 8.0 0.0	3.330 8.000	120	52.895 -1.442			Vel = 31.20
126			0.0 -197.95					38.740		K Factor = -31.80	
111 to 127	30.1 33.43		-198.64	1.5	T 8.0 0.0	3.330 8.000	120	53.239 -1.442			Vel = 31.30
127			0.0 -198.64					39.001		K Factor = -31.81	
112 to 128	30.1 33.43		-199.60	1.5	T 8.0 0.0	3.330 8.000	120	53.720 -1.442			Vel = 31.46
128			0.0 -199.60					39.367		K Factor = -31.81	
113 to 129	30.1 33.43		-200.88	1.5	T 8.0 0.0	3.330 8.000	120	54.363 -1.442			Vel = 31.66
129			0.0 -200.88					39.856		K Factor = -31.82	
114 to 130	30.1 33.43		-57.64	1.5	T 8.0 0.0	3.330 8.000	120	55.189 -1.442			Vel = 9.08
130			0.0 -57.64					52.449		K Factor = -7.96	
131 to 132	35.12 34.7	8.00	35.66	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	19.875 0.182 0.471			Vel = 5.62
132 to 133	34.7 34.28	8.00	36.25	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	20.528 0.182 1.723			Vel = 11.33
133 to 134	34.28 33.87	8.00	37.89	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	22.433 0.178 3.771			Vel = 17.30
134 to 135	33.87 33.45	8.00	41.09	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	26.382 0.182 6.792			Vel = 23.78
135 to 123	33.45 33.43	8.00	46.21	1.5	E 4.0 0.0	0.540 4.000	120	33.356 0.009 5.053			Vel = 31.06
123			0.0 197.10					38.418		K Factor = 31.80	
136 to 137	35.12 34.7	8.00	35.69	1.5	0.0 0.0 0.0	10.000 0.0 10.000	120	19.901 0.182 0.471			Vel = 5.62

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
137 to 138	34.7 34.28	8.00	36.27 71.96	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1726	20.554 0.182 1.726		Vel = 11.34	
138 to 139	34.28 33.87	8.00	37.91 109.87	1.5 1.61		0.0 0.0	10.000 0.0	120 0.3776	22.462 0.178 3.776		Vel = 17.31	
139 to 140	33.87 33.45	8.00	41.12 150.99	1.5 1.61		0.0 0.0	10.000 0.0	120 0.6799	26.416 0.182 6.799		Vel = 23.80	
140 to 124	33.45 33.43	8.00	46.23 197.22	1.5 1.61	E	4.0 0.0	0.540 4.000	120 1.1145	33.397 0.009 5.060		Vel = 31.08	
124			0.0 197.22						38.466		K Factor = 31.80	
141 to 142	35.12 34.7	8.00	35.74 35.74	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0473	19.957 0.182 0.473		Vel = 5.63	
142 to 143	34.7 34.28	8.00	36.32 72.06	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1730	20.612 0.182 1.730		Vel = 11.36	
143 to 144	34.28 33.87	8.00	37.97 110.03	1.5 1.61		0.0 0.0	10.000 0.0	120 0.3785	22.524 0.178 3.785		Vel = 17.34	
144 to 145	33.87 33.45	8.00	41.17 151.2	1.5 1.61		0.0 0.0	10.000 0.0	120 0.6817	26.487 0.182 6.817		Vel = 23.83	
145 to 125	33.45 33.43	8.00	46.29 197.49	1.5 1.61	E	4.0 0.0	0.540 4.000	120 1.1172	33.486 0.009 5.072		Vel = 31.12	
125			0.0 197.49						38.567		K Factor = 31.80	
146 to 147	35.12 34.7	8.00	35.82 35.82	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0475	20.052 0.182 0.475		Vel = 5.64	
147 to 148	34.7 34.28	8.00	36.41 72.23	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1737	20.709 0.182 1.737		Vel = 11.38	
148 to 149	34.28 33.87	8.00	38.05 110.28	1.5 1.61		0.0 0.0	10.000 0.0	120 0.3803	22.628 0.178 3.803		Vel = 17.38	
149 to 150	33.87 33.45	8.00	41.27 151.55	1.5 1.61		0.0 0.0	10.000 0.0	120 0.6846	26.609 0.182 6.846		Vel = 23.88	
150 to 126	33.45 33.43	8.00	46.40 197.95	1.5 1.61	E	4.0 0.0	0.540 4.000	120 1.1220	33.637 0.009 5.094		Vel = 31.20	
126			0.0 197.95						38.740		K Factor = 31.80	

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
151 to 152	35.12 34.7	8.00	35.95 35.95	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0478	20.196 0.182 0.478		Vel = 5.67	
152 to 153	34.7 34.28	8.00	36.54 72.49	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1749	20.856 0.182 1.749		Vel = 11.42	
153 to 154	34.28 33.87	8.00	38.19 110.68	1.5 1.61		0.0 0.0	10.000 0.0	120 0.3827	22.787 0.178 3.827		Vel = 17.44	
154 to 155	33.87 33.45	8.00	41.40 152.08	1.5 1.61		0.0 0.0	10.000 0.0	120 0.6891	26.792 0.182 6.891		Vel = 23.97	
155 to 127	33.45 33.43	8.00	46.56 198.64	1.5 1.61	E	4.0 0.0	0.540 4.000	120 1.1293	33.865 0.009 5.127		Vel = 31.30	
127			0.0 198.64						39.001		K Factor = 31.81	
156 to 157	35.12 34.7	8.00	36.13 36.13	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0483	20.398 0.182 0.483		Vel = 5.69	
157 to 158	34.7 34.28	8.00	36.72 72.85	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1765	21.063 0.182 1.765		Vel = 11.48	
158 to 159	34.28 33.87	8.00	38.37 111.22	1.5 1.61		0.0 0.0	10.000 0.0	120 0.3862	23.010 0.178 3.862		Vel = 17.53	
159 to 160	33.87 33.45	8.00	41.61 152.83	1.5 1.61		0.0 0.0	10.000 0.0	120 0.6953	27.050 0.182 6.953		Vel = 24.08	
160 to 128	33.45 33.43	8.00	46.77 199.6	1.5 1.61	E	4.0 0.0	0.540 4.000	120 1.1394	34.185 0.009 5.173		Vel = 31.46	
128			0.0 199.60						39.367		K Factor = 31.81	
161 to 162	35.12 34.7	8.00	36.37 36.37	1.5 1.61		0.0 0.0	10.000 0.0	120 0.0488	20.668 0.182 0.488		Vel = 5.73	
162 to 163	34.7 34.28	8.00	36.95 73.32	1.5 1.61		0.0 0.0	10.000 0.0	120 0.1787	21.338 0.182 1.787		Vel = 11.55	
163 to 164	34.28 33.87	8.00	38.63 111.95	1.5 1.61		0.0 0.0	10.000 0.0	120 0.3909	23.307 0.178 3.909		Vel = 17.64	
164 to 165	33.87 33.45	8.00	41.87 153.82	1.5 1.61		0.0 0.0	10.000 0.0	120 0.7037	27.394 0.182 7.037		Vel = 24.24	
165 to 129	33.45 33.43	8.00	47.06 200.88	1.5 1.61	E	4.0 0.0	0.540 4.540	120 1.1529	34.613 0.009 5.234		Vel = 31.66	

Final Calculations - Hazen-Williams

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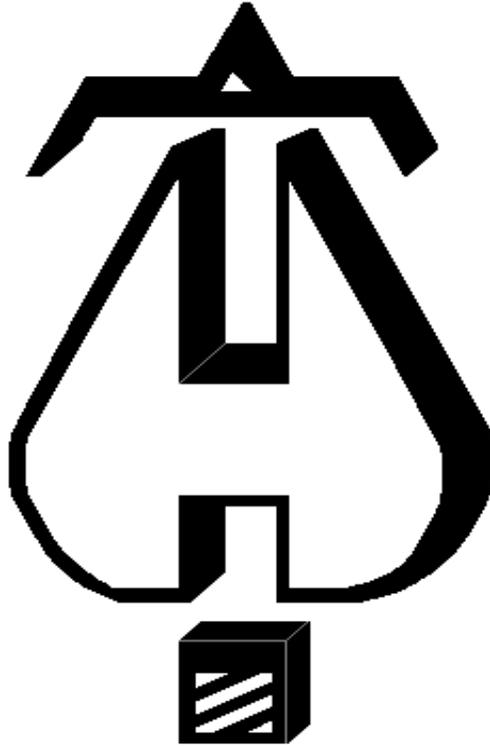
Node1	Elev1	K	Qa	Nom	Fitting or		Pipe Ftng's	CFact	Pt Pe	*****	Notes	*****
to Node2	Elev2	Fact	Qt	Act	Eqv.	Ln.	Total	Pf/Ft	Pf			
			0.0									
129			200.88						39.856		K Factor =	31.82
166	33.45	8.00	57.64	1.5	E	4.0	0.540	120	51.921			
to						0.0	4.000		0.009			
130	33.43		57.64	1.61		0.0	4.540	0.1143	0.519		Vel =	9.08
			0.0									
130			57.64						52.449		K Factor =	7.96

APPENDIX B

Storage Area Calculation

Hydraulic Analysis
Fire Protection

Poole Fire Protection



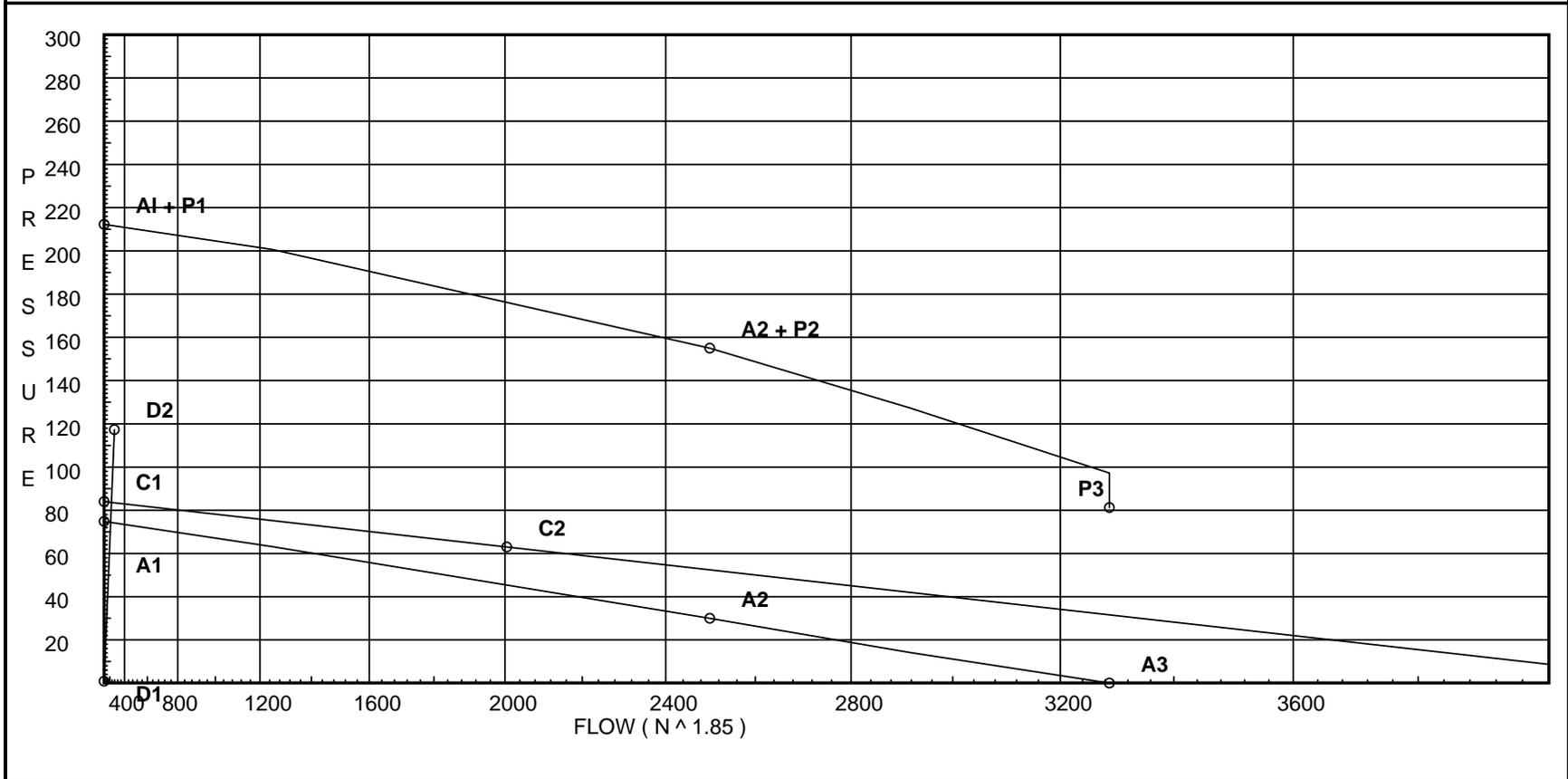
... Fire Protection by Computer Design

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2001 PorEnergy Blvd
Sedalia, MO 65301
660 829 5100

Job Name : Rail Unloading-R5
Drawing :
Location :
Remote Area :
Contract :
Data File : Tank Area 9 r7.WXF

Water Supply Curve C

City Water Supply: C1 - Static Pressure : 84 C2 - Residual Pressure: 63 C2 - Residual Flow : 2005 City Water Adjusted to Pump Inlet for Pf - Elev - Hose Flow A1 - Adjusted Static: 74.800 A2 - Adj Resid : 29.971 @ 2500 A3 - Adj Resid : 0 @ 3287.66	Pump Data: P1 - Pump Churn Pressure : 137.5 P2 - Pump Rated Pressure : 125 P2 - Pump Rated Flow : 2500 P3 - Pump Pressure @ Max Flow : 81.25 P3 - Pump Max Flow : 3287.66 City Residual Flow @ 0 = 4241.82 City Residual Flow @ 20 = 3661.97 City Water @ 150% of Pump = 31.57 Pump flow terminated at adjusted curve 0 psi	Demand: D1 - Elevation : 0.866 D2 - System Flow : 275.43 D2 - System Pressure : 117.304 Hose (Demand) : _____ D3 - System Demand : 275.43 Hose (Adj City) : 2750 Safety Margin : 1.646
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Fittings Used Summary

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Fitting Legend		½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24	
Abbrev.	Name																					
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0	0
Bvcb	B Fly Vic 705W	0	0	0	0	0	0	5	5	0	12	12	8	11	12	14	0	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61	
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13	
L	NFPA 13 Long Turn Elbow	0.5	1	2	2	3	4	5	5	6	8	9	13	16	18	24	27	30	34	40		
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65						
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121	
Zie	Wilkins 375	Fitting generates a Fixed Loss Based on Flow																				

Units Summary

Diameter Units Inches
 Length Units Feet
 Flow Units US Gallons per Minute
 Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

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SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
PO	See Information on Pump Curve			118.95	3025.43	117.304
TFC	84.0	63	2005.0	39.046	3025.43	39.046

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
FM10	48.0	2	46.3	13.61	
FM9	48.0	2	46.31	13.61	
FM8	48.0	2	46.37	13.62	
FM7	48.0	2	46.5	13.64	
FM6	48.0	2	46.73	13.67	
FM5	48.0	2	47.07	13.72	
FM4	48.0	2	47.55	13.79	
FM3	48.0	2	48.2	13.89	
FM2	48.0	2	48.81	13.97	
FM1	48.0	2	49.85	14.12	
901	48.0		50.69		
902	2.0		72.18		
904	2.0		74.6		
903	6.0		72.96		
905	6.0		74.24		
906	2.0		76.07		
907	2.0		102.39		
908	8.0		99.94		
TOR3	8.0		102.57		
BOR3	2.0		109.05		
PO	0.0		117.3		
PI	0.0		9.75		
FF	2.0		10.39		
UG1	-6.5		31.87		
UG2	-6.5		32.75		
TFC	0.0		39.05		
FM11	48.0	2	46.3	13.61	
FM12	48.0	2	46.32	13.61	
FM13	48.0	2	46.38	13.62	
FM14	48.0	2	46.53	13.64	
FM15	48.0	2	46.77	13.68	
FM16	48.0	2	47.13	13.73	
FM17	48.0	2	47.63	13.8	
FM18	48.0	2	48.3	13.9	
FM19	48.0	2	49.16	14.02	
FM20	48.0	2	50.24	14.18	
H1	2.0		106.21		
H2	2.0		101.76		
H3	2.0		98.24		
H4	2.0		94.85		
H5	2.0		94.85		

NODE ANALYSIS (cont.)

