An Introduction to Petroleum Fuel Facilities: *Pipelines and Ground Fueling Facilities*

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1. INTERTERMINAL AND INSTALLATION PIPELINES

1.1 INTRODUCTION. This discussion provides guidance for the design of pipelines. Pipelines are typically either interterminal pipelines which are cross country and connect installations, or installation pipelines which connect petroleum-oil-lubricants (POL) facilities within an installation. The primary differences are that interterminal pipelines cross public and private properties, streets, highways, railroads, and utility rights-of-way, whereas installation pipelines do not. Interterminal pipelines may be dedicated lines connecting two or more facilities or privately owned common carrier lines serving several shippers. In some cases, the shipping facility may consist of a relatively short spur which delivers the fuel to the suction side of a pumping station which is part of the main line of a larger pipeline system. Pipeline receiving and dispensing facilities are normally part of a bulk fuel storage facility.

1.2 GENERAL REQUIREMENTS. Do not start the design of any fueling system without first becoming completely familiar with general design requirements.

1.3 DESIGN REQUIREMENTS.

1.3.1 FUEL SEGREGATION. Clean products, such as diesel fuel and distillate-type burner fuels, may be shipped in the same system without segregation. Batches are usually pumped product to product, but they may be separated by fresh or suitably treated water. Separate piping systems are required for residual fuels. For many projects, provide a dedicated pipeline for aviation turbine fuels.

1.3.2 APPLICABLE REGULATIONS. Interterminal and installation pipelines shall be designed as described below. Where federal, state, or local regulations are more restrictive than the requirements indicated, the more restrictive requirements shall apply.

1.3.2.1 INSTALLATION PIPELINES. All installation pipelines shall be designed in accordance with ANSI/ASME B31.3.

1.3.2.2 INTERTERMINAL PIPELINES. The U.S. Department of Transportation regulates the design, construction and operation of interterminal pipelines for liquid petroleum. Intrastate interterminal pipelines shall be designed in accordance with ANSI/ASME B31.4. Interstate interterminal pipelines, shall be designed in accordance with the requirements of 49 CFR Part 195.

1.3.3 SAMPLING. Provide a means for taking samples of the products shipped.

1.3.4 PIGGING. Pipelines shall be smart piggable including long radius elbows and barred fittings unless otherwise directed by The Owner.

1.3.5 SURGE SUPPRESSION. Provide surge suppressors for hydraulic shock when required.

1.4 PIPING SYSTEMS. Refer to appropriate references for information regarding piping systems.

1.5 EQUIPMENT. Equip all pipelines with meters and basket strainers, and provide the capability to install a proving meter.

1.5.1 METERS.

1.5.1.1 METERS – POSITIVE DISPLACEMENT. Use flange-connected, cast steel bodied positive displacement meters of the desired pressure and flow rating to meet applicable service requirements. Ensure that meter has case drain and register. Provide meter with temperature compensation and adjustable calibration where there is custody transfer. Ensure meter accessories are compatible with either the mechanical or electronic support equipment selected. Consult the Owner for requirements for the meter to communicate to a remote location or equipment.

1.5.1.2 METERS – TURBINE. Use flange-connected steel bodied turbine meters of the desired pressure and flow rating to meet applicable service requirements. Provide a flow straightener before turbine meters or provide a straight length of pipe at a minimum of ten pipe diameters upstream and five pipe diameters downstream of all turbine meters, or as required by manufacturer. Ensure meter has case drain and register. Provide \1\ meter with temperature compensation and adjustable calibration /1/ where there is custody transfer. Ensure all supporting equipment for meter is compatible with the turbine meter selected. Consult the Owner for requirements for the meter to communicate to a remote location or equipment. Consider the use of a card-operated or key-operated data acquisition system. Cards or keys, as appropriate, are coded to identify the receiver of the fuel and to allow access to the fuel. The quantities taken are transmitted to a data-receiving device by electronic pulse transmitters mounted on each meter, and each transaction is automatically recorded.

1.5.2 MANUAL VALVES.

1.5.2.1 MATERIALS OF CONSTRUCTION. Require valves to have carbon steel bodies and bonnets. Do not allow valves with aluminum, cast iron, or bronze materials. Use only API fire-safe valves.

