Fire Protection Basis of Design Engineering Evaluation Report

Tesoro Savage Vancouver Energy Distribution Terminal

Port of Vancouver, Washington

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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 ft^2). 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 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.

H_2S 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, O_2 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.

H_2S 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 – H_2S, LEL, and O_2 gas detection will be provided in the pump pits of the Railcar Unloading Building. H_2S and LEL detection will be provided at each unloading station in the Railcar Unloading Building near grade. H_2S 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
19910 West 161st Street
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innovative leader
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POOLE FIRE PROTECTION

Table of Contents

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 - Desig*n, 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.

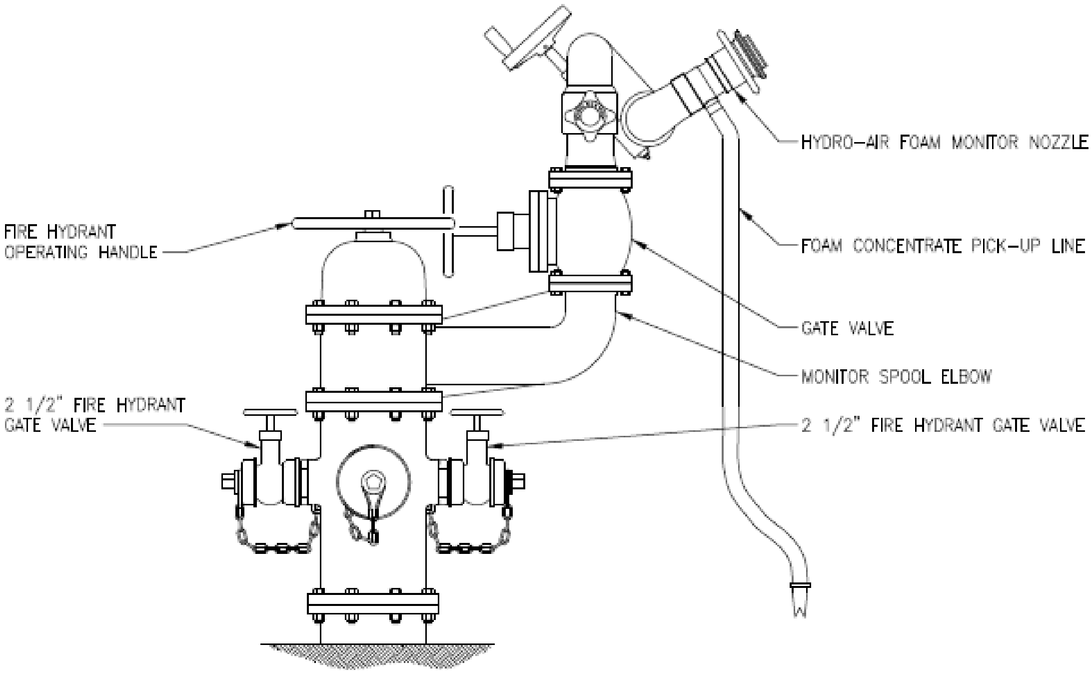
4.3.2 Area 300 – Storage

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 Fiords 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.

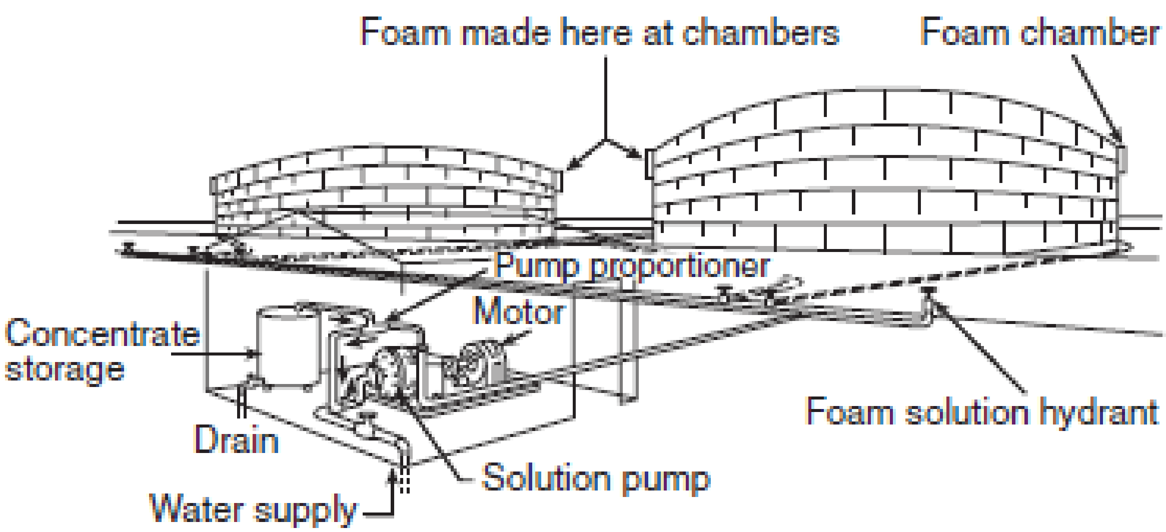
The closed-head foam-water pre-action sprinkler system and the closed-head wet-pipe sprinkler system will be pressurized by the City of Vancouver water distribution system and fire pump; therefore, when either system activates, and pressure drops on the downstream side of the fire pump, the fire pump will start and supplying adequate pressure to the system to control or extinguish the fire.

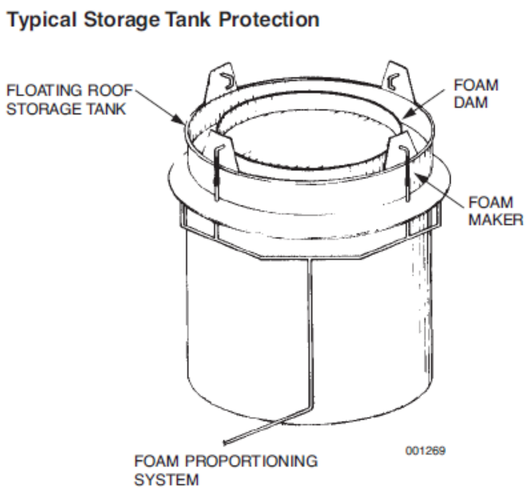
6.1.3 Area 300 – Storage Area

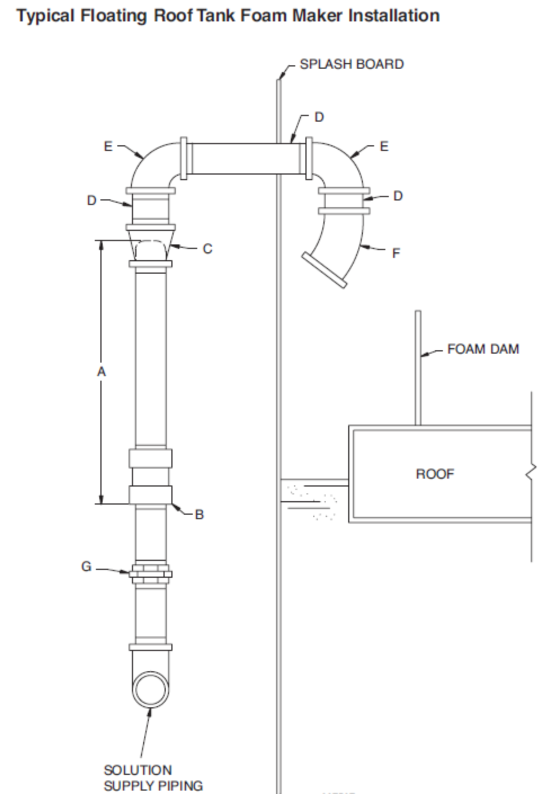
An automatic fixed foam system will be provided for each storage tank to protect the seal area of the internal floating roof. This system will be a Pre-Action Foam System activated by the linear heat detection system installed at the foam dam of the floating roof or by the manual foam release stations 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.







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.

H_2S 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, O_2 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.

H_2S and LEL detection is also provided strategically in the rail unloading structure near every unloading station.

7.2 Fire Alarm Panel Reporting Capability

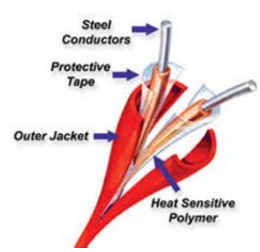
Each fire alarm panel will be FM Approved and will be provided with a way to directly communicate to the control operations HMI (human-machine interface); the panel will also be provided with a method to transmit/communicate all alarm signals to a supervising station. The rail unloading structure area,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

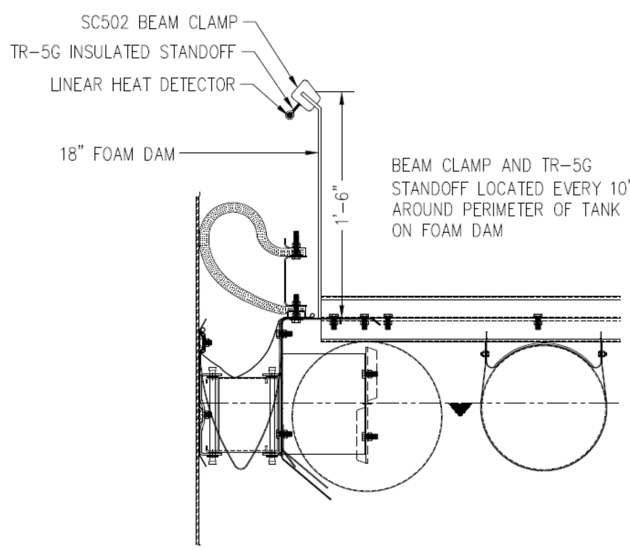
7.3.1 Linear Heat Detection

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.

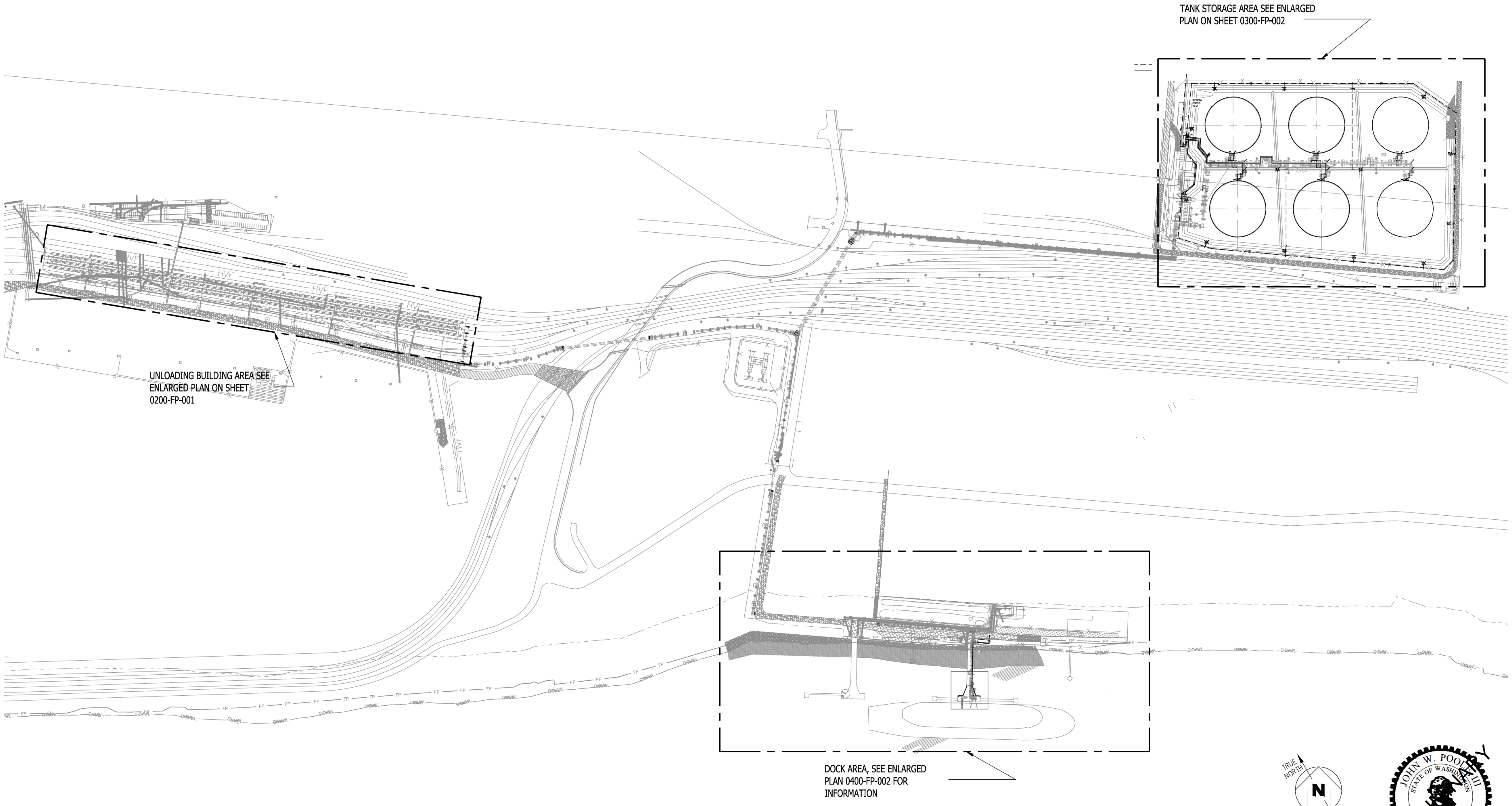
The tone of the gas audible device will be different from that of the fire alarm tone which will be a three-pulse temporal pattern as required by NFPA 72. In addition, all gas notification devices will be equipped with a strobe that, upon detection of high gas, will activate the strobes in the zone that 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

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

PRO3 PROCESS • PROTECT • PROCEED
ProEnergy SERVICES
POOLE FIRE PROTECTION
TESORO SAVAGE

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

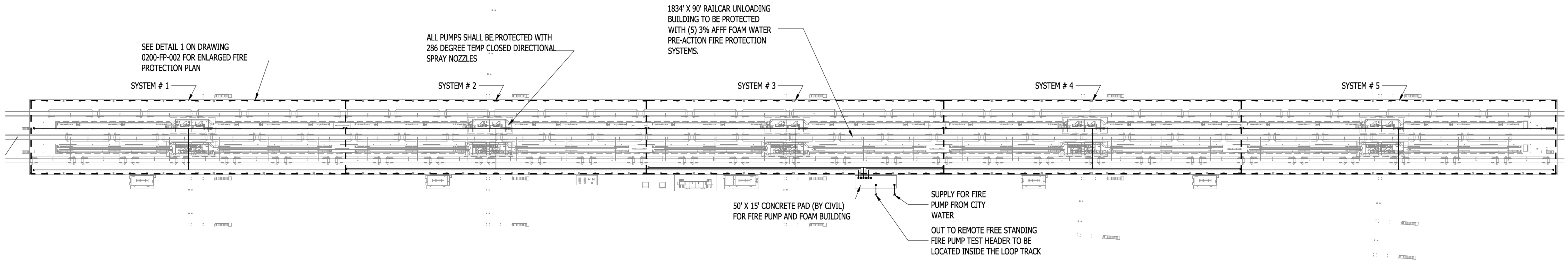
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

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

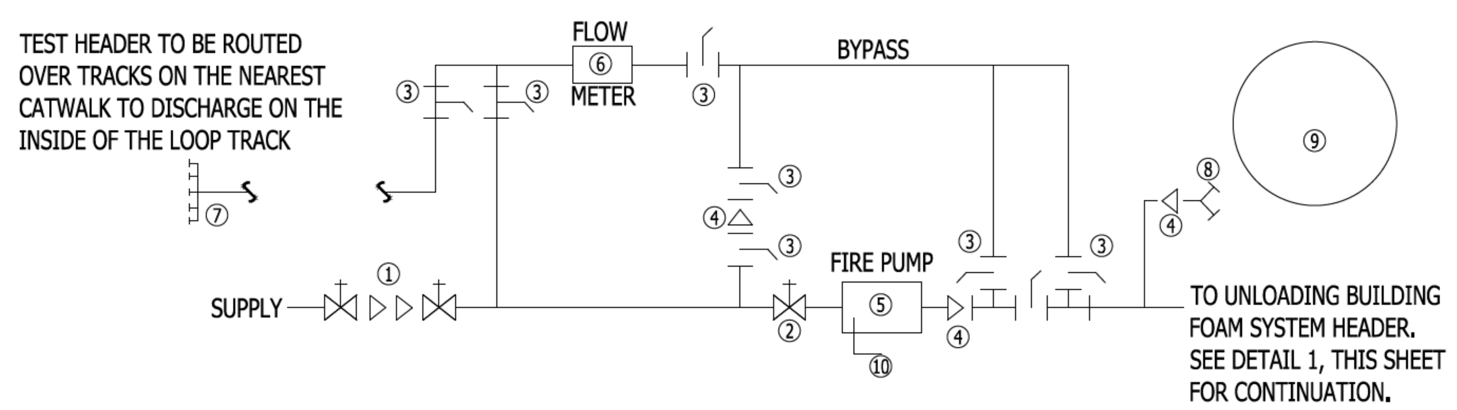
DRAWING NUMBER	SHEET	REV.
0100-FP-001	1/1	E

JOHN W. POOLE III STATE OF WASHINGTON 34993 REGISTERED PROFESSIONAL ENGINEER PRELIMINARY



3 OVERALL UNLOADING BUILDING FIRE PROTECTION PLAN

0200-FP-001 SCALE: 1" = 60'

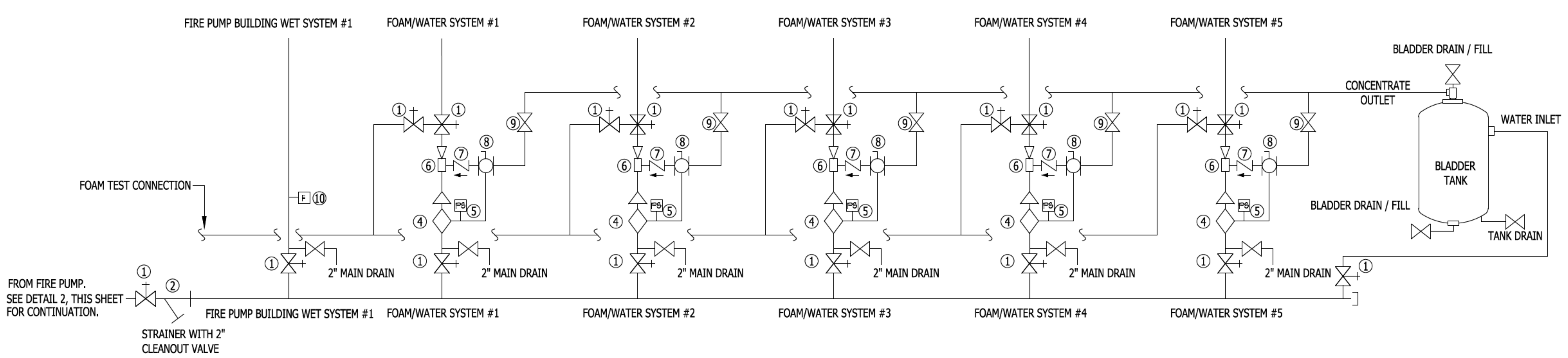


LEGEND

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 ½" 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

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PRELIMINARY, NOT FOR CONSTRUCTION

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

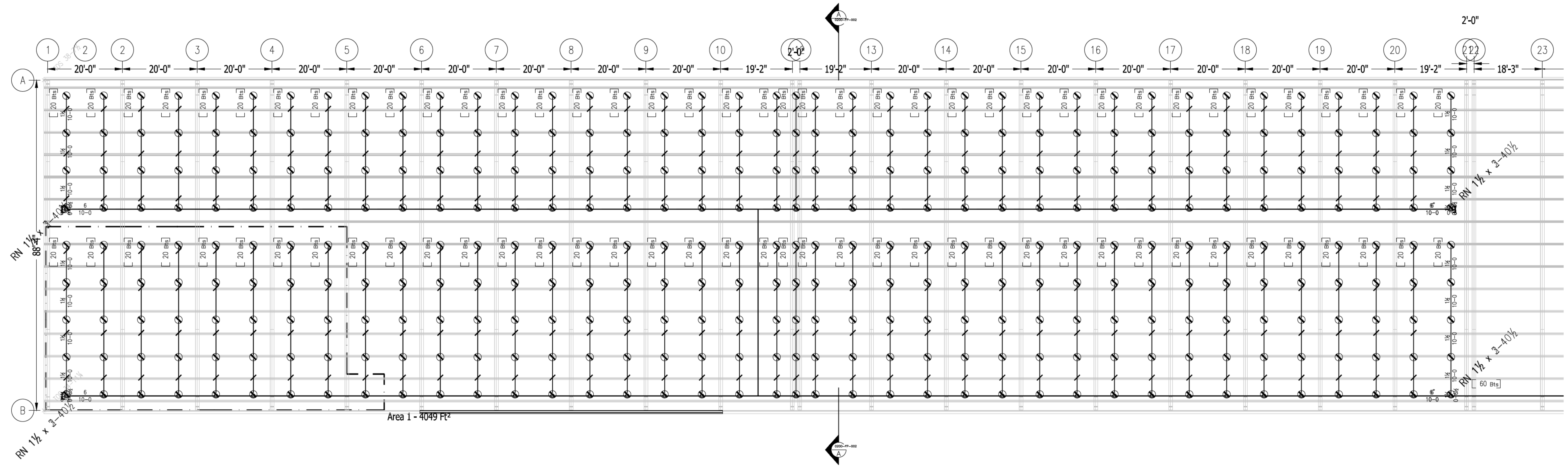
PRO3 PROCESS • PROTECT • PROCEED — ProEnergy SERVICES — POOLE FIRE PROTECTION — TESORO — SAVAGE

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: UNLOADING BUILDING AREA FIRE PROTECTION

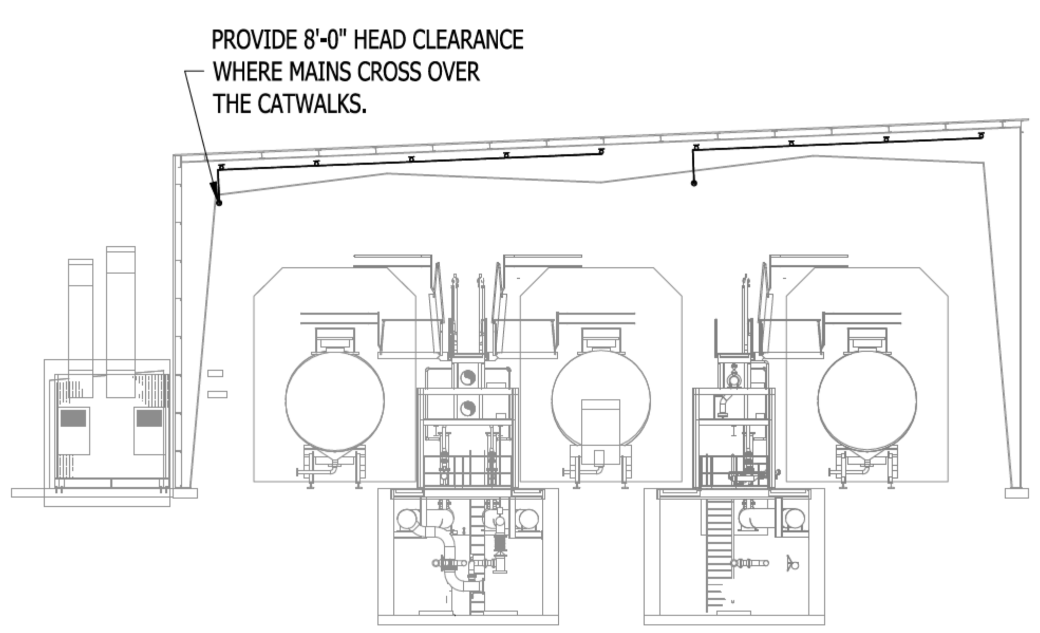
DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36
DRAWING NUMBER	0200-FP-001	SHEET	1/1	REV.	E



1
0200-FP-002

TYPICAL UNLOADING BUILDING FIRE PROTECTION PLAN

SCALE: 1/16" = 1'-0"



A
0200-FP-002

UNLOADING BUILDING FIRE PROTECTION SECTION A

SCALE: 1/16" = 1'-0"

PRELIMINARY, NOT FOR CONSTRUCTION

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

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ProEnergy SERVICES

POOLE FIRE PROTECTION

TESORO

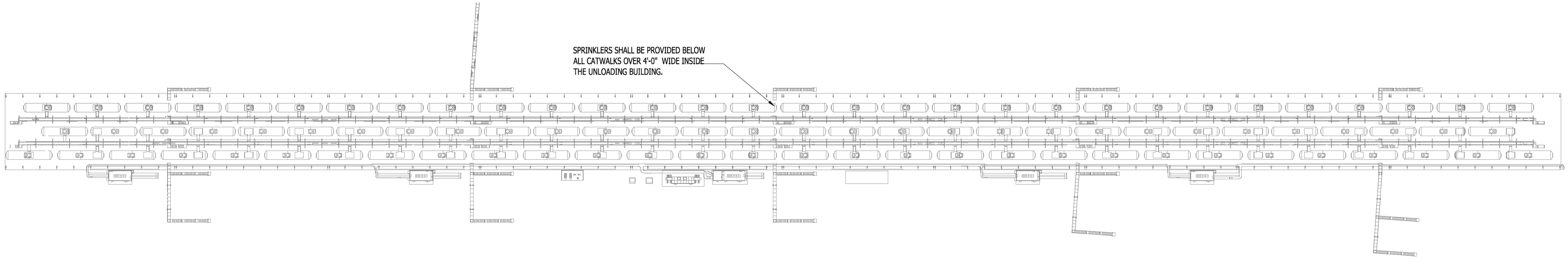
SAVAGE

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

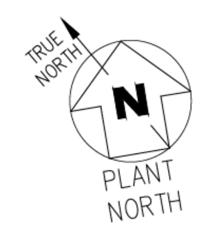
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

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	0200-FP-002	SHEET	1/1	REV.	E



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



PRELIMINARY, NOT FOR CONSTRUCTION

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

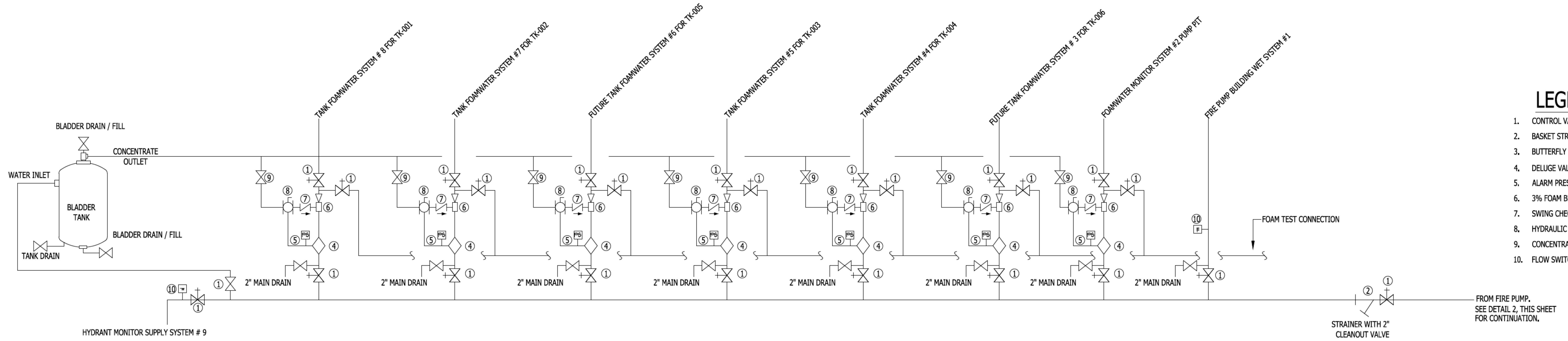
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

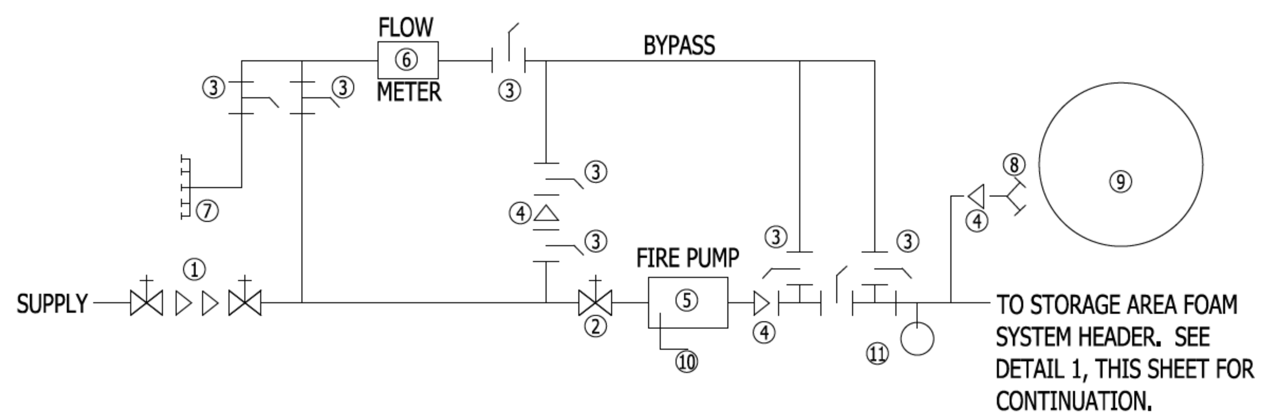


LEGEND

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 ½" 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. FLOW SWITCH

1 STORAGE AREA FIRE PROTECTION RISER DIAGRAM

0300-FP-001 SCALE: NTS



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
11. PRESSURE MAINTENANCE JOCKEY PUMP

2 STORAGE AREA FIRE PROTECTION FIRE PUMP DIAGRAM

0300-FP-001 SCALE: NTS

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PRELIMINARY, NOT FOR CONSTRUCTION

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B	07-04-13	CONCEPTUAL FOR REVIEW	CSW	SED	JWP

PRO3 PROCESS • PROTECT • PROCEED
ProEnergy SERVICES
POOLE FIRE PROTECTION
TESORO
SAVAGE

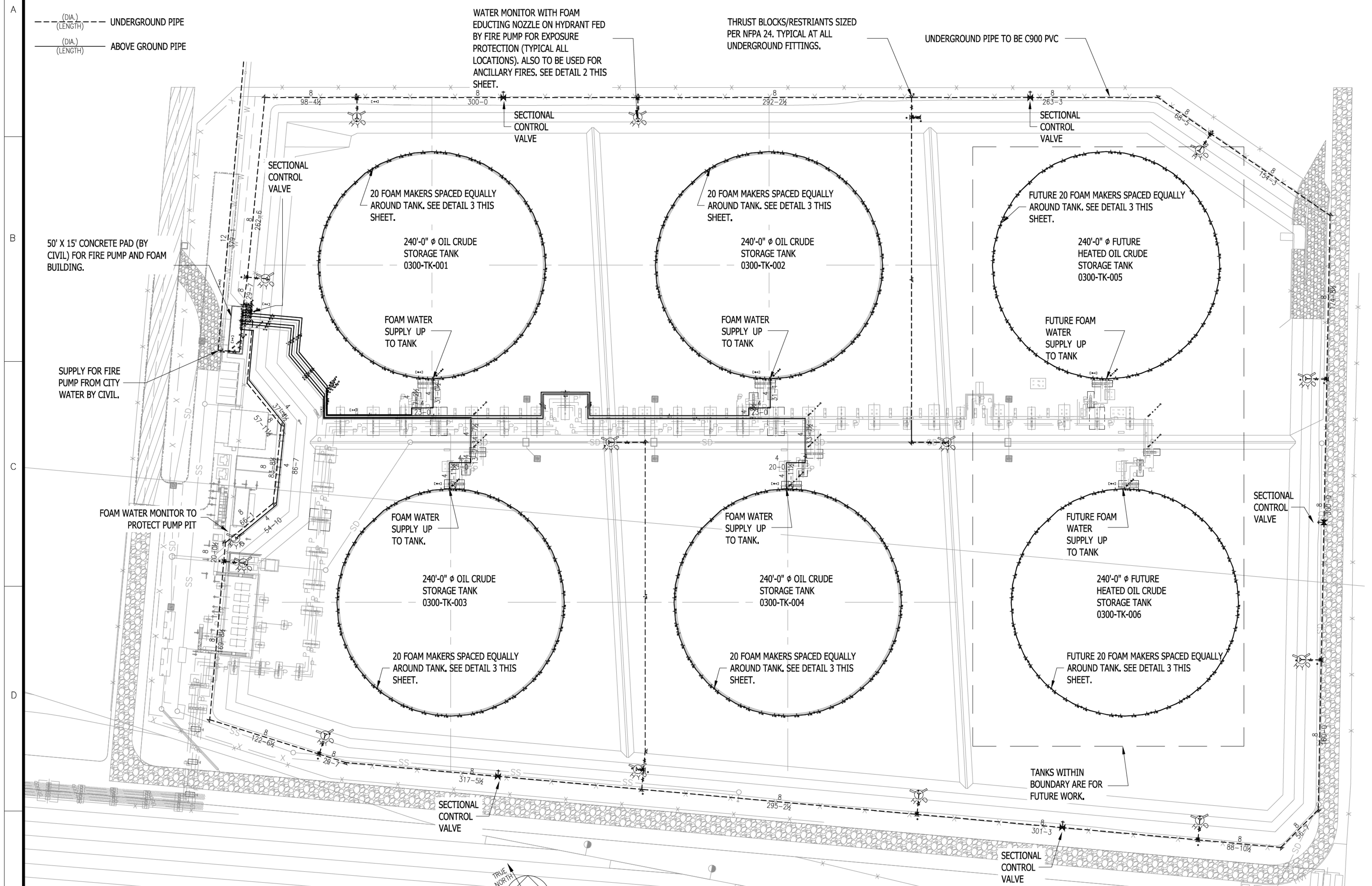
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: STORAGE AREA
FIRE PROTECTION

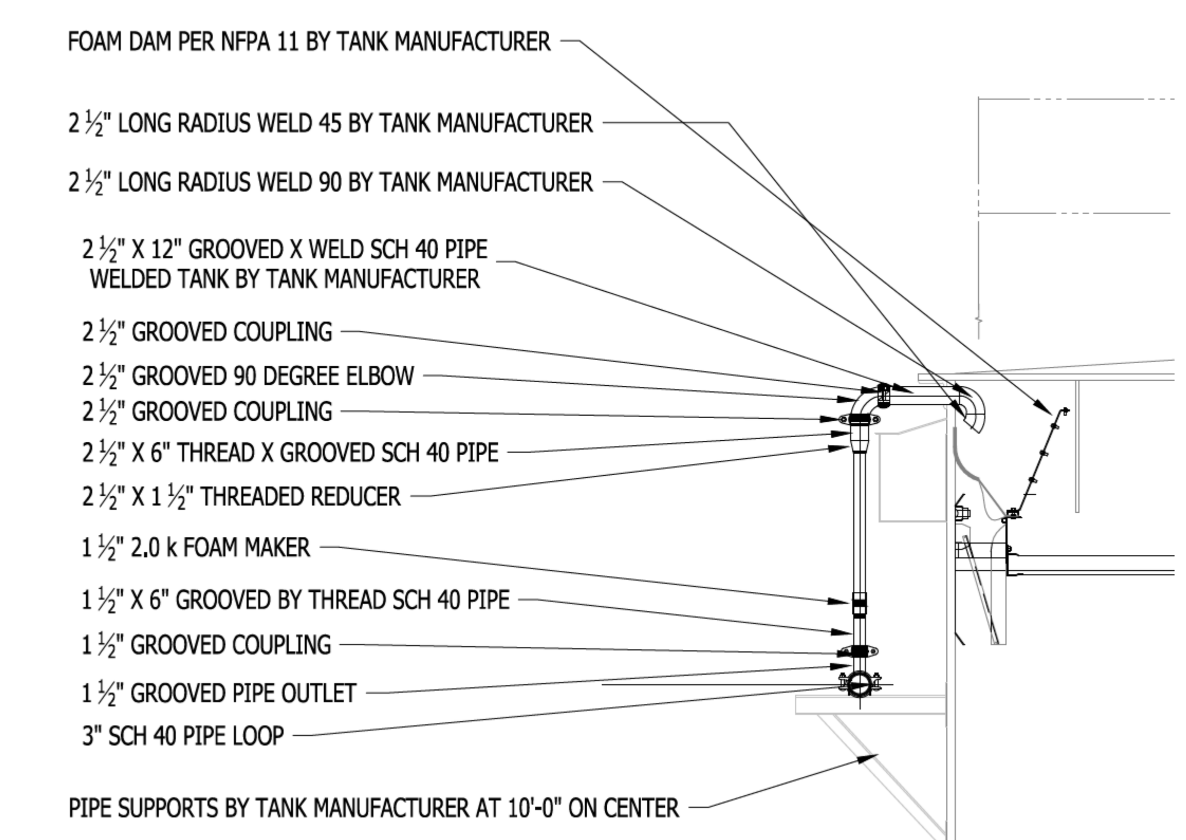
DESIGN:	C. WILSON	START DATE:	06/19/2013	SCALE:	AS-NOTED
DRAWN:	C. WILSON	PRINT DATE:	07/14/2014	PROJECT MANAGER:	S.DURFLINGER
CHECKED:	S. DURFLINGER	APPROVED:	J. POOLE	SIZE:	24x36

DRAWING NUMBER	SHEET	REV.
0300-FP-001	1/1	E



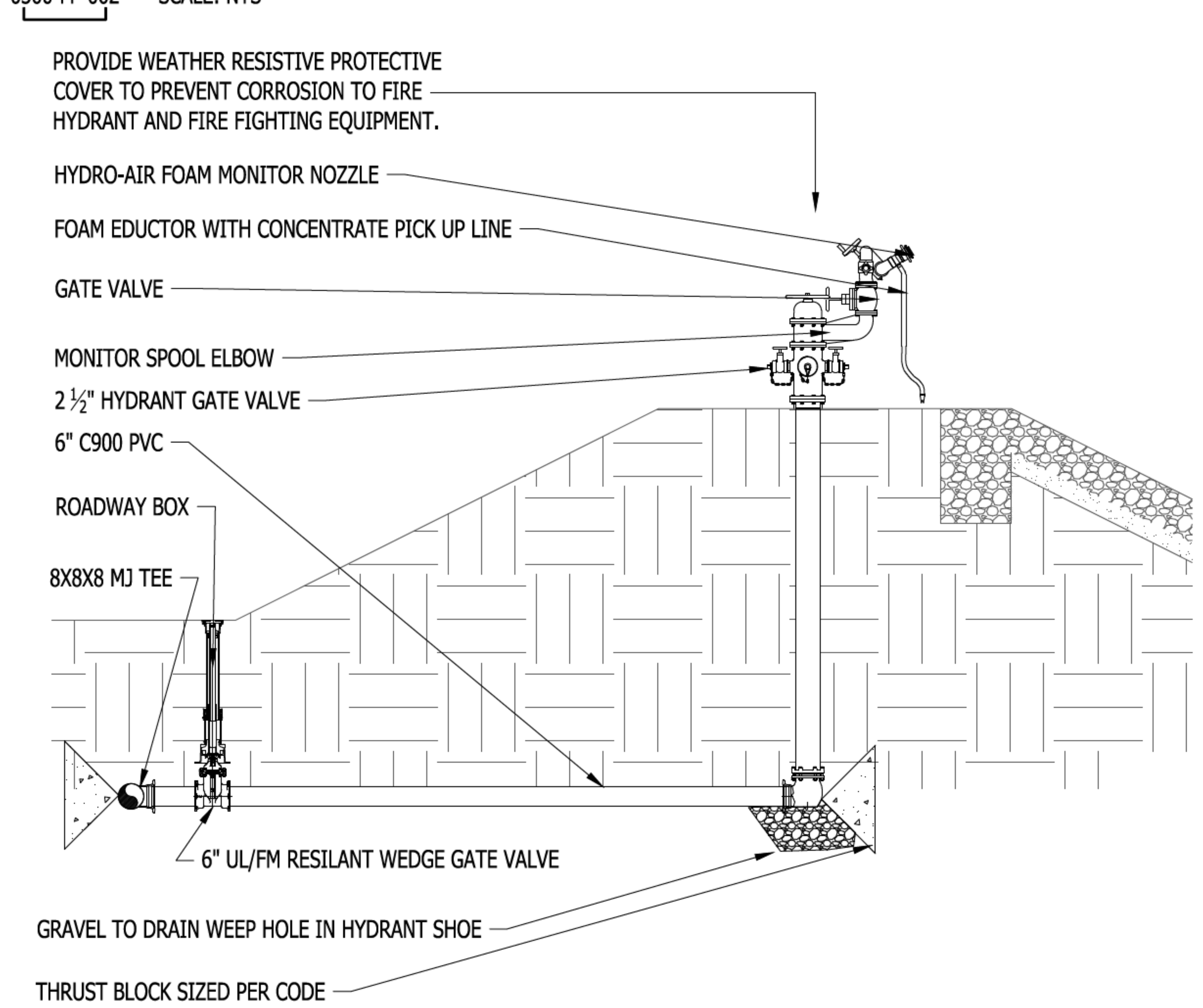
1 STORAGE AREA ENLARGED FIRE PROTECTION PLAN

0300-FP-002 SCALE: 1"=60'



3 TANK FOAM MAKER

0300-FP-002 SCALE: NTS



2 STORAGE AREA HYDRANT WITH FOAM EDUCTING MONITOR

0300-FP-002 SCALE: NTS

JOHN W. POOLE III, STATE OF WASHINGTON, 34993, REGISTERED PROFESSIONAL ENGINEER — PRELIMINARY

PRELIMINARY, NOT FOR CONSTRUCTION

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

PRO3 PROCESS • PROTECT • PROCEED — ProEnergy SERVICES — POOLE FIRE PROTECTION — 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.