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
H6	2.0		90.68		
H7	2.0		85.31	750.0	
H8	2.0		85.0	625.0	
H9	2.0		85.04	625.0	
H10	2.0		85.91	750.0	
H11	2.0		91.69		
H12	2.0		91.69		
H13	2.0		97.37		
H14	2.0		102.13		
M1	-6.5		112.06		
M2	-6.5		111.48		
M3	-6.5		109.89		
M4	-6.5		105.44		
M5	-6.5		101.92		
M6	-6.5		98.53		
M7	-6.5		98.53		
M8	-6.5		94.36		
M9	-6.5		90.29		
M10	-6.5		89.6		
M11	-6.5		89.64		
M12	-6.5		90.89		
M13	-6.5		95.37		
M14	-6.5		95.37		
M15	-6.5		101.05		
M16	-6.5		105.81		

EOD

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
FM10 to FM9	48 48	2.00	12.67 12.67	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0003	46.296 0.015		Vel = 0.55	
FM9 to FM8	48 48	2.00	13.61 26.28	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0012	46.311 0.061		Vel = 1.14	
FM8 to FM7	48 48	2.00	13.62 39.9	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0025	46.372 0.130		Vel = 1.73	
FM7 to FM6	48 48	2.00	13.64 53.54	3 3.068	2E	14.0 0.0	38.090 52.090	120 0.0043	46.502 0.225		Vel = 2.32	
FM6 to FM5	48 48	2.00	13.67 67.21	3 3.068	2E	14.0 0.0	38.090 52.090	120 0.0066	46.727 0.343		Vel = 2.92	
FM5 to FM4	48 48	2.00	13.72 80.93	3 3.068	2E	14.0 0.0	38.090 52.090	120 0.0093	47.070 0.484		Vel = 3.51	
FM4 to FM3	48 48	2.00	13.79 94.72	3 3.068	2E	14.0 0.0	38.090 52.090	120 0.0124	47.554 0.647		Vel = 4.11	
FM3 to FM2	48 48	2.00	13.89 108.61	3 3.068		0.0 0.0	38.010 0.0	120 0.0160	48.201 0.608		Vel = 4.71	
FM2 to FM1	48 48	2.00	13.97 122.58	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0200	48.809 0.042		Vel = 5.32	
FM1 to 901	48 48	2.00	14.12 136.7	3 3.068	E	7.0 0.0	27.200 7.000	120 0.0245	49.851 0.837		Vel = 5.93	
901 to 902	48 2		138.73 275.43	4 4.026	T	20.0 0.0	46.000 20.000	120 0.0238	50.688 19.923		Vel = 6.94	
902 to 904	2 2		0.0 275.43	4 4.026	4E	40.0 0.0	61.560 40.000	120 0.0238	72.183 0.0		Vel = 6.94	
904 to 903	2 6		0.0 275.43	4 4.026		0.0 0.0	4.000 0.0	120 0.0238	74.602 -1.732		Vel = 6.94	
903 to 905	6 6		0.0 275.43	4 4.026	2E	20.0 0.0	33.630 20.000	120 0.0238	72.965 0.0		Vel = 6.94	
905 to 906	6 2		0.0 275.43	4 4.026		0.0 0.0	4.000 0.0	120 0.0238	74.243 1.732		Vel = 6.94	
906 to 907	2 2		0.0 275.43	4 4.026	10E	100.0 0.0	1005.000 100.000	120 0.0238	76.070 26.322		Vel = 6.94	

Final Calculations - Hazen-Williams

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
907 to 908	2 8		0.0 275.43	4 4.026		0.0 0.0	6.000 0.0	120 0.0238	102.392 -2.599 0.143		Vel = 6.94	
908 to TOR3	8 8		0.0 275.43	4 4.026	2E	20.0 0.0	90.490 20.000	120 0.0238	99.936 0.0 2.632		Vel = 6.94	
TOR3 to BOR3	8 2		0.0 275.43	4 4.026	T 2B Eq	20.0 24.0 29.0	6.000 73.000 79.000	120 0.0238	102.568 4.599 1.881		** Fixed Loss = 2 Vel = 6.94	
BOR3 to PO	2 0		2750.00 3025.43	10 10.02	L S Bvcb	16.0 55.0 12.0	18.000 83.000 101.000	120 0.0237	109.048 5.866 2.390		** Fixed Loss = 5 Vel = 12.31	
PO			0.0 3025.43						117.304		K Factor = 279.34	
System Demand Pressure									117.304			
Safety Margin									1.646			
Continuation Pressure									118.950			
Pressure @ Pump Outlet									118.950			
Pressure From Pump Curve									-109.204			
Pressure @ Pump Inlet									9.746			
PI to FF	0 2		0.0 3025.43	10 10.02	2E	44.0 0.0	19.990 44.000	120 0.0237	9.746 -0.866 1.514		Vel = 12.31	
FF to UG1	2 -6.5		0.0 3025.43	10 10.28	E 2L T Zie	24.923 36.252 56.644 0.0	8.500 117.819 126.319	120 0.0209	10.394 18.838 2.638		** Fixed Loss = 15.157 Vel = 11.69	
UG1 to UG2	-6.5 -6.5		0.0 3025.43	10 9.42	E	21.661 0.0	15.210 21.661	140 0.0240	31.870 0.0 0.885		Vel = 13.93	
UG2 to TFC	-6.5 0		0.0 3025.43	10 9.42		0.0 0.0	379.070 0.0	140 0.0240	32.755 -2.815 9.107		Vel = 13.93	
TFC			0.0 3025.43						39.047		K Factor = 484.16	
FM10 to FM11	48 48		0.94 0.94	3 3.068	2E	14.0 0.0	38.090 14.000	120 0	46.296 0.0 0.0		Vel = 0.04	
FM11 to FM12	48 48	2.00	13.61 14.55	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0004	46.296 0.0 0.020		Vel = 0.63	
FM12 to FM13	48 48	2.00	13.61 28.16	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0013	46.316 0.0 0.068		Vel = 1.22	
FM13 to FM14	48 48	2.00	13.62 41.78	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0027	46.384 0.0 0.143		Vel = 1.81	
FM14 to FM15	48 48	2.00	13.64 55.42	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0046	46.527 0.0 0.240		Vel = 2.41	

Final Calculations - Hazen-Williams

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
FM15 to FM16	48 48	2.00	13.68 69.1	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0069	46.767 0.0 0.361		Vel = 3.00	
FM16 to FM17	48 48	2.00	13.73 82.83	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0097	47.128 0.0 0.505		Vel = 3.59	
FM17 to FM18	48 48	2.00	13.80 96.63	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0129	47.633 0.0 0.671		Vel = 4.19	
FM18 to FM19	48 48	2.00	13.90 110.53	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0165	48.304 0.0 0.861		Vel = 4.80	
FM19 to FM20	48 48	2.00	14.03 124.56	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0206	49.165 0.0 1.073		Vel = 5.41	
FM20 to 901	48 48	2.00	14.17 138.73	3 3.068	E	7.0 0.0	10.890 7.000	120 0.0252	50.238 0.0 0.450		Vel = 6.02	
901			0.0 138.73						50.688		K Factor = 19.49	
H1 to M3	2 -6.500	.0	0.0 0.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0	106.209 3.681 0.0		Vel = 0	
M3			0.0 0.0						109.890		K Factor = 0	
H2 to M4	2 -6.500	.0	0.0 0.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0	101.763 3.681 0.0		Vel = 0	
M4			0.0 0.0						105.444		K Factor = 0	
H3 to M5	2 -6.500	.0	0.0 0.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0	98.237 3.681 0.0		Vel = 0	
M5			0.0 0.0						101.918		K Factor = 0	
H4 to M6	2 -6.500	.0	0.0 0.0	6 5.86	2E G	35.786 3.834	367.000 39.620	150 0	94.850 3.681 0.0		Vel = 0	
M6			0.0 0.0						98.531		K Factor = 0	
H5 to M6	2 -6.500	.0	0.0 0.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0	94.850 3.681 0.0		Vel = 0	
M6			0.0 0.0						98.531		K Factor = 0	
H6 to M8	2 -6.500	.0	0.0 0.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0	90.682 3.681 0.0		Vel = 0	

Final Calculations - Hazen-Williams

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
M8			0.0 0.0						94.363		K Factor = 0	
H7 to M9	2 -6.500	H750	750.00 750.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0.0162	85.313 3.681 1.294		Vel = 8.92	
M9			0.0 750.00						90.288		K Factor = 78.93	
H8 to M10	2 -6.500	H625	625.00 625.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0.0115	85.000 3.681 0.924		Vel = 7.43	
M10			0.0 625.00						89.605		K Factor = 66.03	
H9 to M11	2 -6.500	H625	625.00 625.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0.0116	85.036 3.681 0.925		Vel = 7.43	
M11			0.0 625.00						89.642		K Factor = 66.01	
H10 to M12	2 -6.500	H750	750.00 750.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0.0162	85.914 3.681 1.295		Vel = 8.92	
M12			0.0 750.00						90.890		K Factor = 78.67	
H11 to M13	2 -6.500	.0	0.0 0.0	6 5.86	2E G	35.786 3.834 0.0	367.000 39.620 406.620	150 0	91.687 3.681 0.0		Vel = 0	
M13			0.0 0.0						95.368		K Factor = 0	
H12 to M13	2 -6.500	.0	0.0 0.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0	91.687 3.681 0.0		Vel = 0	
M13			0.0 0.0						95.368		K Factor = 0	
H13 to M15	2 -6.500	.0	0.0 0.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0	97.369 3.681 0.0		Vel = 0	
M15			0.0 0.0						101.050		K Factor = 0	
H14 to M16	2 -6.500	.0	0.0 0.0	6 5.86	E T G	17.893 38.342 3.834	20.000 60.069 80.069	150 0	102.129 3.681 0.0		Vel = 0	
M16			0.0 0.0						105.810		K Factor = 0	
M1 to BOR3	-6.500 2		2750.00 2750.0	10 10.28	E G	33.148 7.534 0.0	10.000 40.682 50.682	140 0.0131	112.063 -3.681 0.666		Vel = 10.63	
BOR3			0.0 2750.00						109.048		K Factor = 263.34	

Final Calculations - Hazen-Williams

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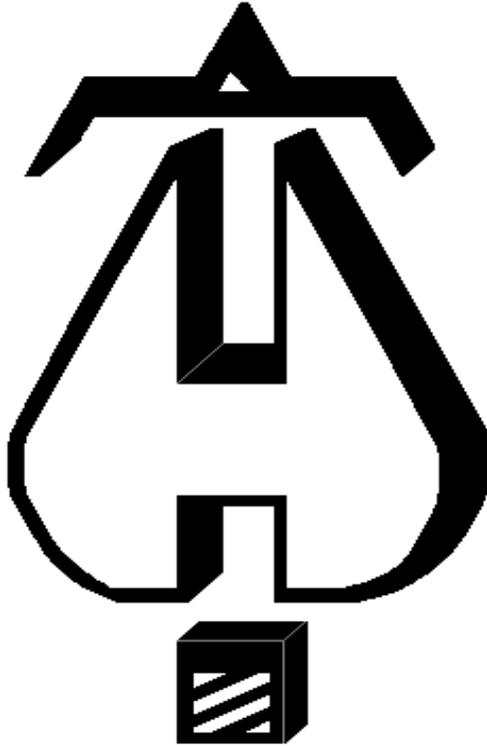
Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
M1 to M2	-6.500 -6.500		-2750.00 -2750.0	10 9.42	E	24.61 0.0	8.000 24.609	150 -0.0177	112.063 0.0			Vel = 12.66
M2 to M3	-6.500 -6.500		1474.85 -1275.15	8 7.68	T 2E G	43.857 45.11 5.012	44.000 93.979 137.979	150 -0.0116	111.485 0.0 -1.595			Vel = 8.83
M3 to M4	-6.500 -6.500		0.0 -1275.15	8 7.68	E	22.555 0.0	362.000 22.555	150 -0.0116	109.890 0.0			Vel = 8.83
M4 to M5	-6.500 -6.500		0.0 -1275.15	8 7.68	G	5.012 0.0	300.000 5.012	150 -0.0116	105.445 0.0			Vel = 8.83
M5 to M7	-6.500 -6.500		0.0 -1275.15	8 7.68		0.0 0.0	293.000 0.0	150 -0.0116	101.919 0.0			Vel = 8.83
M7			0.0 -1275.15						98.532			K Factor = -128.46
M6 to M7	-6.500 -6.500	.0	0.0 0.0	8 7.68	T	43.857 0.0	21.000 43.857	150 0	98.532 0.0			Vel = 0
M7 to M8	-6.500 -6.500		-1275.15 -1275.15	8 7.68	G E	5.012 22.555	333.000 27.567	150 -0.0116	98.532 0.0			Vel = 8.83
M8 to M9	-6.500 -6.500		0.0 -1275.15	8 7.68	E	22.555 0.0	330.000 22.555	150 -0.0116	94.364 0.0			Vel = 8.83
M9 to M10	-6.500 -6.500		750.00 -525.15	8 7.68	G	5.012 0.0	300.000 5.012	150 -0.0022	90.288 0.0			Vel = 3.64
M10 to M11	-6.500 -6.500		625.00 99.85	8 7.68	2E	45.11 0.0	306.000 45.110	150 0.0001	89.605 0.0			Vel = 0.69
M11 to M12	-6.500 -6.500		625.00 724.85	8 7.68	G	5.012 0.0	302.000 5.012	150 0.0041	89.642 0.0			Vel = 5.02
M12 to M14	-6.500 -6.500		750.00 1474.85	8 7.68		0.0 0.0	296.000 0.0	150 0.0151	90.890 0.0			Vel = 10.21
M14			0.0 1474.85						95.368			K Factor = 151.02
M13 to M14	-6.500 -6.500	.0	0.0 0.0	8 7.68	T	43.857 0.0	21.000 43.857	150 0	95.368 0.0			Vel = 0
M14 to M15	-6.500 -6.500		1474.85 1474.85	8 7.68	E G	22.555 5.012	348.000 27.567	150 0.0151	95.368 0.0			Vel = 10.21
M15 to M16	-6.500 -6.500		0.0 1474.85	8 7.68	E	22.555 0.0	292.000 22.555	150 0.0151	101.051 0.0			Vel = 10.21