1.5.2.2 ISOLATION VALVE TYPES.

a) Double Block and Bleed Isolation Valves:

- Use these for separation of product services, on tank shell connections, when piping goes above or below ground, between pier and tank storage, and other locations critical to pressure-testing of piping.

- Plug Valves (Double Block and Bleed): Use lockable, double-seated, tapered lift, plug type valves with an automatic body bleed between the seats (double block and bleed) in critical applications such as separation of product services, on each line at the shore end, when piping goes above or below ground, between pier and tank storage, and other locations critical to pressure-testing of piping. Valves shall be designed so that if the synthetic seating material is burned out in a fire, a metal-to-metal seat will remain to affect closure and comply with API Std 607. Lubricated plug valves are not allowed. Include integral body cavity thermal relief valve.

- Ball Valves (Double Block and Bleed): Use double-seated, trunion mounted, lockable, ball type valves with a body bleed between the seats (double block and bleed). These will be very rarely used but are acceptable as an alternative to double block and bleed plug valves in applications where the valve is operated very infrequently. An example is isolation valves in the middle of piers that are only closed to perform pressure testing of piping. Valves shall be designed so that if the synthetic seating material is burned out in a fire, a metal-to-metal seat will remain to affect closure and comply with API Std 607. Include integral body cavity thermal relief valve.

- Gate Valves: Use double-seated, lockable, gate type valves with a body bleed between the seats (double block and bleed). These will be very rarely used but are acceptable as an alternative to double block and bleed plug valves and double block and bleed ball valves only when other double block and bleed valves will not physically fit. Valves shall be designed so that if the synthetic seating material is burned out in a fire, a metal-to-metal seat will remain to affect closure and comply with API Std 607. Single seated gate valves are not allowed. Include integral body cavity thermal relief valve.

b) Quick Opening/Frequent Opening Isolation Valves.

- Use these for less critical applications where double block and bleed shutoff is not required.

- Ball Valves: Ball type valves may be used as valves for quick or frequent opening applications when a double block and bleed valve is not required. Ball valves shall be designed so that if the synthetic seating material is burned out in a fire, a metal-to-metal seat will remain to affect closure and comply with API Std 607. Use Teflon or Viton synthetic seals or seating material. Use full port ball valves with exact same diameter of the pipe within ten pipe diameters upstream and/or five pipe diameters downstream of a flow or pressure control valve, or a flow-sensing device such as a venturi. Valves should comply with API Std 608.

c) Butterfly Valves: Butterfly valves are not allowed.

d) Use full port valves with exact same diameter of the pipe when line pigging is required.

1.5.2.3 ISOLATION VALVE OPERATORS. Provide manually operated valves not specified for remote, automatic, or emergency operation. Use geared operators for ball and double block and bleed valves larger than 6 inches (150 mm). Double block and bleed gate, ball, and double block and bleed valves specified for remote, automatic, or emergency service may have electric motor operators with suitable torque limiting controls if approved by The Owner. For remote valves, consider using solar battery packs to reduce cost of routing power for the motor operators. Provide locking tabs on isolation valves to allow padlocks to be used to lock out valves during maintenance. Provide chain operators on valves which are located 72 inches (1800 mm) or higher above grade.

1.5.2.4 ISOLATION VALVE LOCATIONS. Provide valves in product piping systems to control flow and to permit isolation of equipment for maintenance or repair. Provide additional valves at required locations necessary to conduct a valid hydrostatic test. Provide manually operated valves, except where motor operators are specifically authorized by applicable standard drawings or technical specifications. Use double block and bleed type isolation valves for separation of product services, on tank shell connections (ASTs over 12,000 gallons (45,800 L) only), when piping goes above or below ground, between pier and tank storage, and other locations critical to periodic pressure-testing of piping. Quick opening/frequent opening type isolation valves may be used for less critical applications where double block and bleed shutoff is not required. Before adding isolation valves, evaluate piping system and make modifications to prevent pressure buildup caused by thermal expansion. As a minimum requirement, provide isolation valves at the following locations:

a) Provide a double block and bleed isolation valve on each branch line at the point of connection to the main product pipeline or header.