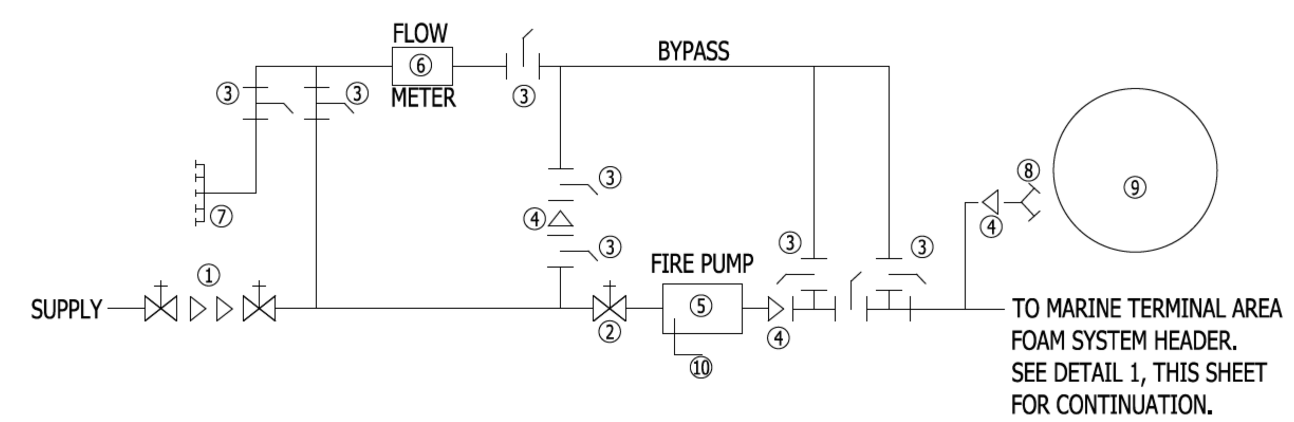
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: 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

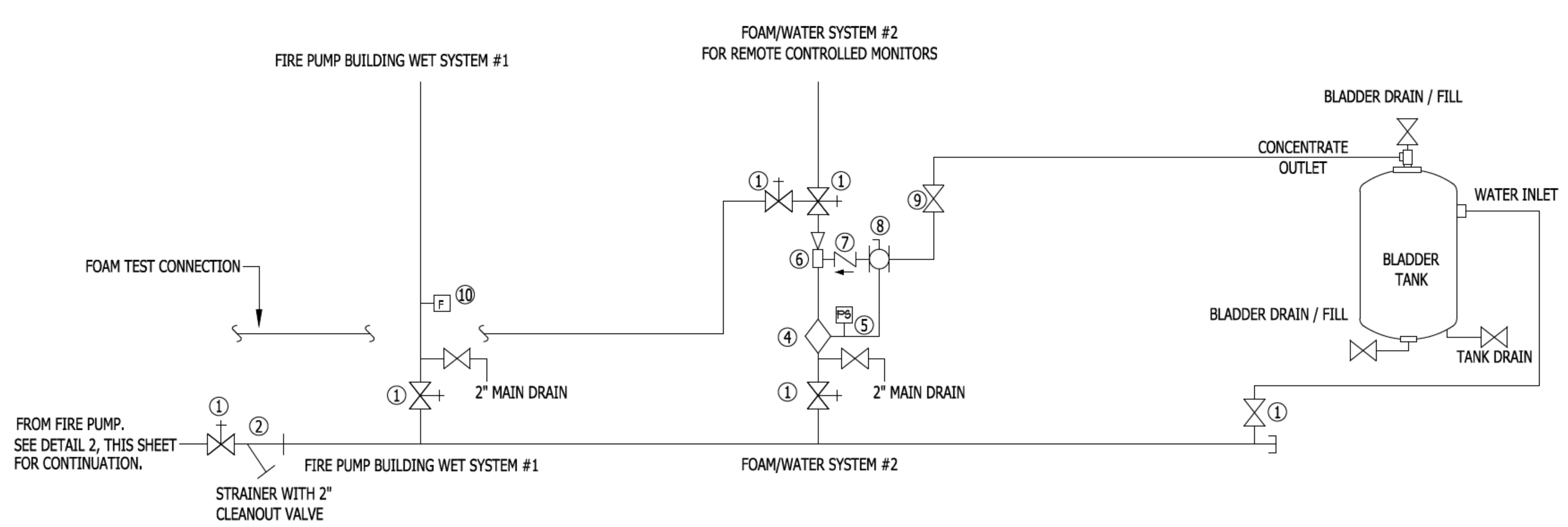


LEGEND

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 ½" 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

JOHN W. POOLE III — STATE OF WASHINGTON — 34993 — REGISTERED PROFESSIONAL ENGINEER — PRELIMINARY

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'D	APP
E	07-14-14		CSW	SED	JWP
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C	10-25-13	90% PRELIMINARY FOR REVIEW	CSW	SED	JWP
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PRO3 PROCESS • PROTECT • PROCEED — ProEnergy SERVICES — POOLE FIRE PROTECTION

TESORO SAVAGE

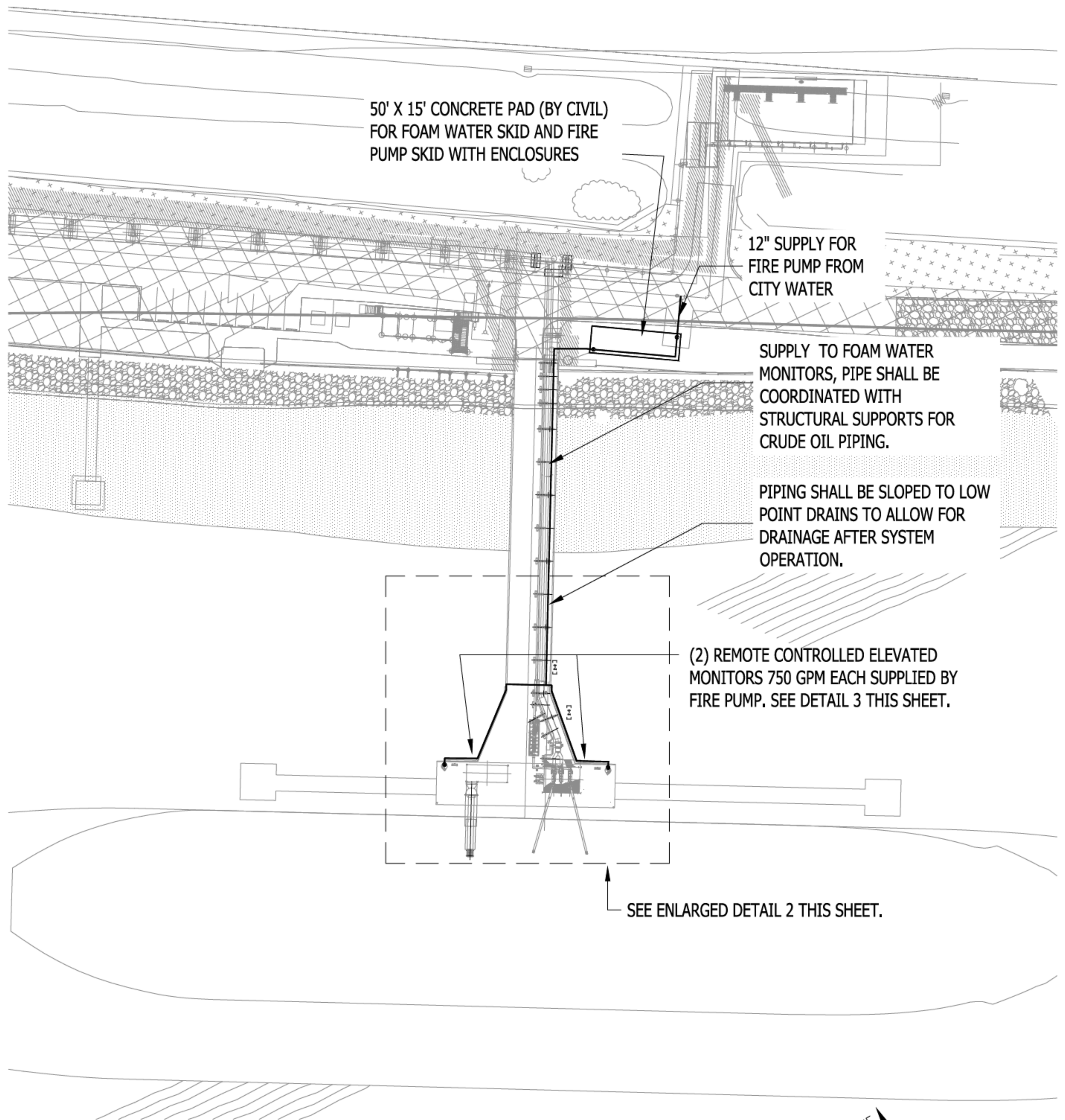
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

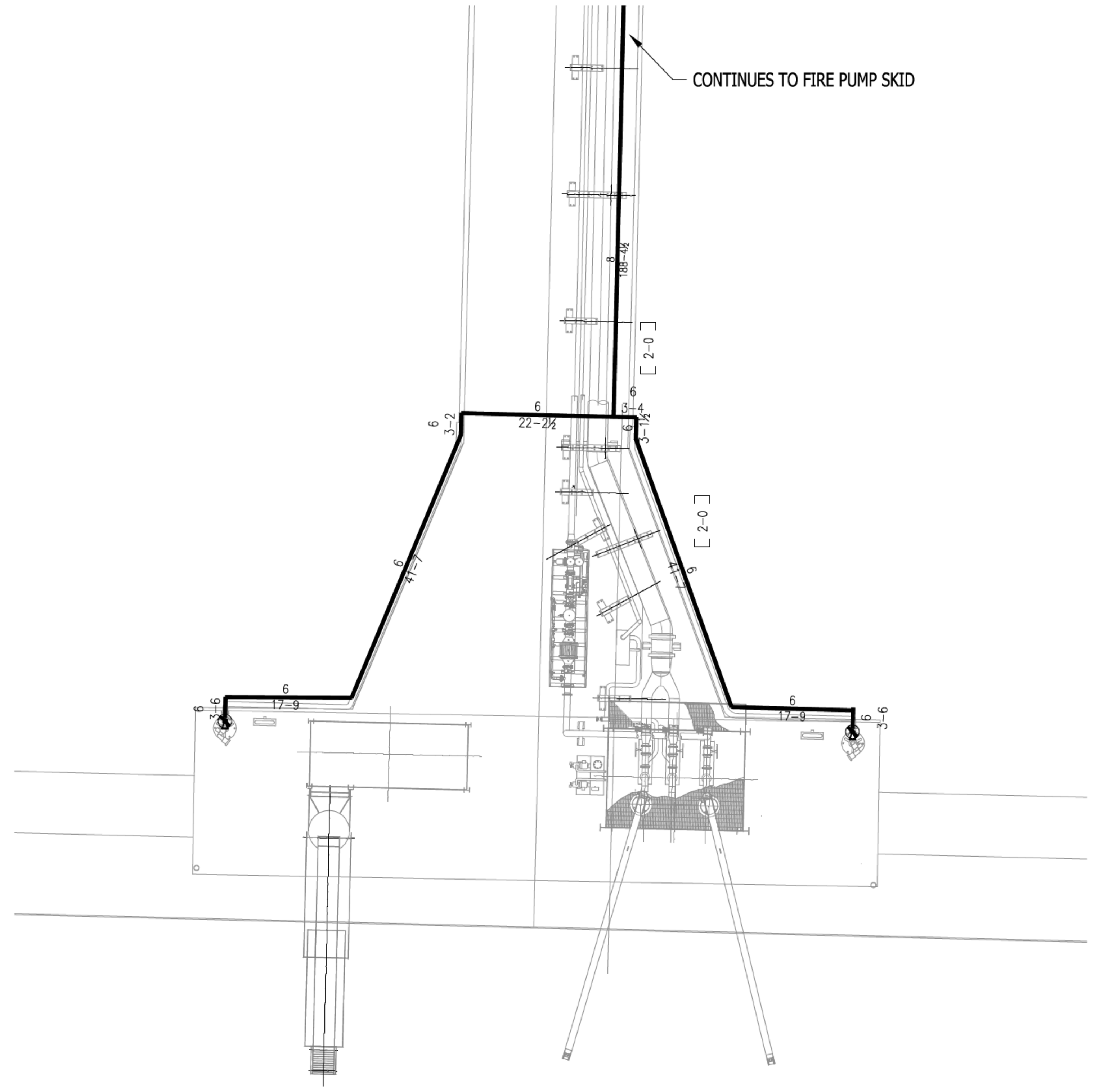
DRAWING NUMBER	SHEET	REV.
0400-FP-001	1/1	E



1 MARINE TERMINAL AREA FIRE PROTECTION PLAN

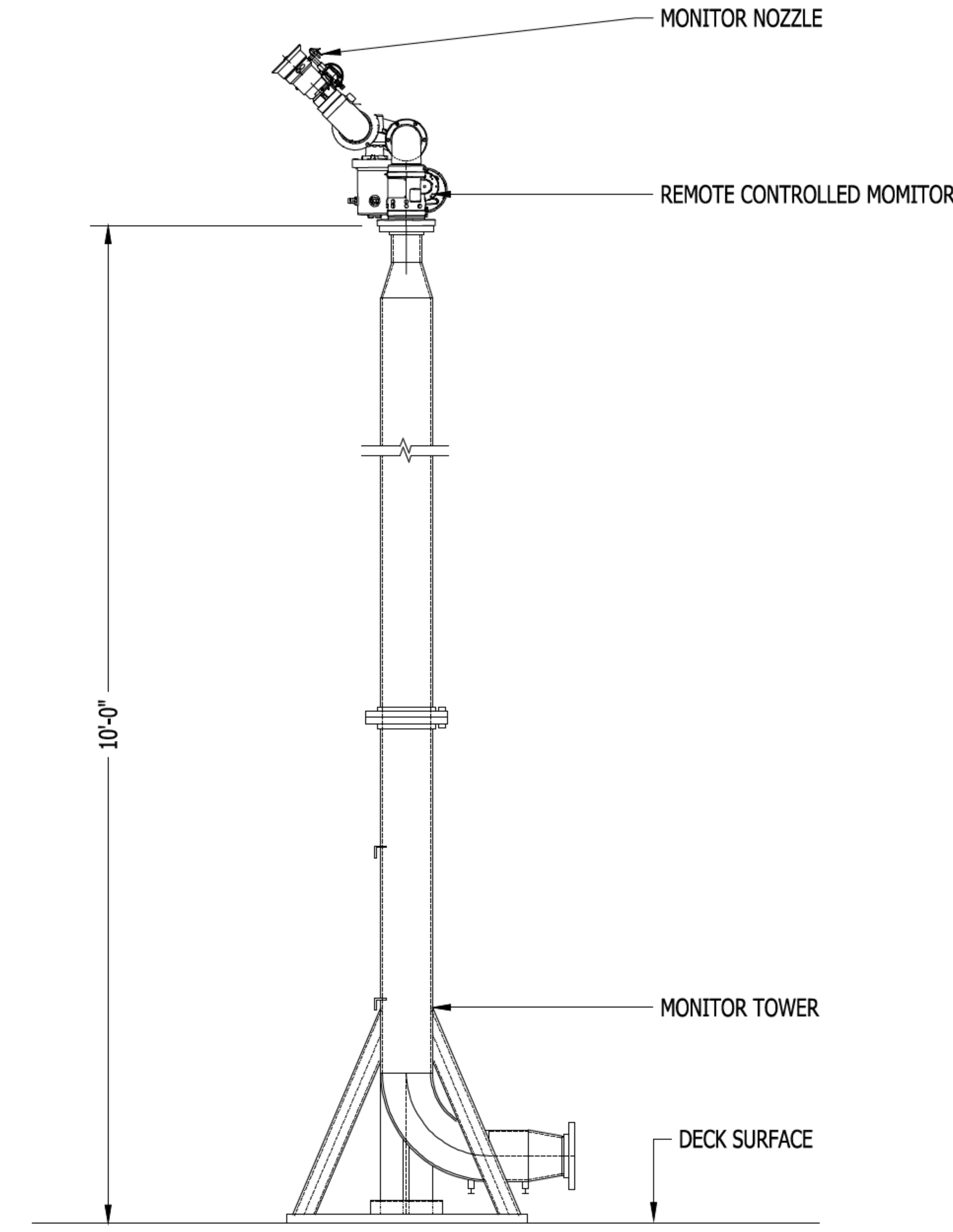
0400-FP-002 SCALE: 1"=60'

TRUE NORTH N PLANT NORTH



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"

JOHN W. POOLE III STATE OF WASHINGTON 34993 REGISTERED PROFESSIONAL ENGINEER PRELIMINARY

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'D	APP
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D	01-31-14	PRELIMINARY BID SET	CSW	SED	JWP
C	10-25-13	90% PRELIMINARY FOR REVIEW	CSW	SED	JWP
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PRO3 PROCESS • PROTECT • PROCEED

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POOLE FIRE PROTECTION

TESORO SAVAGE

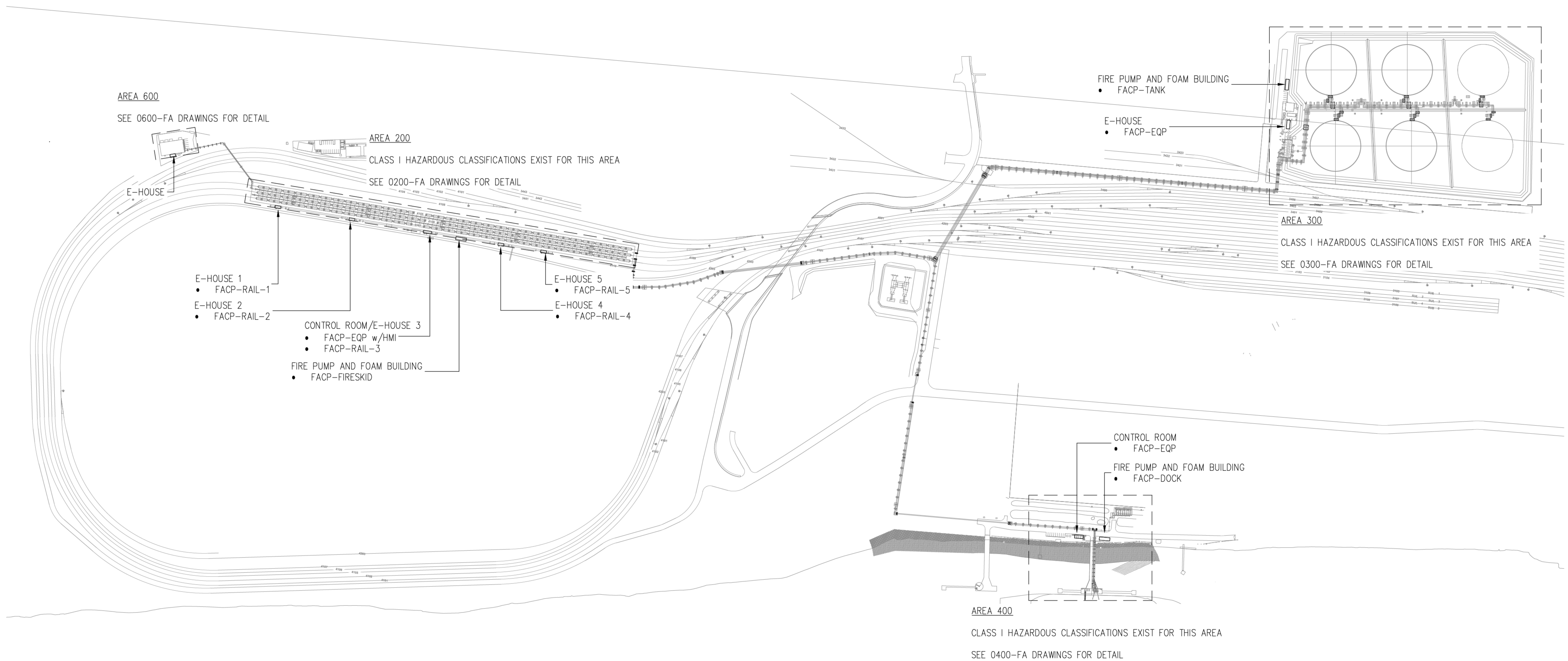
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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: 0400-FP-002 SHEET: 1/1 REV.: E



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

TRUE NORTH
N
PLANT NORTH

JOHN W. POOLE III, STATE OF WASHINGTON, 34993, REGISTERED PROFESSIONAL ENGINEER — PRELIMINARY

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

PRO3 PROCESS • PROTECT • PROCEED
ProEnergy SERVICES
POOLE FIRE PROTECTION
TESORO SAVAGE

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. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER	SHEET	REV.
0100-FA-001	1/1	E

ELECTRICAL NOTES

1. 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.
2. 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.
3. 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.
4. 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".
5. 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%.
6. MAIN FACP WILL BE SUPPLIED FROM CKT: __{TBD}__ IN PANEL __{TBD}__.
7. DEVICE POLARITY MUST BE OBSERVED ON ALL DC CIRCUITS (LON, 4-20mA, IDC, NAC, AND AUXILIARY POWER).
8. ALL INITIATING, NOTIFICATION, & RELEASE CIRCUIT WIRING MUST BE SUPERVISED.
9. ALL WIRING, INCLUDING SHIELDS, MUST BE DRY AND FREE OF SHORTS AND GROUNDS.
10. INITIATING DEVICES SHALL BE SUPPORTED INDEPENDENTLY OF THEIR ATTACHMENT TO FIRE ALARM CIRCUIT CONDUCTORS.
11. 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.
12. 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.
13. DETECTORS SHALL NOT BE INSTALLED UNTIL AFTER THE CONSTRUCTION CLEAN UP OF ALL TRADES IS COMPLETED AND FINAL.
14. ALL FIRE & GAS ALARM DEVICES MUST BE INSTALLED IN AN PROPER BACK BOX. NO DEVICE SHALL BE INSTALLED WITH OUT A BACK BOX.
15. POWER-LIMITED FIRE ALARM CIRCUIT CONDUCTORS AND CABLES SHALL BE INSTALLED AS FOLLOWS: (NEC ARTICLE 760 -71)
    - 15.1. 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.
    - 15.2. 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.
    - 15.3. IN RIGID METAL CONDUIT, RIGID NON-METALIC 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).
16. ALL DEVICES SHALL BE LABELED WITH THEIR ADDRESS AND CIRCUIT NUMBER.
17. 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.
18. 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.
19. INITIATING DEVICE CIRCUITS (IDC) AND NOTIFICATION APPLIANCE CIRCUITS (NAC) ARE TWO WIRE CLASS "B". NO T-TAPPING IS ALLOWED ON EITHER OF THESE CIRCUITS.
20. LOCAL OPERATING NETWORK (LON) CIRCUITS ARE TWO WIRE CLASS "X". NO T-TAPPING IS ALLOWED ON THESE CIRCUITS.
21. AUXILIARY POWER CIRCUITS ARE TWO WIRE CIRCUITS THAT CAN BE T-TAPPED AS REQUIRED.
22. 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.
23. 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:

1. 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.
2. ALL TESTING OF THE FIRE ALARM AND GAS DETECTION SYSTEMS AND EQUIPMENT TO COMPLY WITH THE APPLICABLE CODES AND STANDARDS.
3. 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".
4. ALL EQUIPMENT TO BE INSTALLED SHALL BE IN ACCORDANCE WITH LOCAL, STATE AND OTHER APPLICABLE CODES AND STANDARDS, OR AS REQUIRED BY THE "AHJ".
5. ALL WIRING AND PRODUCT SETTINGS SHALL BE IN ACCORDANCE WITH LOCAL, STATE AND OTHER APPLICABLE CODES AND STANDARDS, OR AS REQUIRED BY THE "AHJ".
6. 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:

1. LON COMMUNICATION CABLES MUST BE IN METALLIC GROUNDED CONDUIT WHEN CROSSING OR CLOSER THAN 12" TO NON COMMUNICATION CABLES.
2. 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.
3. EACH LON DEVICE IS TO BE GROUNDED. EACH FACP CABINET AND BACK PLANE IS TO BE EARTH GROUNDED.
4. ALL LON DEVICES MUST BE ADDRESSED BEFORE SYSTEM POWER UP.
5. ALL WIRING MUST BE CHECKED FOR GROUNDS AND SHORTS PRIOR TO SYSTEM POWER BEING APPLIED.

PROTECTOWIRE (LHD) NOTES:

1. 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.
2. LHD MUST BE INSTALLED IN ONE CONTINUOUS RUN WITHOUT TAPS OR BRANCHES TO COMPLY WITH LOCATION AND SPACING REQUIREMENTS.
3. 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.
4. POSITION STANDOFF EVERY 10' OR AS NEEDED FOR QUALITY INSTALLATION. POSITION 15" FROM CORNERS.
5. 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

CT	DRY CONTACT RELAY OUTPUT
TEMP°	LINEAR HEAT DETECTOR W/ TEMP RATING
GASTYPE	GAS DETECTOR
	STROBE
	HORN/STROBE
	HORN
FO	FOAM RELEASE MANUAL STATION
LA	LOW AIR SWITCH
TS	TAMPER SWITCH
WF	FOAM FLOW/WATERFLOW SWITCH
S	RELEASING SOLENOID
P	SMOKE DETECTOR – PHOTOELECTRIC
MP	MANUAL ALARM STATION
RT	ROOM TEMPERATURE SWITCH
	LHD ZONE BOX
	LHD END-OF-LINE BOX

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PRO3 PROCESS • PROTECT • PROCEED — ProEnergy SERVICES — POOLE FIRE PROTECTION — TESORO — SAVAGE

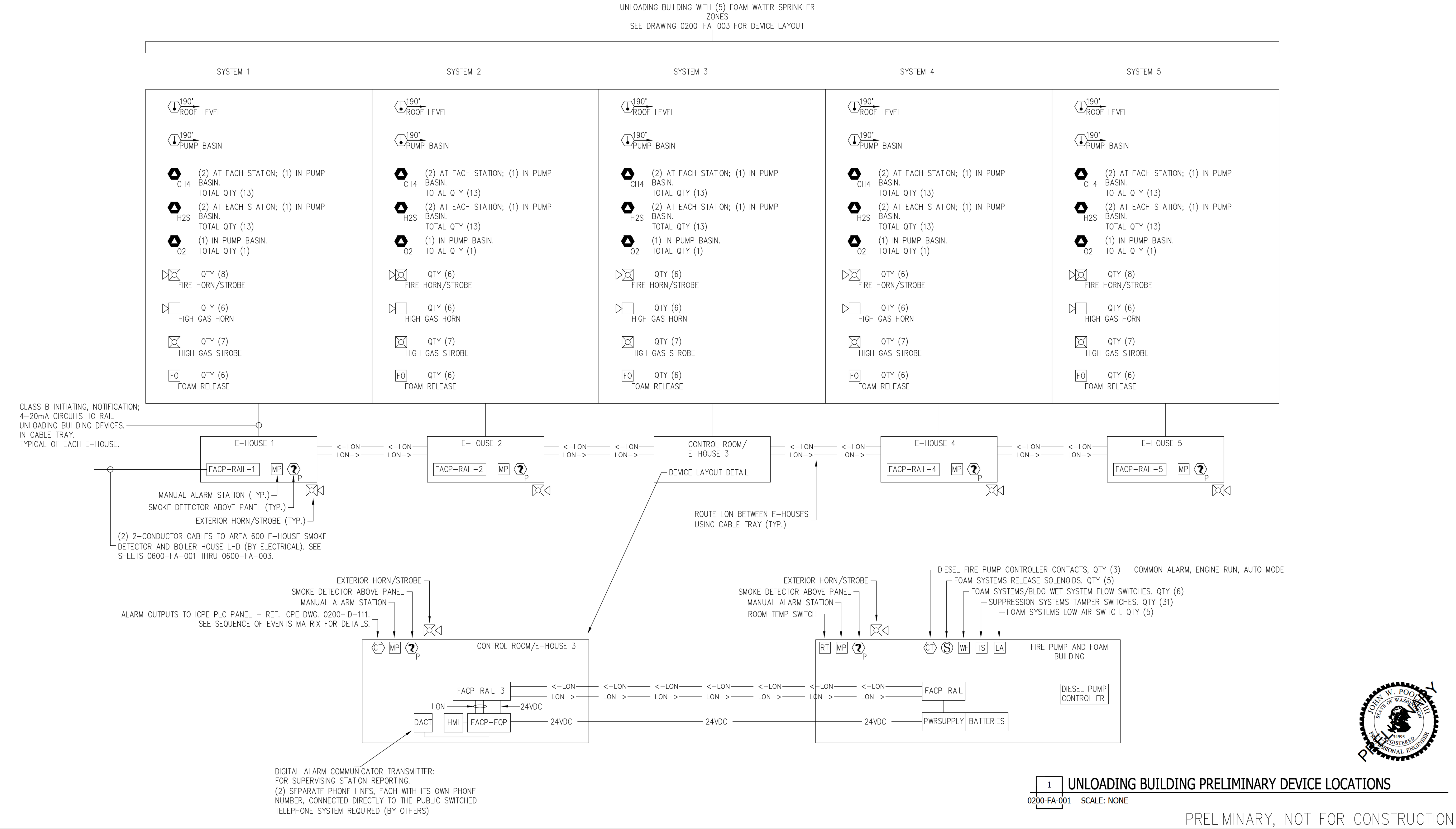
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: OVERALL AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. 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.
0100-FA-002	1/1	E



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

PRELIMINARY, NOT FOR CONSTRUCTION

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PRO3 PROCESS • PROTECT • PROCEED
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POOLE FIRE PROTECTION
TESORO SAVAGE