Final Calculations - Hazen-Williams

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 Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
M16 to M2	-6.500 -6.500		0.0 1474.85	8 7.68	4E G T	90.221 5.012 43.857	236.000 139.090 375.090	150 0.0151	105.810 0.0 5.675		Vel = 10.21	
M2			0.0 1474.85						111.485		K Factor = 139.68	



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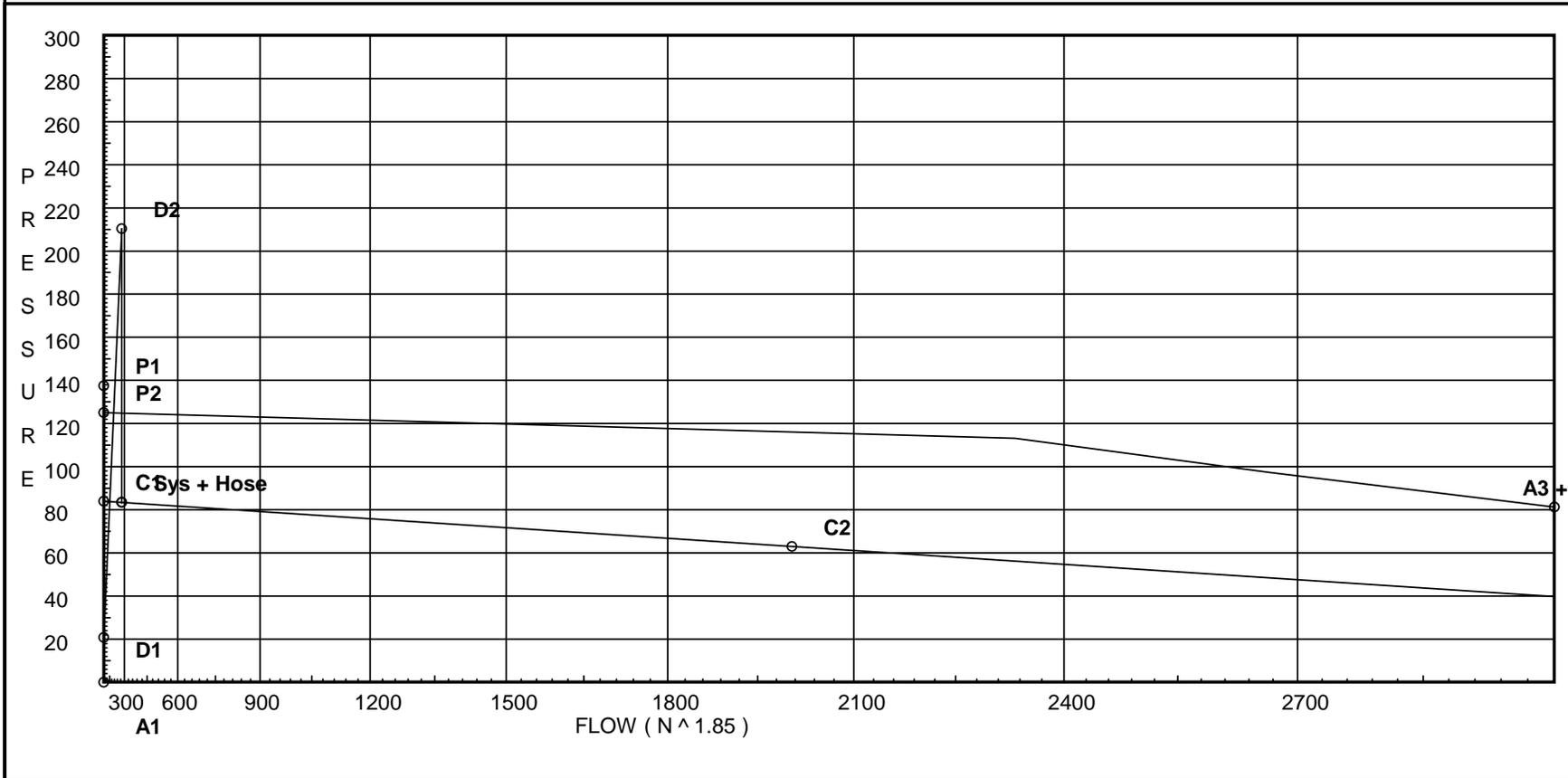
Job Name : Rail Unloading-R5
Drawing :
Location :
Remote Area :
Contract :
Data File : Tank Area 9.WXF

Water Supply Curve C

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 Rail Unloading-R5

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City Water Supply: C1 - Static Pressure : 84 C2 - Residual Pressure: 63 C2 - Residual Flow : 2005 City Water Adjusted to Pump Inlet for Pf - Elev - Hose Flow A1 - Adjusted Static: 0 A2 - Adj Resid : 0 @ 0 A3 - Adj Resid : 0 @ 3000	Pump Data: P1 - Pump Churn Pressure : 137.5 P2 - Pump Rated Pressure : 125 P2 - Pump Rated Flow : 0 P3 - Pump Pressure @ Max Flow : 81.25 P3 - Pump Max Flow : 3000 City Residual Flow @ 0 = 4241.82 City Residual Flow @ 20 = 3661.97 City Water @ 150% of Pump = 39.74 Pump flow terminated at adjusted curve 0 psi	Demand: D1 - Elevation : 20.789 D2 - System Flow : 279.396 D2 - System Pressure : 210.338 Hose (Demand) : _____ D3 - System Demand : 279.396 Safety Margin : 0.004
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Fittings Used Summary

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Fitting Legend		½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24	
Abbrev.	Name																					
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0	0
Bvcb	B Fly Vic 705W	0	0	0	0	0	0	5	5	0	12	12	8	11	12	14	0	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61	61
L	NFPA 13 Long Turn Elbow	0.5	1	2	2	2	3	4	5	5	6	8	9	13	16	18	24	27	30	34	40	40
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65	65	65	65	65	65	65
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121	121
Zie	Wilkins 375	Fitting generates a Fixed Loss Based on Flow																				

Units Summary

Diameter Units Inches
 Length Units Feet
 Flow Units US Gallons per Minute
 Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

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 Rail Unloading-R5

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SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
PO	See Information on Pump Curve			210.342	279.4	210.338
TFC	84.0	63	2005.0	83.452	279.4	83.452

NODE ANALYSIS

<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
FM10	48.0	2	47.64	13.8	
FM9	48.0	2	47.66	13.81	
FM8	48.0	2	47.72	13.82	
FM7	48.0	2	47.85	13.84	
FM6	48.0	2	48.08	13.87	
FM5	48.0	2	48.44	13.92	
FM4	48.0	2	48.93	13.99	
FM3	48.0	2	49.6	14.08	
FM2	48.0	2	50.22	14.17	
FM1	48.0	2	51.29	14.32	
901	48.0		52.15		
902	2.0		77.68		
904	2.0		85.9		
903	6.0		84.54		
905	6.0		88.92		
906	2.0		91.02		
907	2.0		185.86		
908	8.0		183.81		
TOR3	8.0		193.41		
BOR3	2.0		204.44		
PO	0.0		210.34		
PI	0.0		72.84		
FF	2.0		72.0		
UG1	-6.5		86.15		
UG2	-6.5		86.16		
TFC	0.0		83.45		
FM11	48.0	2	47.64	13.8	
FM12	48.0	2	47.66	13.81	
FM13	48.0	2	47.73	13.82	
FM14	48.0	2	47.88	13.84	
FM15	48.0	2	48.12	13.87	
FM16	48.0	2	48.49	13.93	
FM17	48.0	2	49.01	14.0	
FM18	48.0	2	49.7	14.1	
FM19	48.0	2	50.59	14.22	
FM20	48.0	2	51.69	14.38	
HOSE	2.0		204.44		

EOD

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Rail Unloading-R5

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
FM10 to FM9	48 48	2.00	12.85	3	2E	14.0	38.090 14.000	120	47.640 0.0			
			12.85	3.068		0.0	52.090	0.0003	0.016	Vel =	0.56	
FM9 to FM8	48 48	2.00	13.81	3	2E	14.0	38.090 14.000	120	47.656 0.0			
			26.66	3.068		0.0	52.090	0.0012	0.062	Vel =	1.16	
FM8 to FM7	48 48	2.00	13.81	3	2E	14.0	38.090 14.000	120	47.718 0.0			
			40.47	3.068		0.0	52.090	0.0026	0.134	Vel =	1.76	
FM7 to FM6	48 48	2.00	13.84	3	2E	14.0	38.090 14.000	120	47.852 0.0			
			54.31	3.068		0.0	52.090	0.0044	0.231	Vel =	2.36	
FM6 to FM5	48 48	2.00	13.87	3	2E	14.0	38.090 14.000	120	48.083 0.0			
			68.18	3.068		0.0	52.090	0.0068	0.352	Vel =	2.96	
FM5 to FM4	48 48	2.00	13.92	3	2E	14.0	38.090 14.000	120	48.435 0.0			
			82.1	3.068		0.0	52.090	0.0095	0.497	Vel =	3.56	
FM4 to FM3	48 48	2.00	13.99	3	2E	14.0	38.090 14.000	120	48.932 0.0			
			96.09	3.068		0.0	52.090	0.0127	0.664	Vel =	4.17	
FM3 to FM2	48 48	2.00	14.08	3		0.0	38.010 0.0	120	49.596 0.0			
			110.17	3.068		0.0	38.010	0.0164	0.624	Vel =	4.78	
FM2 to FM1	48 48	2.00	14.17	3	2E	14.0	38.090 14.000	120	50.220 0.0			
			124.34	3.068		0.0	52.090	0.0205	1.070	Vel =	5.40	
FM1 to 901	48 48	2.00	14.33	3	E	7.0	27.200 7.000	120	51.290 0.0			
			138.67	3.068		0.0	34.200	0.0251	0.860	Vel =	6.02	
901 to 902	48 2		140.73	3	T	15.0	46.000 15.000	120	52.150 19.923			
			279.4	3.068		0.0	61.000	0.0919	5.604	Vel =	12.13	
902 to 904	2 2		0.0	3	4E	28.0	61.560 28.000	120	77.677 0.0			
			279.4	3.068		0.0	89.560	0.0919	8.228	Vel =	12.13	
904 to 903	2 6		0.0	3		0.0	4.000 0.0	120	85.905 -1.732			
			279.4	3.068		0.0	4.000	0.0918	0.367	Vel =	12.13	
903 to 905	6 6		0.0	3	2E	14.0	33.630 14.000	120	84.540 0.0			
			279.4	3.068		0.0	47.630	0.0919	4.376	Vel =	12.13	
905 to 906	6 2		0.0	3		0.0	4.000 0.0	120	88.916 1.732			
			279.4	3.068		0.0	4.000	0.0920	0.368	Vel =	12.13	
906 to 907	2 2		0.0	3	7E	49.0	983.380 49.000	120	91.016 0.0			
			279.4	3.068		0.0	1032.380	0.0919	94.845	Vel =	12.13	

Final Calculations - Hazen-Williams

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
907 to 908	2 8		0.0 279.4	3 3.068		0.0 0.0	6.000 0.0	120 0.0918	185.861 -2.599 0.551		Vel = 12.13	
908 to TOR3	8 8		0.0 279.4	3 3.068	2E	14.0 0.0	90.490 14.000	120 0.0919	183.813 0.0 9.600		Vel = 12.13	
TOR3 to BOR3	8 2		0.0 279.4	3 3.068	T 2B Eq	15.0 20.0 29.0	6.000 64.000 70.000	120 0.0919	193.413 4.599 6.430		** Fixed Loss = 2 Vel = 12.13	
BOR3 to PO	2 0		0.0 279.4	10 10.02	L S Bvcb	16.0 55.0 12.0	18.000 83.000 101.000	120 0.0003	204.442 5.866 0.030		** Fixed Loss = 5 Vel = 1.14	
PO			0.0 279.40						210.338		K Factor = 19.26	
System Demand Pressure									210.338			
Safety Margin									0.004			
Continuation Pressure									210.342			
Pressure @ Pump Outlet									210.342			
Pressure From Pump Curve									-137.500			
Pressure @ Pump Inlet									72.842			
PI to FF	0 2		0.0 279.4	10 10.02	2E	44.0 0.0	19.990 44.000	120 0.0003	72.842 -0.866 0.019		Vel = 1.14	
FF to UG1	2 -6.5		0.0 279.4	10 10.28	E 2L T Zie	24.923 36.252 56.644 0.0	8.500 117.819 126.319	120 0.0003	71.995 14.118 0.032		** Fixed Loss = 10.437 Vel = 1.08	
UG1 to UG2	-6.5 -6.5		0.0 279.4	10 9.42	E	21.661 0.0	15.210 21.661	140 0.0003	86.145 0.0 0.011		Vel = 1.29	
UG2 to TFC	-6.5 0		0.0 279.4	10 9.42		0.0 0.0	379.070 0.0	140 0.0003	86.156 -2.815 0.111		Vel = 1.29	
TFC			0.0 279.40						83.452		K Factor = 30.58	
FM10 to FM11	48 48		0.95 0.95	3 3.068	2E	14.0 0.0	38.090 14.000	120 0	47.640 0.0 0.0		Vel = 0.04	
FM11 to FM12	48 48	2.00	13.81 14.76	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0004	47.640 0.0 0.021		Vel = 0.64	
FM12 to FM13	48 48	2.00	13.80 28.56	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0013	47.661 0.0 0.070		Vel = 1.24	
FM13 to FM14	48 48	2.00	13.82 42.38	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0028	47.731 0.0 0.146		Vel = 1.84	
FM14 to FM15	48 48	2.00	13.84 56.22	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0047	47.877 0.0 0.247		Vel = 2.44	

Final Calculations - Hazen-Williams

ProEnergy Services
Rail Unloading-R5

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Date

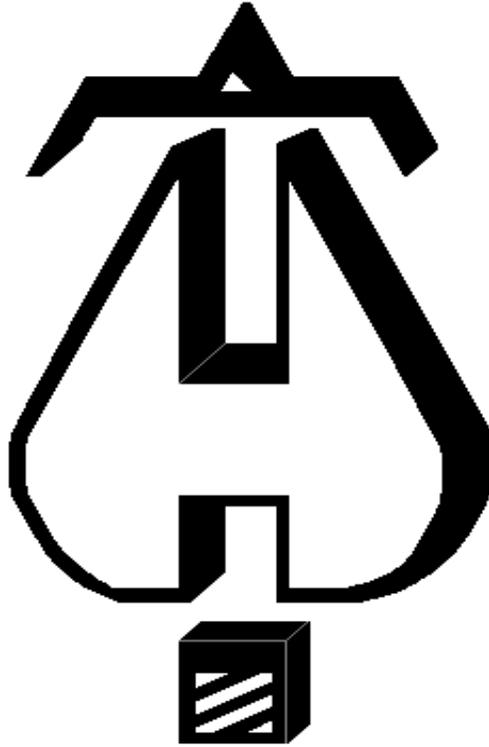
Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
FM15 to FM16	48 48	2.00	13.88 70.1	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0071	48.124 0.0		Vel = 3.04	
FM16 to FM17	48 48	2.00	13.92 84.02	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0100	48.494 0.0		Vel = 3.65	
FM17 to FM18	48 48	2.00	14.00 98.02	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0132	49.013 0.0		Vel = 4.25	
FM18 to FM19	48 48	2.00	14.10 112.12	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0170	49.702 0.0		Vel = 4.87	
FM19 to FM20	48 48	2.00	14.23 126.35	3 3.068	2E	14.0 0.0	38.090 14.000	120 0.0212	50.586 0.0		Vel = 5.48	
FM20 to 901	48 48	2.00	14.38 140.73	3 3.068	E	7.0 0.0	10.890 7.000	120 0.0258	51.688 0.0		Vel = 6.11	
901			0.0 140.73						52.150		K Factor = 19.49	
HOSE to BOR3	2 2	.0	0.0	10		0.0	15.000	120	204.442			
BOR3			0.0	10.02		0.0	15.000	0	0.0		Vel = 0	
BOR3			0.0						204.442		K Factor = 0	