b) Provide a double block and bleed isolation valve on the product pipeline or header just before the line leaves a pumping station.

c) Provide a double block and bleed isolation valve at the inlet and outlet connection of each line strainer, filter/separator, meter, diaphragm control valve, thermal relief valve, and other equipment that requires periodic servicing. One inlet and one outlet double block and bleed isolation valve may be used to isolate more than one piece of adjacent equipment which are connected in series.

d) Provide a double block and bleed isolation valve on the upstream and downstream side of each line blind at connections to cross country pipelines.

e) Provide a double block and bleed isolation valve on each main distribution pipeline immediately downstream of the branch connection to each existing or future operating storage facility served by the pipeline.

f) Provide a double block and bleed isolation valve at intermediate points of approximately 10 miles (16 km) in cross country distribution pipelines to facilitate isolation of a section of the line for maintenance and repair.

g) Provide a double block and bleed isolation valve on each side of water crossing exceeding 100 feet (30 m) in width, and near the shoreline of a submerged sea pipeline.

h) Provide a double block and bleed isolation valve at critical points where pipes cross under runways, taxiways, and roadways.

i) For low-point drains and high-point vents.

1.5.2.5 ISOLATION VALVE PITS. Provide fiberglass or concrete pits with a rolling or hinged cover for all isolation valves installed in non-traffic areas on underground fuel systems. Design valve pits and valve operators so that the valves can be operated by personnel, without confined space entry.

1.5.3 OTHER VALVES (EXCEPT DIAPHRAGM CONTROL VALVES).

1.5.3.1 CHECK VALVES. Use check valves to prevent backflow through pumps, branch lines, meters, or other locations where runback or reverse flow must be avoided. Check valves may be of the swing disk, globe, dual plate hinged disk, spring-loaded poppet, ball, or diaphragm-actuated types. Use checks of soft-seated non-slamming type with renewable seats and disks. Ensure check valves conform to API Spec 6D. Use diaphragm non-surge check valves with flow control feature on the discharge of all pumps. When using non-surge check diaphragm control valves on pump discharge, consider the use of a spring type wafer check before the diaphragm valve to prevent sudden flow reversals during shutdown from passing back thru the pump before the diaphragm control valve diaphragm chamber is filled and reacts by closing the valve.

1.5.3.2 THERMAL RELIEF. Provide thermal relief valves around shutoff and check valves to relieve excessive pressures caused by thermal expansion of liquid trapped between shutoff points. See figures 1, 2, 3 and 4.

1.5.4 DIAPHRAGM CONTROL VALVES. Hydraulically operated, single-seated, globe type, diaphragm actuated control valves are used extensively in fueling systems as control valves. These valves consist of a main valve and a pilot control system. The valve is operated by varying the amount of pressure above the diaphragm. Since the chamber above the diaphragm exposes a greater area of the diaphragm to chamber pressure than the area of the disc exposed to line pressure, an equal pressure in the chamber and pipeline results in a greater force being applied to the top of the disc. This forces the disc against the seat, thus closing the valve. By selecting the proper pilot control system, these valves can be used in numerous ways to control flow, pressure, and level within fueling systems. Use extreme care when including these valves on pipelines as they can significantly contribute to surge potential, if closing time is too short. When properly adjusted, they can reduce surges.

1.5.4.1 OPEN/CLOSE OPERATION. This is the most basic operation of hydraulically operated diaphragm control valves. The operation is accomplished by applying pressure above the diaphragm to close the valve and relieve that pressure to allow line pressure to open the valve. The pilot trim used to perform this operation is a three-way valve which can be controlled by a solenoid, hand, pressure, pressure differential, or a float.

1.5.4.2 THROTTLING OPERATION. This is the other main method of controlling the hydraulically operated diaphragm control valve. In this case, the valve modulates to any degree of opening, in response to changes in the throttling control. The throttling control reacts to a pressure, or a pressure differential across the main valve, or pressure differential across an orifice plate to regulate the position of the disc in the main valve; provide full port manual isolation valves if they are placed within these limits.