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. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36
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UNLOADING BUILDING 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/E-HOUSE 3	ACTIVATE EXTERIOR HORN/STROBES	DISPLAY INFO ON HMI	FIRE PUMP/FOAM BUILDING	ACTIVATE EXTERIOR HORN/STROBES	ACTIVATE SOLENOID-FOAM WATER SYSTEM 1	ACTIVATE SOLENOID-FOAM WATER SYSTEM 2	ACTIVATE SOLENOID-FOAM WATER SYSTEM 3	ACTIVATE SOLENOID-FOAM WATER SYSTEM 4	ACTIVATE SOLENOID-FOAM WATER SYSTEM 5	SYSTEM 1 AREA – RAIL BUILDING	ACTIVATE FIRE HORN/STROBE	ACTIVATE HIGH GAS HORN	ACTIVATE HIGH GAS STROBE	SYSTEM 2 AREA – RAIL BUILDING	ACTIVATE FIRE HORN/STROBE	ACTIVATE HIGH GAS HORN	ACTIVATE HIGH GAS STROBE	SYSTEM 3 AREA – RAIL BUILDING	ACTIVATE FIRE HORN/STROBE	ACTIVATE HIGH GAS HORN	ACTIVATE HIGH GAS STROBE	SYSTEM 4 AREA – RAIL BUILDING	ACTIVATE FIRE HORN/STROBE	ACTIVATE HIGH GAS HORN	ACTIVATE HIGH GAS STROBE	SYSTEM 5 AREA – RAIL BUILDING	ACTIVATE FIRE HORN/STROBE	ACTIVATE HIGH GAS HORN	ACTIVATE HIGH GAS STROBE	RELAY OUTPUTS TO PLANT PLC	GENERAL FIRE ALARM SIGNAL	GENERAL TROUBLE SIGNAL	GENERAL SUPERVISORY SIGNAL	LOW GAS ALARM (CH4 OR H2S)	HIGH GAS ALARM (CH4 OR H2S)	LOW GAS ALARM (O2)	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 LOW GAS ALARM					X						X																																X		X				
PANEL HIGH GAS ALARM						X					X																																	X		X	X		
PANEL SILENCE BUTTON							X																																										
PANEL ACKNOWLEDGE BUTTON								X																																									
CONTROL ROOM/E-HOUSE 3																																																	
FACP-EQP PANEL ANY TROUBLE/FAULT			X								X																														X								
MANUAL ALARM STATION		X								X	X																													X									
SMOKE DETECTOR ABOVE PANEL		X								X	X																													X									
FIRE PUMP AND FOAM BUILDING																																																	
FACP-RAIL PANEL ANY TROUBLE/FAULT			X								X																														X								
FIRE PUMP CONTROLLER OUTPUTS				X							X																															X							
MANUAL ALARM STATION		X									X		X																											X									
SMOKE DETECTOR ABOVE PANEL		X									X		X																											X									
TAMPER SWITCHES – (QTY 31)				X							X																															X							
FOAM SYSTEMS LOW AIR SWITCH				X							X																															X							
FOAM WATER FLOW – SYSTEM 1, 2, 3, 4, OR 5		X									X		X							X				X				X				X				X				X						X	X		
BUILDING WET SYSTEM WATERFLOW		X									X		X																											X									
ROOM LOW TEMP SWITCH				X							X																															X							
SYSTEM 1																																																	
E-HOUSE 1 SMOKE DETECTOR		X									X																													X									
LINEAR HEAT DETECTOR ACTIVE		X									X		X	X	X					X				X				X				X				X				X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X	X	X					X				X				X				X				X				X						X	X		
CH4 OR H2S DETECTOR LOW ALARM					X						X																																X						
CH4 OR HS2 DETECTOR HIGH ALARM						X					X										X	X			X				X				X				X							X		X	X		
O2 DETECTOR (PUMP PIT) LOW ALARM					X						X																																		X				
SYSTEM 2																																																	
E-HOUSE 2 SMOKE DETECTOR		X									X																													X									
LINEAR HEAT DETECTOR ACTIVE		X									X		X	X	X	X				X				X				X				X				X				X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X	X	X	X				X				X				X				X				X				X						X	X		
CH4 OR H2S DETECTOR LOW ALARM					X						X																																X						
CH4 OR HS2 DETECTOR HIGH ALARM						X					X										X				X	X			X				X				X							X		X	X		
O2 DETECTOR (PUMP PIT) LOW ALARM					X						X																																		X				
SYSTEM 3																																																	
E-HOUSE 3 SMOKE DETECTOR		X									X																													X									
LINEAR HEAT DETECTOR ACTIVE		X									X		X		X	X	X			X				X				X				X				X				X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X		X	X	X			X				X				X				X				X				X						X	X		
CH4 OR H2S DETECTOR LOW ALARM					X						X																																X						
CH4 OR HS2 DETECTOR HIGH ALARM						X					X										X				X				X	X			X				X							X		X	X		
O2 DETECTOR (PUMP PIT) LOW ALARM					X						X																																		X				
SYSTEM 4																																																	
E-HOUSE 4 SMOKE DETECTOR		X									X																													X									
LINEAR HEAT DETECTOR ACTIVE		X									X		X			X	X	X		X				X				X				X				X				X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X			X	X	X		X				X				X				X				X				X						X	X		
CH4 OR H2S DETECTOR LOW ALARM					X						X																																X						
CH4 OR HS2 DETECTOR HIGH ALARM						X					X										X				X				X				X	X			X							X		X	X		
O2 DETECTOR (PUMP PIT) LOW ALARM					X						X																																		X				
SYSTEM 5																																																	
E-HOUSE 5 SMOKE DETECTOR		X									X																													X									
LINEAR HEAT DETECTOR ACTIVE		X									X		X				X	X		X				X				X				X				X				X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X				X	X		X				X				X				X				X				X						X	X		
CH4 OR H2S DETECTOR LOW ALARM					X						X																																X						
CH4 OR HS2 DETECTOR HIGH ALARM						X					X										X				X				X				X				X	X						X		X	X		
O2 DETECTOR (PUMP PIT) LOW ALARM					X						X																																		X				
AREA 600 BOILER HOUSE AREA																																																	
E-HOUSE SMOKE DETECTOR		X									X																													X									
LINEAR HEAT DETECTOR ACTIVE		X									X																													X									

JOHN W. POOLE III
STATE OF WASHINGTON
34993
REGISTERED PROFESSIONAL ENGINEER

1 UNLOADING BUILDING AREA 200 SEQUENCE OF EVENTS

0200-FA-002 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

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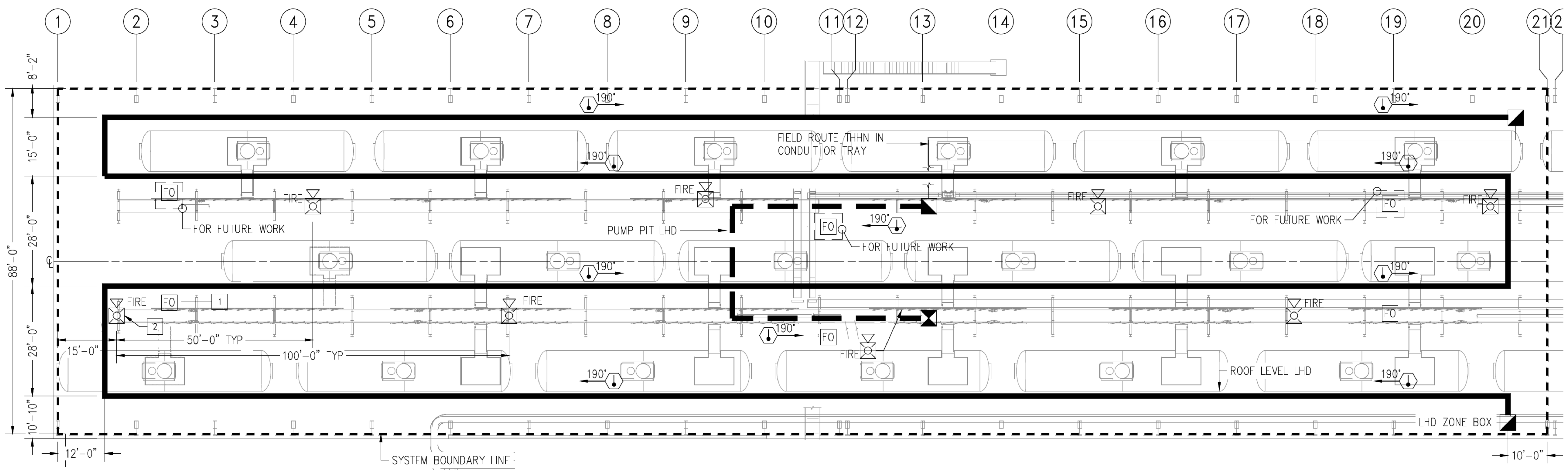
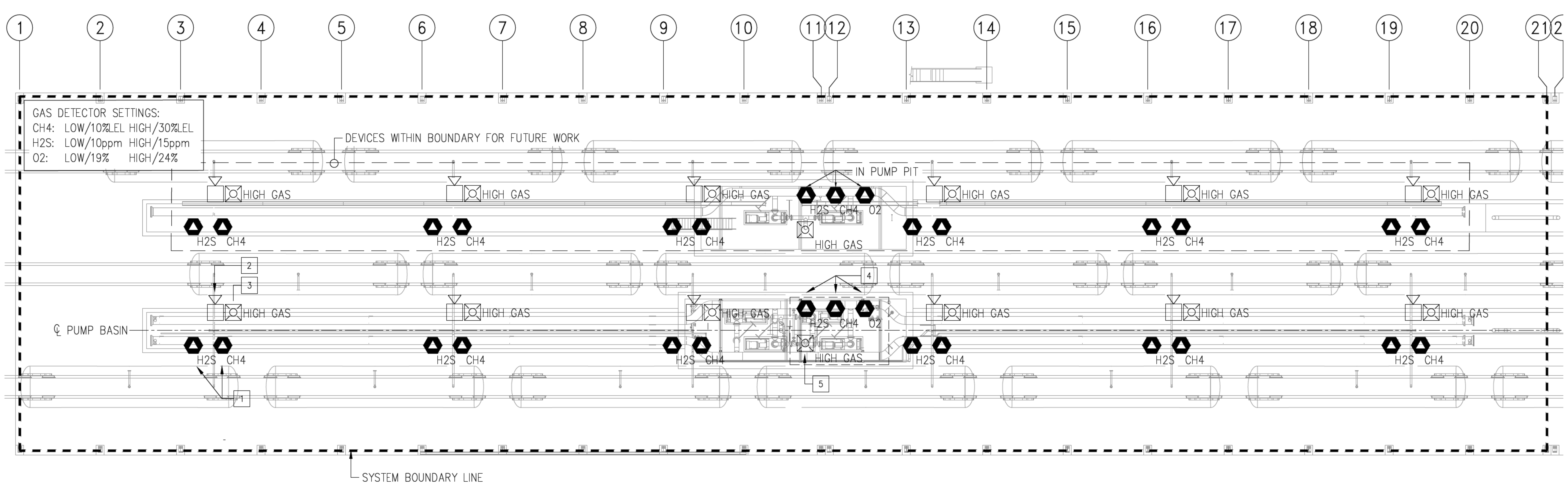


1 TYPICAL UNLOADING BUILDING FIRE DETECTION & ALARM DEVICE LAYOUT
0200-FA-003 SCALE: 1/16" = 1'-0"



2 TYPICAL UNLOADING BUILDING GAS DETECTION AND 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..

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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NO.	DATE	REVISION	BY	CK'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

PRO3 PROCESS • PROTECT • PROCEED
ProEnergy SERVICES
POOLE FIRE PROTECTION
TESORO SAVAGE

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

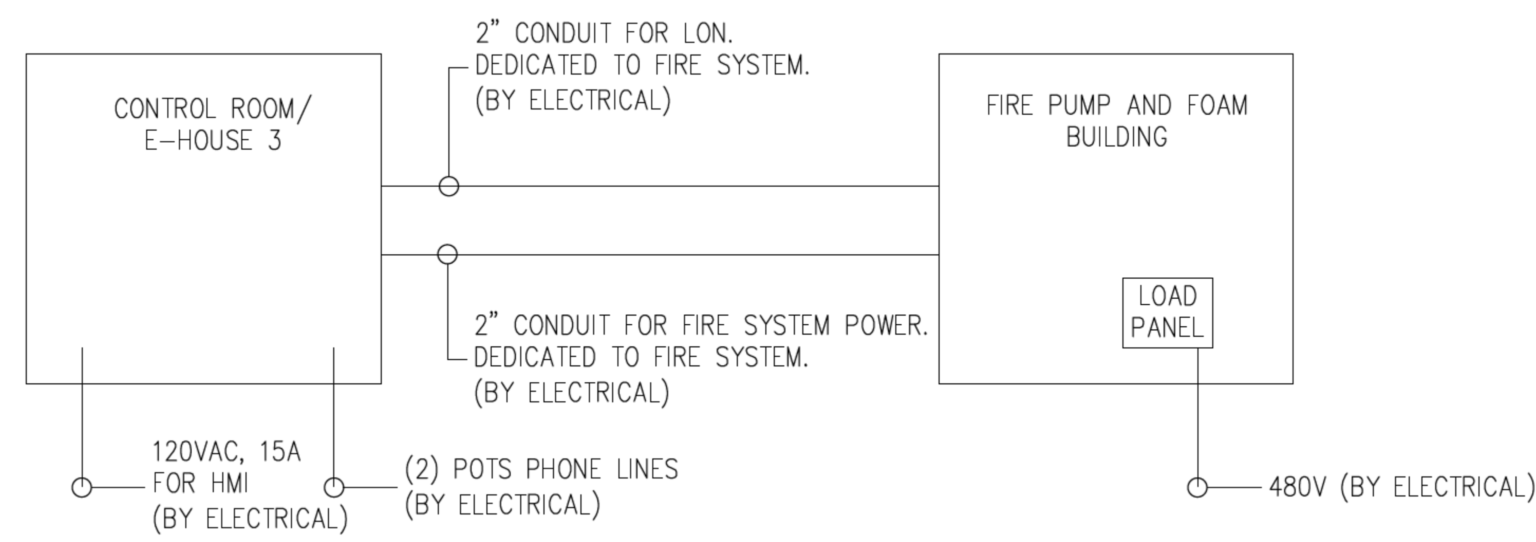
DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER: 0200-FA-003 SHEET: 1/1 REV.: E

JOHN W. POOLE, STATE OF WASHINGTON, 34993, REGISTERED PROFESSIONAL ENGINEER

CONDUIT INSTALLED BY ELECTRICAL
CONDUIT FIELD INSTALLED BY FIRE SYSTEM CONTRACTOR



1 UNLOADING BUILDING PRELIMINARY POWER & UNDERGROUND CONDUIT REQUIREMENTS

0200-FA-004 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

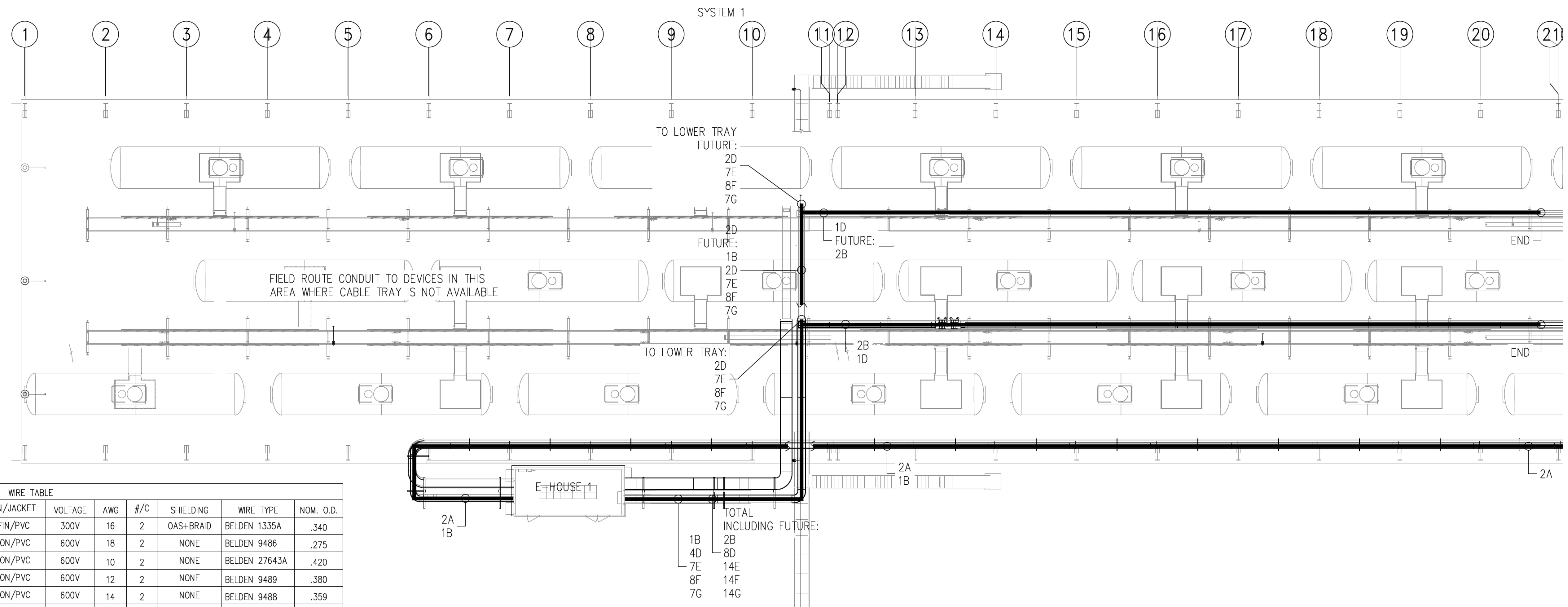
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

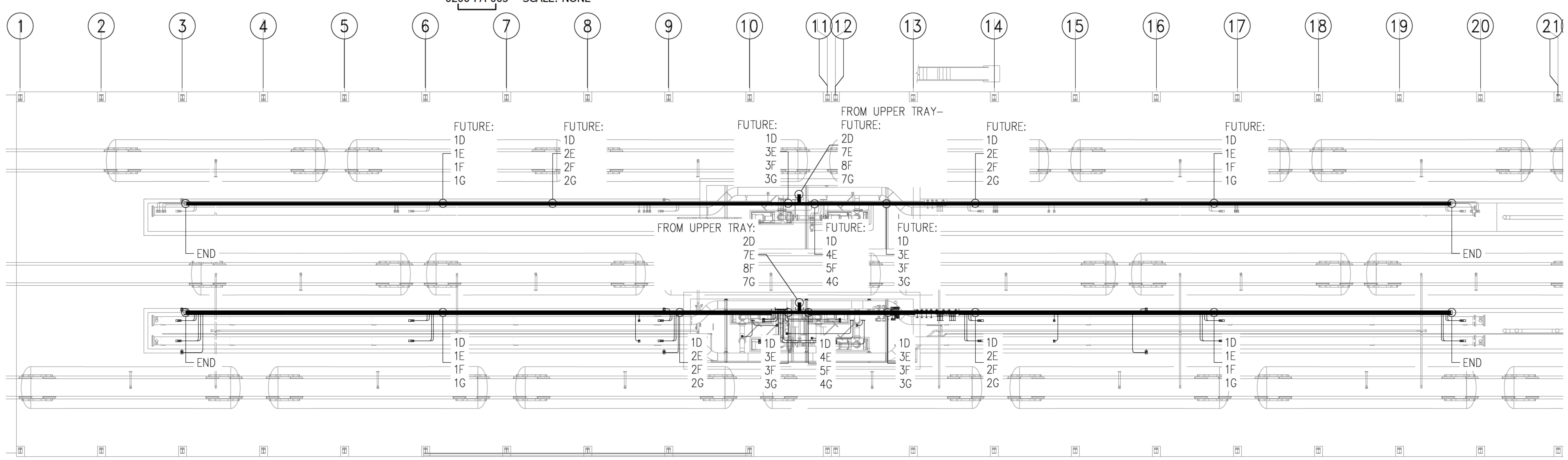
DRAWING NUMBER	SHEET	REV.
0200-FA-004	1/1	E



1 UNLOADING BUILDING SYSTEM 1 CABLE TRAY ROUTE - EL. 57'-8"

0200-FA-005 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 1 CABLE TRAY ROUTE - EL. 32'-6"

0200-FA-005 SCALE: NONE

TRUE NORTH
PLANT NORTH

JOHN W. POOLE III, STATE OF WASHINGTON, 34993, REGISTERED PROFESSIONAL ENGINEER

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

PRO3 PROCESS • PROTECT • PROCEED
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POOLE FIRE PROTECTION
TESORO SAVAGE

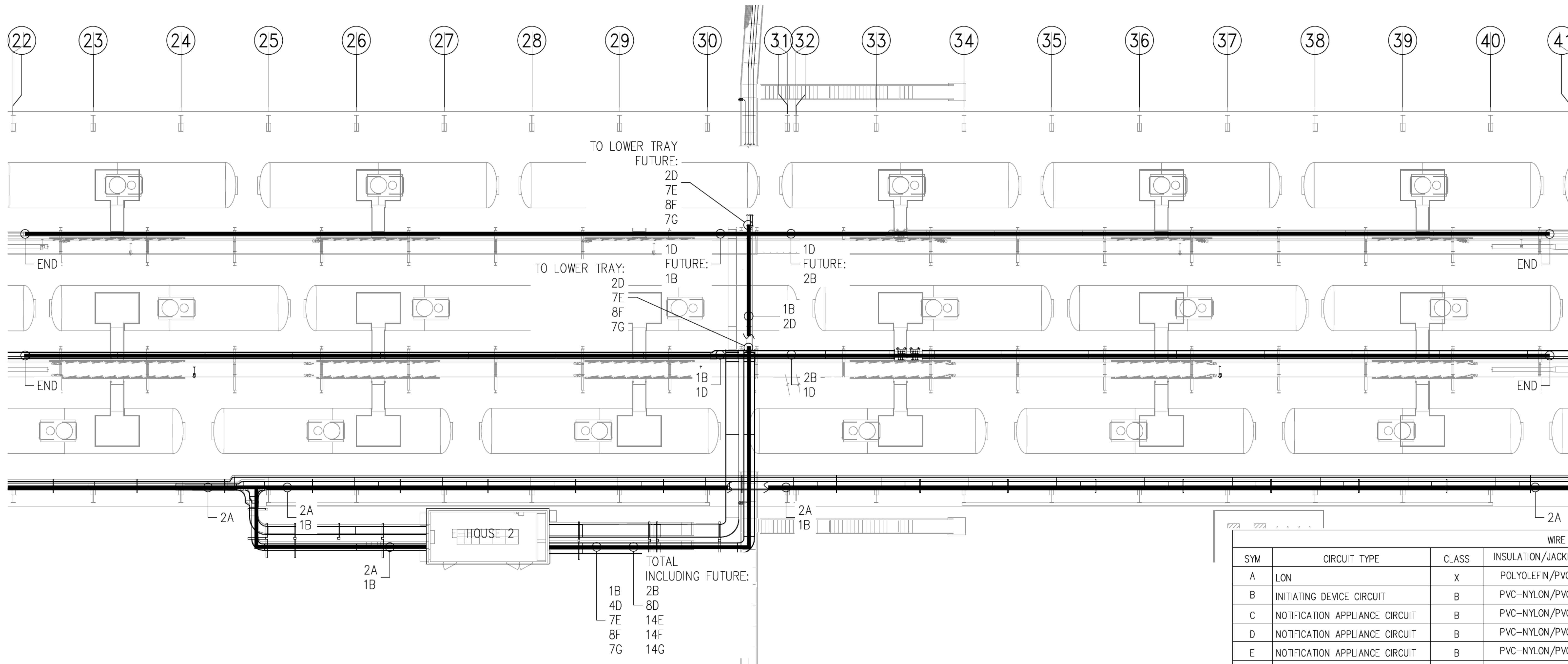
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

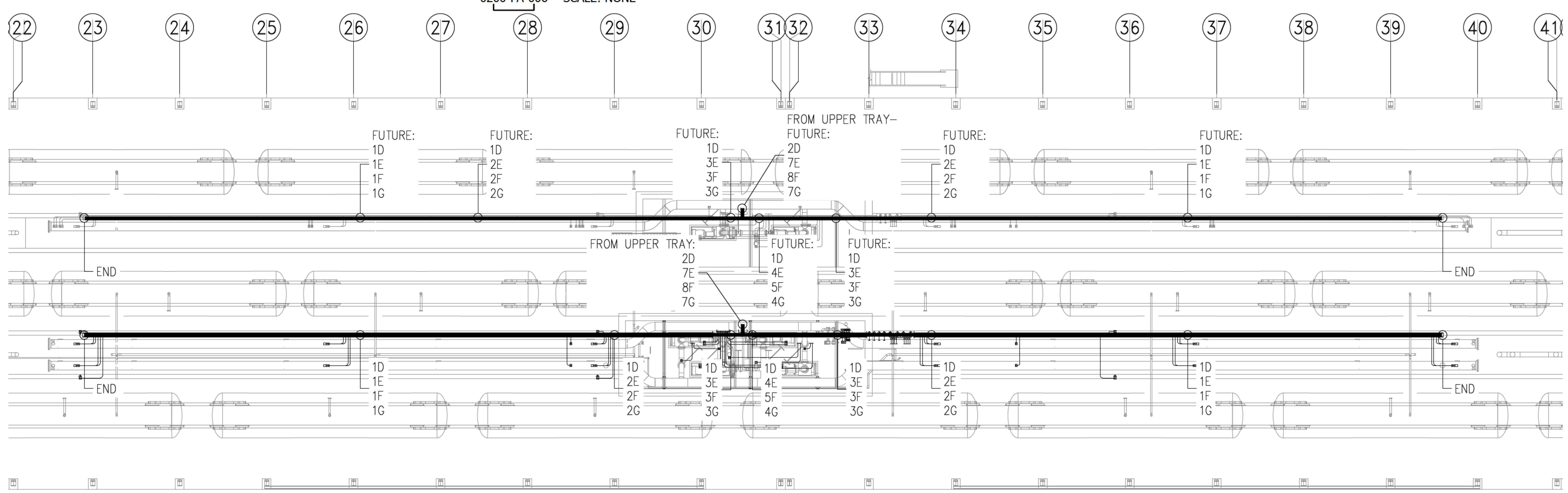
DRAWING NUMBER	SHEET	REV.
0200-FA-005	1/1	E



1 UNLOADING BUILDING SYSTEM 2 CABLE TRAY ROUTE - EL. 57'-8"

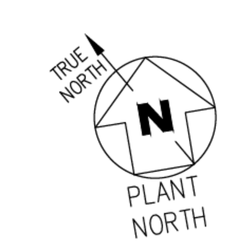
0200-FA-006 SCALE: NONE

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 2 CABLE TRAY ROUTE - EL. 32'-6"

0200-FA-006 SCALE: NONE



JOHN W. POOLE III STATE OF WASHINGTON 34993 REGISTERED PROFESSIONAL ENGINEER

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

PRO3 PROCESS • PROTECT • PROCEED
ProEnergy SERVICES
POOLE FIRE PROTECTION
TESORO SAVAGE

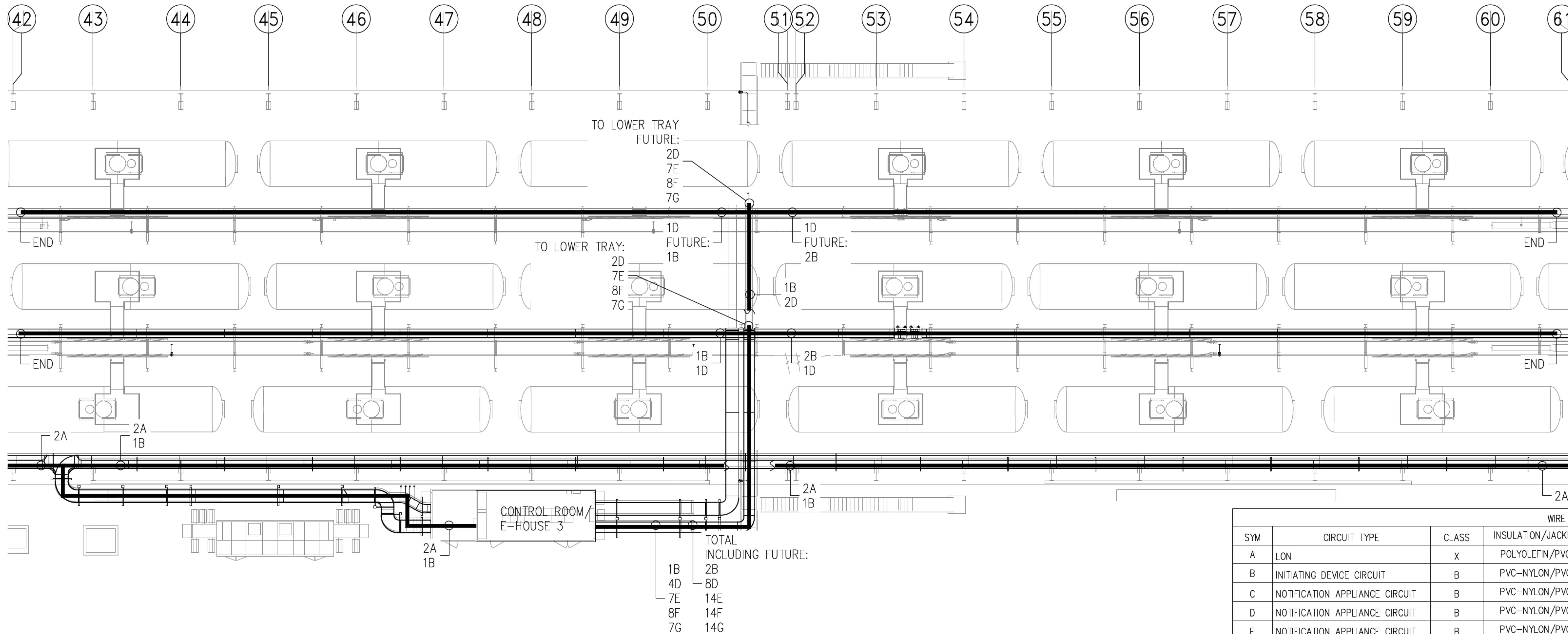
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

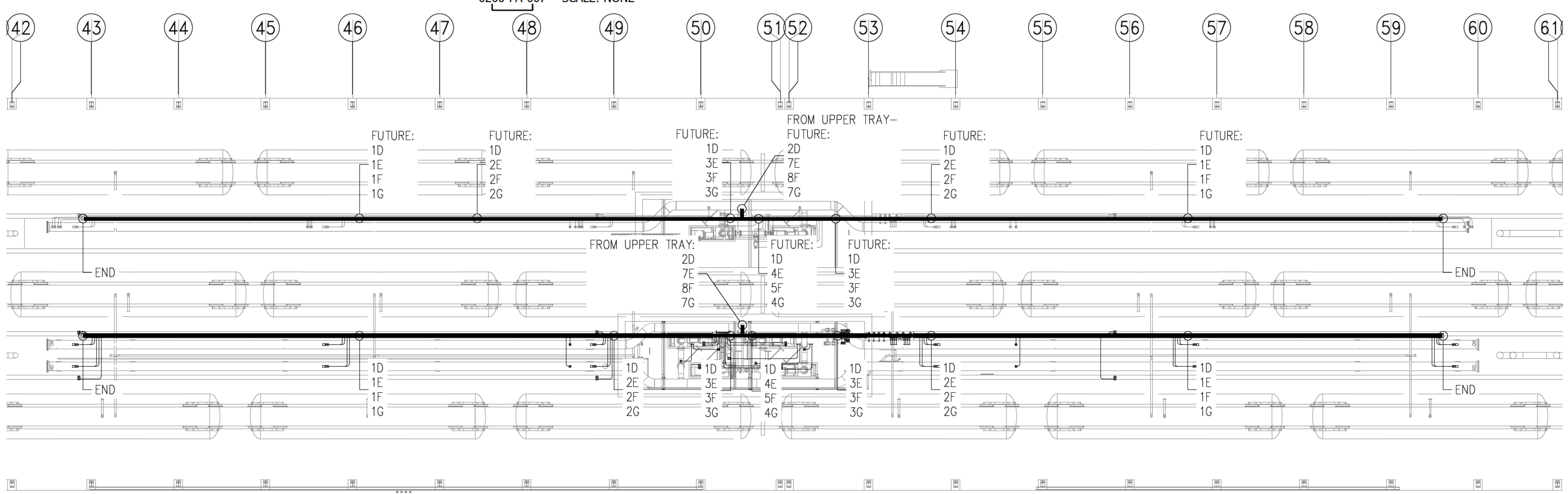
DRAWING NUMBER: 0200-FA-006 SHEET: 1/1 REV.: E



1 UNLOADING BUILDING SYSTEM 3 CABLE TRAY ROUTE - EL. 57'-8"

0200-FA-007 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 3 CABLE TRAY ROUTE - EL. 32'-6"

0200-FA-007 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

PRO3 PROCESS • PROTECT • PROCEED

ProEnergy SERVICES

POOLE FIRE PROTECTION

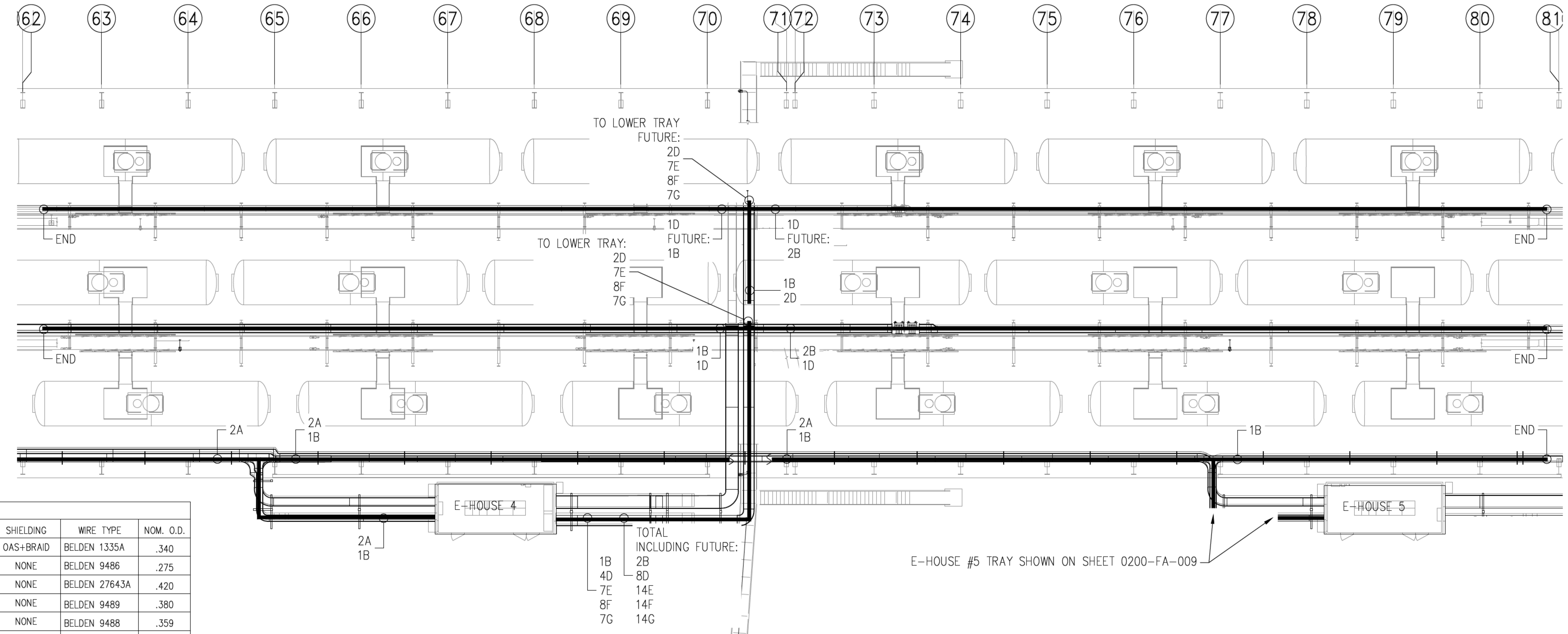
TESORO SAVAGE

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

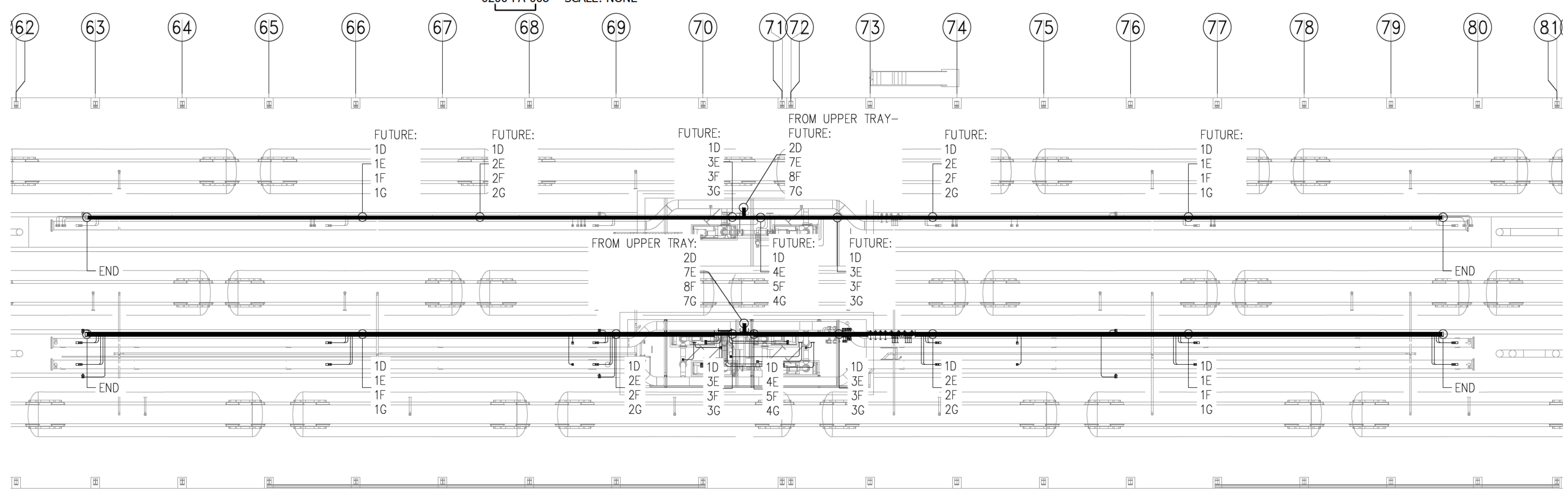
DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER				SHEET	REV.
0200-FA-007				1/1	E



1 UNLOADING BUILDING SYSTEM 4 CABLE TRAY ROUTE - EL. 57'-8"

0200-FA-008 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 4 CABLE TRAY ROUTE - EL. 32'-6"