APPENDIX C

Marine Terminal Area Calculation

Hydraulic Analysis
Fire Protection

Poole Fire Protection



... Fire Protection by Computer Design

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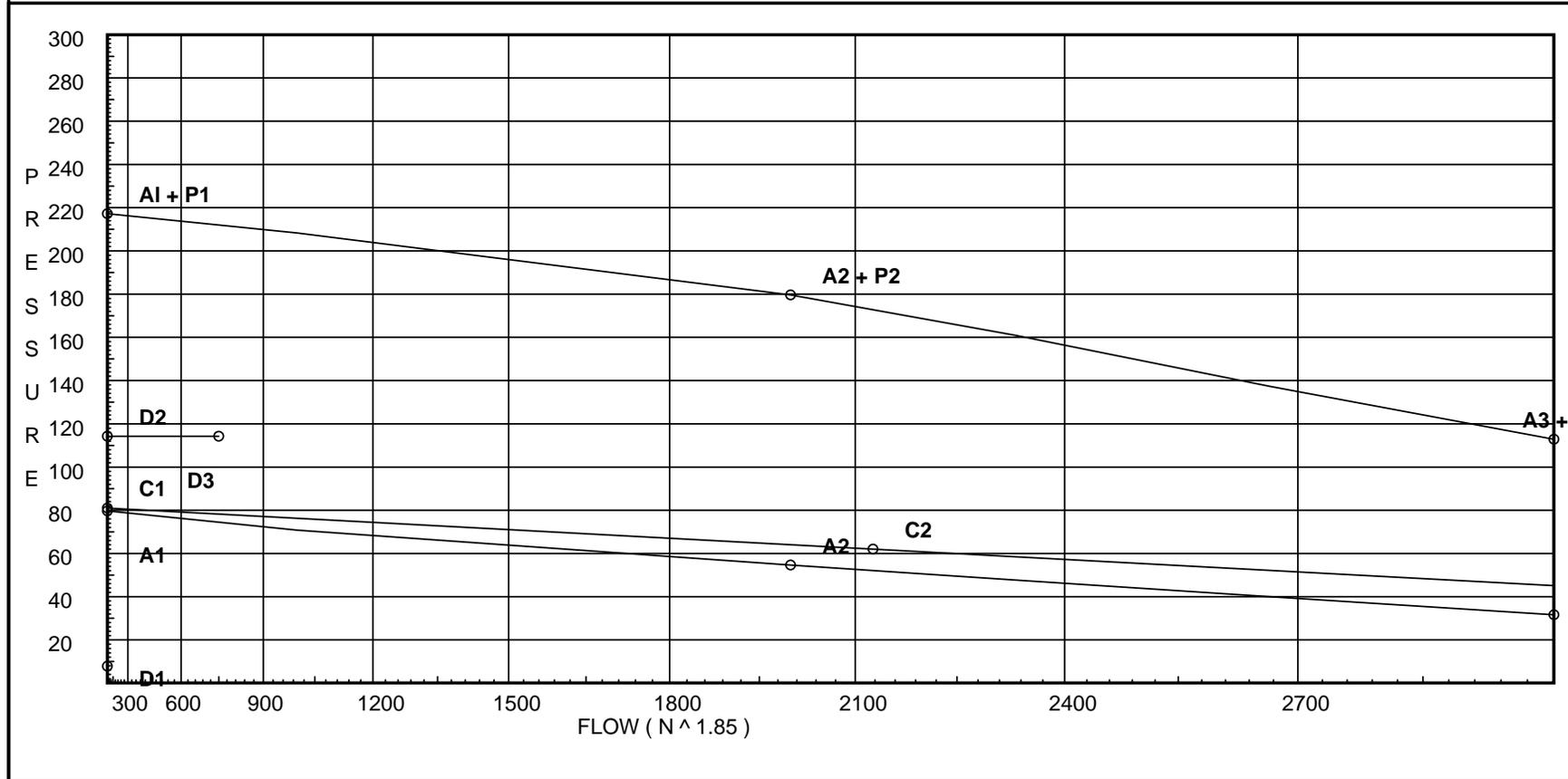
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Drawing :
Location :
Remote Area :
Contract :
Data File : Dock Area 8.WXF

Water Supply Curve C

ProEnergy Services
 Rail Unloading-R5

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City Water Supply: C1 - Static Pressure : 81 C2 - Residual Pressure: 62 C2 - Residual Flow : 2127 City Water Adjusted to Pump Inlet for Pf - Elev - Hose Flow A1 - Adjusted Static: 79.695 A2 - Adj Resid : 54.596 @ 2000 A3 - Adj Resid : 31.596 @ 3000	Pump Data: P1 - Pump Churn Pressure : 137.5 P2 - Pump Rated Pressure : 125 P2 - Pump Rated Flow : 2000 P3 - Pump Pressure @ Max Flow : 81.25 P3 - Pump Max Flow : 3000 City Residual Flow @ 0 = 4657.61 City Residual Flow @ 20 = 3995.70 City Water @ 150% of Pump = 45.10	Demand: D1 - Elevation : 7.796 D2 - System Flow : _____ D2 - System Pressure : 114.227 Hose (Demand) : 750 D3 - System Demand : 750 Hose (Adj City) : 1250 Safety Margin : 81.491
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Fittings Used Summary

ProEnergy Services
Rail Unloading-R5

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Fitting Legend		½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24	
Abbrev.	Name																					
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61	
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121	

Units Summary

Diameter Units Inches
 Length Units Feet
 Flow Units US Gallons per Minute
 Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

ProEnergy Services
 Rail Unloading-R5

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SUPPLY ANALYSIS

<i>Node at Source</i>	<i>Static Pressure</i>	<i>Residual Pressure</i>	<i>Flow</i>	<i>Available Pressure</i>	<i>Total Demand</i>	<i>Required Pressure</i>
PO	See Information on Pump Curve			195.718	1500.0	114.227
TEST	81.0	62	2127.0	64.045	2000.0	64.045

NODE ANALYSIS

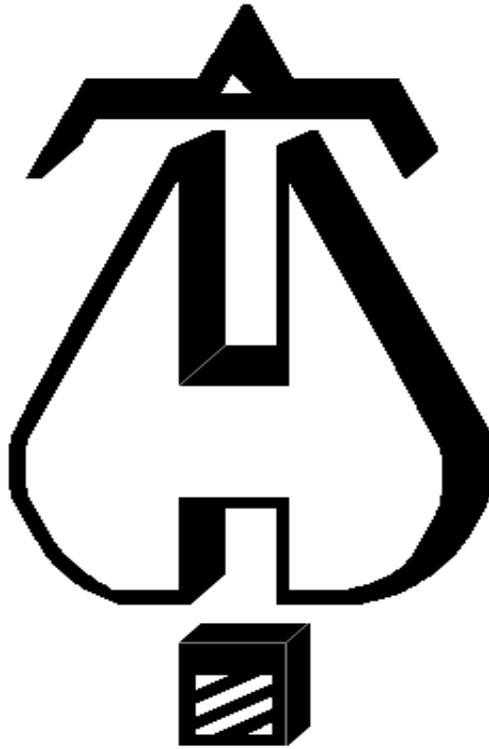
<i>Node Tag</i>	<i>Elevation</i>	<i>Node Type</i>	<i>Pressure at Node</i>	<i>Discharge at Node</i>	<i>Notes</i>
M1	20.0		100.0	750.0	
801	2.0		108.59		
802	2.0		114.02		
803	2.0		114.1		
PO	2.0		114.23		
PI	2.0		63.58		
804	-6.0		67.41		
TEST	2.0		64.04	500.0	
M2	20.0		100.1	750.0	

EOD

ProEnergy Services
 Rail Unloading-R5

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Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
M1 to 801	20 2	H750	750.00 750.0	8 7.981	4E	72.0 0.0	74.730 72.000	120 0.0054	100.000 7.796 0.796		Vel = 4.81	
801 to 802	2 2		750.00 1500.0	8 7.981	T 2E	35.0 36.0	206.450 71.000	120 0.0196	108.592 0.0 5.427		Vel = 9.62	
802 to 803	2 2		0.0 1500.0	8 7.981		0.0 0.0	4.000 0.0	120 0.0198	114.019 0.0 0.079		Vel = 9.62	
803 to PO	2 2		0.0 1500.0	10 10.02		0.0 0.0	20.000 0.0	120 0.0064	114.098 0.0 0.129		Vel = 6.10	
PO			0.0 1500.00						114.227		K Factor = 140.35	
System Demand Pressure									114.227			
Safety Margin									81.491			
Continuation Pressure									195.718			
Pressure @ Pump Outlet									195.718			
Pressure From Pump Curve									-132.133			
Pressure @ Pump Inlet									63.585			
PI to 804	2 -6		0.0 1500.0	10 10.02	E	22.0 0.0	33.980 22.000	120 0.0064	63.585 3.465 0.361		Vel = 6.10	
804 to TEST	-6 2		0.0 1500.0	10 10.28		0.0 0.0	23.140 0.0	140 0.0043	67.411 -3.465 0.099		Vel = 5.80	
TEST			500.00 2000.00						64.045		Qa = 500.00 K Factor = 249.91	
M2 to 801	20 2	H750	750.00 750.0	8 7.981	4E	72.0 0.0	55.810 72.000	120 0.0054	100.103 7.796 0.693		Vel = 4.81	
801			0.0 750.00						108.592		K Factor = 71.97	



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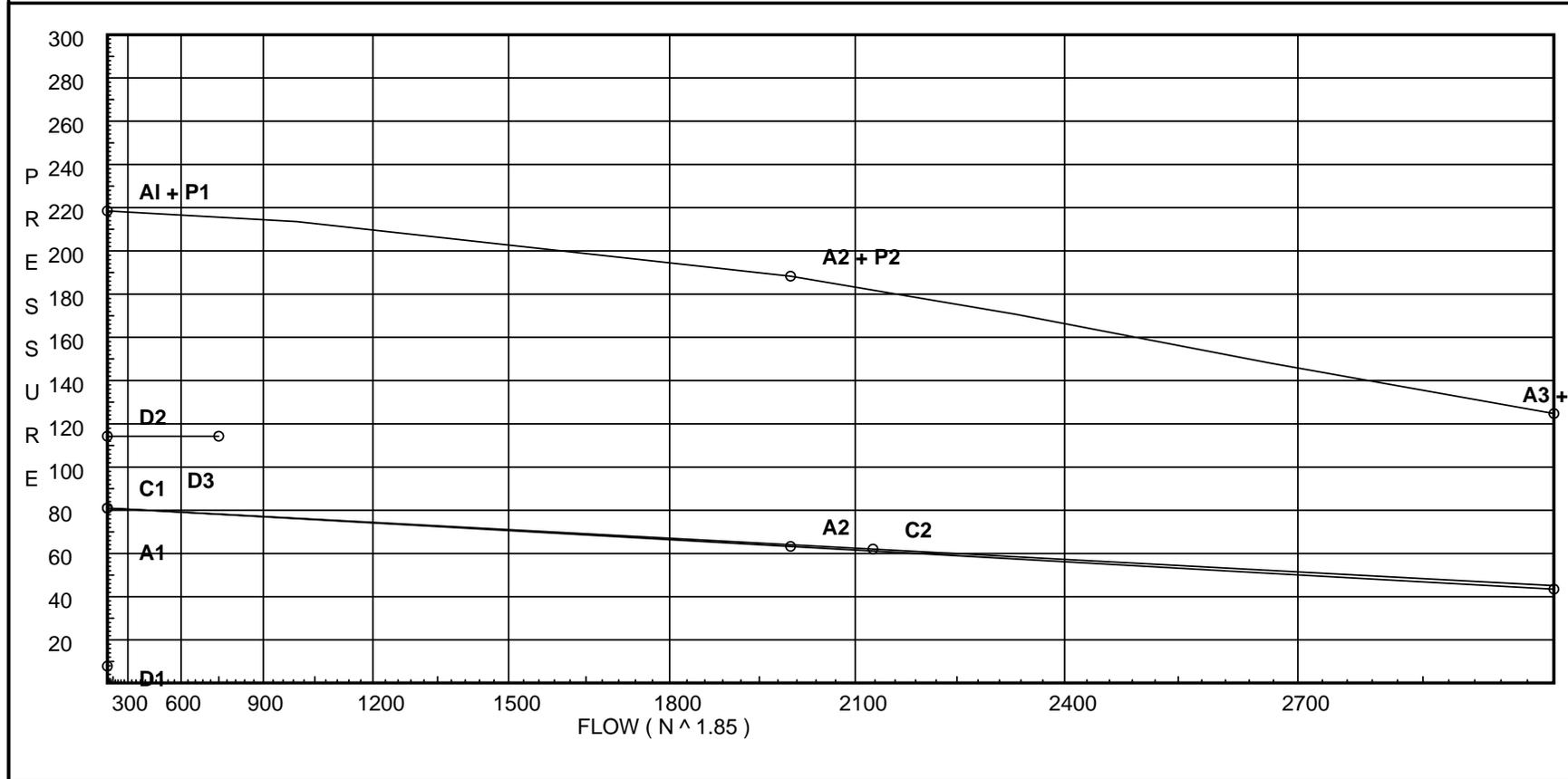
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Drawing :
Location :
Remote Area :
Contract :
Data File : Dock Area 8.WXF

Water Supply Curve C

ProEnergy Services
 Rail Unloading-R5

Page 1
 Date

City Water Supply: C1 - Static Pressure : 81 C2 - Residual Pressure: 62 C2 - Residual Flow : 2127 City Water Adjusted to Pump Inlet for Pf - Elev - Hose Flow A1 - Adjusted Static: 81.000 A2 - Adj Resid : 63.261 @ 2000 A3 - Adj Resid : 43.442 @ 3000	Pump Data: P1 - Pump Churn Pressure : 137.5 P2 - Pump Rated Pressure : 125 P2 - Pump Rated Flow : 2000 P3 - Pump Pressure @ Max Flow : 81.25 P3 - Pump Max Flow : 3000 City Residual Flow @ 0 = 4657.61 City Residual Flow @ 20 = 3995.70 City Water @ 150% of Pump = 45.10	Demand: D1 - Elevation : 7.796 D2 - System Flow : _____ D2 - System Pressure : 114.227 Hose (Demand) : 750 D3 - System Demand : 750 Hose (Adj City) : 750 Safety Margin : 88.488
--	--	--



Fittings Used Summary

ProEnergy Services
Rail Unloading-R5

Page 2
Date

Fitting Legend		½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24	
Abbrev.	Name																					
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61	
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121	

Units Summary

Diameter Units Inches
Length Units Feet
Flow Units US Gallons per Minute
Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Flow Summary - NFPA 2007