1.5.4.3 CHECK VALVE FUNCTION. This is a unique function of a control valve. In this case, the main valve outlet pressure is connected to the diaphragm cover. Therefore, if the downstream outlet pressure exceeds the inlet pressure, which normally holds the valve open, the valve will close and prevent backflow.

1.5.4.4 REMOTE OPERATIONS. Hydraulically operated diaphragm control valves can be operated remotely. This is accomplished by installing tubing from the point of pressure sensing to the valve or by using remote-controlled solenoids within the trim.

1.5.4.5 MATERIALS OF CONSTRUCTION. Use stainless steel pilots and stainless steel tubing. Use bodies, bonnets, and covers made of stainless steel, internally plated (chrome) steel, or internally plated (nickel) nodular iron. Provide Viton or Buna-N diaphragm and disc ring. Enclose all electrical apparatus according to classification of the area in which they are installed. Provide a means to wire seal all adjustable pilots. Do not use aluminum valves.

1.5.4.6 APPLICATIONS. For pipeline systems, use hydraulically operated diaphragm control valves in the following applications:

a) Rate of flow control.
b) Pressure reduction.
c) Pressure relief.
d) Excess flow shutdown.

1.5.4.7 COMBINATIONS. A combination of these controls is also possible.

1.5.5 STRAINERS. Require a strainer to protect centrifugal pumps, unless it precludes meeting the net positive suction head of the pump. Whether or not strainers are installed on the suction side of centrifugal pumps, install a spool piece so that temporary strainers can be installed during startup of the system. Strainers are required on the suction side of all pumps, meters, and receipt filtration. Strainers are not required upstream of issue filter/separators or diaphragm control valves. Also:

a) Use flanged strainers constructed of steel and fitted with removable baskets of fine Monel metal or stainless steel mesh with large mesh reinforcements.
b) Unless otherwise specified, provide a fine screen mesh as follows:
c) In all cases, ensure the effective screen area is not less than three times the cross sectional area of the pipe.

d) Strainers upstream of pump shall be quick opening, single screw type with drain connection at bottom.

e) Provide pressure gauges on both sides of the strainer and a differential type gauge across the strainer.

	Mesh	Size of Opening
Pump suctions (Centrifugal)	7	0.108 inch (2.74 mm)
Pump suctions (Positive Displacement)	40	0.016 inch (0.40 mm)
Receipt Filtration	40	0.016 inch (0.40 mm)
Meter inlets (unless downstream of a filter/separator)	40	0.016 inch (0.40 mm)

1.5.6 SURGE SUPPRESSORS. Every effort should be made to control hydraulic surge or shock to acceptable limits by the design of the piping system rather than by the use of surge suppressors. Where this is not possible or becomes extremely impractical, surge suppressor(s) may be incorporated. Use the diaphragm or bladder type equipped with a top-mounted liquid-filled pressure gauge, wafer-style check valve at the bottom, drain above the check valve, and isolation valve. Provide a needle valve around the check valve to permit controlled bleed back of the surge suppresser without rebounding. Locate surge suppressors as close as possible to the point of shutoff that is expected to cause the shock. Surge suppressors can reduce shock pressure but will not eliminate it entirely. The preferred solution to hydraulic shock is conservative piping design, use of loops, and slow-closing valves. Surge suppressors are strictly a last resort solution and require the approval of The Owner prior to designing into a system.

1.5.7 PIGGING EQUIPMENT. Equip all pipelines with outlets to allow the connection of pig launchers and receivers. Design the outlets so that they can accommodate internal nondestructive inspection trains. Provide sufficient curvature of bends in the pipeline to permit free passage for such equipment. Provide tees with, factory installed internal guide bars, at all branch connections.

1.5.8 PUMPS. If multiple pump stations are required to keep pipeline pressure within safe limits, provide them at appropriate locations.

1.5.9 SAMPLING CONNECTIONS. Provide connections for sampling fuels on each section of a fuel transfer piping system. Install sampling and testing connections at receiving points, tank outlets, inlet and outlet sides of filter/separators, fuel dispensing points, and between isolation valves so that remaining fuel in each portion of a fuel transfer pipeline can be sampled. Where possible, install sampling connections in vertical runs. Provide a 1/4-inch (8 mm) diameter sample point with a probe, ball valve, and quick disconnect with dust cap.