0200-FA-008 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

PRO3 PROCESS • PROTECT • PROCEED

ProEnergy SERVICES

POOLE FIRE PROTECTION

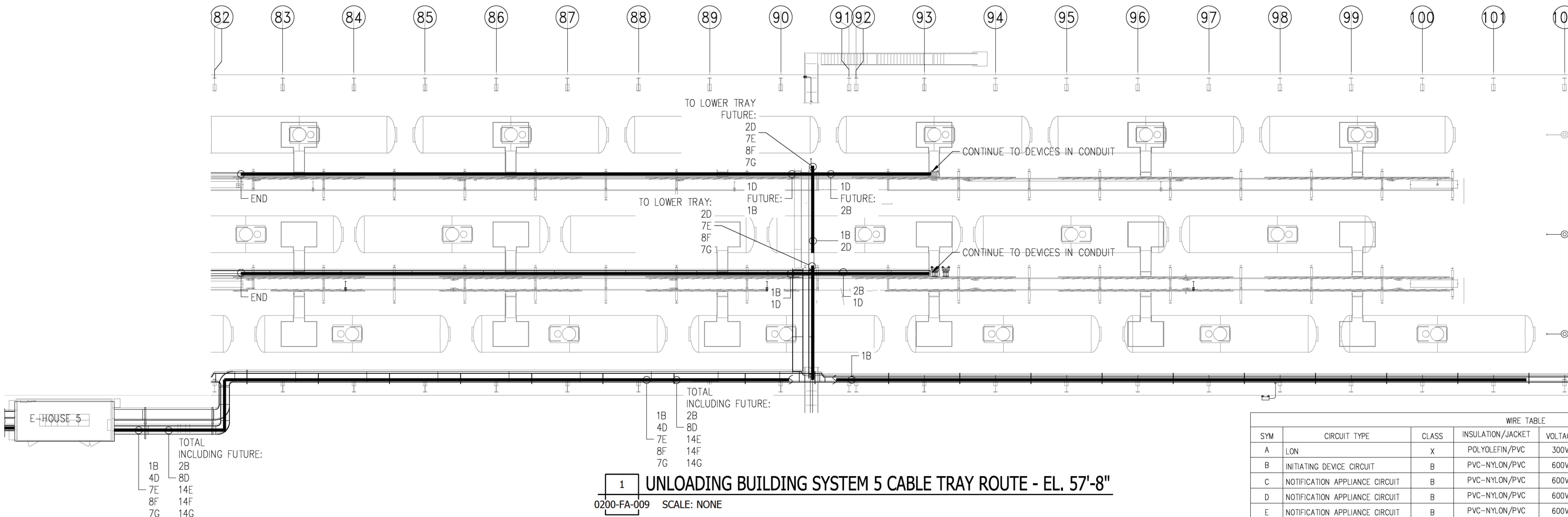
TESORO SAVAGE

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

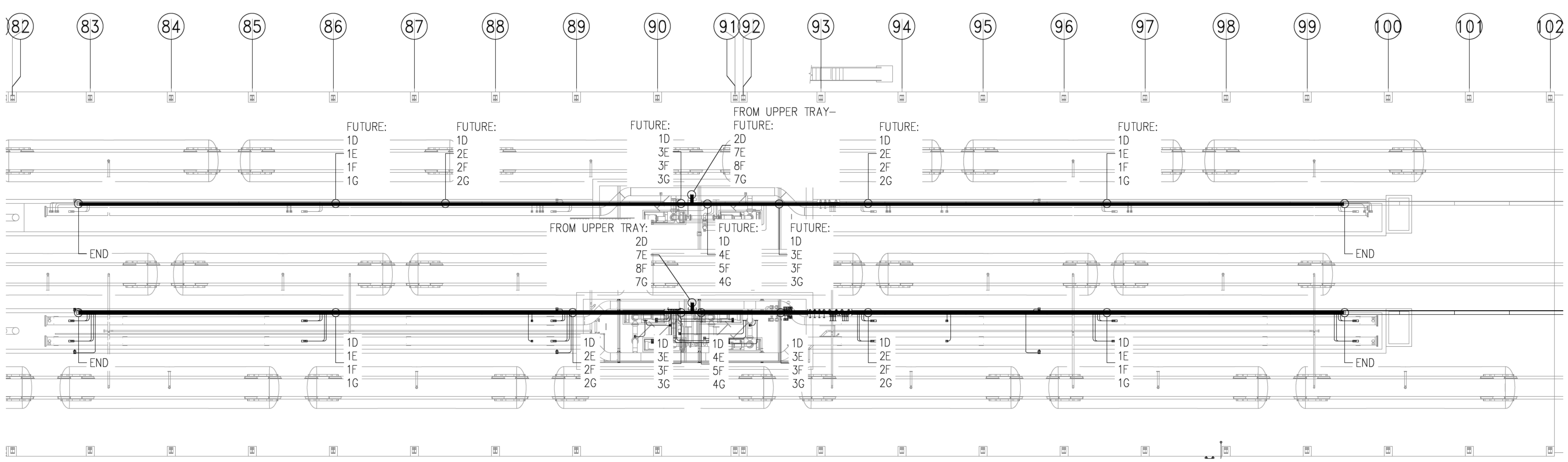
DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER	0200–FA–008	SHEET	1/1	REV.	E



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

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

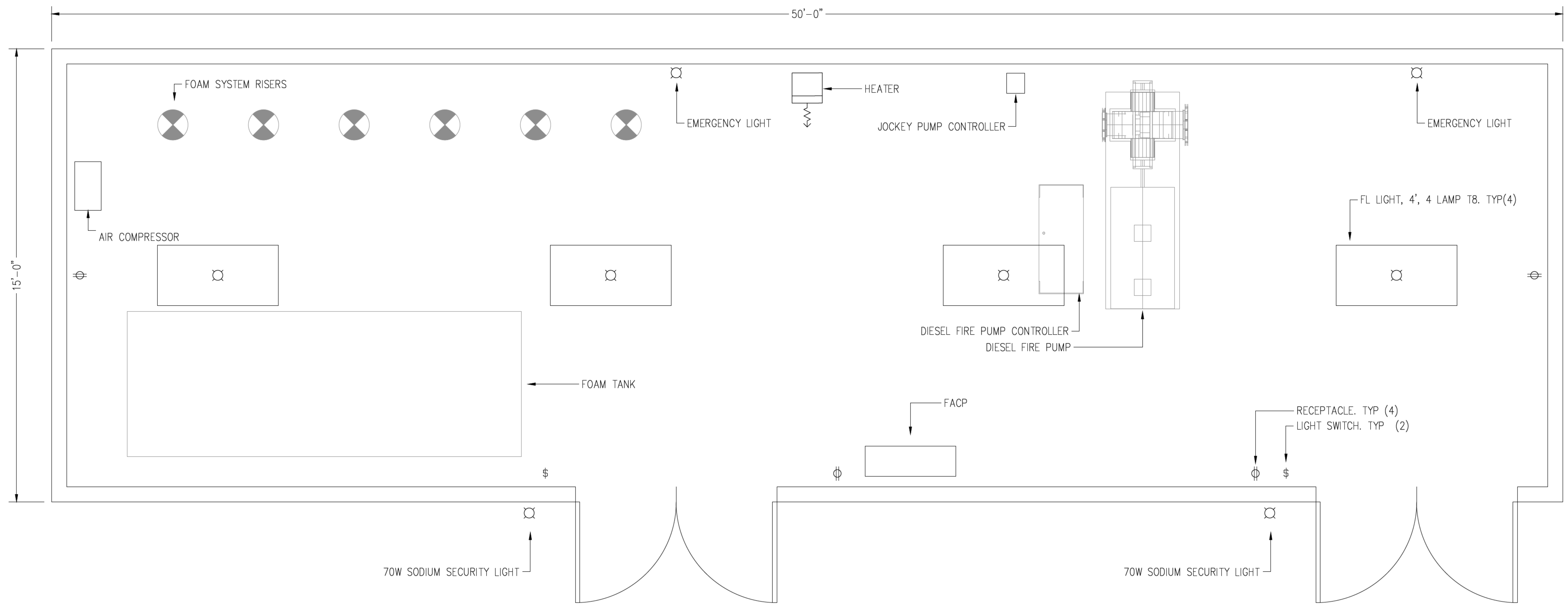
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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-009 SHEET: 1/1 REV.: 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	CK'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

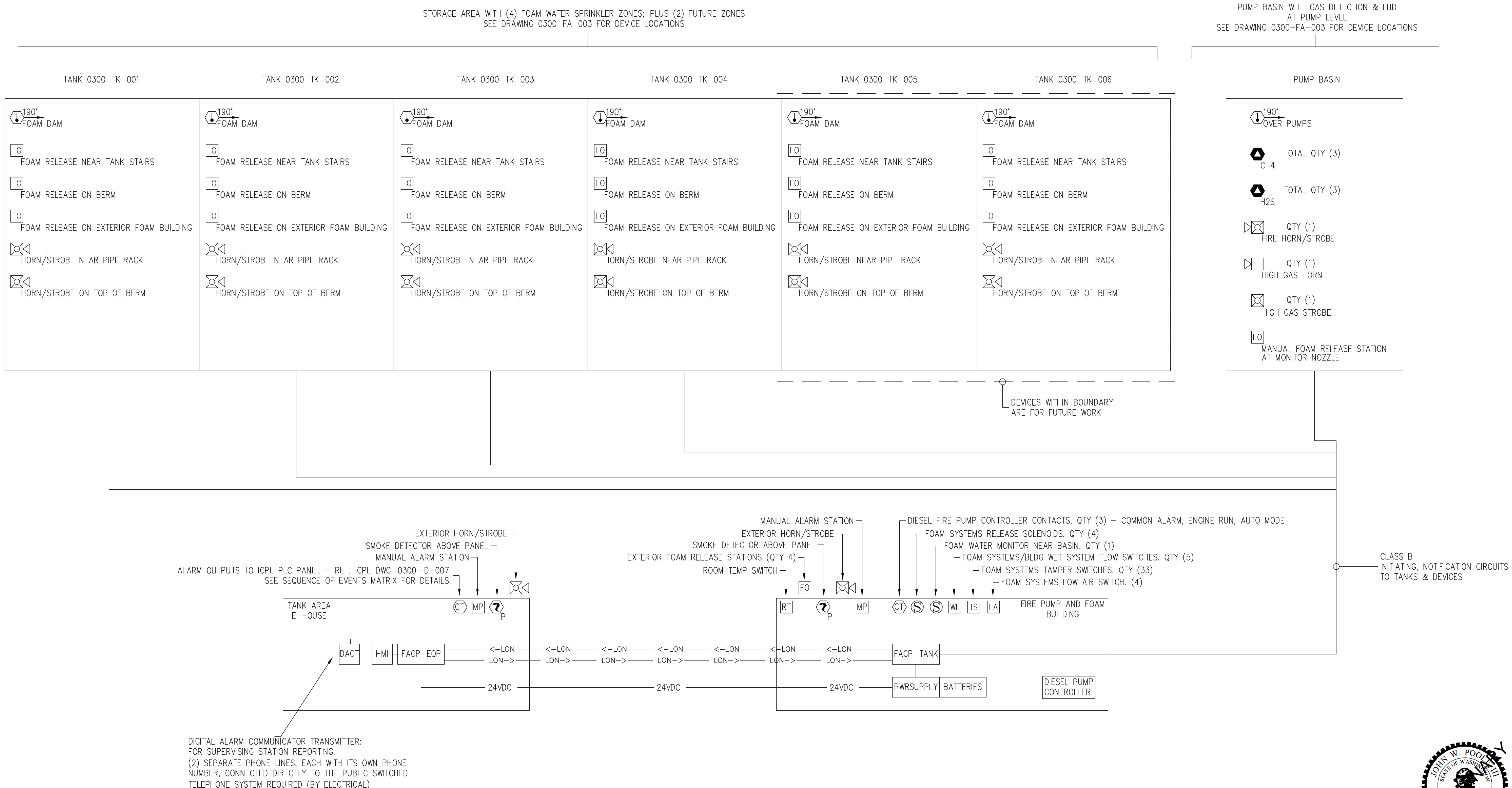
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: UNLOADING BUILDING AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER	SHEET	REV.
0200-FA-010	1/1	E



1 STORAGE AREA PRELIMINARY DEVICE LOCATIONS

0300-FA-001 SCALE: NONE

JOHN W. POOLE III — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER — 34993

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

PRO3 PROCESS • PROTECT • PROCEED — ProEnergy SERVICES — POOLE FIRE PROTECTION — TESORO — SAVAGE

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: STORAGE AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER: 0300-FA-001 — SHEET: 1/1 — REV.: E

STORAGE AREA 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	E-HOUSE	ACTIVATE EXTERIOR HORN/STROBES	DISPLAY INFO ON HMI	FIRE PUMP/FOAM BUILDING	ACTIVATE EXTERIOR HORN/STROBE	ACTIVATE SOLENOID – FOAM WATER – TANK 1	ACTIVATE SOLENOID – FOAM WATER – TANK 2	ACTIVATE SOLENOID – FOAM WATER – TANK 3	ACTIVATE SOLENOID – FOAM WATER – TANK 4	ACTIVATE SOLENOID – FOAM WATER – TANK 5	ACTIVATE SOLENOID – FOAM WATER – TANK 6	TANKS	ACTIVATE HORN/STROBES – TANK 1	ACTIVATE HORN/STROBES – TANK 2	ACTIVATE HORN/STROBES – TANK 3	ACTIVATE HORN/STROBES – TANK 4	ACTIVATE HORN/STROBES – TANK 5	ACTIVATE HORN/STROBES – TANK 6	PUMP BASIN	ACTIVATE FIRE HORN/STROBE	ACTIVATE HIGH GAS HORN	ACTIVATE HIGH GAS STROBE	ACTIVATE SOLENOID – FOAM MONITOR NOZZLE	RELAY OUTPUTS TO PLANT PLC	GENERAL FIRE ALARM SIGNAL	GENERAL TROUBLE SIGNAL	GENERAL SUPERVISORY SIGNAL	LOW GAS ALARM (CH4 OR H2S)	HIGH GAS ALARM (CH4 OR H2S)	(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 LOW GAS ALARM					X						X																									X						
PANEL HIGH GAS ALARM						X					X																			X	X							X		X	X		
PANEL SILENCE BUTTON							X																																			
PANEL ACKNOWLEDGE BUTTON								X																																		
E-HOUSE																																										
FACP-EQP PANEL ANY TROUBLE/FAULT			X								X																							X								
MANUAL ALARM STATION		X								X	X																						X									
SMOKE DETECTOR ABOVE PANEL		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 33)				X							X																								X							
FOAM SYSTEMS LOW AIR SWITCH				X							X																								X							
FOAM WATER FLOW – TANK 1		X									X		X																				X						X	X		
FOAM WATER FLOW – TANK 2		X									X		X																				X						X	X		
FOAM WATER FLOW – TANK 3		X									X		X																				X						X	X		
FOAM WATER FLOW – TANK 4		X									X		X																				X						X	X		
MANUAL FOAM RELEASE – TANK 1		X									X		X	X																			X						X	X		
MANUAL FOAM RELEASE – TANK 2		X									X		X		X																		X						X	X		
MANUAL FOAM RELEASE – TANK 3		X									X		X			X																	X						X	X		
MANUAL FOAM RELEASE – TANK 4		X									X		X				X																X						X	X		
MANUAL FOAM RELEASE – TANK 5		X									X		X					X															X						X	X		
MANUAL FOAM RELEASE – TANK 6		X									X		X						X														X						X	X		
BUILDING WET SYSTEM WATERFLOW		X									X		X																				X									
ROOM LOW TEMP SWITCH				X							X																								X							
TANK 1																																										
LINEAR HEAT DETECTOR ACTIVE		X									X		X	X							X												X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X	X							X												X						X	X		
TANK 2																																										
LINEAR HEAT DETECTOR ACTIVE		X									X		X		X							X											X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X		X							X											X						X	X		
TANK 3																																										
LINEAR HEAT DETECTOR ACTIVE		X									X		X			X							X										X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X			X							X										X						X	X		
TANK 4																																										
LINEAR HEAT DETECTOR ACTIVE		X									X		X				X							X									X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X				X							X									X						X	X		
TANK 5																																										
LINEAR HEAT DETECTOR ACTIVE		X									X		X					X							X								X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X					X							X								X						X	X		
TANK 6																																										
LINEAR HEAT DETECTOR ACTIVE		X									X		X						X							X							X						X	X		
MANUAL FOAM RELEASE STATION ACTIVE		X									X		X						X							X							X						X	X		
PUMP BASIN																																										
LINEAR HEAT DETECTOR ACTIVE		X									X																	X					X						X	X		
MONITOR MANUAL FOAM RELEASE STATION ACTIVE		X									X																	X			X		X						X	X		
CH4 OR H2S DETECTOR LOW ALARM					X						X																									X						
CH4 OR HS2 DETECTOR HIGH ALARM						X					X																		X	X							X		X	X		

1 STORAGE AREA 300 SEQUENCE OF EVENTS

0300-FA-002 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

PRO3 PROCESS • PROTECT • PROCEED

ProEnergy SERVICES

POOLE FIRE PROTECTION

TESORO SAVAGE

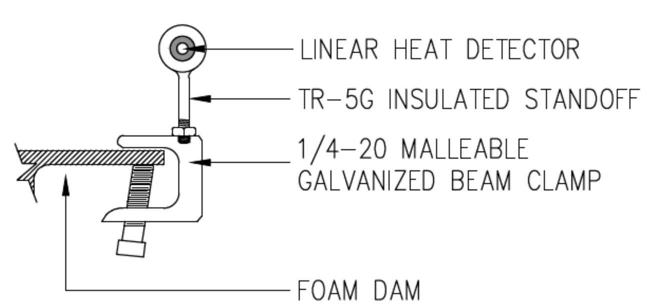
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

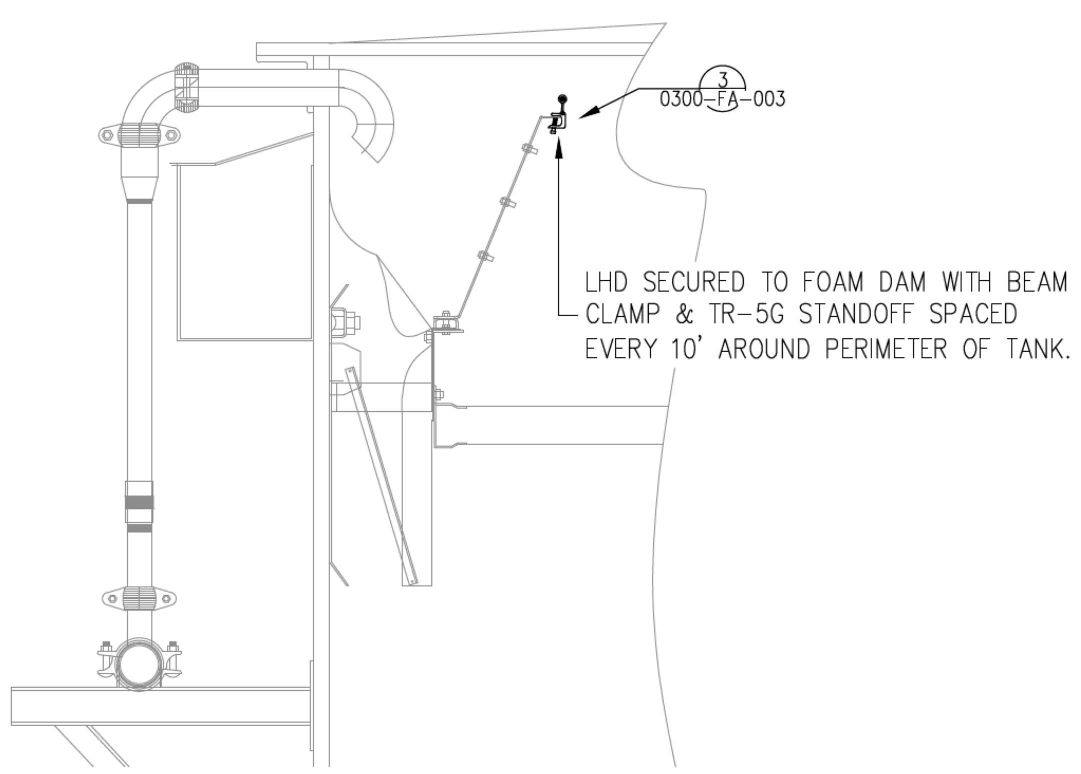
DESCRIPTION: STORAGE AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36
DRAWING NUMBER	0300-FA-002	SHEET	1/1	REV.	E

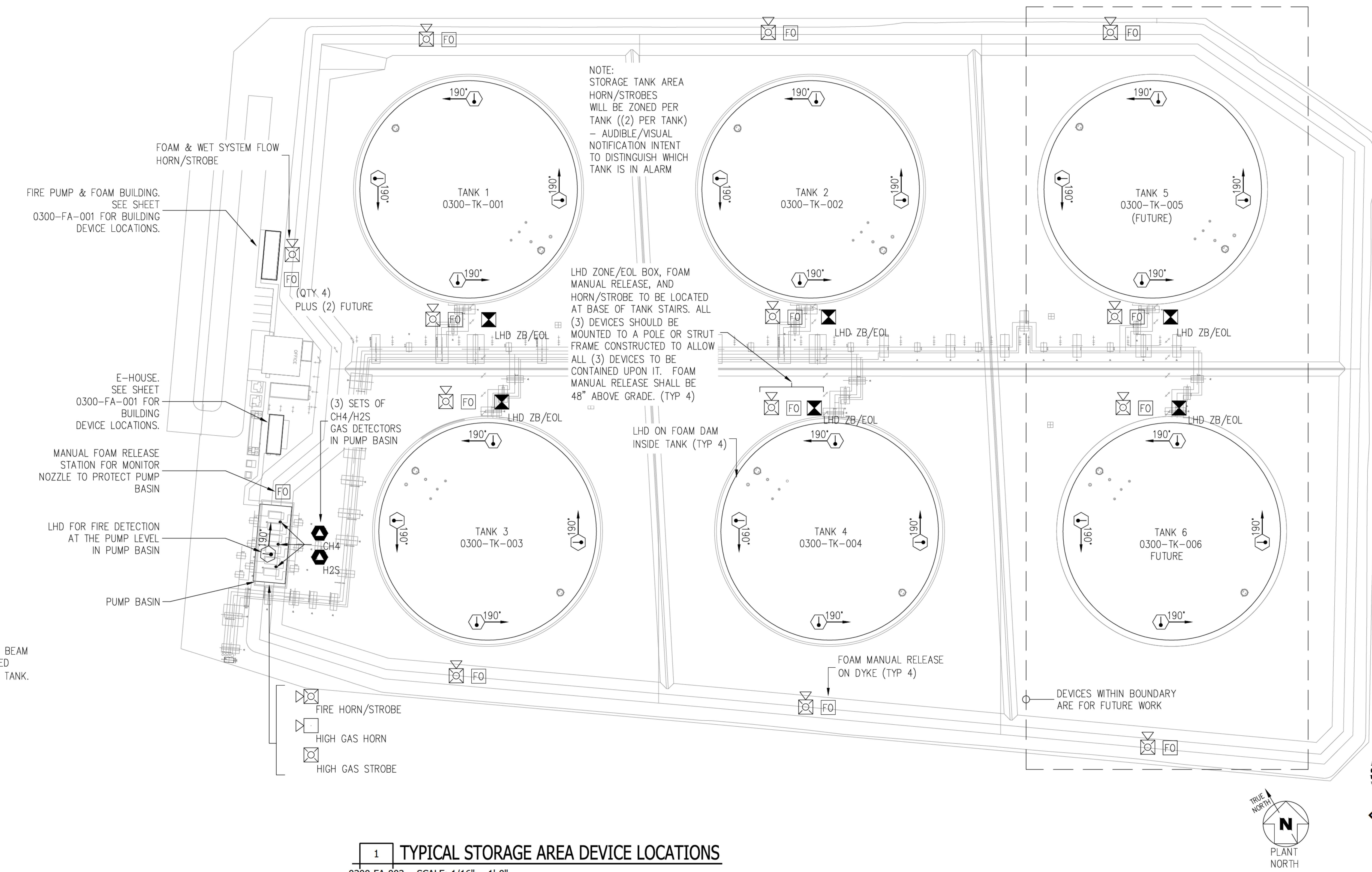
HAZARDOUS CLASSIFICATION NOTES:
1. DEVICES WITHIN THE FIRE PUMP/FOAM SKID ARE NOT WITHIN A CLASSIFIED AREA.
2. DEVICES IN E-HOUSE ARE NOT WITHIN A CLASSIFIED AREA.
3. TANK INTERIOR IS CLASS 1 DIV 1
4. DEVICES WITHIN PUMP BASIN ARE IN CLASS 1 DIV 1 AREA.
5. ALL OTHER DEVICES ARE WITHIN A CLASS 2 DIV 2 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"

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'D	APP
E	07-14-14		JCP	SED	JWP
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POOLE FIRE PROTECTION
TESORO SAVAGE

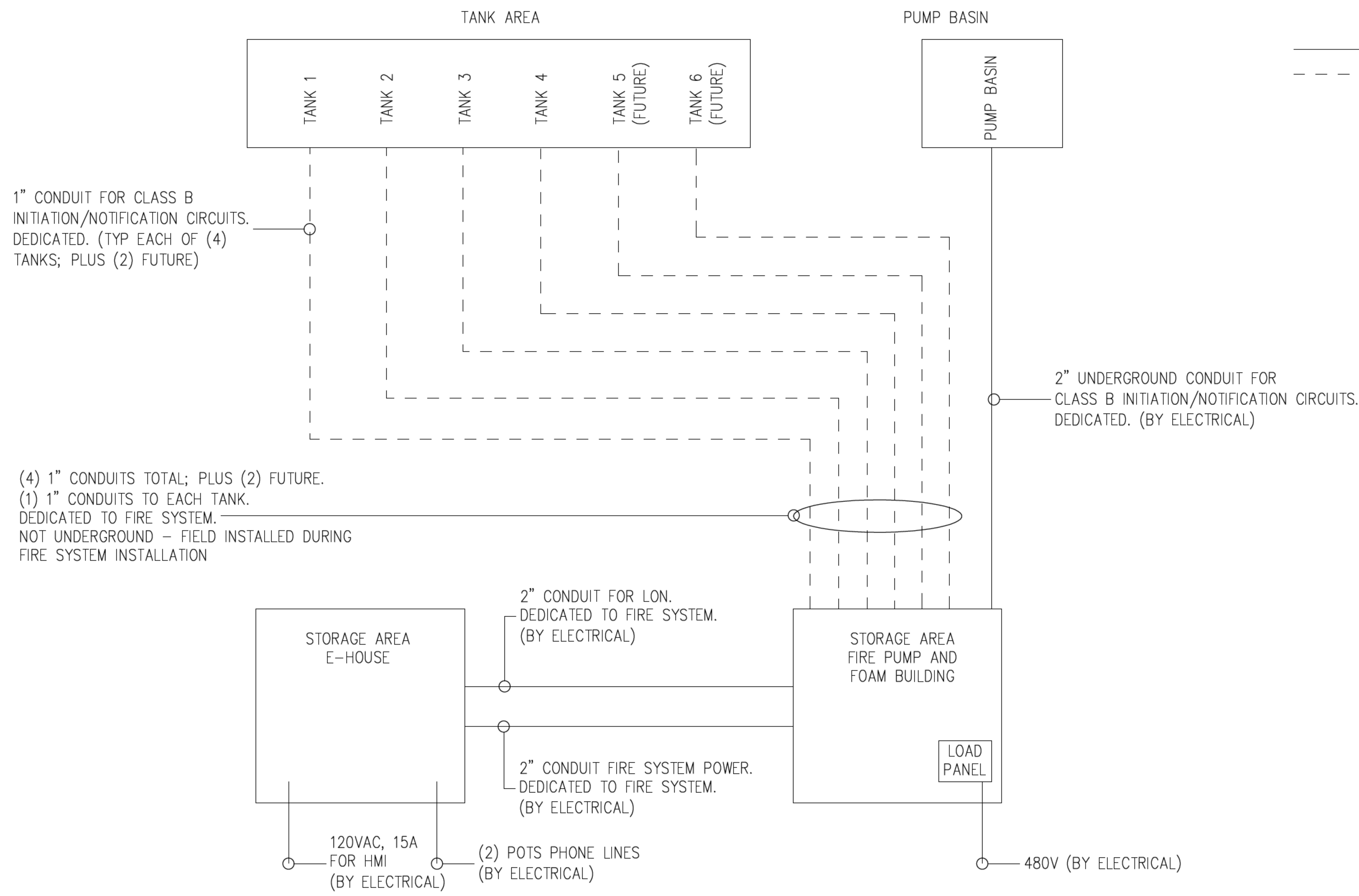
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: STORAGE AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER	SHEET	REV.
0300-FA-003	1/1	E



1 STORAGE AREA POWER & UNDERGROUND CONDUIT REQUIREMENTS

0300-FA-004 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

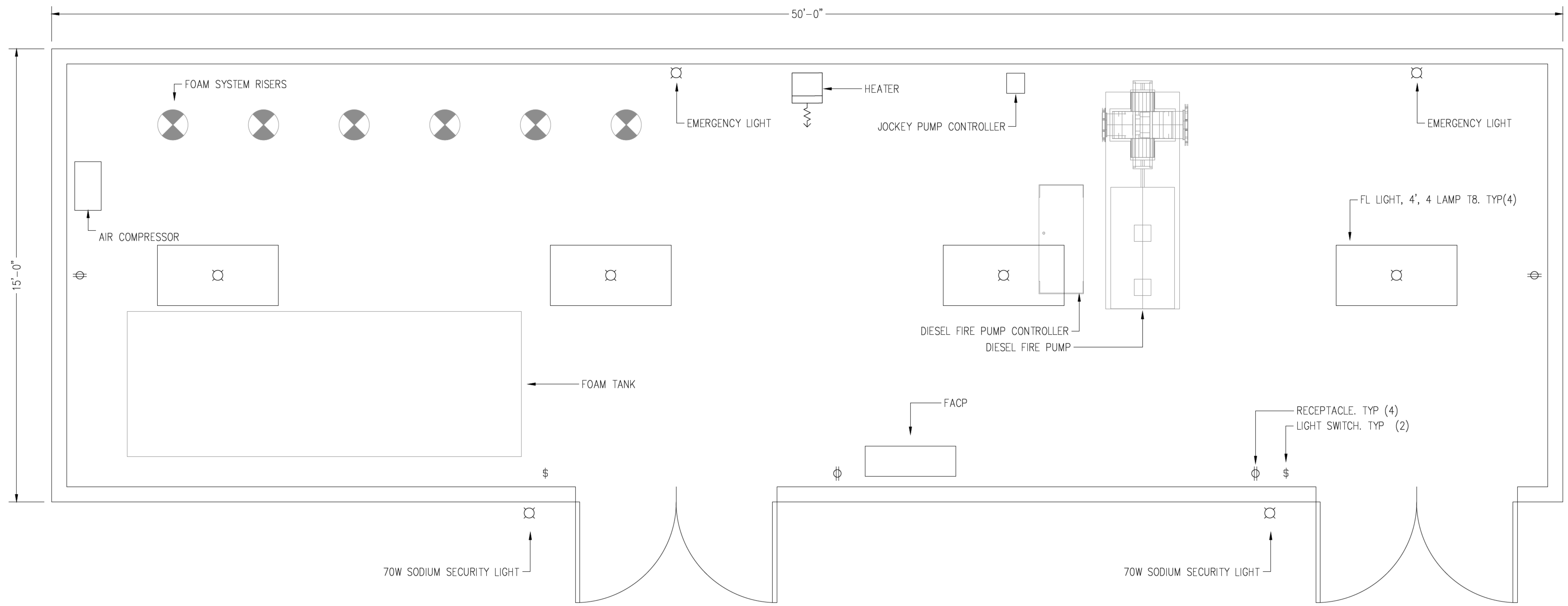
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: STORAGE AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER: 0300-FA-004 SHEET: 1/1 REV.: E



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

PLANT NORTH
TRUE NORTH

JOHN W. POOLE III, STATE OF WASHINGTON, 34993, REGISTERED PROFESSIONAL ENGINEER

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'D	APP
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POOLE FIRE PROTECTION
TESORO SAVAGE

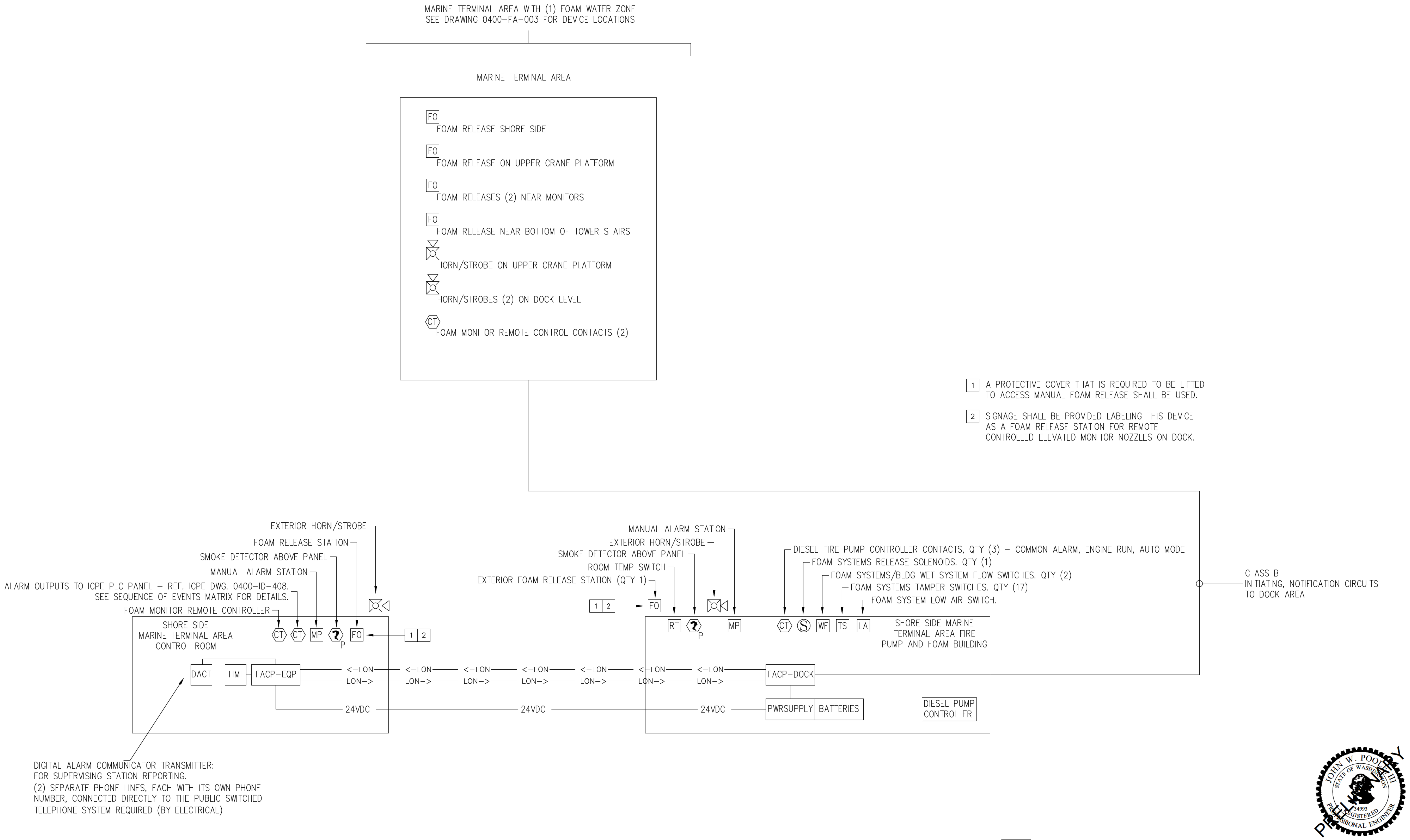
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: STORAGE AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER	SHEET	REV.
0300-FA-005	1/1	E



1 MARINE TERMINAL AREA PRELIMINARY DEVICE LOCATIONS

0400-FA-001 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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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ProEnergy SERVICES

POOLE FIRE PROTECTION

TESORO SAVAGE

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: MARINE TERMINAL AREA
FIRE ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER: 0400-FA-001 | 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

JOHN W. POOLE III
STATE OF WASHINGTON
34993
REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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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ProEnergy SERVICES
POOLE FIRE PROTECTION
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.