ProEnergy Services
 Rail Unloading-R5

Page 3
 Date

SUPPLY ANALYSIS

Node at Source	Static Pressure	Residual Pressure	Flow	Available Pressure	Total Demand	Required Pressure
PO	See Information on Pump Curve			202.715	1500.0	114.227
TEST	81.0	62	2127.0	71.042	1500.0	71.042

NODE ANALYSIS

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
M1	20.0		100.0	750.0	
801	2.0		108.59		
802	2.0		114.02		
803	2.0		114.1		
PO	2.0		114.23		
PI	2.0		70.58		
804	-6.0		74.41		
TEST	2.0		71.04		
M2	20.0		100.1	750.0	

EOD

ProEnergy Services
 Rail Unloading-R5

Page 4
 Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqv.	Ln.	Pipe Ftng's Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
M1 to 801	20 2	H750	750.00 750.0	8 7.981	4E	72.0 0.0	74.730 72.000	120 0.0054	100.000 7.796			
							146.730		0.796	Vel =	4.81	
801 to 802	2 2		750.00 1500.0	8 7.981	T 2E	35.0 36.0	206.450 71.000	120 0.0196	108.592 0.0			
							277.450		5.427	Vel =	9.62	
802 to 803	2 2		0.0 1500.0	8 7.981		0.0 0.0	4.000 0.0	120 0.0198	114.019 0.0			
							4.000		0.079	Vel =	9.62	
803 to PO	2 2		0.0 1500.0	10 10.02		0.0 0.0	20.000 0.0	120 0.0064	114.098 0.0			
							20.000		0.129	Vel =	6.10	
PO			0.0 1500.00						114.227		K Factor =	140.35
System Demand Pressure									114.227			
Safety Margin									88.488			
Continuation Pressure									202.715			
Pressure @ Pump Outlet									202.715			
Pressure From Pump Curve									-132.133			
Pressure @ Pump Inlet									70.582			
PI to 804	2 -6		0.0 1500.0	10 10.02	E	22.0 0.0	33.980 22.000	120 0.0064	70.582 3.465			
							55.980		0.361	Vel =	6.10	
804 to TEST	-6 2		0.0 1500.0	10 10.28		0.0 0.0	23.140 0.0	140 0.0043	74.408 -3.465			
							23.140		0.099	Vel =	5.80	
TEST			0.0 1500.00						71.042		K Factor =	177.96
M2 to 801	20 2	H750	750.00 750.0	8 7.981	4E	72.0 0.0	55.810 72.000	120 0.0054	100.103 7.796			
							127.810		0.693	Vel =	4.81	
801			0.0 750.00						108.592		K Factor =	71.97

APPENDIX D

Flow Test Reports

Hydraulic Analysis
Fire Protection

Poole Fire Protection

City of Vancouver
 PO Box 1995
 Vancouver, WA 98668-1995

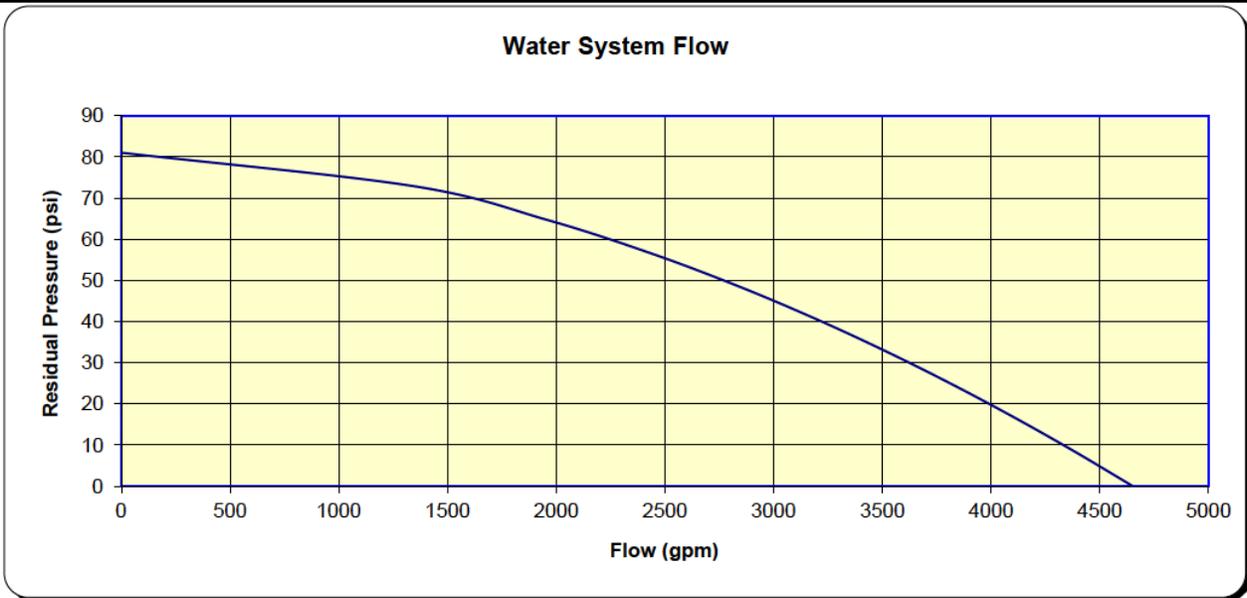


Date: 5/30/13
 Water Systems Planning & Design
 Ph: 360-696-8223 Fx: 360-696-8460
 www.ci.vancouver.wa.us

FIRE HYDRANT FLOW TEST (NFPA 291)

Date: 5/30/2013	Time: 1:15 PM	Initials: GH/TT	Map#:	Zone:	Elevation: ft
Residual FH ID#: H18548	3309 NW Gateway near the warehouse		Static: 81 psi	Residual: 62 psi	
1st Flow FH ID#: H18556	3309 NW Gateway south of the residual hydrant		Port: 4 in	Pitot: 45 psi	
2nd Flow FH ID#:			Port: 0 in	Pitot: 0 psi	

Comments:



RESULTS:	Flow (gpm)	Pressure (psi)
1st Flow	2127 @	62
2nd Flow	0 @	62
Fire Flow*	3992 @	20

*The fire flow calculation and testing is per the 'Recommended Practice for Fire Flow Testing' as documented by the National Fire Protection Agency (NFPA 291, 2002). The calculated fire flow reflects the strength of the water distribution system in the area for which the test was performed. It does not represent flow out of one single fire hydrant.

City of Vancouver
 PO Box 1995
 Vancouver, WA 98668-1995

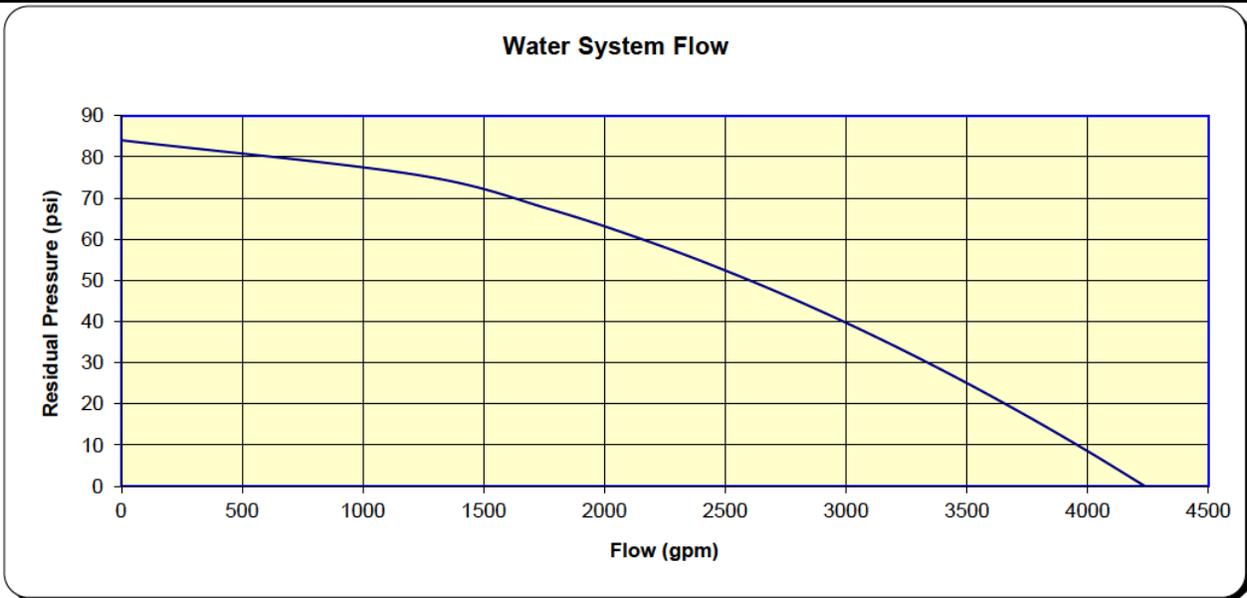


Date: 5/30/13
 Water Systems Planning & Design
 Ph: 360-696-8223 Fx: 360-696-8460
 www.ci.vancouver.wa.us

FIRE HYDRANT FLOW TEST (NFPA 291)

Date: 5/30/2013	Time: 1:45 PM	Initials: GH/TT	Map#:	Zone:	Elevation: ft
Residual FH ID#: H73070	3703 NW Gateway near SW corner of warehouse			Static: 84 psi	Residual: 63 psi
1st Flow FH ID#: H73071	3703 NW Gateway centered south of the warehouse			Port: 4 in	Pitot: 40 psi
2nd Flow FH ID#:				Port: 0 in	Pitot: 0 psi

Comments:



RESULTS:	Flow (gpm)	Pressure (psi)
1st Flow	2005 @	63
2nd Flow	0 @	63
Fire Flow*	3660 @	20

*The fire flow calculation and testing is per the 'Recommended Practice for Fire Flow Testing' as documented by the National Fire Protection Agency (NFPA 291, 2002). The calculated fire flow reflects the strength of the water distribution system in the area for which the test was performed. It does not represent flow out of one single fire hydrant.

10 June 2015

Mr. Stephen Posner
Energy Facility Site Evaluation Council
Washington Utilities and Transportation Commission
P.O. Box 43172
Olympia, WA 98504-3172

Subject: Vancouver Energy
EFSEC Application No. 2013-01, Docket No. EF131590
Response to EFSEC Draft EIS Data Request 9

Dear Mr. Posner:

On behalf of Tesoro Savage Petroleum Terminal LLC (the Applicant), BergerABAM is providing a response to the Energy Facility Site Evaluation Council's (EFSEC) Draft EIS Data Request 9, dated 1 June 2015.

Please feel free to contact me at 206/431-2373, or at irina.makarow@abam.com, if you have any questions about this submittal. We look forward to further coordination with you, your staff, and EFSEC's consultants.

Sincerely,



Irina Makarow
Senior Environmental Project Manager

IM:nb
Enclosure
CD-ROM

cc: Kelly Flint, Savage Companies
Jay Derr, Van Ness Feldman

Response to DEIS Data Request 9

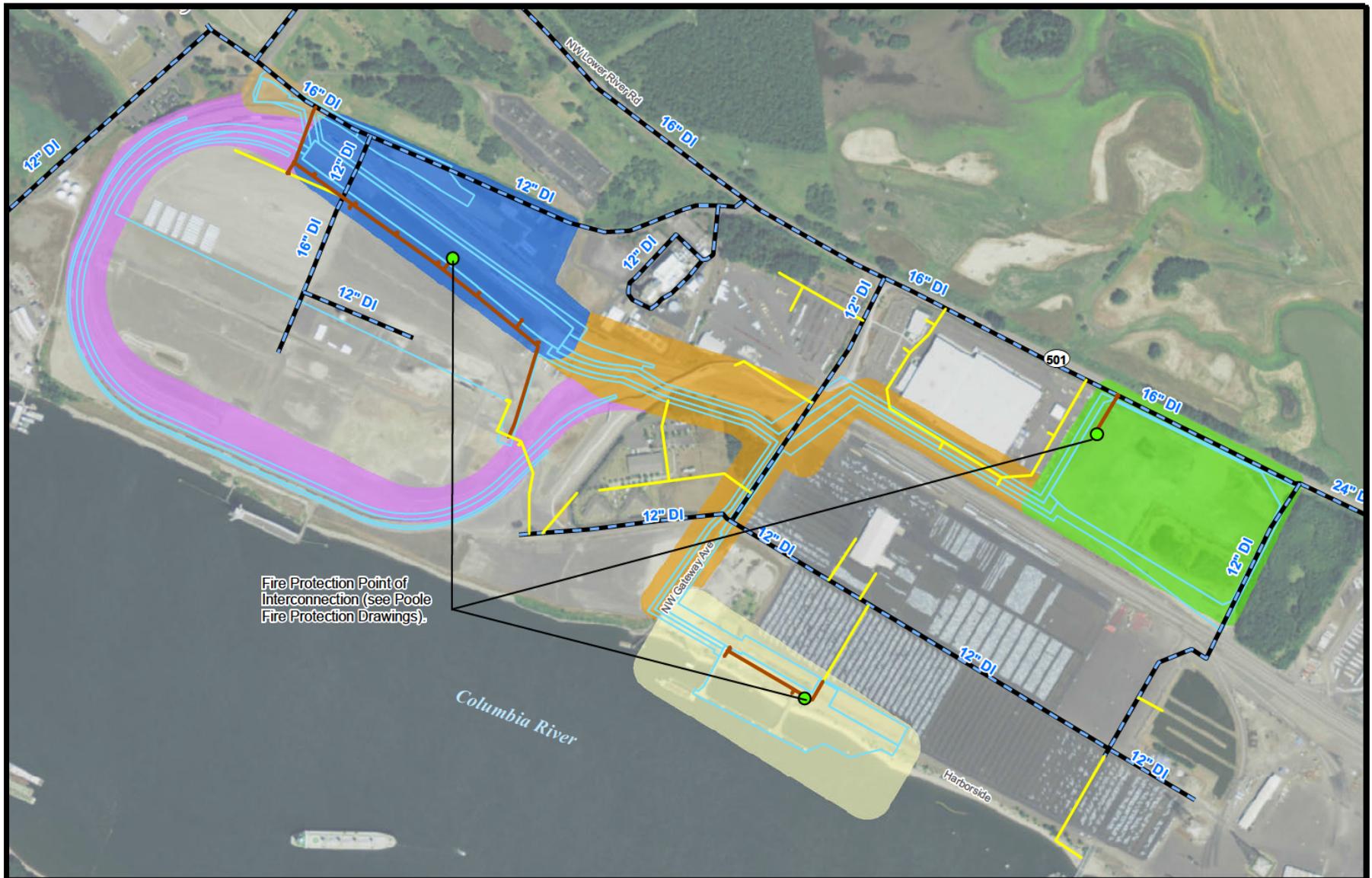
Code	Data Request Item	Applicant Response
Fire Safety		
FS-5	Provide map layouts and schematics of the existing water main system with sizes and hydrant locations, showing connection points to the terminal fire protection system as outlined in the Poole Report. Identify which systems are Port of Vancouver and which systems are City of Vancouver, clearly showing boundaries and any interconnecting links.	<p>The Facility is not proposing to use the Port of Vancouver (Port) water system during operation of the facility for any use, be it process water, or fire protection. The design of the Fire Protection System did not rely on the Port's system for fire protection use. The Facility will only rely on City water supply for fire response.</p> <p>Figure 2.2-11 of the PDEIS – City Water Distribution Network illustrated the City water supply system in the vicinity of the Facility area locations. Attachment 1 provides an updated version of this figure, which includes the City's transmission and distribution lines and illustrates the location of water system improvements constructed for the Facility, including a new water transmission line along the south side of the rail unloading area and a section of replaced water distribution line near the marine terminal. The point of connection of the Facility's fire protection system is also indicated.</p> <p>Although the Applicant is aware that there are multiple existing City-managed fire hydrants present in the vicinity of Facility areas/elements, the Applicant does not have maps or figures identifying all such hydrants that could potentially be used to assist in fire response. The location of existing fire hydrants is, therefore, not indicated in the figures included in Attachment 1. EFSEC's fire protection expert should contact the Vancouver Fire Department for this information.</p> <p>In addition, a system map (titled "POV_WS1_Map") of the City's water distribution system is also included in Attachment 1. The map shows all of the City's water system extending from the nearest water source and reservoirs located at Water Station 1. This figure was prepared based on information received from the City.</p> <p>The Port owns and operates a water supply system. The Port's system is not interconnected to the City's system. As noted above, the Facility will not rely on the Port's water system for fire protection, and the Port system was, therefore, not included in the fire protection system basis of design (refer to the 5 March 2015 supplemental submittal responding to DEIS Data Request 3).</p>
FS-6	Provide any fire flow and pressure test data obtained as part of your design process from the City and the Port.	<p>The Applicant requested fire flow tests from the City, and such tests were completed by the City, in 2013. The Applicant requested tests for three existing hydrant locations, located in Areas 200, 300, and 400 (see Attachment 2, 23 May 2013 e-mail from Dan Shafar [BergerABAM] to Debi Davis (City of Vancouver)).</p> <p>With respect to hydrant testing in Area 200, the City provided the Applicant with data from testing that had been conducted in 2011 (see Attachment 2, 24 May 2013 e-mail from Debi Davis to Dan Shafar).</p> <p>With respect to hydrant testing in Areas 300 and 400, the City tested and provided results for</p>

Response to DEIS Data Request 9

Code	Data Request Item	Applicant Response
Fire Safety		
		<p>hydrants located at 3703 NW Gateway and 3309 NW Gateway. See the last eight pages of Attachment 2.</p> <p>No fire flow testing was requested by the Applicant from the Port as the Applicant is not relying on the Port water system for fire suppression needs.</p>
FS-7	Provide any hydraulic calculations or studies upstream of hydrant or water main connection points for fire water system. The Poole Basis of Design and Hydraulic Calculations were detailed, but only addressed new design conditions downstream of these connection points.	In support of the Application for Site Certification, the Applicant requested a statement from the City regarding water availability for the Facility. The City confirmed that they have sufficient water rights, storage, and distribution capacity to serve the Facility with a minimum of 3,500 gallons per minute of fire flow and sufficient non-fire flow for the facilities anticipated instantaneous peak of 50 gallons per minute for non-fire protection water use. The letter from the City was provided as Appendix E to the Application for Site Certification Supplement (February 2014), and is included in Attachment 3 to this response.
FS-8	Describe the performance standards followed for all fire flow testing done in support of the hydraulic flow calculations and assumptions.	The City performed the hydrant flow tests and subsequent calculations in accordance with National Fire Protection Agency (NFPA) Standard 291, dated 2002. A statement to that effect is included in the fire flow tests (footnote at bottom of test results) discussed in response to FS-6 above and provided in Attachment 2.
FS-9	Provide any relevant communications or contact information between the Applicant and the Port of Vancouver, City of Vancouver and Vancouver Fire Department pertaining to establishing existing water distribution system conditions, performance, and system jurisdictions.	<p>The Applicant assumes that question FS-9 is in relationship to water distribution system capabilities with respect to fire suppression.</p> <p>Because the Applicant chose not to rely on the Port water system for fire suppression, the Applicant does not have any relevant information exchanges with the Port on this subject.</p> <p>Relevant communications between Vancouver Energy and their representatives with staff from the City of Vancouver and Vancouver Fire Department pertaining to the above questions related to fire protection are provided in Attachments 2 and 3.</p> <p>Prior to submittal of the Application for Site Certification in August 2013, and shortly thereafter, the Applicant engaged with VFD staff on issues related to Facility fire protection and response. City water system capacity in relationship to fire response was specifically addressed and resulted in the VFD preparing the letter provided in Attachment 3. The VFD requested that the Applicant participate in a third-party analysis of Facility fire protection design, and the Applicant agreed to do so. The City of Vancouver ultimately declined participating in such a third-party analysis with the Applicant – that review is now being conducted by EFSEC. Since the early discussions were meant to lead up to conducting a detailed analysis, they did not result in a record of information relevant to the information requests made in DEIS Data Request 9.</p>

Attachments

Attachment 1: Updated PDEIS Figure 2.2-11 and City Water Distribution Network



Fire Protection Point of Interconnection (see Poole Fire Protection Drawings).

LEGEND

- | | | |
|---------------------------|---|--------------------------|
| Site Boundary | Vancouver Energy Improvement Areas | 500 - Transfer Pipelines |
| Water System Improvements | 200 - Unloading and Office | 600 - West Boiler |
| Transmission Mains | 300 - Storage | Rail Infrastructure |
| Distribution Mains | 400 - Marine Terminal | |



Transmission Mains from Water Station 1 to POV Property



Attachment 2: Hydrant Test Results for Areas 200, 300, and 400

From: [Shafar, Dan](#)
To: Debi.Davis@cityofvancouver.us
Cc: [Huxley, Matt](#); [Adams, Sam \(Sam.Adams@abam.com\)](mailto:Adams, Sam (Sam.Adams@abam.com))
Subject: Hydrant Flow Tests
Date: Thursday, May 23, 2013 3:45:00 PM
Attachments: [Flow Test Location 1.pdf](#)
[Flow Test Location 2.pdf](#)

Debi,

Attached are copies of the water system maps you provided, with the hydrants we are requesting flow tests. We are requesting that three tests be conducted. We have labeled on each drawing which hydrant we are requesting be flowed, and which hydrant to be utilized to test the static/residual pressures. Also indicated is a very rough indication of presumed connection locations for the proposed fire protection system.

Please confirm that all hydrant testing will be conducted in accordance with NFPA 291.

If at all possible, we are requesting that the flow tests be conducted on Tuesday, May 28, 2013; our client's staff and insurance representatives will be on-site. When you confirm a testing schedule, please let me know so that we can coordinate with our client's scheduled visit.

Regards,

-Dan

Dan Shafar, PE
Senior Engineer 4
Voice 503-872-4084
Fax 503-872-4101

Email dan.shafar@abam.com

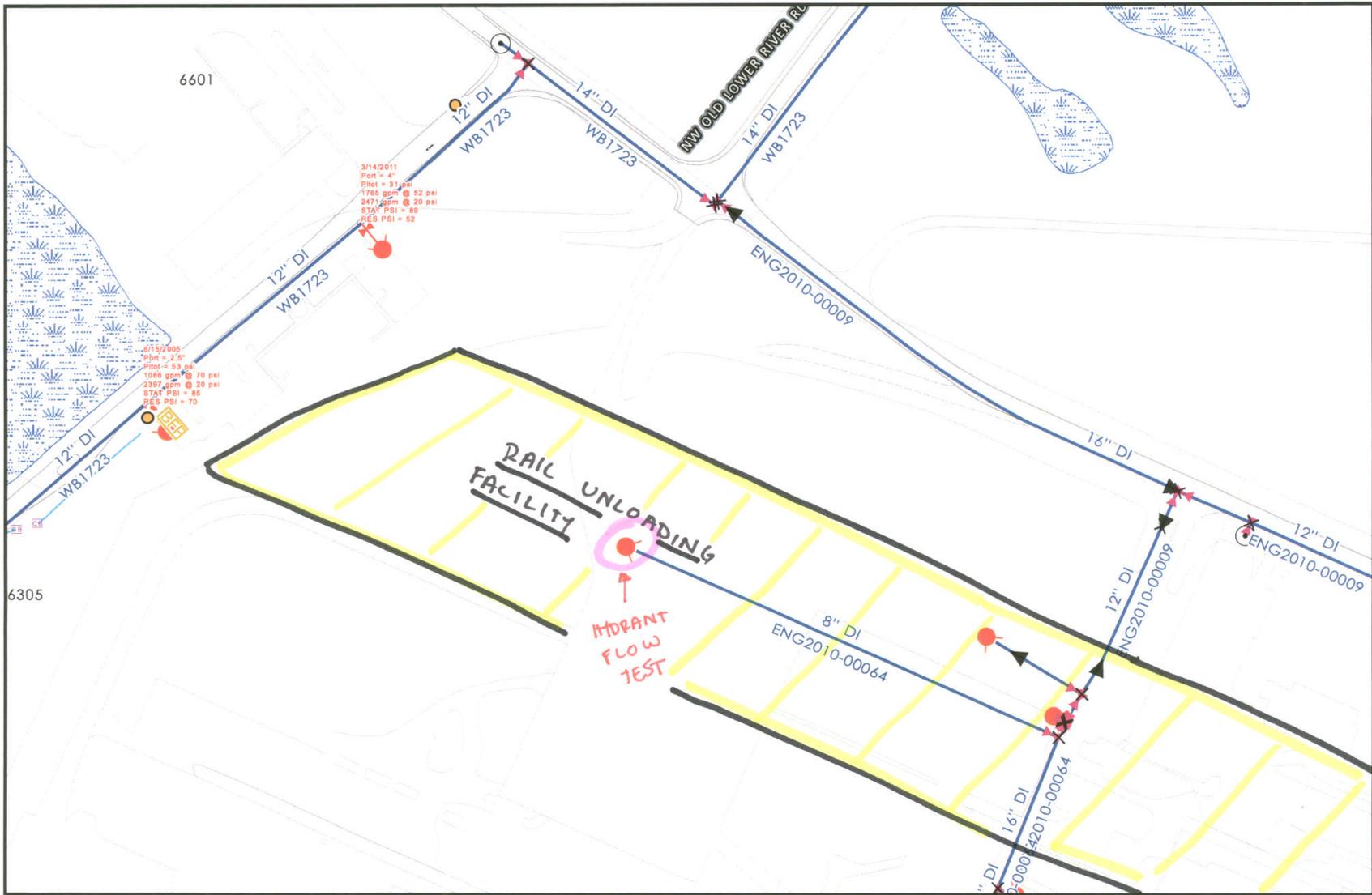
BergerABAM

700 Northeast Multnomah Street, Suite 900
Portland, Oregon 97232-4189

<http://www.abam.com>

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Water Utility Map



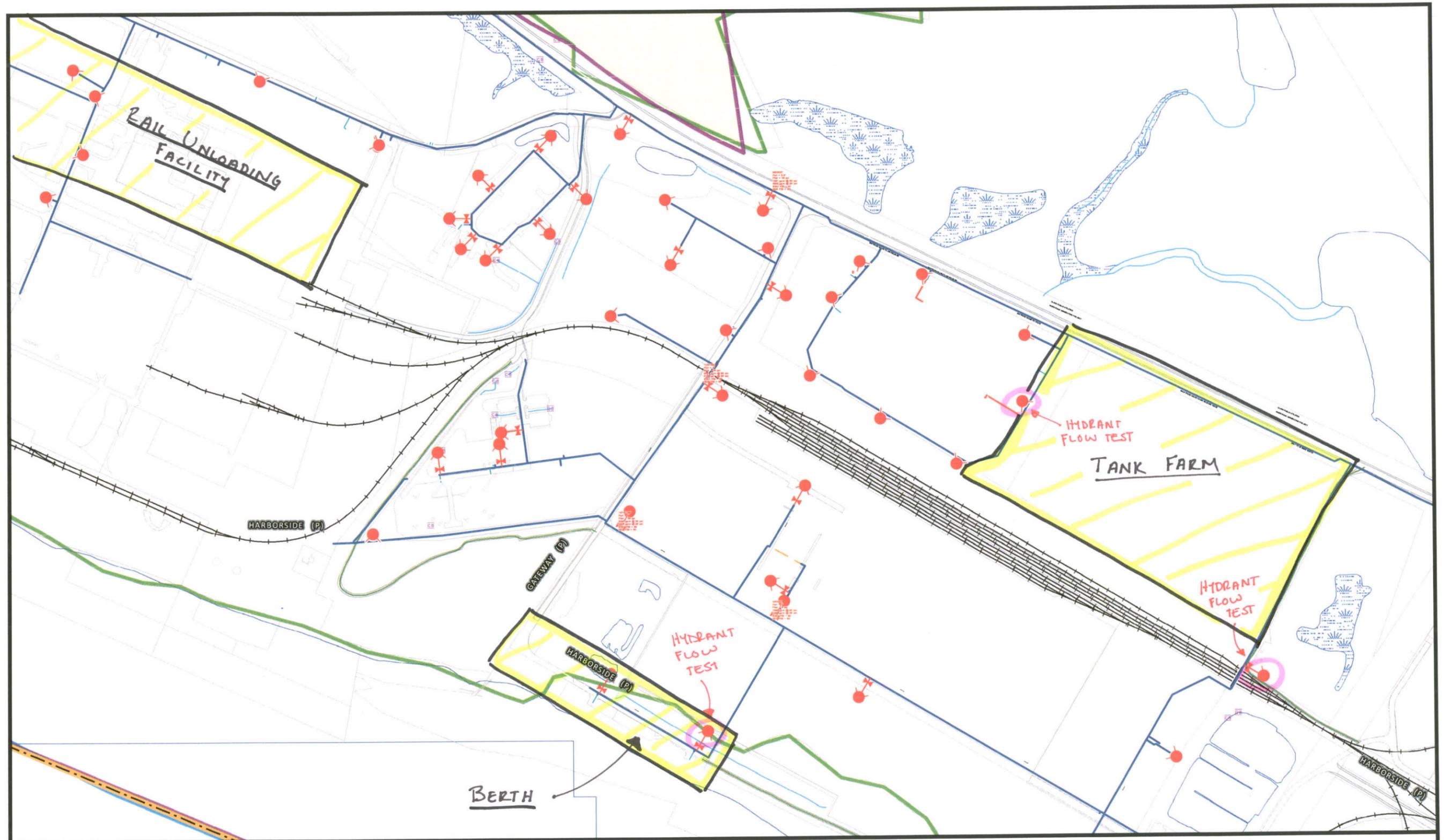
Northwest corner Port



1 inch = 200 feet

THE UTILITY INFORMATION SHOWN ON THIS MAP DOES NOT INDICATE OR IMPLY AVAILABILITY. CONTACT THE ENGINEERING COUNTER STAFF AT THE CDD PERMITS CENTER AT (360) 487-7804 OR 415 W. 6TH ST. FOR AVAILABILITY OF SERVICE.

THIS INFORMATION IS COMPILED FROM A VARIETY OF SOURCES. THE CITY OF VANCOUVER ASSUMES NO RESPONSIBILITY FOR MAP ACCURACY.



Water Utility Map



Port Area
 Taxlot #:
 1 inch = 400 feet



THE UTILITY INFORMATION SHOWN ON THIS MAP DOES NOT INDICATE OR IMPLY AVAILABILITY. CONTACT THE ENGINEERING COUNTER STAFF AT THE CDD PERMITS CENTER AT (360) 487-7804 OR 415 W. 6TH ST. FOR AVAILABILITY OF SERVICE.
 THIS INFORMATION IS COMPILED FROM A VARIETY OF SOURCES. THE CITY OF VANCOUVER ASSUMES NO RESPONSIBILITY FOR MAP ACCURACY.