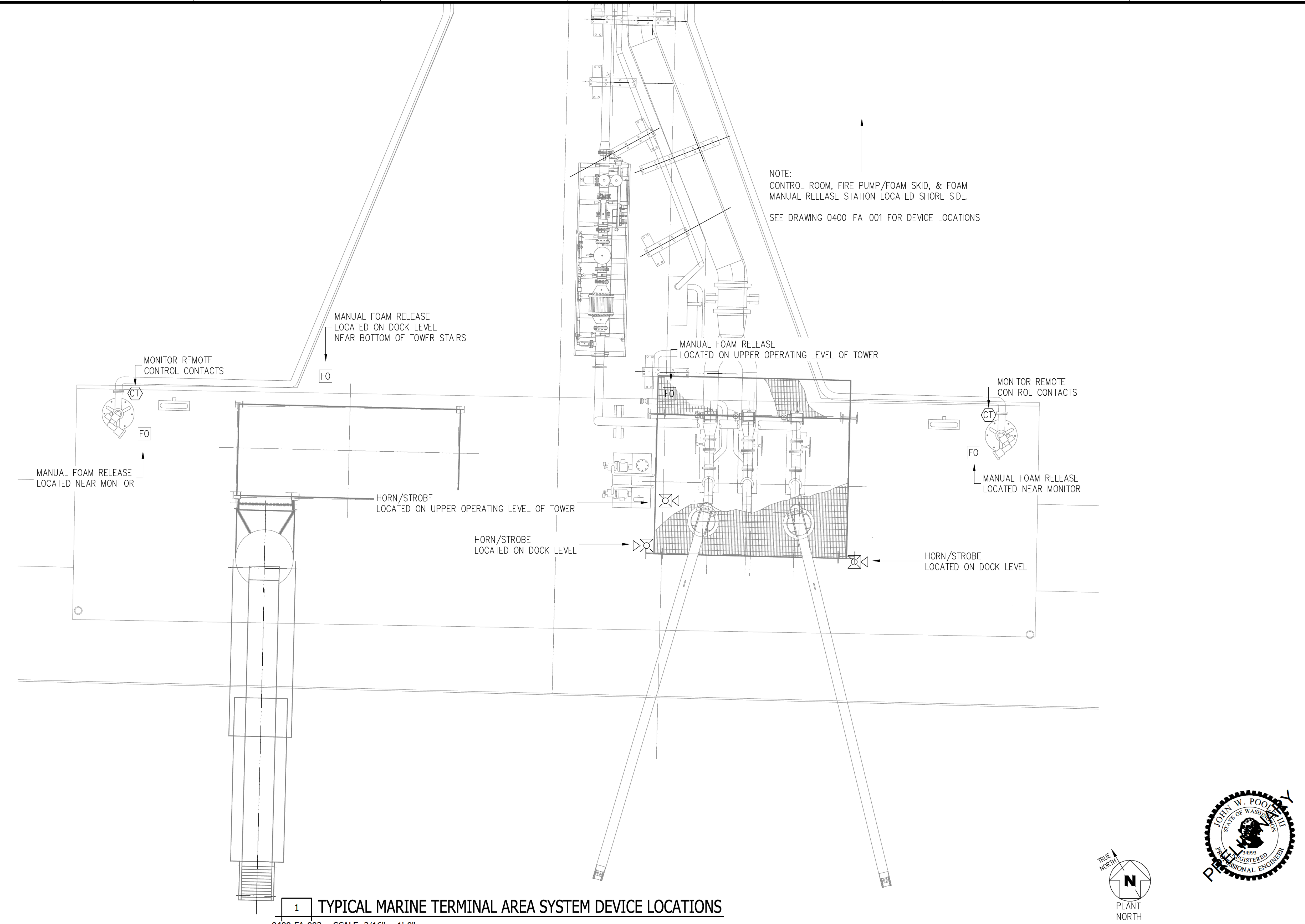
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: MARINE TERMINAL AREA
FIRE ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As–Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER: 0400–FA–002 SHEET: 1/1 REV.: E



1 TYPICAL MARINE TERMINAL AREA SYSTEM DEVICE LOCATIONS

0400-FA-003 SCALE: 3/16" = 1'-0"

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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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ProEnergy SERVICES

POOLE FIRE PROTECTION

TESORO SAVAGE

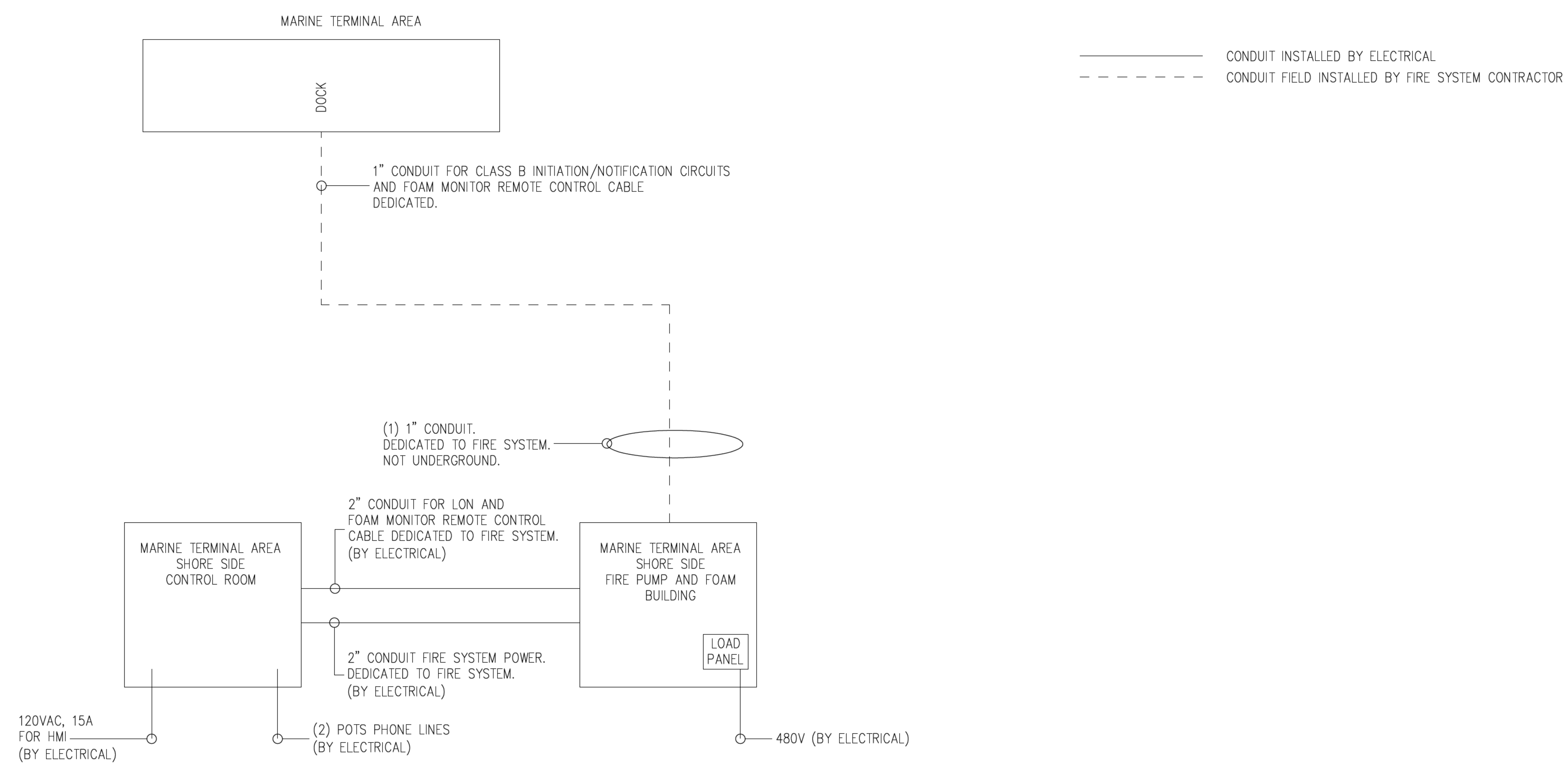
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: MARINE TERMINAL AREA
FIRE ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER	SHEET	REV.
0400-FA-003	1/1	E



1 MARINE TERMINAL AREA POWER & UNDERGROUND CONDUIT REQUIREMENTS

0400-FA-004 SCALE: NONE

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

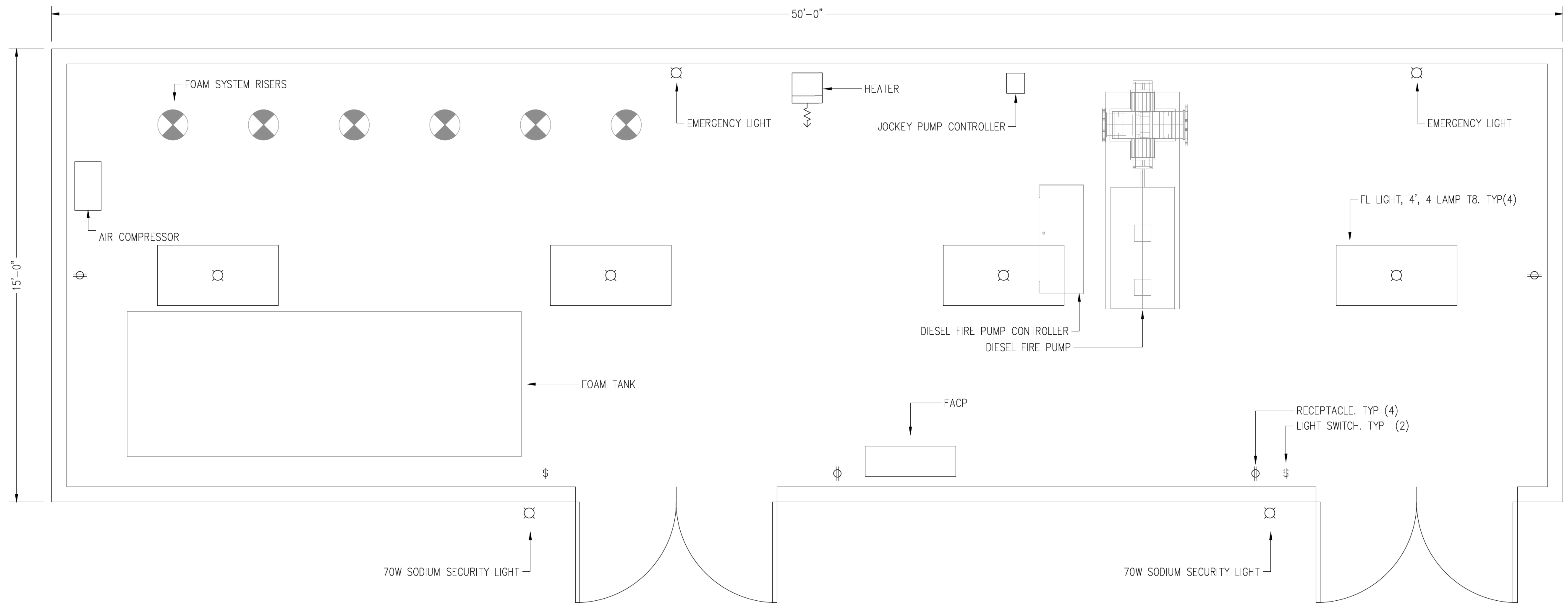
CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: MARINE TERMINAL AREA FIRE ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER: 0400-FA-004 SHEET: 1/1 REV.: E



1 TYPICAL FIRE PUMP AND FOAM BUILDING ELECTRICAL LAYOUT

0400-FA-005 SCALE: 1/2" = 1'-0"

PLANT NORTH

TRUE NORTH

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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
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PRO3 PROCESS • PROTECT • PROCEED

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POOLE FIRE PROTECTION

TESORO SAVAGE

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

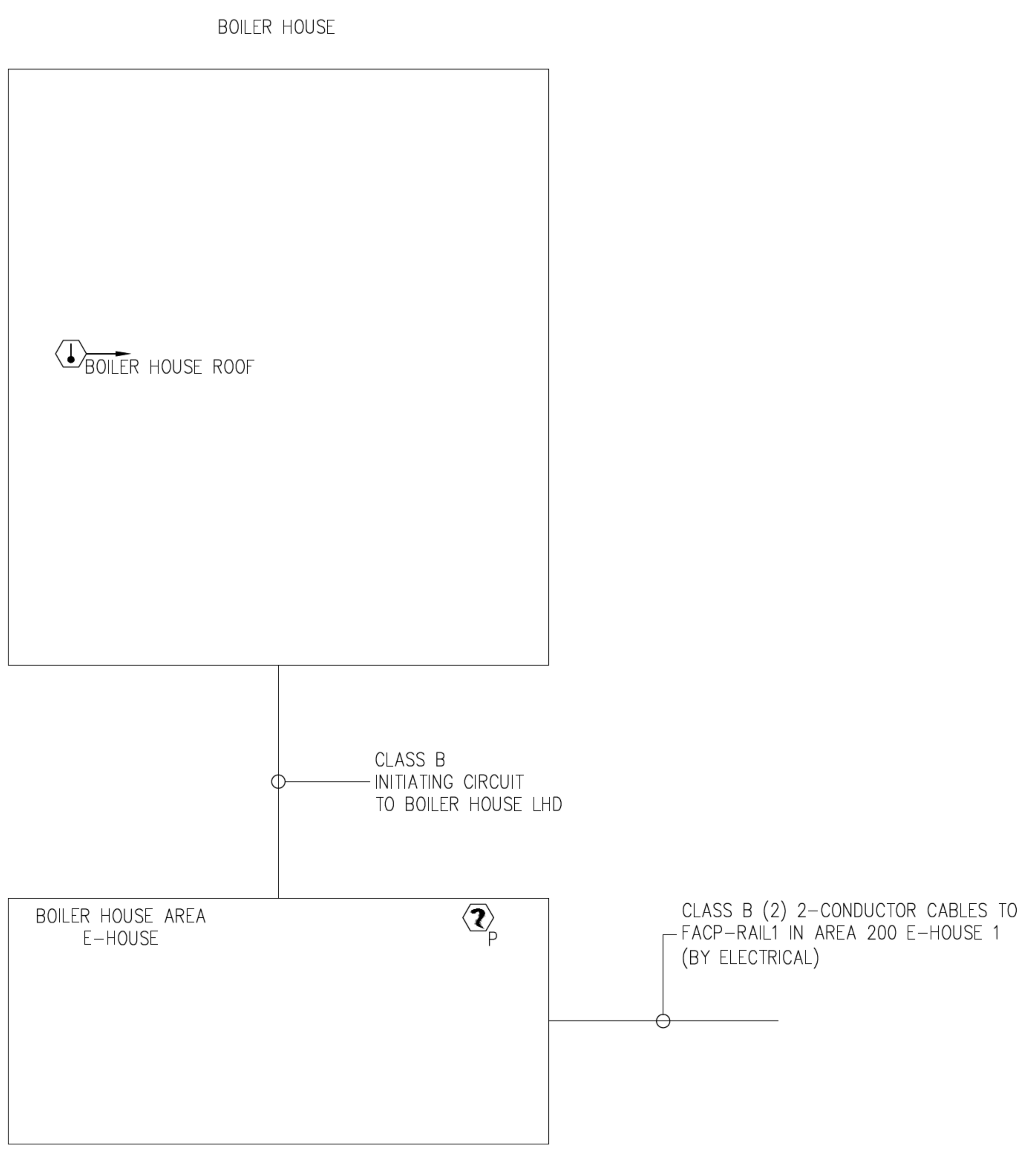
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: MARINE TERMINAL AREA
FIRE & GAS DETECTION AND ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

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

CONDUIT INSTALLED BY ELECTRICAL
CONDUIT FIELD INSTALLED BY FIRE SYSTEM CONTRACTOR



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

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'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

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: BOILER HOUSE AREA
FIRE ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER: 0600-FA-001 SHEET: 1/1 REV.: E

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

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'D	APP
E	07-14-14		JCP	SED	JWP
D	01-31-14	PRELIMINARY BID SET	JCP	SED	JWP
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CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

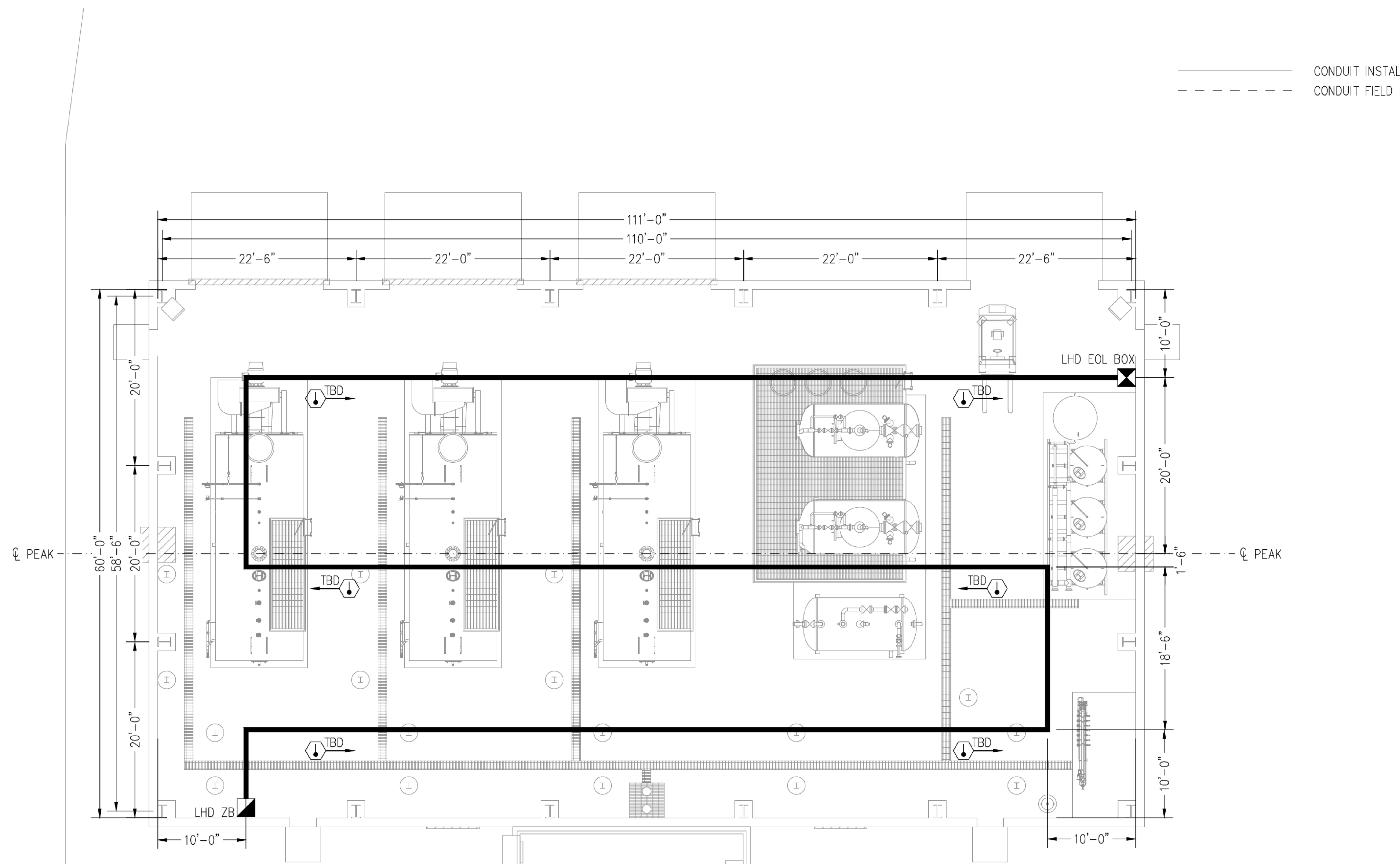
PROJECT: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL
PORT OF VANCOUVER, WASHINGTON

DESCRIPTION: BOILER HOUSE 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. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

DRAWING NUMBER	SHEET	REV.
0600-FA-002	1/1	E

CONDUIT INSTALLED BY ELECTRICAL
CONDUIT FIELD INSTALLED BY FIRE SYSTEM CONTRACTOR



NOTES:
DETECTION SYSTEM OF THIS AREA IS CONSIDERED SUPPLEMENTARY. NOTIFICATION APPLIANCES ARE NOT PROVIDED.

LHD TEMPERATURE RATING TO BE DETERMINED AND SHOWN ON SHOP DRAWINGS.

THE LHD CIRCUIT AND SMOKE DETECTOR CIRCUIT REPRESENTED HERE WILL BE CONNECTED TO FACP-RAIL1 IN E-HOUSE 1 IN AREA 200. THE (2) 2-CONDUCTOR CABLES REQUIRED WILL BE RUN BETWEEN THE BOILER HOUSE E-HOUSE AND E-HOUSE 1 IN AREA 200 BY ELECTRICAL.

1 BOILER HOUSE AREA DEVICE LAYOUT
0600-FA-003 SCALE: NONE

TRUE NORTH
N
PLANT NORTH

JOHN W. POOLE III
STATE OF WASHINGTON
34993
REGISTERED PROFESSIONAL ENGINEER

PRELIMINARY, NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	CK'D	APP
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POOLE FIRE PROTECTION
TESORO
SAVAGE

CUSTOMER: TESORO SAVAGE VANCOUVER ENERGY DISTRIBUTION TERMINAL

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

DESCRIPTION: BOILER HOUSE AREA
FIRE ALARM

DESIGN:	J. Pohlow	START DATE:	06/19/2013	SCALE:	As-Noted
DRAWN:	J. Pohlow	PRINT DATE:	01/31/2014	PROJECT MANAGER:	S. Durflinger
CHECKED:	S. Durflinger	APPROVED:	J. Poole	SIZE:	24x36

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Fire Suppression Hydraulic Analysis

Tesoro Savage Vancouver Energy Distribution Terminal

Port of Vancouver, Washington

Submitted: July 14, 2014

Poole Fire Protection

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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^{o}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/ft^2 over an operating area of 4,000 ft^2 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 ft^2 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 ll 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

. . . Fire Protection by Computer Design

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

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

Water Supply Curve C

ProEnergy Services
Rail Unloading-R4

Page 1
Date

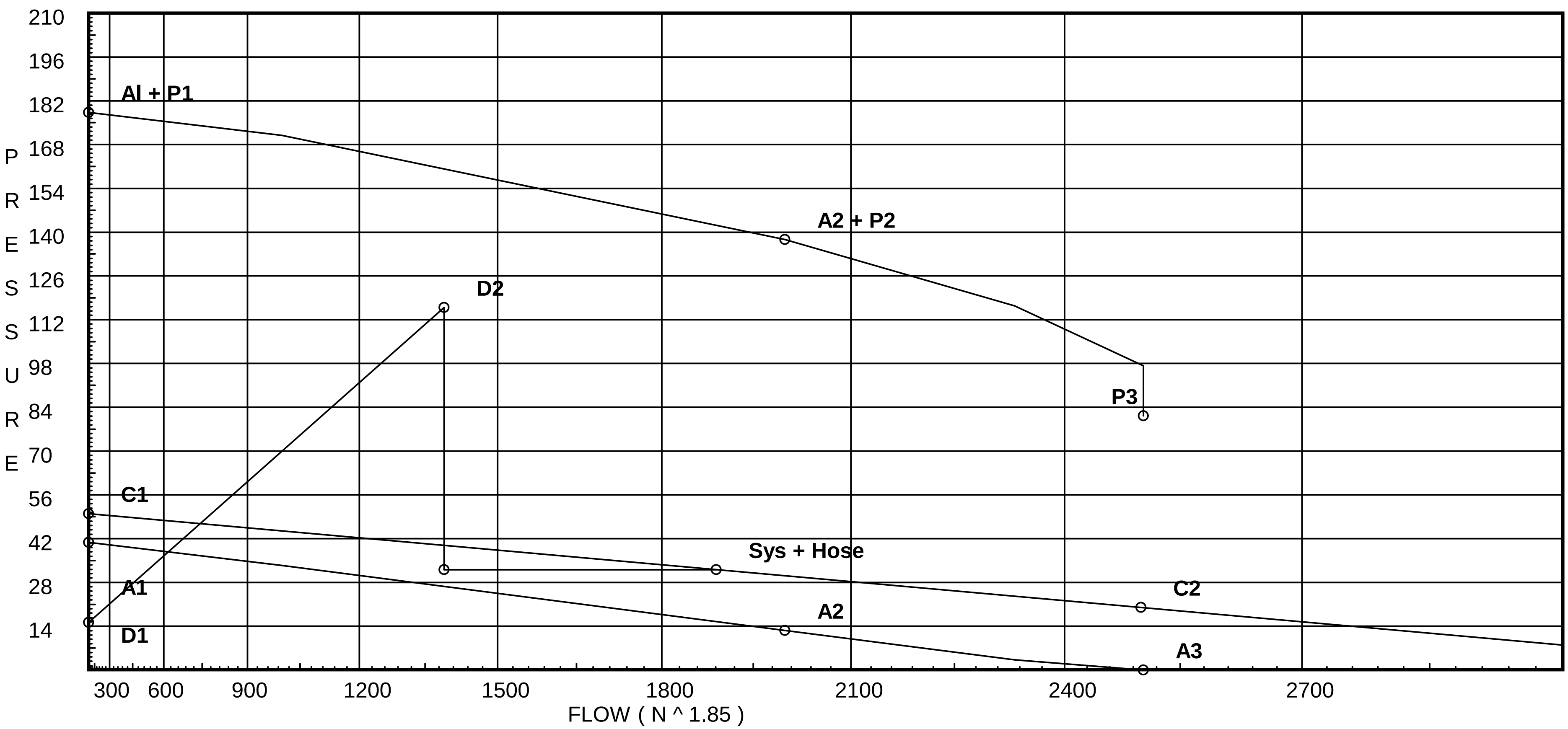
City Water Supply:
- C1 - Static Pressure : 50
- C2 - Residual Pressure: 20
- C2 - Residual Flow : 2500

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



Fittings Used Summary

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
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.

SUPPLY ANALYSIS

Node at Source	Static Pressure	Residual Pressure	Flow	Available Pressure	Total Demand	Required Pressure
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

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
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	

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	

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	35.12	8.00	30.00	1.5		0.0	10.000	120	14.062	
to						0.0	0.0		0.182	
102	34.7		30.0	1.61		0.0	10.000	0.0342	0.342	Vel = 4.73
102	34.7	8.00	30.55	1.5		0.0	10.000	120	14.586	
to						0.0	0.0		0.182	
103	34.28		60.55	1.61		0.0	10.000	0.1255	1.255	Vel = 9.54
103	34.28	8.00	32.03	1.5		0.0	10.000	120	16.023	
to						0.0	0.0		0.178	
104	33.87		92.58	1.61		0.0	10.000	0.2750	2.750	Vel = 14.59
104	33.87	8.00	34.82	1.5		0.0	10.000	120	18.951	
to						0.0	0.0		0.182	
105	33.45		127.4	1.61		0.0	10.000	0.4965	4.965	Vel = 20.08
105	33.45	8.00	39.28	1.5	E	4.0	3.870	120	24.098	
to					T	8.0	12.000		1.451	
106	30.1		166.68	1.61		0.0	15.870	0.8164	12.956	Vel = 26.27
106	30.1		0.0	6		0.0	10.000	120	38.505	
to						0.0	0.0		0.0	
107	30.1		166.68	6.065		0.0	10.000	0.0012	0.012	Vel = 1.85
107	30.1		166.70	6		0.0	10.000	120	38.517	
to						0.0	0.0		0.0	
108	30.1		333.38	6.065		0.0	10.000	0.0047	0.047	Vel = 3.70
108	30.1		166.81	6		0.0	10.000	120	38.564	
to						0.0	0.0		0.0	
109	30.1		500.19	6.065		0.0	10.000	0.0097	0.097	Vel = 5.55
109	30.1		167.05	6		0.0	10.000	120	38.661	
to						0.0	0.0		0.0	
110	30.1		667.24	6.065		0.0	10.000	0.0167	0.167	Vel = 7.41
110	30.1		167.43	6		0.0	10.000	120	38.828	
to						0.0	0.0		0.0	
111	30.1		834.67	6.065		0.0	10.000	0.0251	0.251	Vel = 9.27
111	30.1		168.03	6		0.0	10.000	120	39.079	
to						0.0	0.0		0.0	
112	30.1		1002.7	6.065		0.0	10.000	0.0354	0.354	Vel = 11.14
112	30.1		168.85	6		0.0	10.000	120	39.433	
to						0.0	0.0		0.0	
113	30.1		1171.55	6.065		0.0	10.000	0.0471	0.471	Vel = 13.01
113	30.1		169.95	6		0.0	10.000	120	39.904	
to						0.0	0.0		0.0	
114	30.1		1341.5	6.065		0.0	10.000	0.0606	0.606	Vel = 14.90
114	30.1		49.13	6	2E	28.0	818.520	120	40.510	
to						0.0	28.000		0.0	
TOR	30.1		1390.63	6.065		0.0	846.520	0.0647	54.808	Vel = 15.44
TOR	30.1		0.0	8	T	35.0	28.600	120	95.318	
to					B	12.0	120.000		16.387	* * Fixed Loss = 4
BOR	1.5		1390.63	7.981	Eql	73.0	148.600	0.0170	2.527	Vel = 8.92
BOR	1.5		0.0	10		0.0	15.000	120	114.232	
to						0.0	0.0		0.0	
118	1.5		1390.63	10.02		0.0	15.000	0.0056	0.084	Vel = 5.66

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	1.5		0.0	10	B	19.0	10.000	120	114.316	
to					S	55.0	162.000		0.650	
PO	0		1390.63	10.02	4E	88.0	172.000	0.0056	0.965	Vel = 5.66
			0.0							
PO			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	0		0.0	10	E	22.0	10.000	120	17.840	
to						0.0	22.000		-0.650	
119	1.5		1390.63	10.02		0.0	32.000	0.0056	0.180	Vel = 5.66
119	1.5		0.0	10	3E	66.0	7.500	120	17.370	
to					G	5.0	71.000		12.881	* * Fixed Loss = 9.633
120	-6		1390.63	10.02	Zie	0.0	78.500	0.0056	0.442	Vel = 5.66
120	-6		0.0	10	T	75.336	50.000	140	30.693	
to					G	7.534	179.300		0.0	
121	-6		1390.63	10.28	4L	96.43	229.300	0.0037	0.854	Vel = 5.38
121	-6		500.00	12	E	42.195	600.000	140	31.547	
to					T	93.767	323.496		0.0	
122	-6		1890.63	12.34	2G	18.753	923.496	0.0027	2.496	Vel = 5.07
					6L	168.781				
122	-6		0.0	16	6L	333.719	450.000	140	34.043	
to					T	166.859	533.539		-2.599	
TEST	0		1890.63	16.41	2G	32.96	983.539	0.0007	0.664	Vel = 2.87
			0.0							
TEST			1890.63						32.108	K Factor = 333.66
HOSE	-6	H500	500.00	6	T	43.037	3.500	140	-4.138	
to						0.0	43.037		0.0	
121	-6		500.0	6.16		0.0	46.537	0.0068	0.316	Vel = 5.38
			0.0							
121			500.00						-3.822	K Factor = 255.76
107	30.1		-166.70	1.5	T	8.0	3.330	120	38.517	
to						0.0	8.000		-1.442	
123	33.43		-166.7	1.61		0.0	11.330	-0.8166	-9.252	Vel = 26.27
			0.0							
123			-166.70						27.823	K Factor = -31.60
108	30.1		-166.81	1.5	T	8.0	3.330	120	38.564	
to						0.0	8.000		-1.442	
124	33.43		-166.81	1.61		0.0	11.330	-0.8177	-9.264	Vel = 26.29
			0.0							
124			-166.81						27.858	K Factor = -31.60
109	30.1		-167.04	1.5	T	8.0	3.330	120	38.661	
to						0.0	8.000		-1.442	
125	33.43		-167.04	1.61		0.0	11.330	-0.8197	-9.287	Vel = 26.32

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 ******
			0.0							
125			-167.04						27.932	K Factor = -31.61
110	30.1		-167.44	1.5	T	8.0	3.330	120	38.828	
to						0.0	8.000		-1.442	
126	33.43		-167.44	1.61		0.0	11.330	-0.8233	-9.328	Vel = 26.39
			0.0							
126			-167.44						28.058	K Factor = -31.61
111	30.1		-168.03	1.5	T	8.0	3.330	120	39.079	
to						0.0	8.000		-1.442	
127	33.43		-168.03	1.61		0.0	11.330	-0.8286	-9.388	Vel = 26.48
			0.0							
127			-168.03						28.249	K Factor = -31.61
112	30.1		-168.85	1.5	T	8.0	3.330	120	39.433	
to						0.0	8.000		-1.442	
128	33.43		-168.85	1.61		0.0	11.330	-0.8362	-9.474	Vel = 26.61
			0.0							
128			-168.85						28.517	K Factor = -31.62
113	30.1		-169.95	1.5	T	8.0	3.330	120	39.904	
to						0.0	8.000		-1.442	
129	33.43		-169.95	1.61		0.0	11.330	-0.8462	-9.588	Vel = 26.78
			0.0							
129			-169.95						28.874	K Factor = -31.63
114	30.1		-49.12	1.5	T	8.0	3.330	120	40.510	
to						0.0	8.000		-1.442	
130	33.43		-49.12	1.61		0.0	11.330	-0.0852	-0.965	Vel = 7.74
			0.0							
130			-49.12						38.103	K Factor = -7.96
131	35.12	8.00	30.01	1.5		0.0	10.000	120	14.068	
to						0.0	0.0		0.182	
132	34.7		30.01	1.61		0.0	10.000	0.0342	0.342	Vel = 4.73
132	34.7	8.00	30.55	1.5		0.0	10.000	120	14.592	
to						0.0	0.0		0.182	
133	34.28		60.56	1.61		0.0	10.000	0.1254	1.254	Vel = 9.54
133	34.28	8.00	32.03	1.5		0.0	10.000	120	16.028	
to						0.0	0.0		0.178	
134	33.87		92.59	1.61		0.0	10.000	0.2752	2.752	Vel = 14.59
134	33.87	8.00	34.84	1.5		0.0	10.000	120	18.958	
to						0.0	0.0		0.182	
135	33.45		127.43	1.61		0.0	10.000	0.4967	4.967	Vel = 20.08
135	33.45	8.00	39.27	1.5	E	4.0	0.540	120	24.107	
to						0.0	4.000		0.009	
123	33.43		166.7	1.61		0.0	4.540	0.8165	3.707	Vel = 26.27
			0.0							
123			166.70						27.823	K Factor = 31.60
136	35.12	8.00	30.03	1.5		0.0	10.000	120	14.087	
to						0.0	0.0		0.182	
137	34.7		30.03	1.61		0.0	10.000	0.0342	0.342	Vel = 4.73

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	34.7	8.00	30.58	1.5		0.0	10.000	120	14.611	
to						0.0	0.0		0.182	
138	34.28		60.61	1.61		0.0	10.000	0.1256	1.256	Vel = 9.55
138	34.28	8.00	32.05	1.5		0.0	10.000	120	16.049	
to						0.0	0.0		0.178	
139	33.87		92.66	1.61		0.0	10.000	0.2755	2.755	Vel = 14.60
139	33.87	8.00	34.85	1.5		0.0	10.000	120	18.982	
to						0.0	0.0		0.182	
140	33.45		127.51	1.61		0.0	10.000	0.4973	4.973	Vel = 20.09
140	33.45	8.00	39.30	1.5	E	4.0	0.540	120	24.137	
to						0.0	4.000		0.009	
124	33.43		166.81	1.61		0.0	4.540	0.8176	3.712	Vel = 26.29
			0.0							
124			166.81						27.858	K Factor = 31.60
141	35.12	8.00	30.07	1.5		0.0	10.000	120	14.127	
to						0.0	0.0		0.182	
142	34.7		30.07	1.61		0.0	10.000	0.0343	0.343	Vel = 4.74
142	34.7	8.00	30.62	1.5		0.0	10.000	120	14.652	
to						0.0	0.0		0.182	
143	34.28		60.69	1.61		0.0	10.000	0.1260	1.260	Vel = 9.56
143	34.28	8.00	32.09	1.5		0.0	10.000	120	16.094	
to						0.0	0.0		0.178	
144	33.87		92.78	1.61		0.0	10.000	0.2762	2.762	Vel = 14.62
144	33.87	8.00	34.91	1.5		0.0	10.000	120	19.034	
to						0.0	0.0		0.182	
145	33.45		127.69	1.61		0.0	10.000	0.4986	4.986	Vel = 20.12
145	33.45	8.00	39.35	1.5	E	4.0	0.540	120	24.202	
to						0.0	4.000		0.009	
125	33.43		167.04	1.61		0.0	4.540	0.8196	3.721	Vel = 26.32
			0.0							
125			167.04						27.932	K Factor = 31.61
146	35.12	8.00	30.14	1.5		0.0	10.000	120	14.196	
to						0.0	0.0		0.182	
147	34.7		30.14	1.61		0.0	10.000	0.0345	0.345	Vel = 4.75
147	34.7	8.00	30.70	1.5		0.0	10.000	120	14.723	
to						0.0	0.0		0.182	
148	34.28		60.84	1.61		0.0	10.000	0.1265	1.265	Vel = 9.59
148	34.28	8.00	32.17	1.5		0.0	10.000	120	16.170	
to						0.0	0.0		0.178	
149	33.87		93.01	1.61		0.0	10.000	0.2774	2.774	Vel = 14.66
149	33.87	8.00	34.98	1.5		0.0	10.000	120	19.122	
to						0.0	0.0		0.182	
150	33.45		127.99	1.61		0.0	10.000	0.5008	5.008	Vel = 20.17
150	33.45	8.00	39.45	1.5	E	4.0	0.540	120	24.312	
to						0.0	4.000		0.009	
126	33.43		167.44	1.61		0.0	4.540	0.8231	3.737	Vel = 26.39
			0.0							
126			167.44						28.058	K Factor = 31.61