From: [Davis, Debi \(City\)](#)
To: [Shafar, Dan](#)
Subject: RE: Hydrant Flow Tests
Date: Friday, May 24, 2013 6:36:06 AM
Attachments: [BHPSITE.xls](#)

Dan,

We have a flow from the hydrant on your first map it was taken 3/14/11. See attached.

Debi Davis
Senior Engineering Tech
Water System Planning & Design
Engineering Services
360-487-7173
debi.davis@cityofvancouver.us

From: Shafar, Dan [mailto:Dan.Shafar@abam.com]
Sent: Thursday, May 23, 2013 3:45 PM
To: Davis, Debi (City)
Cc: Huxley, Matt; Adams, Sam
Subject: Hydrant Flow Tests

Debi,

Attached are copies of the water system maps you provided, with the hydrants we are requesting flow tests. We are requesting that three tests be conducted. We have labeled on each drawing which hydrant we are requesting be flowed, and which hydrant to be utilized to test the static/residual pressures. Also indicated is a very rough indication of presumed connection locations for the proposed fire protection system.

Please confirm that all hydrant testing will be conducted in accordance with NFPA 291.

If at all possible, we are requesting that the flow tests be conducted on Tuesday, May 28, 2013; our client's staff and insurance representatives will be on-site. When you confirm a testing schedule, please let me know so that we can coordinate with our client's scheduled visit.

Regards,

-Dan

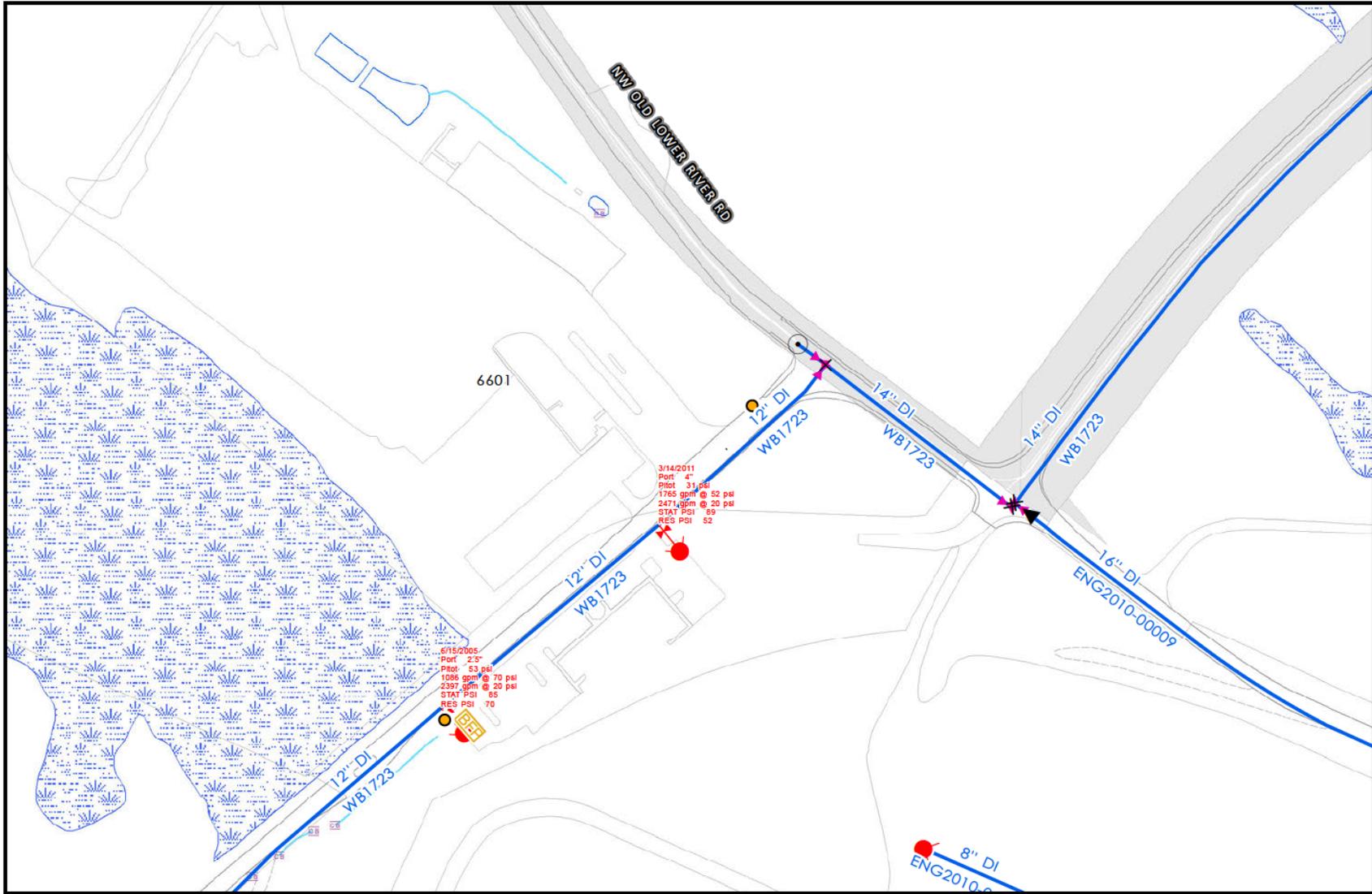
Dan Shafar, PE
Senior Engineer 4
Voice 503-872-4084
Fax 503-872-4101
Email dan.shafar@abam.com

BergerABAM
700 Northeast Multnomah Street, Suite 900
Portland, Oregon 97232-4189
<http://www.abam.com>

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Water Utility Map

Fire flow Old Lower River Road



Taxlot #:

1 inch = 200 feet



THE UTILITY INFORMATION SHOWN ON THIS MAP DOES NOT INDICATE OR IMPLY AVAILABILITY. CONTACT THE ENGINEERING COUNTER STAFF AT THE CDD PERMITS CENTER AT (360) 487-7804 OR 415 W. 6TH ST. FOR AVAILABILITY OF SERVICE.

THIS INFORMATION IS COMPILED FROM A VARIETY OF SOURCES. THE CITY OF VANCOUVER ASSUMES NO RESPONSIBILITY FOR MAP ACCURACY.

City of Vancouver
 PO Box 1995
 Vancouver, WA 98668-1995

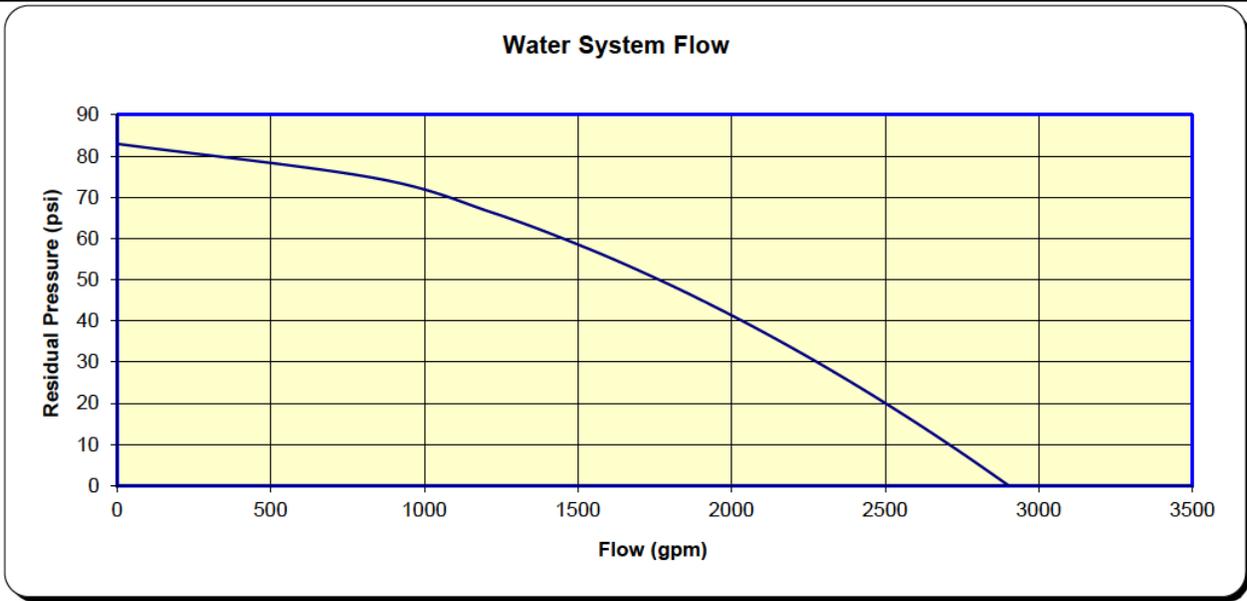


Date: 3/14/11
 Water Systems Planning & Design
 Ph: 360-696-8223 Fx: 360-696-8460
 www.ci.vancouver.wa.us

FIRE HYDRANT FLOW TEST (NFPA 291)

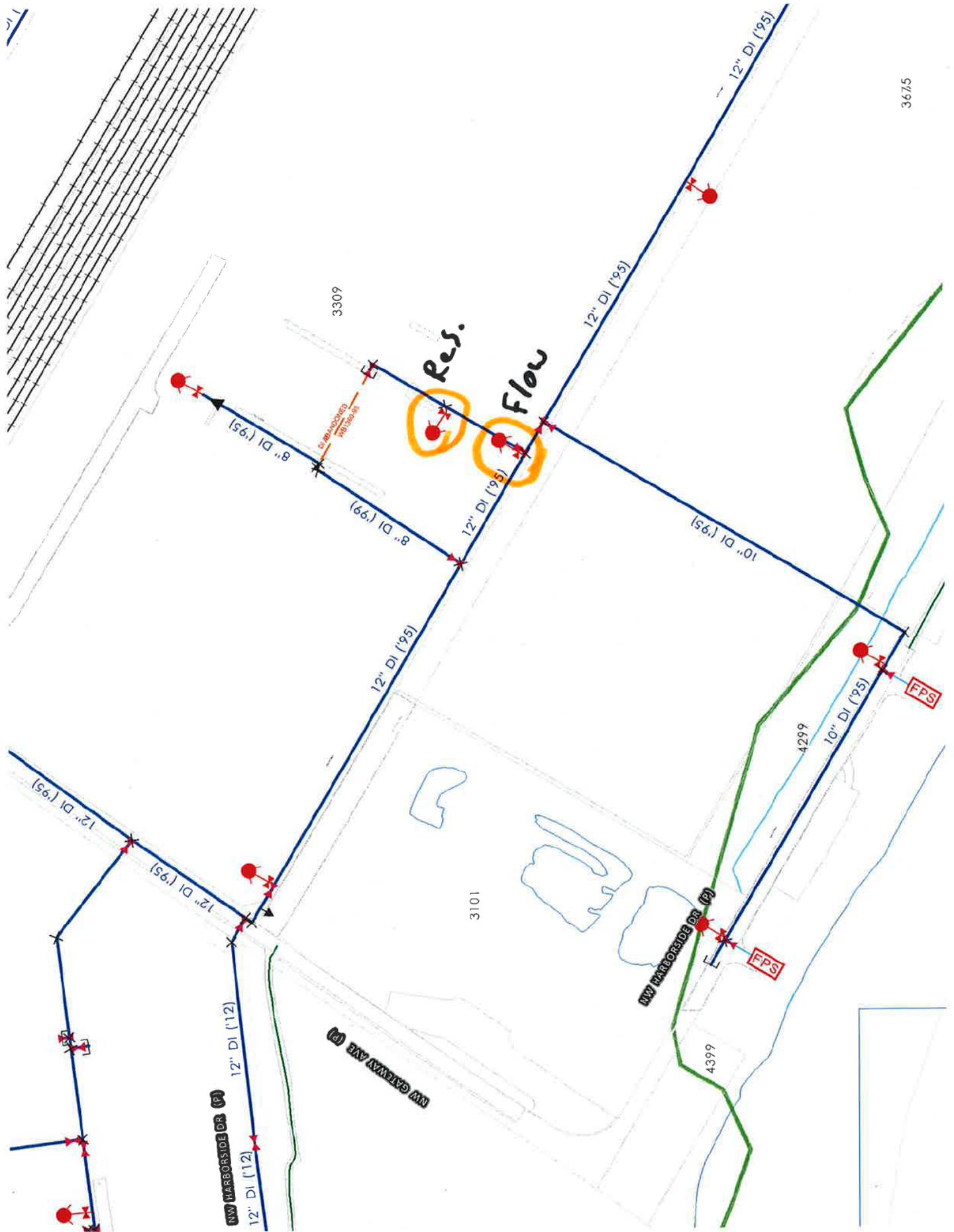
Date: 3/14/2011	Time: 2:30 AM	Initials: GH	Map#:	Zone:	Elevation: ft
Residual FH ID#:	Keyera entrance gated			Static: 83 psi	Residual: 47 psi
1st Flow FH ID#:	BHP onsite north hydrant			Port: 4 in	Pitot: 34 psi
2nd Flow FH ID#:				Port: 0 in	Pitot: 0 psi

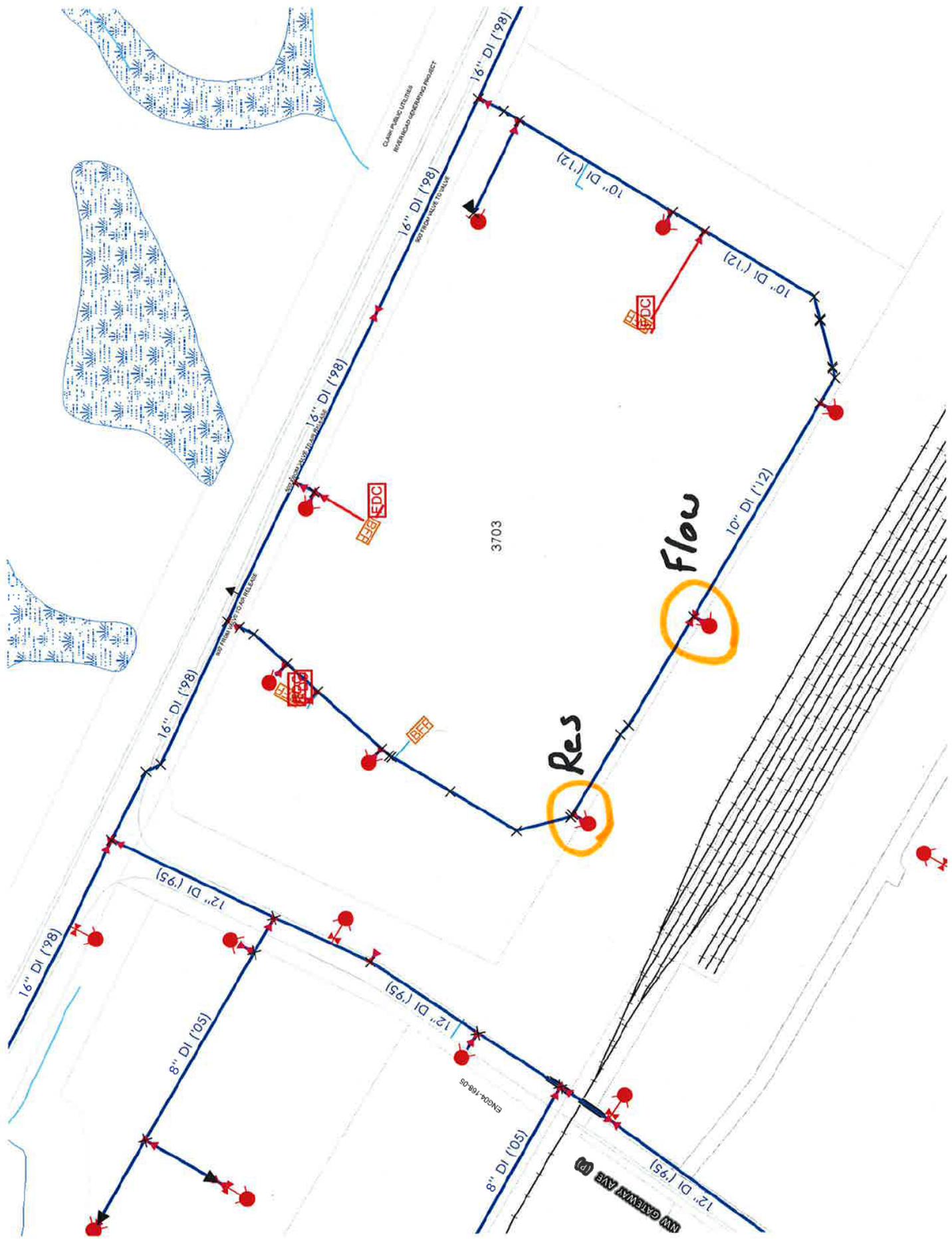
Comments:



RESULTS:	Flow (gpm)	Pressure (psi)
1st Flow	1849 @	47
2nd Flow	0 @	47
Fire Flow*	2501 @	20

*The fire flow calculation and testing is per the 'Recommended Practice for Fire Flow Testing' as documented by the National Fire Protection Agency (NFPA 291, 2002). The calculated fire flow reflects the strength of the water distribution system in the area for which the test was performed. It does not represent flow out of one single fire hydrant.





City of Vancouver
 PO Box 1995
 Vancouver, WA 98668-1995

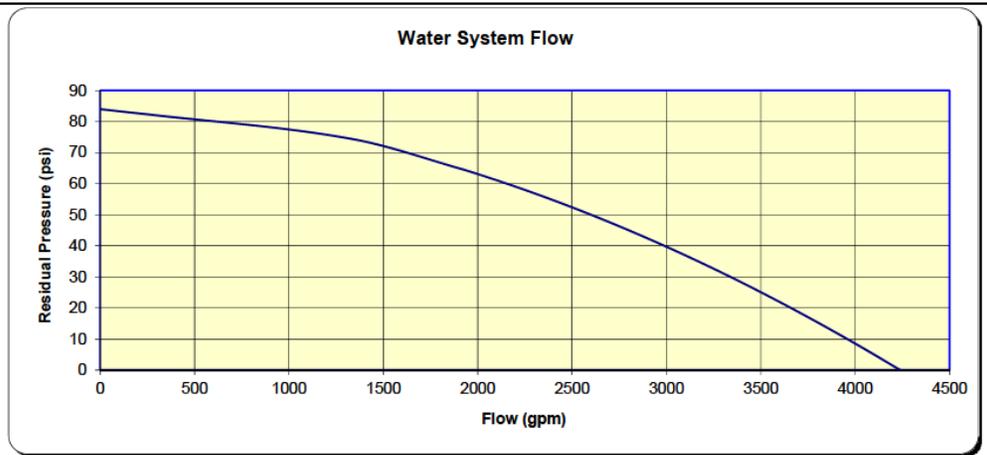


Date: 5/30/13
 Water Systems Planning & Design
 Ph: 360-696-8223 Fx: 360-696-8460
 www.ci.vancouver.wa.us

FIRE HYDRANT FLOW TEST (NFPA 291)

Date: 5/30/2013	Time: 1:45 PM	Initials: GH/TT	Map#:	Zone:	Elevation: ft
Residual FH ID#: H73070	3703 NW Gateway near SW corner of warehouse			Static: 84 psi	Residual: 63 psi
1st Flow FH ID#: H73071	3703 NW Gateway centered south of the warehouse			Port: 4 in	Pitot: 40 psi
2nd Flow FH ID#:				Port: 0 in	Pitot: 0 psi

Comments:



RESULTS:	Flow (gpm)	Pressure (psi)
1st Flow	2005 @	63
2nd Flow	0 @	63
Fire Flow*	3660 @	20

*The fire flow calculation and testing is per the 'Recommended Practice for Fire Flow Testing' as documented by the National Fire Protection Agency (NFPA 291, 2002). The calculated fire flow reflects the strength of the water distribution system in the area for which the test was performed. It does not represent flow out of one single fire hydrant.

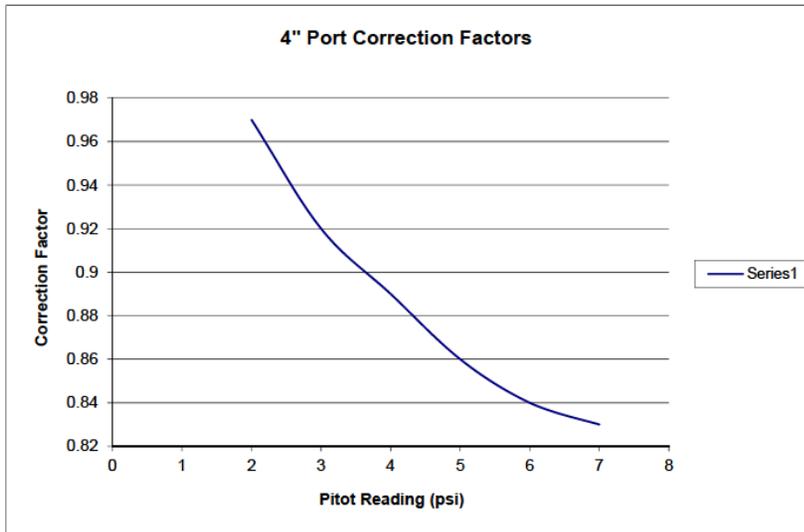
1st FH Flow Coefficient =
2nd FH Flow Coefficient =

Typically 0.8 if diffuser used, 0.9 without diffuser.

Is the 1st FH Flow from the 4" port? Correction Factor =

The correction factor is a multiplier. The coefficient is multiplied by this correction factor when the 4" port is used instead of the 2.5" port.

Is the 2nd FH Flow from the 4" port? Correction Factor =



psi	Correction Factor
2	0.97
3	0.92
4	0.89
5	0.86
6	0.84
7	0.83

Date:	Time:	Initials:	Map#:	Zone:	Elevation:	ft		
Residual FH ID#:			Static:	<input type="text"/>	psi	Residual:	<input type="text"/>	psi
1st Flow FH ID#:			Port:	<input type="text"/>	in	Pitot:	<input type="text"/>	psi
2nd Flow FH ID#:			Port:	<input type="text"/>	in	Pitot:	<input type="text"/>	psi
Comments:								

Date:	Time:	Initials:	Map#:	Zone:	Elevation:	ft		
Residual FH ID#:			Static:	<input type="text"/>	psi	Residual:	<input type="text"/>	psi
1st Flow FH ID#:			Port:	<input type="text"/>	in	Pitot:	<input type="text"/>	psi
2nd Flow FH ID#:			Port:	<input type="text"/>	in	Pitot:	<input type="text"/>	psi
Comments:								

Date:	Time:	Initials:	Map#:	Zone:	Elevation:	ft		
Residual FH ID#:			Static:	<input type="text"/>	psi	Residual:	<input type="text"/>	psi
1st Flow FH ID#:			Port:	<input type="text"/>	in	Pitot:	<input type="text"/>	psi
2nd Flow FH ID#:			Port:	<input type="text"/>	in	Pitot:	<input type="text"/>	psi
Comments:								

City of Vancouver
 PO Box 1995
 Vancouver, WA 98668-1995

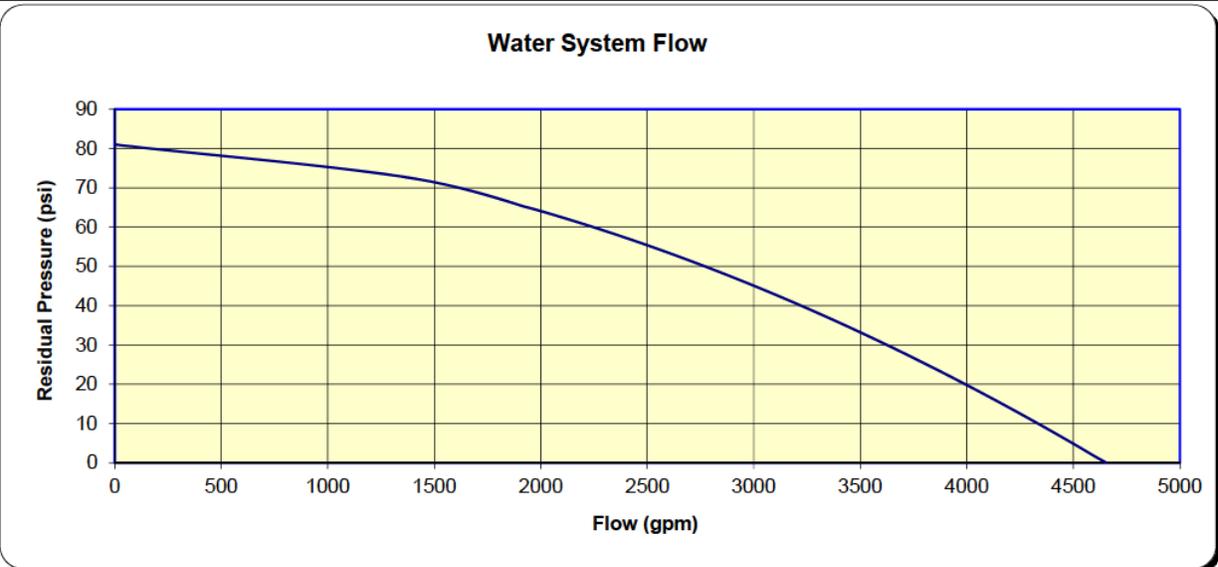


Date: 5/30/13
 Water Systems Planning & Design
 Ph: 360-696-8223 Fx: 360-696-8460
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FIRE HYDRANT FLOW TEST (NFPA 291)

Date: 5/30/2013	Time: 1:15 PM	Initials: GH/TT	Map#:	Zone:	Elevation: ft
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1st Flow FH ID#: H18556	3309 NW Gateway south of the residual hydrant			Port: 4 in	Pitot: 45 psi
2nd Flow FH ID#:				Port: 0 in	Pitot: 0 psi

Comments:



RESULTS:	Flow (gpm)	Pressure (psi)
1st Flow	2127 @	62
2nd Flow	0 @	62
Fire Flow*	3992 @	20

*The fire flow calculation and testing is per the 'Recommended Practice for Fire Flow Testing' as documented by the National Fire Protection Agency (NFPA 291, 2002). The calculated fire flow reflects the strength of the water distribution system in the area for which the test was performed. It does not represent flow out of one single fire hydrant.

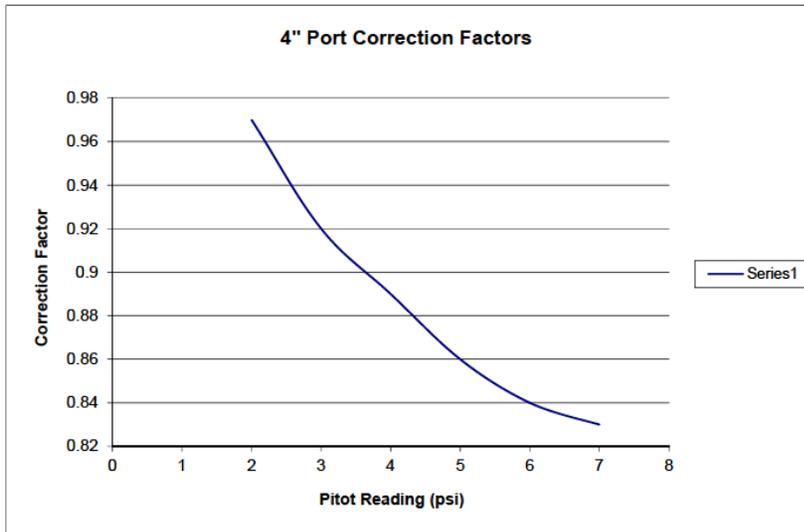
1st FH Flow Coefficient =
2nd FH Flow Coefficient =

Typically 0.8 if diffuser used, 0.9 without diffuser.

Is the 1st FH Flow from the 4" port? Correction Factor =

The correction factor is a multiplier. The coefficient is multiplied by this correction factor when the 4" port is used instead of the 2.5" port.

Is the 2nd FH Flow from the 4" port? Correction Factor =



psi	Correction Factor
2	0.97
3	0.92
4	0.89
5	0.86
6	0.84
7	0.83

Date:	Time:	Initials:	Map#:	Zone:	Elevation: ft
Residual FH ID#:			Static:	<input type="text"/> psi	Residual: <input type="text"/> psi
1st Flow FH ID#:			Port:	<input type="text"/> in	Pitot: <input type="text"/> psi
2nd Flow FH ID#:			Port:	<input type="text"/> in	Pitot: <input type="text"/> psi
Comments:					

Date:	Time:	Initials:	Map#:	Zone:	Elevation: ft
Residual FH ID#:			Static:	<input type="text"/> psi	Residual: <input type="text"/> psi
1st Flow FH ID#:			Port:	<input type="text"/> in	Pitot: <input type="text"/> psi
2nd Flow FH ID#:			Port:	<input type="text"/> in	Pitot: <input type="text"/> psi
Comments:					

Date:	Time:	Initials:	Map#:	Zone:	Elevation: ft
Residual FH ID#:			Static:	<input type="text"/> psi	Residual: <input type="text"/> psi
1st Flow FH ID#:			Port:	<input type="text"/> in	Pitot: <input type="text"/> psi
2nd Flow FH ID#:			Port:	<input type="text"/> in	Pitot: <input type="text"/> psi
Comments:					

Attachment 3: Application for Site Certification Supplement, Appendix E (January 2014)



City of Vancouver • P.O. Box 1995 • Vancouver, WA 98668-1995
www.cityofvancouver.us

August 13, 2013

Sam Adams, P.E.
BergerABAM
1111 Main Street, Suite 300
Vancouver, WA 98669-2958

Subject: Tesoro Savage Petroleum Terminal Water Availability

Mr. Adams,

The City of Vancouver Water Department acknowledges the request to serve the Tesoro Savage Petroleum Terminal project with water. The estimated instantaneous maximum water use of 30 gpm of boiler blow down process water, 5 gpm pressure washing for equipment cleaning, and 15 gpm for peak domestic usage in restrooms and general office/kitchen use for a total instantaneous of approximately 50 gpm is available for the project from the city water system. In addition, it is estimated that at least 3500 gpm of water for fire flow purposes is currently available from hydrants in the proposed project area.

The city currently has sufficient water rights, storage and distribution capacity to serve the various sites with the requested flow, contingent on the extension of water utilities to the site as spelled out in the pre-application comments.

For additional information regarding the project, please contact me at (360) 487-7169.

Sincerely,

A handwritten signature in black ink, appearing to read 'Tyler Clary'.

Tyler Clary
Water Engineering Program Manager
City of Vancouver

cc: Tracy Tuntland
Debi Davis
Jon Wagner