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	35.12	8.00	30.25	1.5		0.0	10.000	120	14.300	
to						0.0	0.0		0.182	
152	34.7		30.25	1.61		0.0	10.000	0.0347	0.347	Vel = 4.77
152	34.7	8.00	30.81	1.5		0.0	10.000	120	14.829	
to						0.0	0.0		0.182	
153	34.28		61.06	1.61		0.0	10.000	0.1274	1.274	Vel = 9.62
153	34.28	8.00	32.28	1.5		0.0	10.000	120	16.285	
to						0.0	0.0		0.178	
154	33.87		93.34	1.61		0.0	10.000	0.2792	2.792	Vel = 14.71
154	33.87	8.00	35.11	1.5		0.0	10.000	120	19.255	
to						0.0	0.0		0.182	
155	33.45		128.45	1.61		0.0	10.000	0.5041	5.041	Vel = 20.24
155	33.45	8.00	39.58	1.5	E	4.0	0.540	120	24.478	
to						0.0	4.000		0.009	
127	33.43		168.03	1.61		0.0	4.540	0.8286	3.762	Vel = 26.48
			0.0							
127			168.03						28.249	K Factor = 31.61
156	35.12	8.00	30.41	1.5		0.0	10.000	120	14.446	
to						0.0	0.0		0.182	
157	34.7		30.41	1.61		0.0	10.000	0.0350	0.350	Vel = 4.79
157	34.7	8.00	30.96	1.5		0.0	10.000	120	14.978	
to						0.0	0.0		0.182	
158	34.28		61.37	1.61		0.0	10.000	0.1286	1.286	Vel = 9.67
158	34.28	8.00	32.44	1.5		0.0	10.000	120	16.446	
to						0.0	0.0		0.178	
159	33.87		93.81	1.61		0.0	10.000	0.2818	2.818	Vel = 14.78
159	33.87	8.00	35.27	1.5		0.0	10.000	120	19.442	
to						0.0	0.0		0.182	
160	33.45		129.08	1.61		0.0	10.000	0.5088	5.088	Vel = 20.34
160	33.45	8.00	39.77	1.5	E	4.0	0.540	120	24.712	
to						0.0	4.000		0.009	
128	33.43		168.85	1.61		0.0	4.540	0.8361	3.796	Vel = 26.61
			0.0							
128			168.85						28.517	K Factor = 31.62
161	35.12	8.00	30.61	1.5		0.0	10.000	120	14.640	
to						0.0	0.0		0.182	
162	34.7		30.61	1.61		0.0	10.000	0.0355	0.355	Vel = 4.82
162	34.7	8.00	31.17	1.5		0.0	10.000	120	15.177	
to						0.0	0.0		0.182	
163	34.28		61.78	1.61		0.0	10.000	0.1302	1.302	Vel = 9.74
163	34.28	8.00	32.65	1.5		0.0	10.000	120	16.661	
to						0.0	0.0		0.178	
164	33.87		94.43	1.61		0.0	10.000	0.2853	2.853	Vel = 14.88
164	33.87	8.00	35.50	1.5		0.0	10.000	120	19.692	
to						0.0	0.0		0.182	
165	33.45		129.93	1.61		0.0	10.000	0.5149	5.149	Vel = 20.48
165	33.45	8.00	40.02	1.5	E	4.0	0.540	120	25.023	
to						0.0	4.000		0.009	
129	33.43		169.95	1.61		0.0	4.540	0.8463	3.842	Vel = 26.78

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 ******
			0.0							
129			169.95						28.874	K Factor = 31.63
166	33.45	8.00	49.12	1.5	E	4.0	0.540	120	37.708	
to						0.0	4.000		0.009	
130	33.43		49.12	1.61		0.0	4.540	0.0850	0.386	Vel = 7.74
			0.0							
130			49.12						38.103	K Factor = 7.96

. . . Fire Protection by Computer Design

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

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

Water Supply Curve C

ProEnergy Services
Rail Unloading-R4

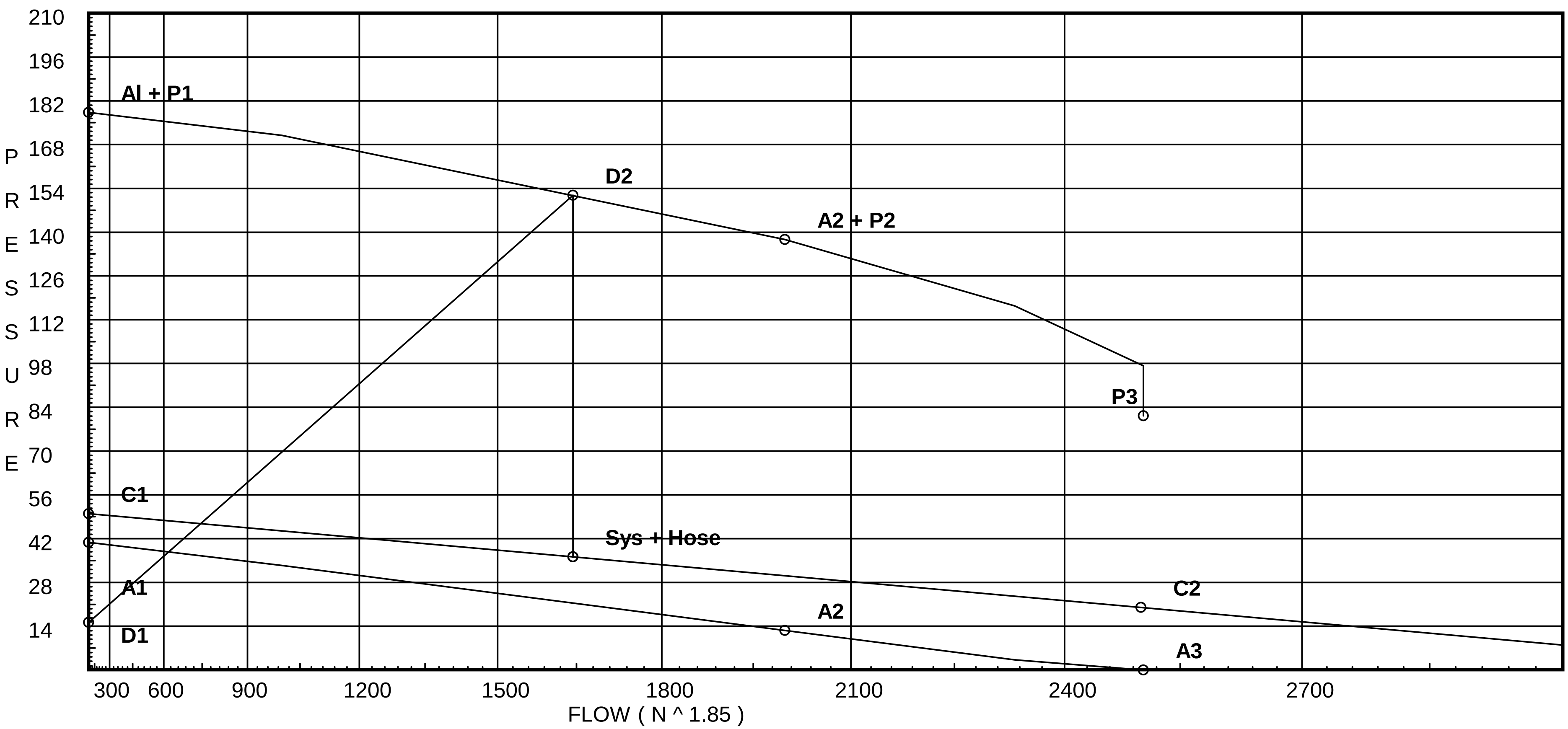
Page 1
Date

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



Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
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.

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	

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	35.12	8.00	35.66	1.5		0.0	10.000	120	19.867	
to						0.0	0.0		0.182	
102	34.7		35.66	1.61		0.0	10.000	0.0471	0.471	Vel = 5.62
102	34.7	8.00	36.24	1.5		0.0	10.000	120	20.520	
to						0.0	0.0		0.182	
103	34.28		71.9	1.61		0.0	10.000	0.1723	1.723	Vel = 11.33
103	34.28	8.00	37.88	1.5		0.0	10.000	120	22.425	
to						0.0	0.0		0.178	
104	33.87		109.78	1.61		0.0	10.000	0.3770	3.770	Vel = 17.30
104	33.87	8.00	41.08	1.5		0.0	10.000	120	26.373	
to						0.0	0.0		0.182	
105	33.45		150.86	1.61		0.0	10.000	0.6789	6.789	Vel = 23.77
105	33.45	8.00	46.20	1.5	E	4.0	3.870	120	33.344	
to					T	8.0	12.000		1.451	
106	30.1		197.06	1.61		0.0	15.870	1.1128	17.660	Vel = 31.06
106	30.1		0.0	6		0.0	10.000	120	52.455	
to						0.0	0.0		0.0	
107	30.1		197.06	6.065		0.0	10.000	0.0018	0.018	Vel = 2.19
107	30.1		197.10	6		0.0	10.000	120	52.473	
to						0.0	0.0		0.0	
108	30.1		394.16	6.065		0.0	10.000	0.0062	0.062	Vel = 4.38
108	30.1		197.22	6		0.0	10.000	120	52.535	
to						0.0	0.0		0.0	
109	30.1		591.38	6.065		0.0	10.000	0.0133	0.133	Vel = 6.57
109	30.1		197.49	6		0.0	10.000	120	52.668	
to						0.0	0.0		0.0	
110	30.1		788.87	6.065		0.0	10.000	0.0227	0.227	Vel = 8.76
110	30.1		197.95	6		0.0	10.000	120	52.895	
to						0.0	0.0		0.0	
111	30.1		986.82	6.065		0.0	10.000	0.0344	0.344	Vel = 10.96
111	30.1		198.64	6		0.0	10.000	120	53.239	
to						0.0	0.0		0.0	
112	30.1		1185.46	6.065		0.0	10.000	0.0481	0.481	Vel = 13.16
112	30.1		199.60	6		0.0	10.000	120	53.720	
to						0.0	0.0		0.0	
113	30.1		1385.06	6.065		0.0	10.000	0.0643	0.643	Vel = 15.38
113	30.1		200.89	6		0.0	10.000	120	54.363	
to						0.0	0.0		0.0	
114	30.1		1585.95	6.065		0.0	10.000	0.0826	0.826	Vel = 17.61
114	30.1		57.64	6	2E	28.0	818.520	120	55.189	
to						0.0	28.000		0.0	
TOR	30.1		1643.59	6.065		0.0	846.520	0.0882	74.666	Vel = 18.25
TOR	30.1		0.0	8	T	35.0	28.600	120	129.855	
to					B	12.0	120.000		16.387	* * Fixed Loss = 4
BOR	1.5		1643.59	7.981	Eql	73.0	148.600	0.0232	3.442	Vel = 10.54
BOR	1.5		0.0	10		0.0	15.000	120	149.684	
to						0.0	0.0		0.0	
118	1.5		1643.59	10.02		0.0	15.000	0.0077	0.115	Vel = 6.69

Node1	Elev1	K	Qa	Nom	Fitting		Pipe	CFact	Pt	******* Notes ******
to					or		Ftng's		Pe	
Node2	Elev2	Fact	Qt	Act	Eqv.	Ln.	Total	Pf/Ft	Pf	
118	1.5		0.0	10	B	19.0	10.000	120	149.799	
to					S	55.0	162.000		0.650	
PO	0		1643.59	10.02	4E	88.0	172.000	0.0076	1.315	Vel = 6.69
			0.0							
PO			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	0		0.0	10	E	22.0	10.000	120	21.505	
to						0.0	22.000		-0.650	
119	1.5		1643.59	10.02		0.0	32.000	0.0077	0.245	Vel = 6.69
119	1.5		0.0	10	3E	66.0	7.500	120	21.100	
to					G	5.0	71.000		13.487	* * Fixed Loss = 10.238
120	-6		1643.59	10.02	Zie	0.0	78.500	0.0076	0.600	Vel = 6.69
120	-6		0.0	10	T	75.336	50.000	140	35.187	
to					G	7.534	179.300		0.0	
121	-6		1643.59	10.28	4L	96.43	229.300	0.0051	1.165	Vel = 6.35
121	-6		0.0	12	E	42.195	600.000	140	36.352	
to					T	93.767	323.496		0.0	
122	-6		1643.59	12.34	2G	18.753	923.496	0.0021	1.926	Vel = 4.41
					6L	168.781				
122	-6		0.0	16	6L	333.719	450.000	140	38.278	
to					T	166.859	533.539		-2.599	
TEST	0		1643.59	16.41	2G	32.96	983.539	0.0005	0.512	Vel = 2.49
			0.0							
TEST			1643.59						36.191	K Factor = 273.21
HOSE	-6		0.0	6	T	43.037	3.500	140	36.348	
to						0.0	43.037		0.0	
121	-6		0.0	6.16		0.0	46.537	0	0.0	Vel = 0
			0.0							
121			0.0						36.348	K Factor = 0
107	30.1		-197.10	1.5	T	8.0	3.330	120	52.473	
to						0.0	8.000		-1.442	
123	33.43		-197.1	1.61		0.0	11.330	-1.1132	-12.613	Vel = 31.06
			0.0							
123			-197.10						38.418	K Factor = -31.80
108	30.1		-197.22	1.5	T	8.0	3.330	120	52.535	
to						0.0	8.000		-1.442	
124	33.43		-197.22	1.61		0.0	11.330	-1.1145	-12.627	Vel = 31.08
			0.0							
124			-197.22						38.466	K Factor = -31.80
109	30.1		-197.49	1.5	T	8.0	3.330	120	52.668	
to						0.0	8.000		-1.442	
125	33.43		-197.49	1.61		0.0	11.330	-1.1173	-12.659	Vel = 31.12

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 ******
			0.0							
125			-197.49						38.567	K Factor = -31.80
110	30.1		-197.95	1.5	T	8.0	3.330	120	52.895	
to						0.0	8.000		-1.442	
126	33.43		-197.95	1.61		0.0	11.330	-1.1221	-12.713	Vel = 31.20
			0.0							
126			-197.95						38.740	K Factor = -31.80
111	30.1		-198.64	1.5	T	8.0	3.330	120	53.239	
to						0.0	8.000		-1.442	
127	33.43		-198.64	1.61		0.0	11.330	-1.1294	-12.796	Vel = 31.30
			0.0							
127			-198.64						39.001	K Factor = -31.81
112	30.1		-199.60	1.5	T	8.0	3.330	120	53.720	
to						0.0	8.000		-1.442	
128	33.43		-199.6	1.61		0.0	11.330	-1.1395	-12.911	Vel = 31.46
			0.0							
128			-199.60						39.367	K Factor = -31.81
113	30.1		-200.88	1.5	T	8.0	3.330	120	54.363	
to						0.0	8.000		-1.442	
129	33.43		-200.88	1.61		0.0	11.330	-1.1531	-13.065	Vel = 31.66
			0.0							
129			-200.88						39.856	K Factor = -31.82
114	30.1		-57.64	1.5	T	8.0	3.330	120	55.189	
to						0.0	8.000		-1.442	
130	33.43		-57.64	1.61		0.0	11.330	-0.1146	-1.298	Vel = 9.08
			0.0							
130			-57.64						52.449	K Factor = -7.96
131	35.12	8.00	35.66	1.5		0.0	10.000	120	19.875	
to						0.0	0.0		0.182	
132	34.7		35.66	1.61		0.0	10.000	0.0471	0.471	Vel = 5.62
132	34.7	8.00	36.25	1.5		0.0	10.000	120	20.528	
to						0.0	0.0		0.182	
133	34.28		71.91	1.61		0.0	10.000	0.1723	1.723	Vel = 11.33
133	34.28	8.00	37.89	1.5		0.0	10.000	120	22.433	
to						0.0	0.0		0.178	
134	33.87		109.8	1.61		0.0	10.000	0.3771	3.771	Vel = 17.30
134	33.87	8.00	41.09	1.5		0.0	10.000	120	26.382	
to						0.0	0.0		0.182	
135	33.45		150.89	1.61		0.0	10.000	0.6792	6.792	Vel = 23.78
135	33.45	8.00	46.21	1.5	E	4.0	0.540	120	33.356	
to						0.0	4.000		0.009	
123	33.43		197.1	1.61		0.0	4.540	1.1130	5.053	Vel = 31.06
			0.0							
123			197.10						38.418	K Factor = 31.80
136	35.12	8.00	35.69	1.5		0.0	10.000	120	19.901	
to						0.0	0.0		0.182	
137	34.7		35.69	1.61		0.0	10.000	0.0471	0.471	Vel = 5.62

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	34.7	8.00	36.27	1.5		0.0	10.000	120	20.554	
to						0.0	0.0		0.182	
138	34.28		71.96	1.61		0.0	10.000	0.1726	1.726	Vel = 11.34
138	34.28	8.00	37.91	1.5		0.0	10.000	120	22.462	
to						0.0	0.0		0.178	
139	33.87		109.87	1.61		0.0	10.000	0.3776	3.776	Vel = 17.31
139	33.87	8.00	41.12	1.5		0.0	10.000	120	26.416	
to						0.0	0.0		0.182	
140	33.45		150.99	1.61		0.0	10.000	0.6799	6.799	Vel = 23.80
140	33.45	8.00	46.23	1.5	E	4.0	0.540	120	33.397	
to						0.0	4.000		0.009	
124	33.43		197.22	1.61		0.0	4.540	1.1145	5.060	Vel = 31.08
			0.0							
124			197.22						38.466	K Factor = 31.80
141	35.12	8.00	35.74	1.5		0.0	10.000	120	19.957	
to						0.0	0.0		0.182	
142	34.7		35.74	1.61		0.0	10.000	0.0473	0.473	Vel = 5.63
142	34.7	8.00	36.32	1.5		0.0	10.000	120	20.612	
to						0.0	0.0		0.182	
143	34.28		72.06	1.61		0.0	10.000	0.1730	1.730	Vel = 11.36
143	34.28	8.00	37.97	1.5		0.0	10.000	120	22.524	
to						0.0	0.0		0.178	
144	33.87		110.03	1.61		0.0	10.000	0.3785	3.785	Vel = 17.34
144	33.87	8.00	41.17	1.5		0.0	10.000	120	26.487	
to						0.0	0.0		0.182	
145	33.45		151.2	1.61		0.0	10.000	0.6817	6.817	Vel = 23.83
145	33.45	8.00	46.29	1.5	E	4.0	0.540	120	33.486	
to						0.0	4.000		0.009	
125	33.43		197.49	1.61		0.0	4.540	1.1172	5.072	Vel = 31.12
			0.0							
125			197.49						38.567	K Factor = 31.80
146	35.12	8.00	35.82	1.5		0.0	10.000	120	20.052	
to						0.0	0.0		0.182	
147	34.7		35.82	1.61		0.0	10.000	0.0475	0.475	Vel = 5.64
147	34.7	8.00	36.41	1.5		0.0	10.000	120	20.709	
to						0.0	0.0		0.182	
148	34.28		72.23	1.61		0.0	10.000	0.1737	1.737	Vel = 11.38
148	34.28	8.00	38.05	1.5		0.0	10.000	120	22.628	
to						0.0	0.0		0.178	
149	33.87		110.28	1.61		0.0	10.000	0.3803	3.803	Vel = 17.38
149	33.87	8.00	41.27	1.5		0.0	10.000	120	26.609	
to						0.0	0.0		0.182	
150	33.45		151.55	1.61		0.0	10.000	0.6846	6.846	Vel = 23.88
150	33.45	8.00	46.40	1.5	E	4.0	0.540	120	33.637	
to						0.0	4.000		0.009	
126	33.43		197.95	1.61		0.0	4.540	1.1220	5.094	Vel = 31.20
			0.0							
126			197.95						38.740	K Factor = 31.80

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

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			0.0 200.88						 39.856	 K Factor = 31.82
166 to 130	33.45 33.43	8.00	57.64 57.64	1.5 1.61	E	4.0 0.0 0.0	0.540 4.000 4.540	120 0.1143	51.921 0.009 0.519	 Vel = 9.08
 130			0.0 57.64						 52.449	 K Factor = 7.96

APPENDIX B

Storage Area Calculation

. . . Fire Protection by Computer Design

ProEnergy Services
2001PorEnergy 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

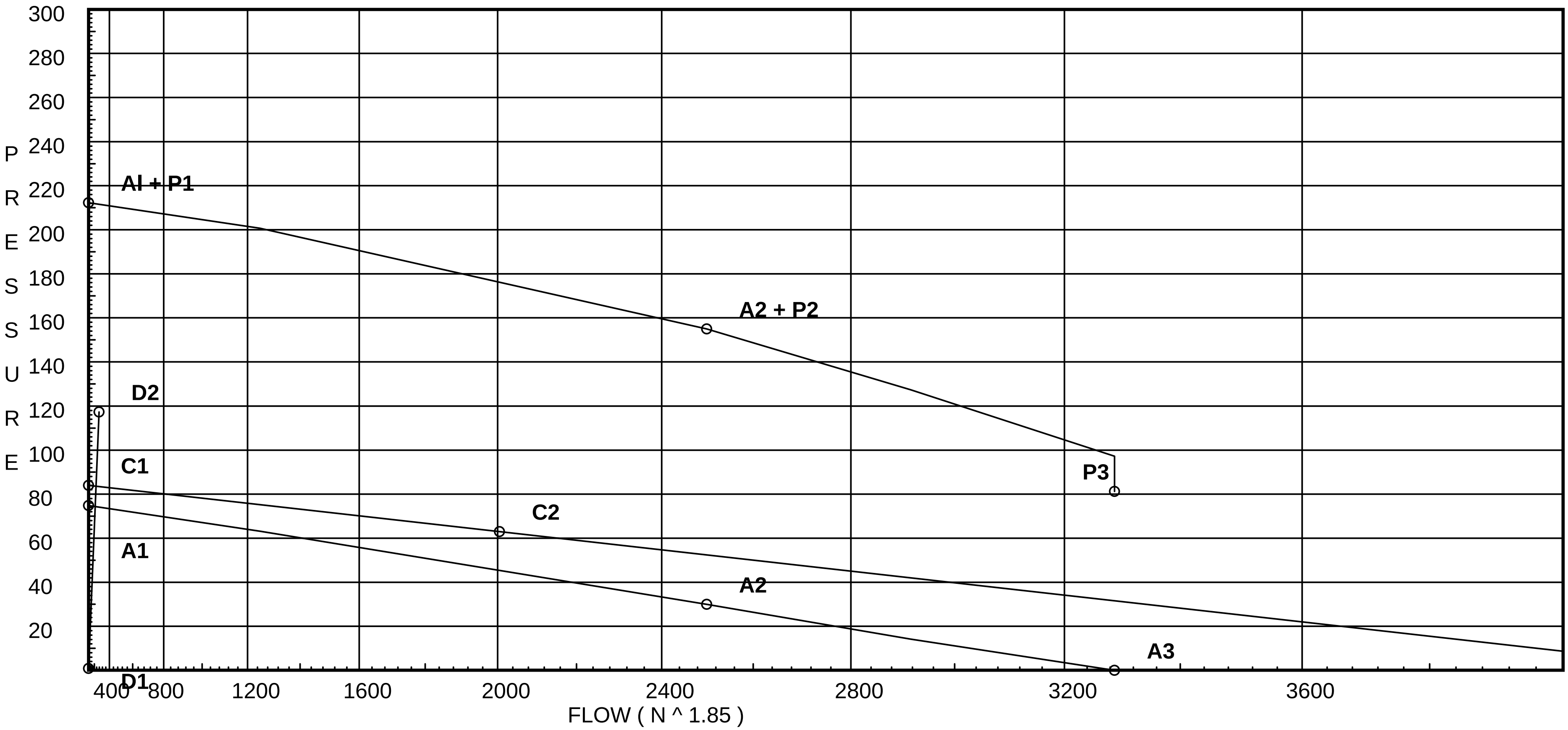
ProEnergy Services
Rail Unloading-R5

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



Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
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
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
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.

SUPPLY ANALYSIS

Node at Source	Static Pressure	Residual Pressure	Flow	Available Pressure	Total Demand	Required Pressure
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

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
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		

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	48	2.00	12.67	3	2E	14.0	38.090	120	46.296	
to						0.0	14.000		0.0	
FM9	48		12.67	3.068		0.0	52.090	0.0003	0.015	Vel = 0.55
FM9	48	2.00	13.61	3	2E	14.0	38.090	120	46.311	
to						0.0	14.000		0.0	
FM8	48		26.28	3.068		0.0	52.090	0.0012	0.061	Vel = 1.14
FM8	48	2.00	13.62	3	2E	14.0	38.090	120	46.372	
to						0.0	14.000		0.0	
FM7	48		39.9	3.068		0.0	52.090	0.0025	0.130	Vel = 1.73
FM7	48	2.00	13.64	3	2E	14.0	38.090	120	46.502	
to						0.0	14.000		0.0	
FM6	48		53.54	3.068		0.0	52.090	0.0043	0.225	Vel = 2.32
FM6	48	2.00	13.67	3	2E	14.0	38.090	120	46.727	
to						0.0	14.000		0.0	
FM5	48		67.21	3.068		0.0	52.090	0.0066	0.343	Vel = 2.92
FM5	48	2.00	13.72	3	2E	14.0	38.090	120	47.070	
to						0.0	14.000		0.0	
FM4	48		80.93	3.068		0.0	52.090	0.0093	0.484	Vel = 3.51
FM4	48	2.00	13.79	3	2E	14.0	38.090	120	47.554	
to						0.0	14.000		0.0	
FM3	48		94.72	3.068		0.0	52.090	0.0124	0.647	Vel = 4.11
FM3	48	2.00	13.89	3		0.0	38.010	120	48.201	
to						0.0	0.0		0.0	
FM2	48		108.61	3.068		0.0	38.010	0.0160	0.608	Vel = 4.71
FM2	48	2.00	13.97	3	2E	14.0	38.090	120	48.809	
to						0.0	14.000		0.0	
FM1	48		122.58	3.068		0.0	52.090	0.0200	1.042	Vel = 5.32
FM1	48	2.00	14.12	3	E	7.0	27.200	120	49.851	
to						0.0	7.000		0.0	
901	48		136.7	3.068		0.0	34.200	0.0245	0.837	Vel = 5.93
901	48		138.73	4	T	20.0	46.000	120	50.688	
to						0.0	20.000		19.923	
902	2		275.43	4.026		0.0	66.000	0.0238	1.572	Vel = 6.94
902	2		0.0	4	4E	40.0	61.560	120	72.183	
to						0.0	40.000		0.0	
904	2		275.43	4.026		0.0	101.560	0.0238	2.419	Vel = 6.94
904	2		0.0	4		0.0	4.000	120	74.602	
to						0.0	0.0		-1.732	
903	6		275.43	4.026		0.0	4.000	0.0238	0.095	Vel = 6.94
903	6		0.0	4	2E	20.0	33.630	120	72.965	
to						0.0	20.000		0.0	
905	6		275.43	4.026		0.0	53.630	0.0238	1.278	Vel = 6.94
905	6		0.0	4		0.0	4.000	120	74.243	
to						0.0	0.0		1.732	
906	2		275.43	4.026		0.0	4.000	0.0238	0.095	Vel = 6.94
906	2		0.0	4	10E	100.0	1005.000	120	76.070	
to						0.0	100.000		0.0	
907	2		275.43	4.026		0.0	1105.000	0.0238	26.322	Vel = 6.94

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	2		0.0	4		0.0	6.000	120	102.392	
to						0.0	0.0		-2.599	
908	8		275.43	4.026		0.0	6.000	0.0238	0.143	Vel = 6.94
908	8		0.0	4	2E	20.0	90.490	120	99.936	
to						0.0	20.000		0.0	
TOR3	8		275.43	4.026		0.0	110.490	0.0238	2.632	Vel = 6.94
TOR3	8		0.0	4	T	20.0	6.000	120	102.568	
to					2B	24.0	73.000		4.599	* * Fixed Loss = 2
BOR3	2		275.43	4.026	Eql	29.0	79.000	0.0238	1.881	Vel = 6.94
BOR3	2		2750.00	10	L	16.0	18.000	120	109.048	
to					S	55.0	83.000		5.866	* * Fixed Loss = 5
PO	0		3025.43	10.02	Bvcb	12.0	101.000	0.0237	2.390	Vel = 12.31
			0.0							
PO			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	0		0.0	10	2E	44.0	19.990	120	9.746	
to						0.0	44.000		-0.866	
FF	2		3025.43	10.02		0.0	63.990	0.0237	1.514	Vel = 12.31
FF	2		0.0	10	E	24.923	8.500	120	10.394	
to					2L	36.252	117.819		18.838	* * Fixed Loss = 15.157
UG1	-6.5		3025.43	10.28	T	56.644	126.319	0.0209	2.638	Vel = 11.69
					Zie	0.0				
UG1	-6.5		0.0	10	E	21.661	15.210	140	31.870	
to						0.0	21.661		0.0	
UG2	-6.5		3025.43	9.42		0.0	36.871	0.0240	0.885	Vel = 13.93
UG2	-6.5		0.0	10		0.0	379.070	140	32.755	
to						0.0	0.0		-2.815	
TFC	0		3025.43	9.42		0.0	379.070	0.0240	9.107	Vel = 13.93
			0.0							
TFC			3025.43						39.047	K Factor = 484.16
FM10	48		0.94	3	2E	14.0	38.090	120	46.296	
to						0.0	14.000		0.0	
FM11	48		0.94	3.068		0.0	52.090	0	0.0	Vel = 0.04
FM11	48	2.00	13.61	3	2E	14.0	38.090	120	46.296	
to						0.0	14.000		0.0	
FM12	48		14.55	3.068		0.0	52.090	0.0004	0.020	Vel = 0.63
FM12	48	2.00	13.61	3	2E	14.0	38.090	120	46.316	
to						0.0	14.000		0.0	
FM13	48		28.16	3.068		0.0	52.090	0.0013	0.068	Vel = 1.22
FM13	48	2.00	13.62	3	2E	14.0	38.090	120	46.384	
to						0.0	14.000		0.0	
FM14	48		41.78	3.068		0.0	52.090	0.0027	0.143	Vel = 1.81
FM14	48	2.00	13.64	3	2E	14.0	38.090	120	46.527	
to						0.0	14.000		0.0	
FM15	48		55.42	3.068		0.0	52.090	0.0046	0.240	Vel = 2.41

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	48	2.00	13.68	3	2E	14.0	38.090	120	46.767	
to						0.0	14.000		0.0	
FM16	48		69.1	3.068		0.0	52.090	0.0069	0.361	Vel = 3.00
FM16	48	2.00	13.73	3	2E	14.0	38.090	120	47.128	
to						0.0	14.000		0.0	
FM17	48		82.83	3.068		0.0	52.090	0.0097	0.505	Vel = 3.59
FM17	48	2.00	13.80	3	2E	14.0	38.090	120	47.633	
to						0.0	14.000		0.0	
FM18	48		96.63	3.068		0.0	52.090	0.0129	0.671	Vel = 4.19
FM18	48	2.00	13.90	3	2E	14.0	38.090	120	48.304	
to						0.0	14.000		0.0	
FM19	48		110.53	3.068		0.0	52.090	0.0165	0.861	Vel = 4.80
FM19	48	2.00	14.03	3	2E	14.0	38.090	120	49.165	
to						0.0	14.000		0.0	
FM20	48		124.56	3.068		0.0	52.090	0.0206	1.073	Vel = 5.41
FM20	48	2.00	14.17	3	E	7.0	10.890	120	50.238	
to						0.0	7.000		0.0	
901	48		138.73	3.068		0.0	17.890	0.0252	0.450	Vel = 6.02
			0.0							
901			138.73						50.688	K Factor = 19.49
H1	2	.0	0.0	6	E	17.893	20.000	150	106.209	
to					T	38.342	60.069		3.681	
M3	-6.500		0.0	5.86	G	3.834	80.069	0	0.0	Vel = 0
			0.0							
M3			0.0						109.890	K Factor = 0
H2	2	.0	0.0	6	E	17.893	20.000	150	101.763	
to					T	38.342	60.069		3.681	
M4	-6.500		0.0	5.86	G	3.834	80.069	0	0.0	Vel = 0
			0.0							
M4			0.0						105.444	K Factor = 0
H3	2	.0	0.0	6	E	17.893	20.000	150	98.237	
to					T	38.342	60.069		3.681	
M5	-6.500		0.0	5.86	G	3.834	80.069	0	0.0	Vel = 0
			0.0							
M5			0.0						101.918	K Factor = 0
H4	2	.0	0.0	6	2E	35.786	367.000	150	94.850	
to					G	3.834	39.620		3.681	
M6	-6.500		0.0	5.86		0.0	406.620	0	0.0	Vel = 0
			0.0							
M6			0.0						98.531	K Factor = 0
H5	2	.0	0.0	6	E	17.893	20.000	150	94.850	
to					T	38.342	60.069		3.681	
M6	-6.500		0.0	5.86	G	3.834	80.069	0	0.0	Vel = 0
			0.0							
M6			0.0						98.531	K Factor = 0
H6	2	.0	0.0	6	E	17.893	20.000	150	90.682	
to					T	38.342	60.069		3.681	
M8	-6.500		0.0	5.86	G	3.834	80.069	0	0.0	Vel = 0

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 ******
			0.0							
M8			0.0						94.363	K Factor = 0
H7	2	H750	750.00	6	E	17.893	20.000	150	85.313	
to					T	38.342	60.069		3.681	
M9	-6.500		750.0	5.86	G	3.834	80.069	0.0162	1.294	Vel = 8.92
			0.0							
M9			750.00						90.288	K Factor = 78.93
H8	2	H625	625.00	6	E	17.893	20.000	150	85.000	
to					T	38.342	60.069		3.681	
M10	-6.500		625.0	5.86	G	3.834	80.069	0.0115	0.924	Vel = 7.43
			0.0							
M10			625.00						89.605	K Factor = 66.03
H9	2	H625	625.00	6	E	17.893	20.000	150	85.036	
to					T	38.342	60.069		3.681	
M11	-6.500		625.0	5.86	G	3.834	80.069	0.0116	0.925	Vel = 7.43
			0.0							
M11			625.00						89.642	K Factor = 66.01
H10	2	H750	750.00	6	E	17.893	20.000	150	85.914	
to					T	38.342	60.069		3.681	
M12	-6.500		750.0	5.86	G	3.834	80.069	0.0162	1.295	Vel = 8.92
			0.0							
M12			750.00						90.890	K Factor = 78.67
H11	2	.0	0.0	6	2E	35.786	367.000	150	91.687	
to					G	3.834	39.620		3.681	
M13	-6.500		0.0	5.86		0.0	406.620	0	0.0	Vel = 0
			0.0							
M13			0.0						95.368	K Factor = 0
H12	2	.0	0.0	6	E	17.893	20.000	150	91.687	
to					T	38.342	60.069		3.681	
M13	-6.500		0.0	5.86	G	3.834	80.069	0	0.0	Vel = 0
			0.0							
M13			0.0						95.368	K Factor = 0
H13	2	.0	0.0	6	E	17.893	20.000	150	97.369	
to					T	38.342	60.069		3.681	
M15	-6.500		0.0	5.86	G	3.834	80.069	0	0.0	Vel = 0
			0.0							
M15			0.0						101.050	K Factor = 0
H14	2	.0	0.0	6	E	17.893	20.000	150	102.129	
to					T	38.342	60.069		3.681	
M16	-6.500		0.0	5.86	G	3.834	80.069	0	0.0	Vel = 0
			0.0							
M16			0.0						105.810	K Factor = 0
M1	-6.500		2750.00	10	E	33.148	10.000	140	112.063	
to					G	7.534	40.682		-3.681	
BOR3	2		2750.0	10.28		0.0	50.682	0.0131	0.666	Vel = 10.63
			0.0							
BOR3			2750.00						109.048	K Factor = 263.34

Final Calculations - Hazen-Williams

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	-6.500		-2750.00	10	E	24.61	8.000	150	112.063	
to						0.0	24.609		0.0	
M2	-6.500		-2750.0	9.42		0.0	32.609	-0.0177	-0.578	Vel = 12.66
M2	-6.500		1474.85	8	T	43.857	44.000	150	111.485	
to					2E	45.11	93.979		0.0	
M3	-6.500		-1275.15	7.68	G	5.012	137.979	-0.0116	-1.595	Vel = 8.83
M3	-6.500		0.0	8	E	22.555	362.000	150	109.890	
to						0.0	22.555		0.0	
M4	-6.500		-1275.15	7.68		0.0	384.555	-0.0116	-4.445	Vel = 8.83
M4	-6.500		0.0	8	G	5.012	300.000	150	105.445	
to						0.0	5.012		0.0	
M5	-6.500		-1275.15	7.68		0.0	305.012	-0.0116	-3.526	Vel = 8.83
M5	-6.500		0.0	8		0.0	293.000	150	101.919	
to						0.0	0.0		0.0	
M7	-6.500		-1275.15	7.68		0.0	293.000	-0.0116	-3.387	Vel = 8.83
			0.0							
M7			-1275.15						98.532	K Factor = -128.46
M6	-6.500	.0	0.0	8	T	43.857	21.000	150	98.532	
to						0.0	43.857		0.0	
M7	-6.500		0.0	7.68		0.0	64.857	0	0.0	Vel = 0
M7	-6.500		-1275.15	8	G	5.012	333.000	150	98.532	
to					E	22.555	27.567		0.0	
M8	-6.500		-1275.15	7.68		0.0	360.567	-0.0116	-4.168	Vel = 8.83
M8	-6.500		0.0	8	E	22.555	330.000	150	94.364	
to						0.0	22.555		0.0	
M9	-6.500		-1275.15	7.68		0.0	352.555	-0.0116	-4.076	Vel = 8.83
M9	-6.500		750.00	8	G	5.012	300.000	150	90.288	
to						0.0	5.012		0.0	
M10	-6.500		-525.15	7.68		0.0	305.012	-0.0022	-0.683	Vel = 3.64
M10	-6.500		625.00	8	2E	45.11	306.000	150	89.605	
to						0.0	45.110		0.0	
M11	-6.500		99.85	7.68		0.0	351.110	0.0001	0.037	Vel = 0.69
M11	-6.500		625.00	8	G	5.012	302.000	150	89.642	
to						0.0	5.012		0.0	
M12	-6.500		724.85	7.68		0.0	307.012	0.0041	1.248	Vel = 5.02
M12	-6.500		750.00	8		0.0	296.000	150	90.890	
to						0.0	0.0		0.0	
M14	-6.500		1474.85	7.68		0.0	296.000	0.0151	4.478	Vel = 10.21
			0.0							
M14			1474.85						95.368	K Factor = 151.02
M13	-6.500	.0	0.0	8	T	43.857	21.000	150	95.368	
to						0.0	43.857		0.0	
M14	-6.500		0.0	7.68		0.0	64.857	0	0.0	Vel = 0
M14	-6.500		1474.85	8	E	22.555	348.000	150	95.368	
to					G	5.012	27.567		0.0	
M15	-6.500		1474.85	7.68		0.0	375.567	0.0151	5.683	Vel = 10.21
M15	-6.500		0.0	8	E	22.555	292.000	150	101.051	
to						0.0	22.555		0.0	
M16	-6.500		1474.85	7.68		0.0	314.555	0.0151	4.759	Vel = 10.21

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 ******
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

. . . Fire Protection by Computer Design

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

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

Water Supply Curve C

ProEnergy Services
Rail Unloading-R5

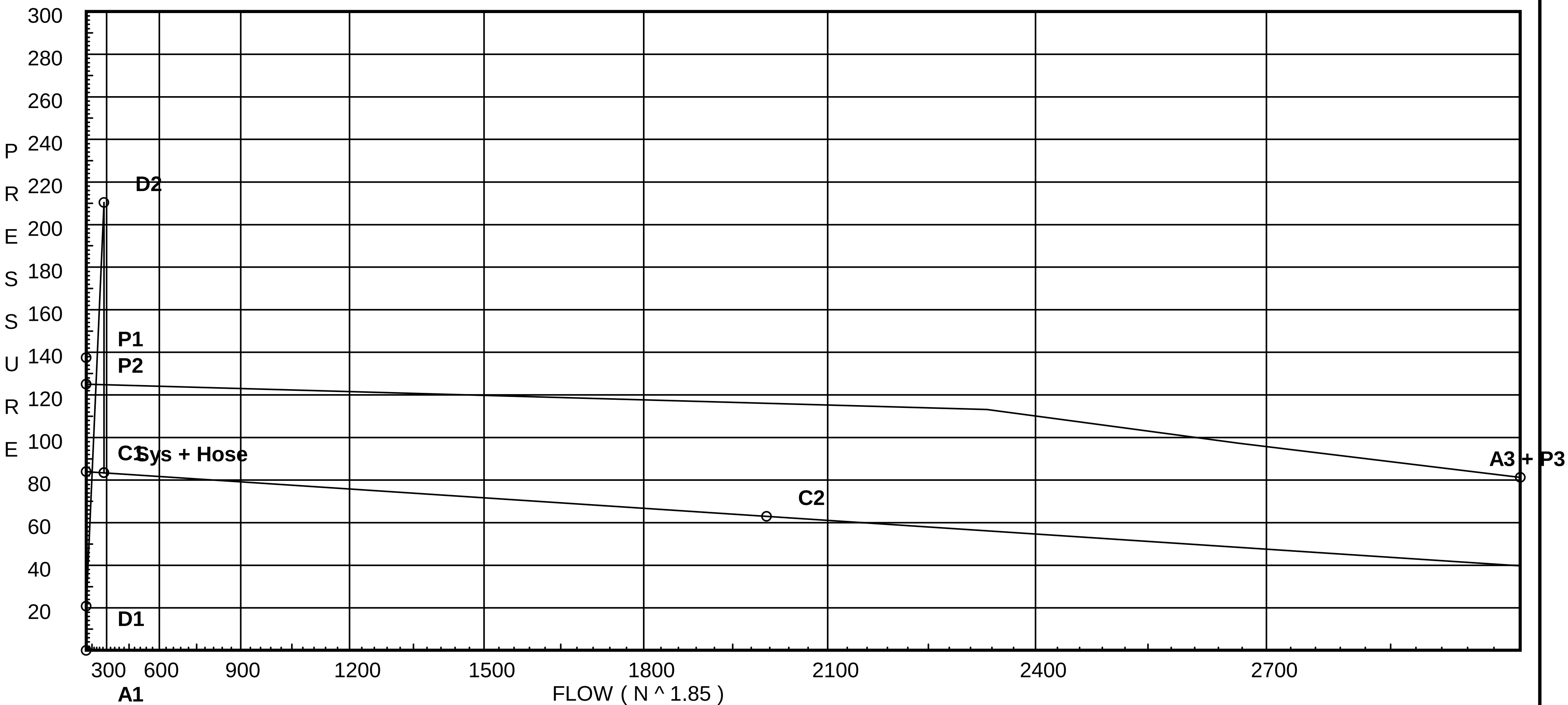
Page 1
Date

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



Fittings Used Summary

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
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
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
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
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.

SUPPLY ANALYSIS

Node at Source	*Static Pressure*	*Residual Pressure*	*Flow*	*Available Pressure*	*Total Demand*	*Required Pressure*
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

Node Tag	*Elevation*	*Node Type*	*Pressure at Node*	*Discharge at Node*	*Notes*
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		

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	48	2.00	12.85	3	2E	14.0	38.090	120	47.640	
to						0.0	14.000		0.0	
FM9	48		12.85	3.068		0.0	52.090	0.0003	0.016	Vel = 0.56
FM9	48	2.00	13.81	3	2E	14.0	38.090	120	47.656	
to						0.0	14.000		0.0	
FM8	48		26.66	3.068		0.0	52.090	0.0012	0.062	Vel = 1.16
FM8	48	2.00	13.81	3	2E	14.0	38.090	120	47.718	
to						0.0	14.000		0.0	
FM7	48		40.47	3.068		0.0	52.090	0.0026	0.134	Vel = 1.76
FM7	48	2.00	13.84	3	2E	14.0	38.090	120	47.852	
to						0.0	14.000		0.0	
FM6	48		54.31	3.068		0.0	52.090	0.0044	0.231	Vel = 2.36
FM6	48	2.00	13.87	3	2E	14.0	38.090	120	48.083	
to						0.0	14.000		0.0	
FM5	48		68.18	3.068		0.0	52.090	0.0068	0.352	Vel = 2.96
FM5	48	2.00	13.92	3	2E	14.0	38.090	120	48.435	
to						0.0	14.000		0.0	
FM4	48		82.1	3.068		0.0	52.090	0.0095	0.497	Vel = 3.56
FM4	48	2.00	13.99	3	2E	14.0	38.090	120	48.932	
to						0.0	14.000		0.0	
FM3	48		96.09	3.068		0.0	52.090	0.0127	0.664	Vel = 4.17
FM3	48	2.00	14.08	3		0.0	38.010	120	49.596	
to						0.0	0.0		0.0	
FM2	48		110.17	3.068		0.0	38.010	0.0164	0.624	Vel = 4.78
FM2	48	2.00	14.17	3	2E	14.0	38.090	120	50.220	
to						0.0	14.000		0.0	
FM1	48		124.34	3.068		0.0	52.090	0.0205	1.070	Vel = 5.40
FM1	48	2.00	14.33	3	E	7.0	27.200	120	51.290	
to						0.0	7.000		0.0	
901	48		138.67	3.068		0.0	34.200	0.0251	0.860	Vel = 6.02
901	48		140.73	3	T	15.0	46.000	120	52.150	
to						0.0	15.000		19.923	
902	2		279.4	3.068		0.0	61.000	0.0919	5.604	Vel = 12.13
902	2		0.0	3	4E	28.0	61.560	120	77.677	
to						0.0	28.000		0.0	
904	2		279.4	3.068		0.0	89.560	0.0919	8.228	Vel = 12.13
904	2		0.0	3		0.0	4.000	120	85.905	
to						0.0	0.0		-1.732	
903	6		279.4	3.068		0.0	4.000	0.0918	0.367	Vel = 12.13
903	6		0.0	3	2E	14.0	33.630	120	84.540	
to						0.0	14.000		0.0	
905	6		279.4	3.068		0.0	47.630	0.0919	4.376	Vel = 12.13
905	6		0.0	3		0.0	4.000	120	88.916	
to						0.0	0.0		1.732	
906	2		279.4	3.068		0.0	4.000	0.0920	0.368	Vel = 12.13
906	2		0.0	3	7E	49.0	983.380	120	91.016	
to						0.0	49.000		0.0	
907	2		279.4	3.068		0.0	1032.380	0.0919	94.845	Vel = 12.13

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	2		0.0	3		0.0	6.000	120	185.861	
to						0.0	0.0		-2.599	
908	8		279.4	3.068		0.0	6.000	0.0918	0.551	Vel = 12.13
908	8		0.0	3	2E	14.0	90.490	120	183.813	
to						0.0	14.000		0.0	
TOR3	8		279.4	3.068		0.0	104.490	0.0919	9.600	Vel = 12.13
TOR3	8		0.0	3	T	15.0	6.000	120	193.413	
to					2B	20.0	64.000		4.599	* * Fixed Loss = 2
BOR3	2		279.4	3.068	Eql	29.0	70.000	0.0919	6.430	Vel = 12.13
BOR3	2		0.0	10	L	16.0	18.000	120	204.442	
to					S	55.0	83.000		5.866	* * Fixed Loss = 5
PO	0		279.4	10.02	Bvcb	12.0	101.000	0.0003	0.030	Vel = 1.14
			0.0							
PO			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	0		0.0	10	2E	44.0	19.990	120	72.842	
to						0.0	44.000		-0.866	
FF	2		279.4	10.02		0.0	63.990	0.0003	0.019	Vel = 1.14
FF	2		0.0	10	E	24.923	8.500	120	71.995	
to					2L	36.252	117.819		14.118	* * Fixed Loss = 10.437
UG1	-6.5		279.4	10.28	T	56.644	126.319	0.0003	0.032	Vel = 1.08
					Zie	0.0				
UG1	-6.5		0.0	10	E	21.661	15.210	140	86.145	
to						0.0	21.661		0.0	
UG2	-6.5		279.4	9.42		0.0	36.871	0.0003	0.011	Vel = 1.29
UG2	-6.5		0.0	10		0.0	379.070	140	86.156	
to						0.0	0.0		-2.815	
TFC	0		279.4	9.42		0.0	379.070	0.0003	0.111	Vel = 1.29
			0.0							
TFC			279.40						83.452	K Factor = 30.58
FM10	48		0.95	3	2E	14.0	38.090	120	47.640	
to						0.0	14.000		0.0	
FM11	48		0.95	3.068		0.0	52.090	0	0.0	Vel = 0.04
FM11	48	2.00	13.81	3	2E	14.0	38.090	120	47.640	
to						0.0	14.000		0.0	
FM12	48		14.76	3.068		0.0	52.090	0.0004	0.021	Vel = 0.64
FM12	48	2.00	13.80	3	2E	14.0	38.090	120	47.661	
to						0.0	14.000		0.0	
FM13	48		28.56	3.068		0.0	52.090	0.0013	0.070	Vel = 1.24
FM13	48	2.00	13.82	3	2E	14.0	38.090	120	47.731	
to						0.0	14.000		0.0	
FM14	48		42.38	3.068		0.0	52.090	0.0028	0.146	Vel = 1.84
FM14	48	2.00	13.84	3	2E	14.0	38.090	120	47.877	
to						0.0	14.000		0.0	
FM15	48		56.22	3.068		0.0	52.090	0.0047	0.247	Vel = 2.44

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	48	2.00	13.88	3	2E	14.0	38.090	120	48.124	
to						0.0	14.000		0.0	
FM16	48		70.1	3.068		0.0	52.090	0.0071	0.370	Vel = 3.04
FM16	48	2.00	13.92	3	2E	14.0	38.090	120	48.494	
to						0.0	14.000		0.0	
FM17	48		84.02	3.068		0.0	52.090	0.0100	0.519	Vel = 3.65
FM17	48	2.00	14.00	3	2E	14.0	38.090	120	49.013	
to						0.0	14.000		0.0	
FM18	48		98.02	3.068		0.0	52.090	0.0132	0.689	Vel = 4.25
FM18	48	2.00	14.10	3	2E	14.0	38.090	120	49.702	
to						0.0	14.000		0.0	
FM19	48		112.12	3.068		0.0	52.090	0.0170	0.884	Vel = 4.87
FM19	48	2.00	14.23	3	2E	14.0	38.090	120	50.586	
to						0.0	14.000		0.0	
FM20	48		126.35	3.068		0.0	52.090	0.0212	1.102	Vel = 5.48
FM20	48	2.00	14.38	3	E	7.0	10.890	120	51.688	
to						0.0	7.000		0.0	
901	48		140.73	3.068		0.0	17.890	0.0258	0.462	Vel = 6.11
			0.0							
901			140.73						52.150	K Factor = 19.49
HOSE	2	.0	0.0	10		0.0	15.000	120	204.442	
to						0.0	0.0		0.0	
BOR3	2		0.0	10.02		0.0	15.000	0	0.0	Vel = 0
			0.0							
BOR3			0.0						204.442	K Factor = 0

APPENDIX C

Marine Terminal Area Calculation

. . . Fire Protection by Computer Design

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

Job Name	:	Rail Unloading-R5
Drawing	:	
Location	:	
Remote Area	:	
Contract	:	
Data File	:	Dock Area 8.WXF

Water Supply Curve C

ProEnergy Services
Rail Unloading-R5

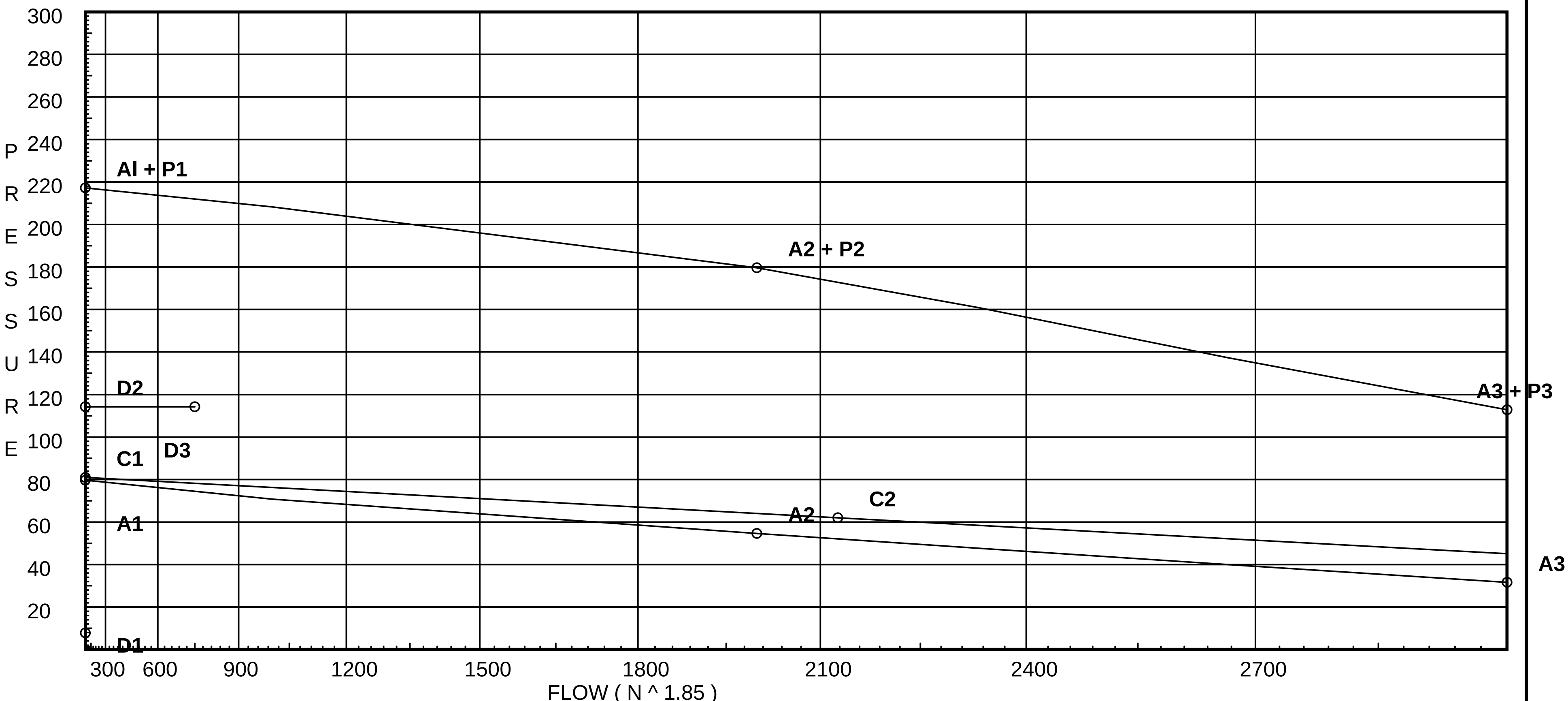
Page 1
Date

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: 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



Fittings Used Summary

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
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.

SUPPLY ANALYSIS

Node at Source	Static Pressure	Residual Pressure	Flow	Available Pressure	Total Demand	Required Pressure
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

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		63.58		
804	-6.0		67.41		
TEST	2.0		64.04	500.0	
M2	20.0		100.1	750.0	

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	20	H750	750.00	8	4E	72.0	74.730	120	100.000	
to						0.0	72.000		7.796	
801	2		750.0	7.981		0.0	146.730	0.0054	0.796	Vel = 4.81
801	2		750.00	8	T	35.0	206.450	120	108.592	
to					2E	36.0	71.000		0.0	
802	2		1500.0	7.981		0.0	277.450	0.0196	5.427	Vel = 9.62
802	2		0.0	8		0.0	4.000	120	114.019	
to						0.0	0.0		0.0	
803	2		1500.0	7.981		0.0	4.000	0.0198	0.079	Vel = 9.62
803	2		0.0	10		0.0	20.000	120	114.098	
to						0.0	0.0		0.0	
PO	2		1500.0	10.02		0.0	20.000	0.0064	0.129	Vel = 6.10
			0.0							
PO			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	2		0.0	10	E	22.0	33.980	120	63.585	
to						0.0	22.000		3.465	
804	-6		1500.0	10.02		0.0	55.980	0.0064	0.361	Vel = 6.10
804	-6		0.0	10		0.0	23.140	140	67.411	
to						0.0	0.0		-3.465	
TEST	2		1500.0	10.28		0.0	23.140	0.0043	0.099	Vel = 5.80
			500.00							Qa = 500.00
TEST			2000.00						64.045	K Factor = 249.91
M2	20	H750	750.00	8	4E	72.0	55.810	120	100.103	
to						0.0	72.000		7.796	
801	2		750.0	7.981		0.0	127.810	0.0054	0.693	Vel = 4.81
			0.0							
801			750.00						108.592	K Factor = 71.97

. . . Fire Protection by Computer Design

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

Job Name	:	Rail Unloading-R5
Drawing	:	
Location	:	
Remote Area	:	
Contract	:	
Data File	:	Dock Area 8.WXF

Water Supply Curve C

ProEnergy Services
Rail Unloading-R5

Page 1
Date

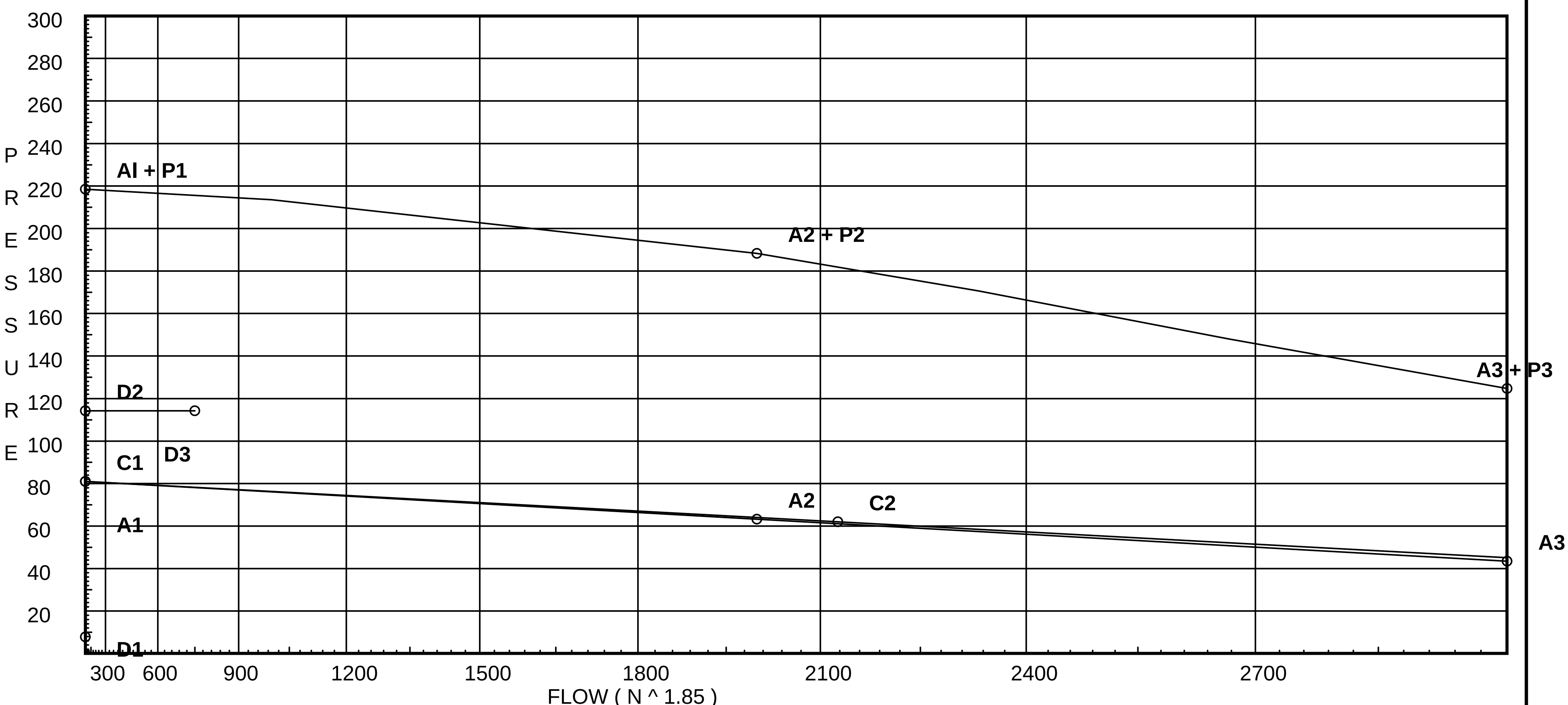
City Water Supply:
C1 - Static Pressure : 81
C2 - Residual Pressure: 62
C2 - Residual Flow : 2127

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

Fitting Legend

Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
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.

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	

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	20	H750	750.00	8	4E	72.0	74.730	120	100.000	
to						0.0	72.000		7.796	
801	2		750.0	7.981		0.0	146.730	0.0054	0.796	Vel = 4.81
801	2		750.00	8	T	35.0	206.450	120	108.592	
to					2E	36.0	71.000		0.0	
802	2		1500.0	7.981		0.0	277.450	0.0196	5.427	Vel = 9.62
802	2		0.0	8		0.0	4.000	120	114.019	
to						0.0	0.0		0.0	
803	2		1500.0	7.981		0.0	4.000	0.0198	0.079	Vel = 9.62
803	2		0.0	10		0.0	20.000	120	114.098	
to						0.0	0.0		0.0	
PO	2		1500.0	10.02		0.0	20.000	0.0064	0.129	Vel = 6.10
			0.0							
PO			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	2		0.0	10	E	22.0	33.980	120	70.582	
to						0.0	22.000		3.465	
804	-6		1500.0	10.02		0.0	55.980	0.0064	0.361	Vel = 6.10
804	-6		0.0	10		0.0	23.140	140	74.408	
to						0.0	0.0		-3.465	
TEST	2		1500.0	10.28		0.0	23.140	0.0043	0.099	Vel = 5.80
			0.0							
TEST			1500.00						71.042	K Factor = 177.96
M2	20	H750	750.00	8	4E	72.0	55.810	120	100.103	
to						0.0	72.000		7.796	
801	2		750.0	7.981		0.0	127.810	0.0054	0.693	Vel = 4.81
			0.0							
801			750.00						108.592	K Factor = 71.97

APPENDIX D

Flow Test Reports

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

Date: 5/30/13

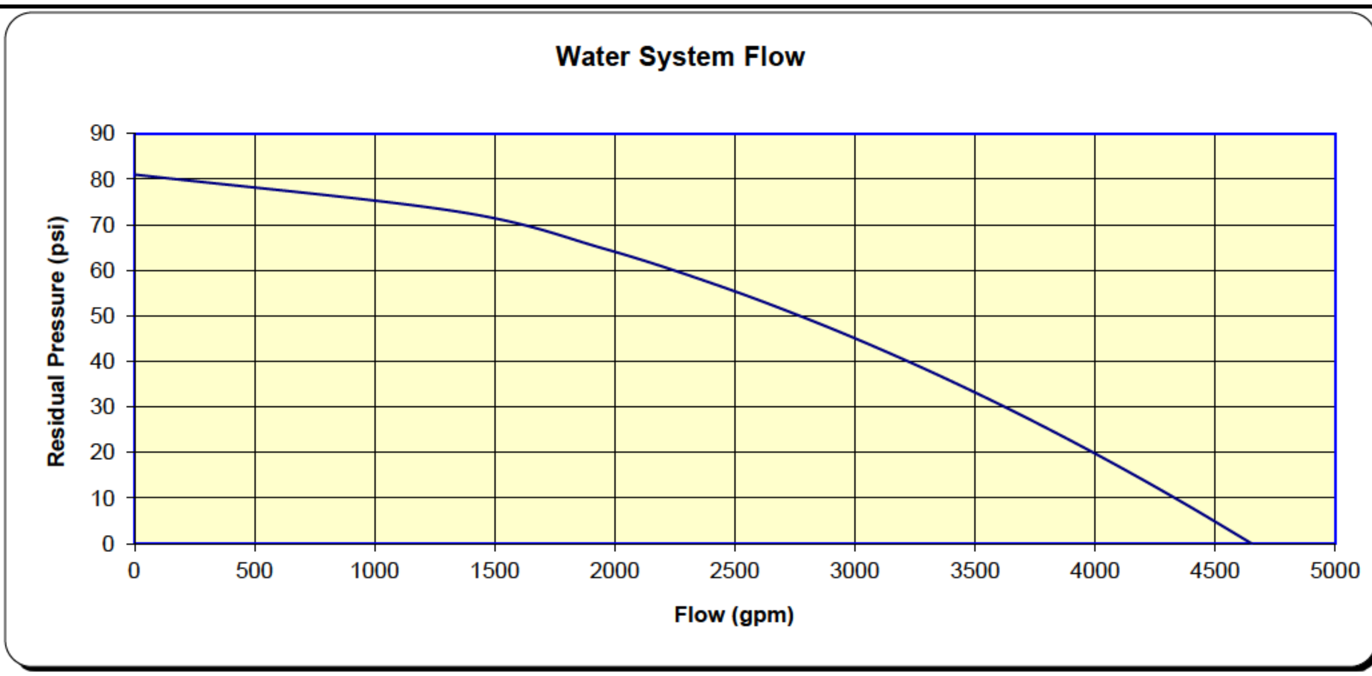
Water Systems Planning & Design
Ph: 360-696-8223 Fx: 360-696-8460
www.ci.vancouver.wa.us

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

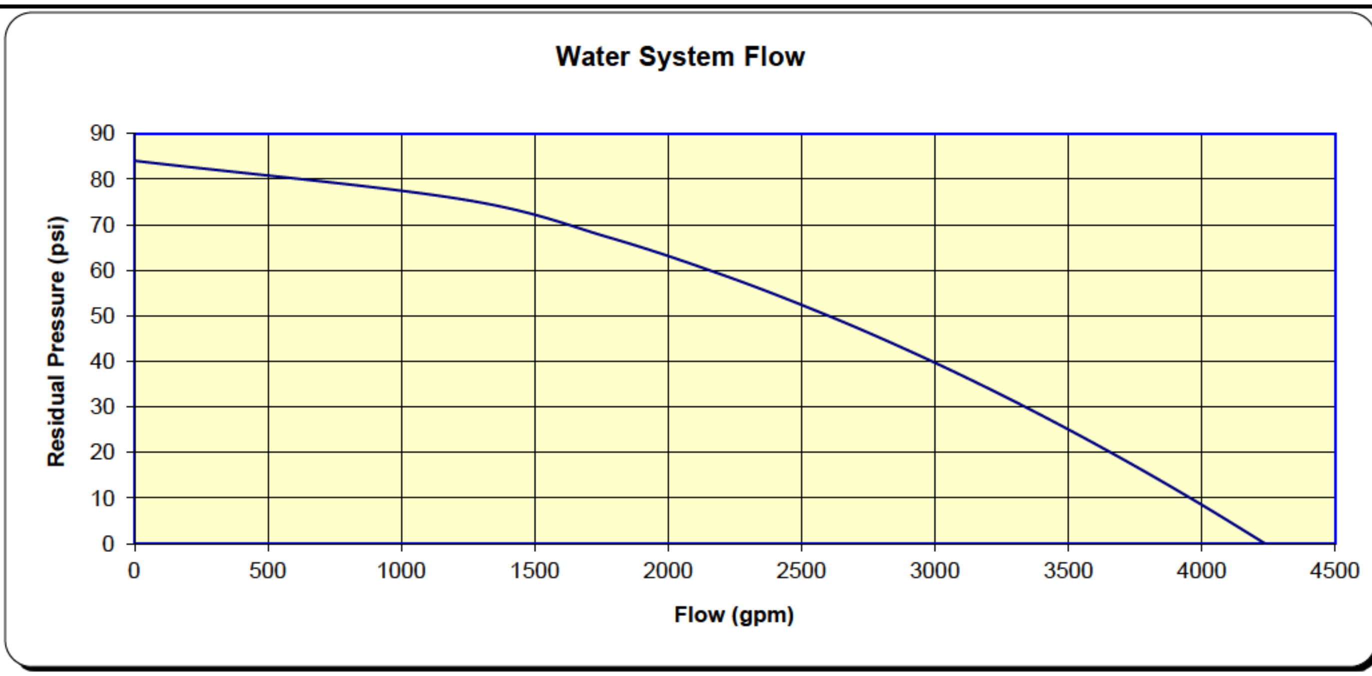
Water Systems Planning & Design
Ph: 360-696-8223 Fx: 360-696-8460
www.ci.vancouver.wa.us

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 cornerof 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.


16" CITY WATER (60 PSI)
16" CITY WATER (50 PSI)
CITY FIRE HYDRANT (3500 GPM @ 20 PSI)
16" CITY WATER (60 PSI)
24" CITY WATER
POTENTIAL OFFICE BUILDING SITE
14" CITY WATER (50 PSI)
12" STORM DRAIN
POTENTIAL OFFICE BUILDING SITE
CITY SANITARY MH
PROPOSED TANK FARM SITE
12" CITY WATER
10" PORT WATER (100 PSI)
STORM TO T4 POND (2)
30" STORM TO T4 POND BYPASS
16" CITY WATER
12" WATER
CITY FIRE HYDRANT (2500 GPM @ 20 PSI)
10" STORM
PROPOSED RAIL CAR LOADING AREA
CITY FIRE HYDRANT (5166 GPM @ 20 PSI)
12" CITY WATER
CITY SANITARY MH
18" CITY SANITARY SEWER
12" CITY WATER
CITY FIRE HYDRANT (1989 GPM @ 20 PSI)
12" CITY WATER
CITY SANITARY MH
10" CITY WATER
12" – 48" STORM DRAIN
10" STORM
24" STORM
10" CITY WATER
BERTH 13 & 14
CPU OUTFALL
36" STORM OUTFALL
LEGEND
COMMUNICATIONS
ELECTRIC
GAS
SANITARY SEWER
STORM SEWER
WATER
200 0 200 400
scale feet
DRAFT
BergerABAM

BergerABAM
210 East 13th Street, Suite 300, Vancouver, Washington 98660-3231
360/823-6100 • 360/823-6101 Fax • www.abam.com

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

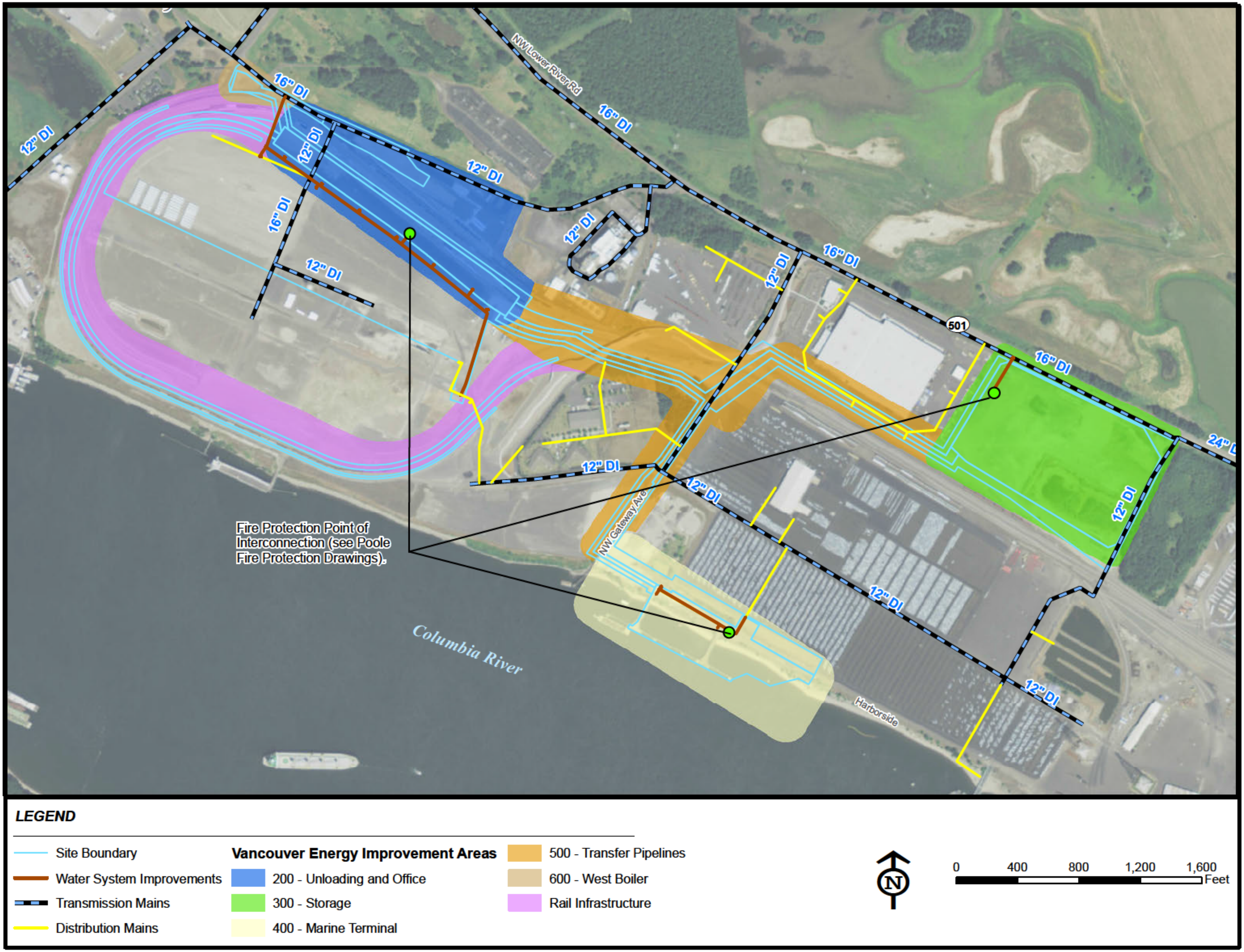
cc: Kelly Flint, Savage Companies
Jay Derr, Van Ness Feldman

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.	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. 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. 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. 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. 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).
FS-6	Provide any fire flow and pressure test data obtained as part of your design process from the City and the Port.	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). 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). With respect to hydrant testing in Areas 300 and 400, the City tested and provided results for

Code	Data Request Item	Applicant Response
Fire Safety		
		hydrants located at 3703 NW Gateway and 3309 NW Gateway. See the last eight pages of Attachment 2. 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.
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.	The Applicant assumes that question FS-9 is in relationship to water distribution system capabilities with respect to fire suppression. 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. 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. 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.

Attachments

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



NW Lower River Rd
16" DI
12" DI
12" DI
16" DI
12" DI
16" DI
12" DI
12" DI
16" DI
501
16" DI
24" DI
12" DI
12" DI
12" DI
12" DI
12" DI
12" DI
NW Gateway Ave
Harborside
Columbia River
Fire Protection Point of Interconnection (see Poole Fire Protection Drawings).
LEGEND
Site Boundary
Water System Improvements
Transmission Mains
Distribution Mains
Vancouver Energy Improvement Areas
200 - Unloading and Office
300 - Storage
400 - Marine Terminal
500 - Transfer Pipelines
600 - West Boiler
Rail Infrastructure
N
0
400
800
1,200
1,600
Feet

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)
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.

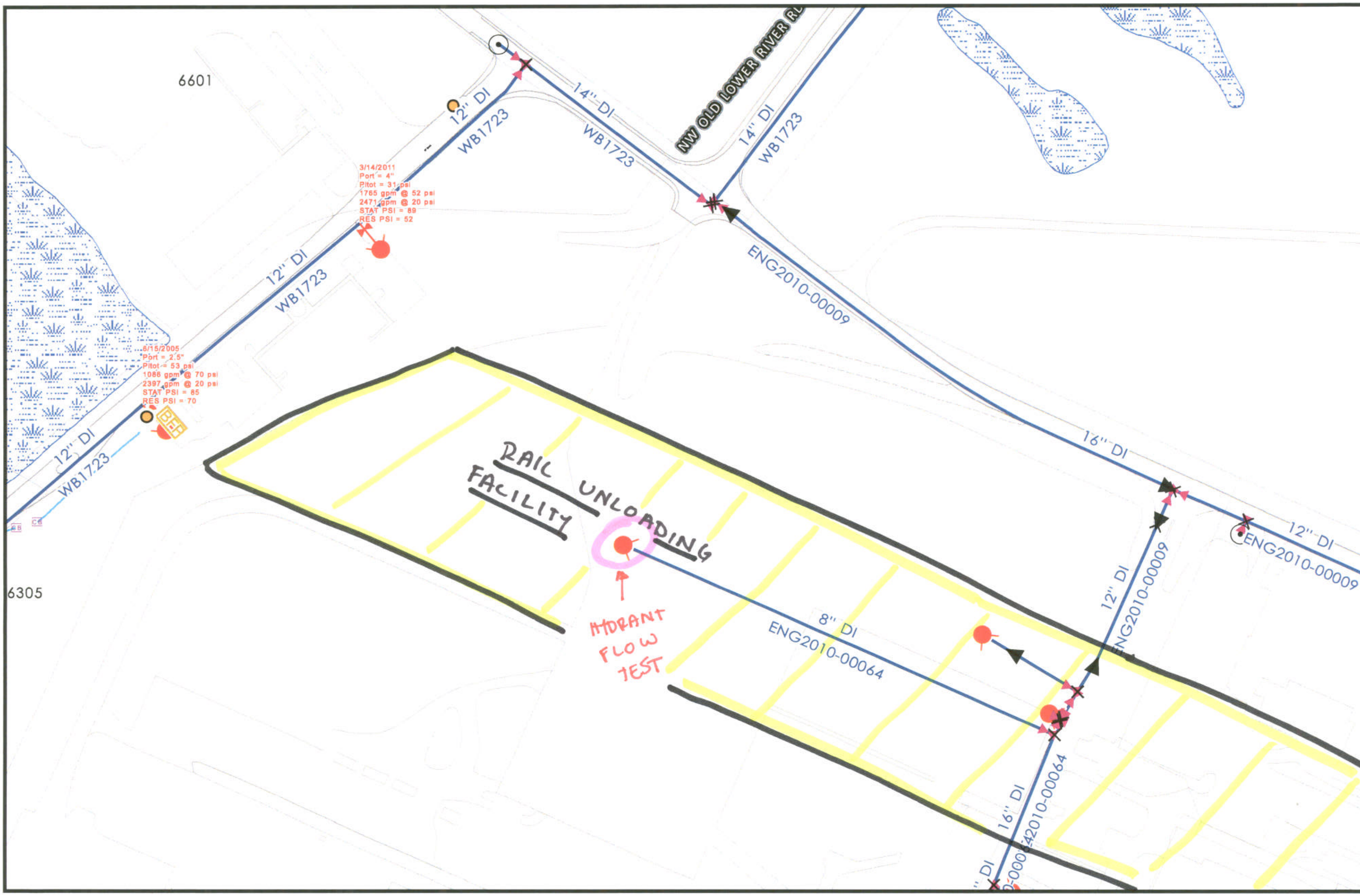
Please confirm that all hydrant testing will be conducted in accordance with NFPA 291.

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



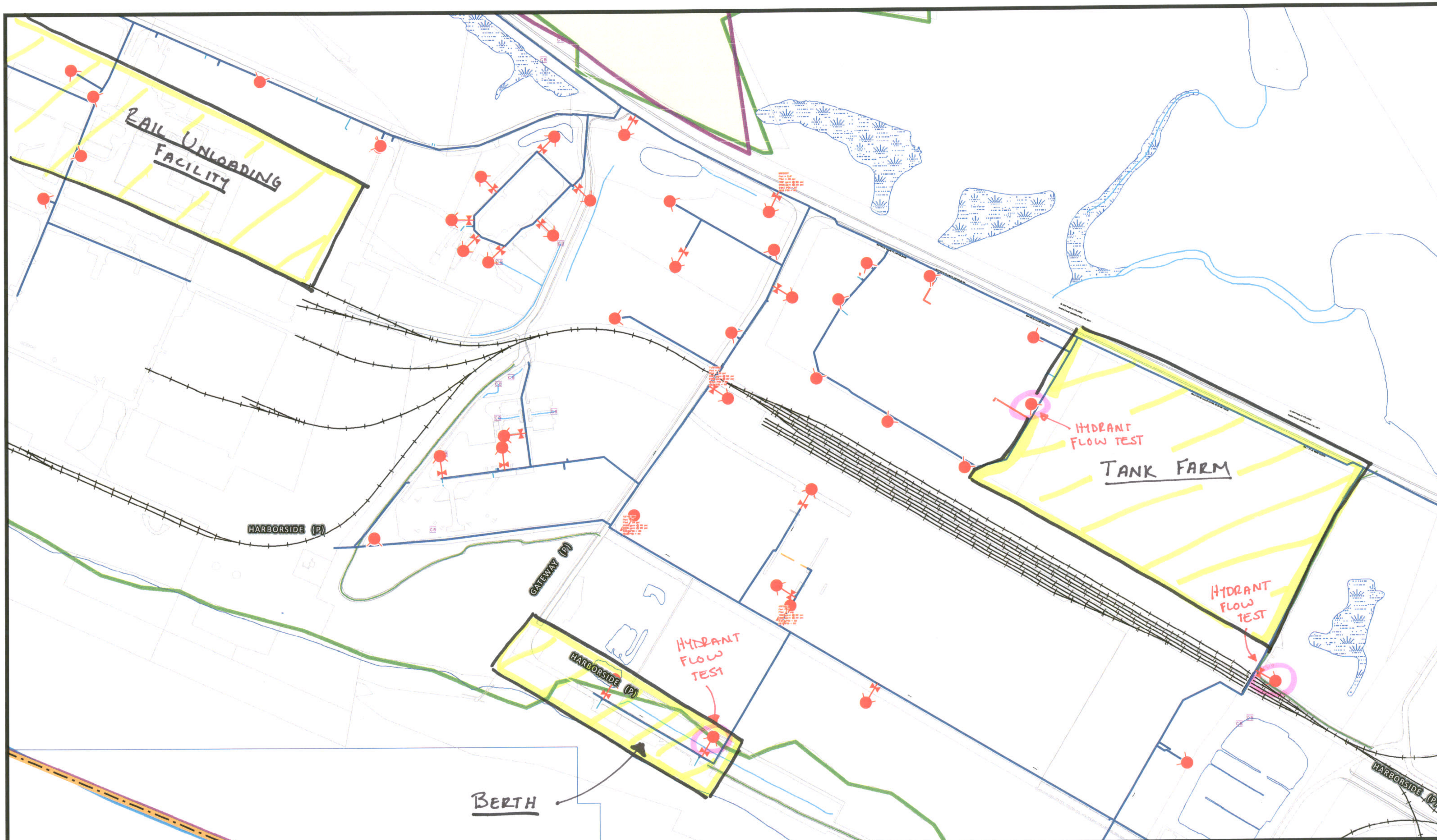
Water Utility Map

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.

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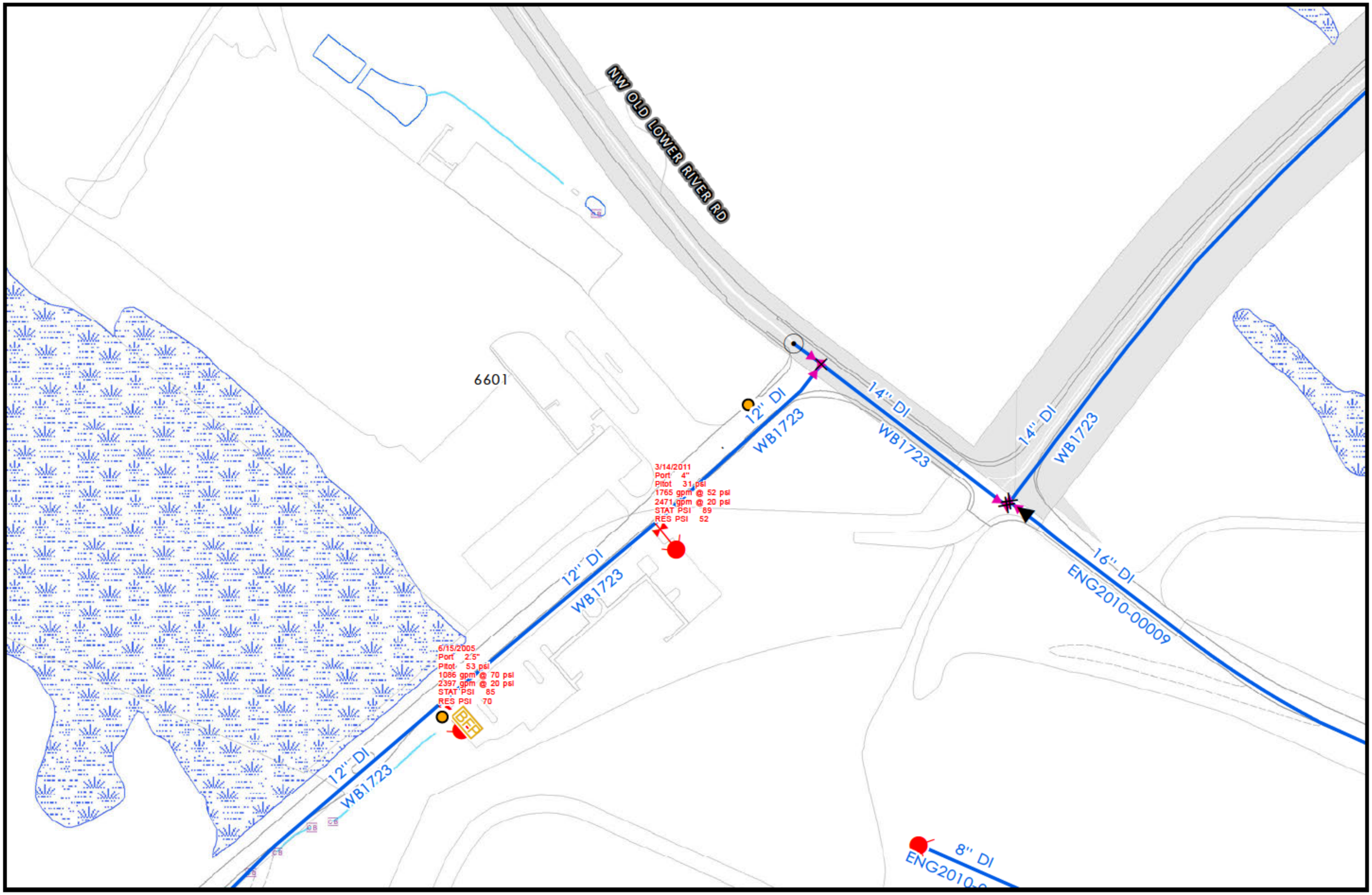
If at all possible, we are requesting that the flow tests be conducted on Tuesday, May 28, 2013; our client's staff and insurance representatives will be on-site. When you confirm a testing schedule, please let me know so that we can coordinate with our client's scheduled visit.

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



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

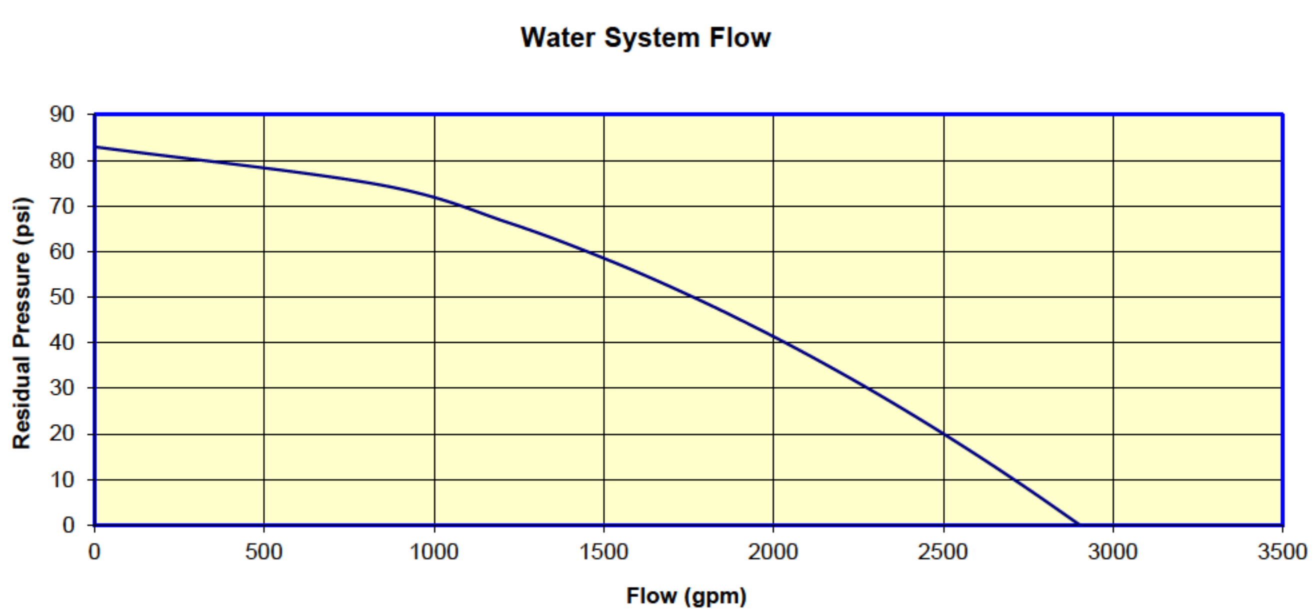
Water Systems Planning & Design
Ph: 360-696-8223 Fx: 360-696-8460
www.ci.vancouver.wa.us

FIRE HYDRANT FLOW TEST (NFPA 291)

Date: 3/14/2011	Time: 2:30 AM	Initials: GH	Map#:	Zone:	Elevation: ft

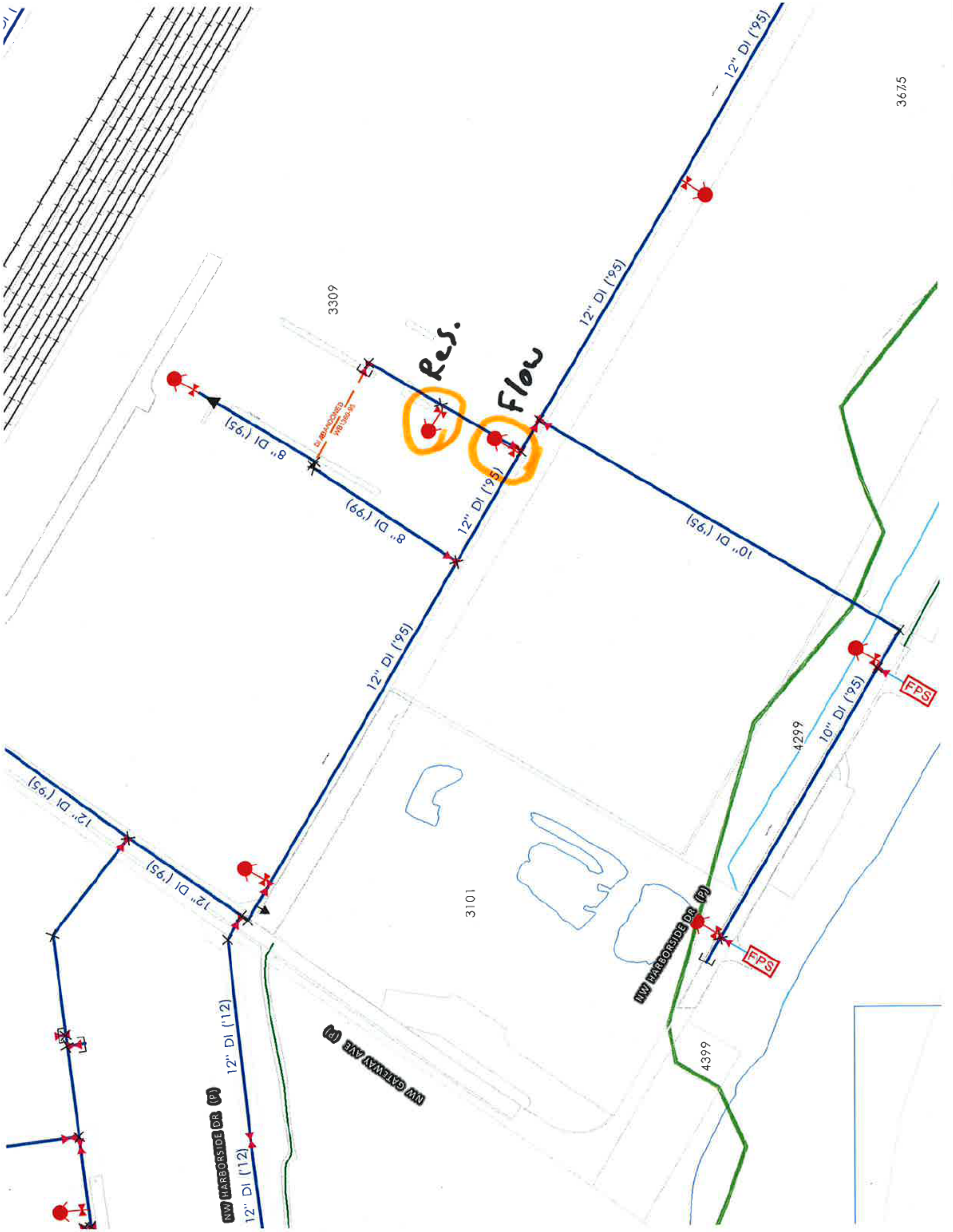
Residual FH ID#:	Keyera entrance gated	Static:	83 psi	Residual:	47 psi
1st Flow FH ID#:	BHP onsite north hydrant	Port:	4 in	Pitot:	34 psi
2nd Flow FH ID#:		Port:	0 in	Pitot:	0 psi

Comments:

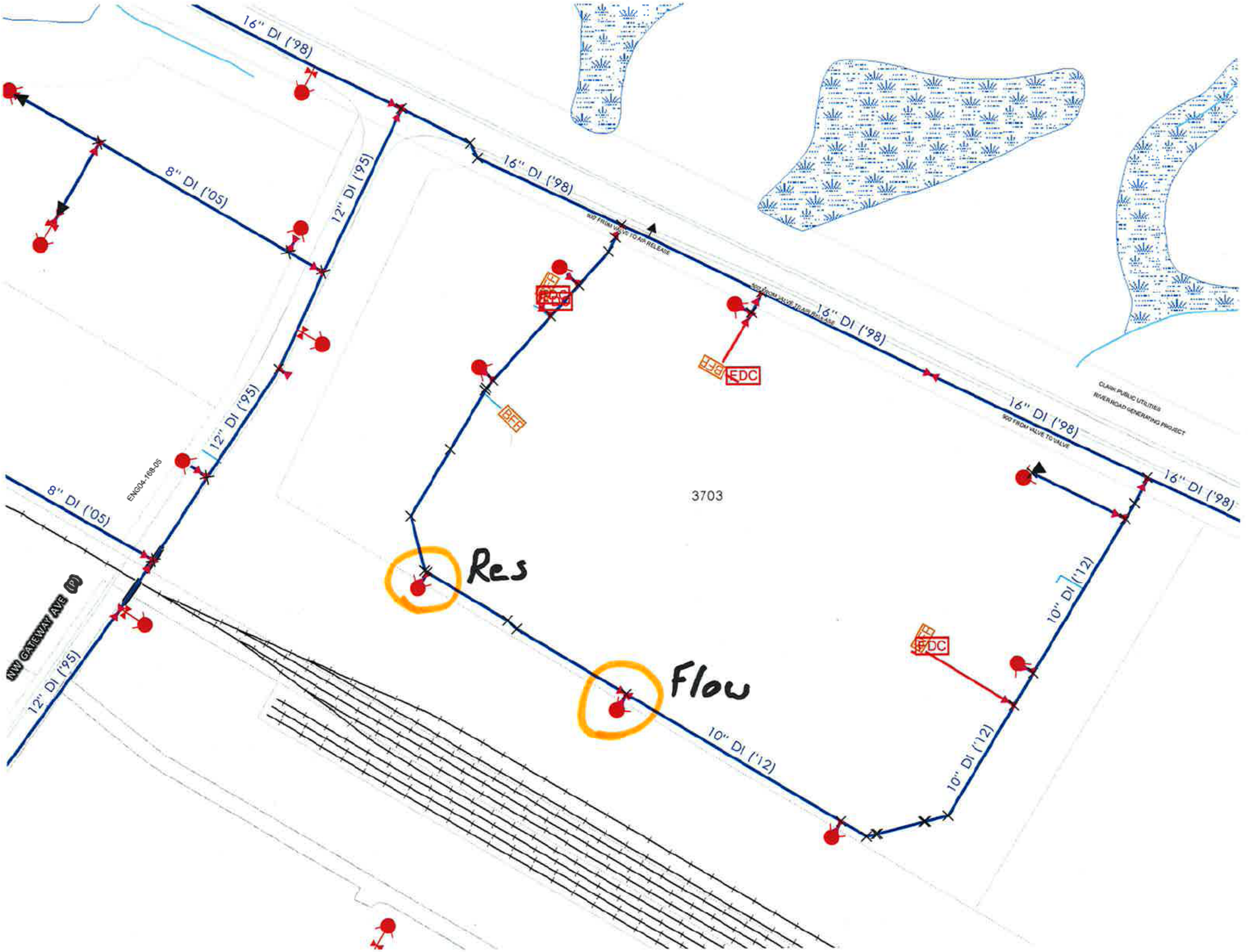


RESULTS:	Flow (gpm)		Pressure (psi)
1st Flow	1849	@	47
2nd Flow	0	@	47
Fire Flow*	2501	@	20

*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.



12" DI ('95)
3675
3309
12" DI ('95)
Res.
Flow
DI ABANDONED
WB1380-95
8" DI ('95)
8" DI ('99)
12" DI ('95)
10" DI ('95)
12" DI ('95)
12" DI ('95)
12" DI ('95)
FPS
4299
10" DI ('95)
3101
NW HARBORSIDE DR (P)
FPS
4399
12" DI ('12)
NW GATEWAY AVE (P)
NW HARBORSIDE DR (P)
12" DI ('12)



CLARK PUBLIC UTILITIES
RIVER ROAD GENERATING PROJECT
16" DI ('98)
10" DI ('12)
12" DI ('95)
8" DI ('05)
EDC
BFE
3703
Res
Flow
ENG04-168-05
NW GATEWAY AVE

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

Date: 5/30/13

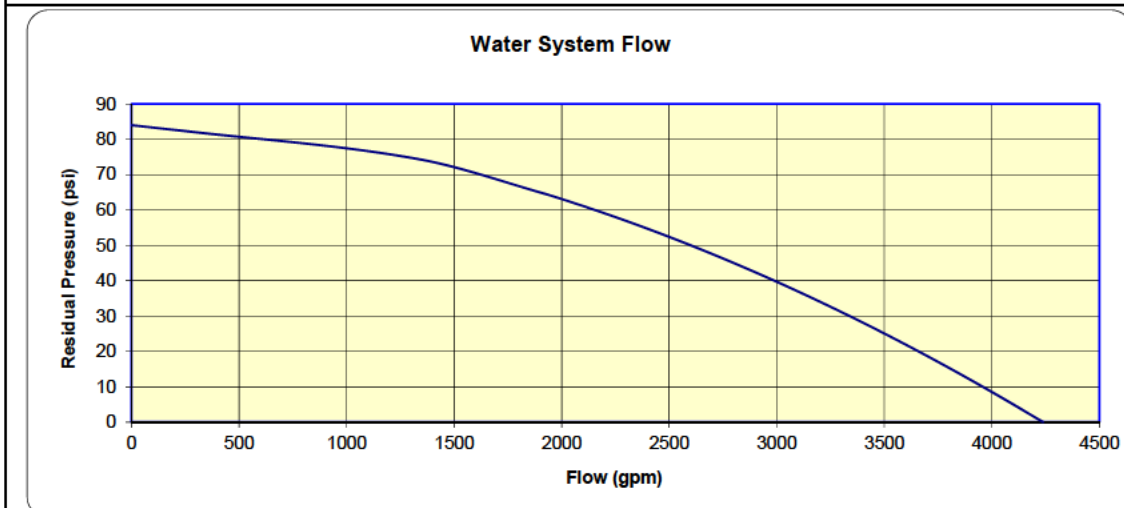
Water Systems Planning & Design
Ph: 360-696-8223 Fx: 360-696-8460
www.ci.vancouver.wa.us

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 cornerof 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:

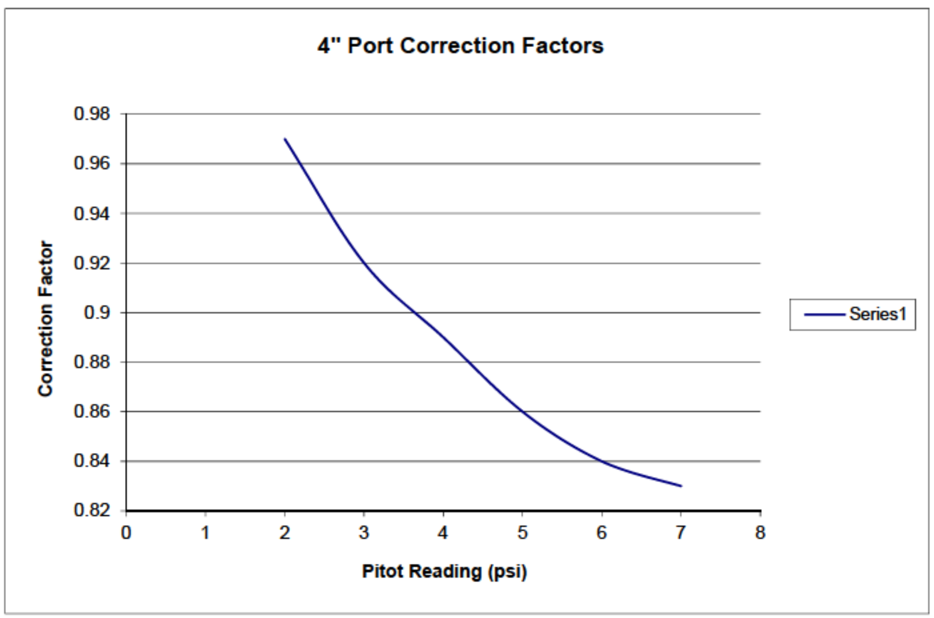


RESULTS:	Flow (gpm)		Pressure (psi)
1st Flow	2005	@	63
2nd Flow	0	@	63
Fire Flow*	3660	@	20

*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 =	0.8	Typically 0.8 if diffuser used, 0.9 without diffuser.		
2nd FH Flow Coefficient =	0.8			

Is the 1st FH Flow from the 4" port?	YES	**Correction Factor =**	0.83	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 2st FH Flow from the 4" port?	NO	**Correction Factor =**	1	



4" Port Correction Factors per NFPA 291

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:	psi	Residual:	psi
1st Flow FH ID#:		Port:	in	Pitot:	psi
2nd Flow FH ID#:		Port:	in	Pitot:	psi
Comments:					

Date:	Time:	Initials:	Map#:	Zone:	Elevation: ft
Residual FH ID#:		Static:	psi	Residual:	psi
1st Flow FH ID#:		Port:	in	Pitot:	psi
2nd Flow FH ID#:		Port:	in	Pitot:	psi
Comments:					

Date:	Time:	Initials:	Map#:	Zone:	Elevation: ft
Residual FH ID#:		Static:	psi	Residual:	psi
1st Flow FH ID#:		Port:	in	Pitot:	psi
2nd Flow FH ID#:		Port:	in	Pitot:	psi
Comments:					

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

City of VANCOUVER WASHINGTON

Date: 5/30/13

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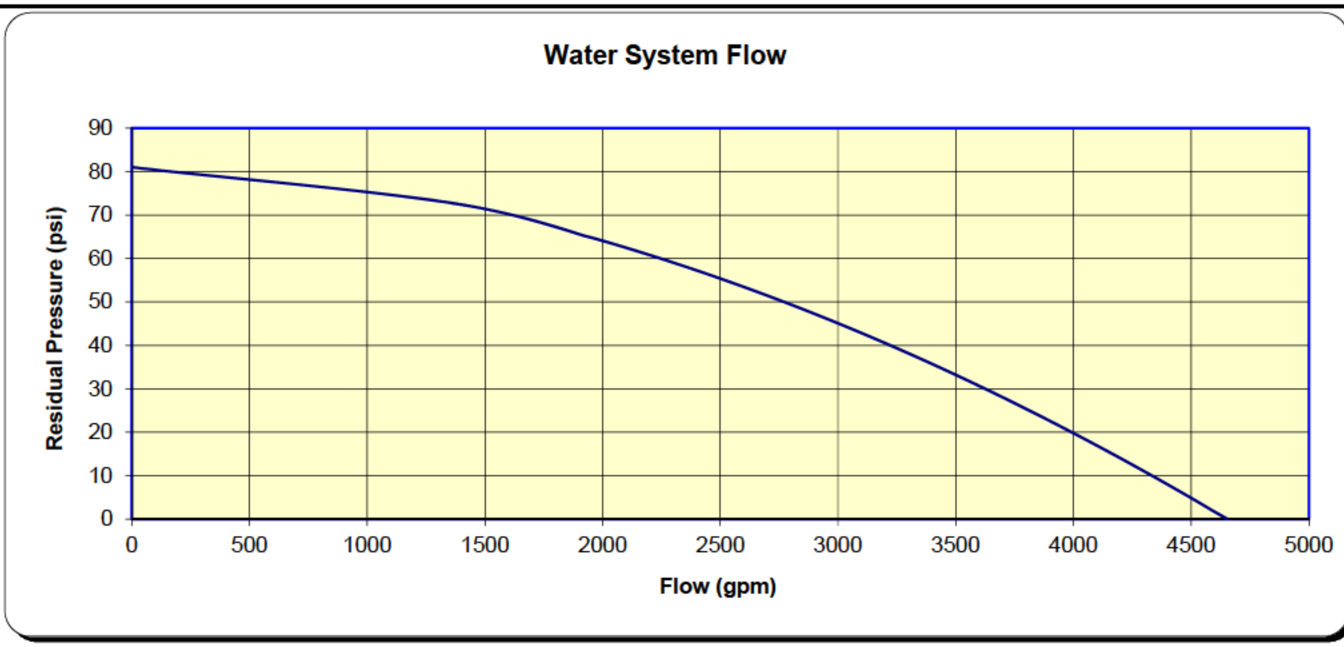
FIRE HYDRANT FLOW TEST (NFPA 291)

Date: 5/30/2013	Time: 1:15 PM	Initials: GH/TT	Map#:	Zone:	Elevation: ft

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:

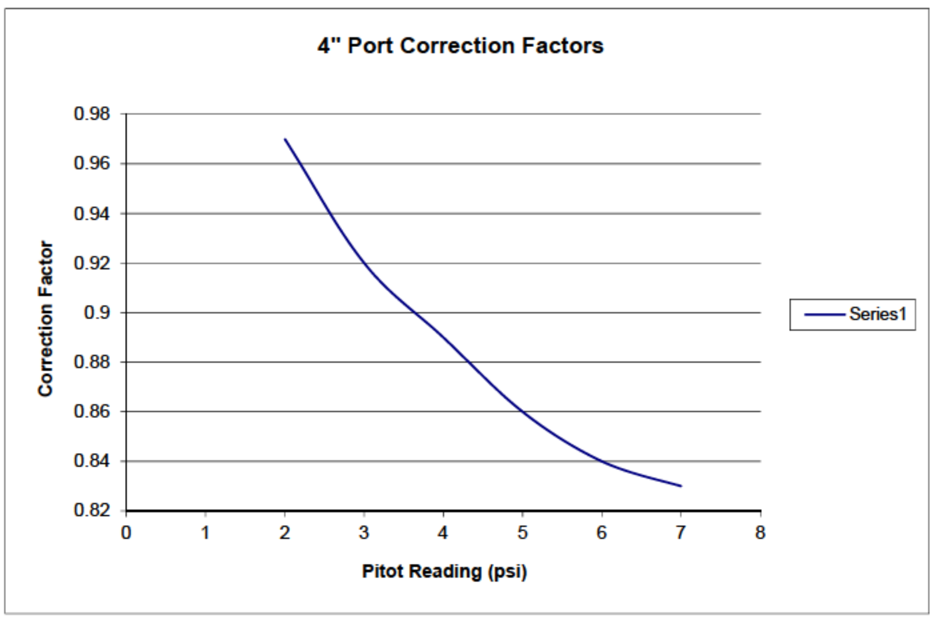


RESULTS:	Flow (gpm)		Pressure (psi)
1st Flow	2127	@	62
2nd Flow	0	@	62
Fire Flow*	3992	@	20

*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.

1st FH Flow Coefficient =	0.8	Typically 0.8 if diffuser used, 0.9 without diffuser.		
2nd FH Flow Coefficient =	0.8			

Is the 1st FH Flow from the 4" port?	YES	**Correction Factor =**	0.83	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 2st FH Flow from the 4" port?	NO	**Correction Factor =**	1	



4" Port Correction Factors per NFPA 291

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: psi		Residual: psi
1st Flow FH ID#:			Port: in		Pitot: psi
2nd Flow FH ID#:			Port: in		Pitot: psi
Comments:					

Date:	Time:	Initials:	Map#:	Zone:	Elevation: ft
Residual FH ID#:			Static: psi		Residual: psi
1st Flow FH ID#:			Port: in		Pitot: psi
2nd Flow FH ID#:			Port: in		Pitot: psi
Comments:					

Date:	Time:	Initials:	Map#:	Zone:	Elevation: ft
Residual FH ID#:			Static: psi		Residual: psi
1st Flow FH ID#:			Port: in		Pitot: psi
2nd Flow FH ID#:			Port: in		Pitot: 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,

Tyler Clary
Water Engineering Program Manager
City of Vancouver

cc: Tracy Tuntland
Debi Davis
Jon Wagner