1.5.10 SPECIAL CONSIDERATION FOR AVIATIONTURBINE FUELS. Special considerations for inbound filtration of aviation turbine fuels apply.

1.6 PRODUCT RECOVERY SYSTEMS. Provide a product recovery system to collect and store usable aviation turbine fuel that would otherwise become waste from operational or maintenance activities. Consider a product recovery system for other products.

1.7 CANOPIES.

1.7.1 CANOPIES TO PROTECT FIXED ASSETS FROM EXTREME WEATHER CONDITIONS. Unless otherwise directed by The Owner, provide a canopy to protect fixed facility assets, operators, and equipment from the extreme weather conditions (I.E. re-occurring/sustained extreme icing/snow or desert like conditions. Fixed facilities and equipment include but are not limited to: pump pads, filtration pads, meter pads, isolation valve pads, tank truck and tank-car off-loading and loading equipment pads, control panels, electrical panels, and motor control centers (MCCs).

1.7.2 CANOPIES TO REDUCE STORMWATER. Do not provide a canopy to preclude rain from reaching the containment area unless it is required by federal, state, or local regulations; or it is economically justified by reducing the size of the concrete remote spill containment or spill treatment system; or if directed by The Owner. At a canopy over a tank truck or tank car loading and off-loading containment area, ensure that the underside of the canopy is high enough to provide operator head room when walking on top of the truck or car.

1.8 SPECIAL CALCULATIONS. Calculate pipeline filling/venting times and draining/stripping times. The larger and the longer the pipeline, the greater the volume of fuel required to fill the line and, therefore, the greater the volume of air required to be vented. Undersized vent lines will delay filling the lines and delay changeover of products in multiproduct lines. Size vent lines to allow filling of the line at not more than four times the design transit time of the line. Where applicable, connect vent lines to system drain lines to avoid spills to the environment. Check vent line air velocity, which must not exceed the allowable air velocity to avoid electrostatic buildup, in accordance with API RP 2003. Vent rate must be not less than the lowest allowable pumping rate from ship or shore. Vent rate must be less than the design transit velocity to minimize hydraulic shock.

2. GROUND PRODUCTS FUELING FACILITIES.

2.1 INTRODUCTION. This discussion provides guidance for the design of ground products (gasoline, diesel) fueling facilities and covers vehicle motive fuel filling stations and tactical refueler truck loading facilities. Private vehicle filling stations, such as exchange service stations, are not included.

2.1.1 TYPES OF FACILITIES.

The following three types of filling stations may be required (see figures 5, 6 and 7):

a) A filling station for dispensing motive fuel gasoline and diesel into government (commercial type) sedans, vans, and small trucks. See figure 5.

b) A filling station for dispensing motive fuel gasoline and diesel into vehicles. See figures 5 and 6.

c) A truck loading facility for loading gasoline and diesel into refueler vehicles. See figures 6 and 7.

2.2 GENERAL REQUIREMENTS. Do not start the design of any fueling system without first becoming completely familiar with general design requirements.

2.3 DESIGN REQUIREMENTS.

2.3.1 FUEL SEGREGATION. Provide separate receiving, storage and distribution systems for each grade or type of fuel. Except as otherwise approved by The Owner, prevent misfueling (transferring a type of fuel other than the type intended) by using different size piping, valves, adaptors, nozzles, etc. Use color coding in accordance with API RP 1637. Outside the U.S., use host nation standard if it is different than API RP 1637. Use API RP 1637 if no other standard is in effect.

2.3.2 FACILITY SIZE. In each filling station, provide one commercial-type dispensing unit which displays volume only for each 100 vehicles assigned to the activity. The total amount of storage capacity in each station should be approximately twice the capacity of all vehicle fuel tanks, by grade or type of fuel, assigned to the activity. Minimum storage capacity for any grade or type of fuel is 5,000 gallons (19,000 L) unless approved by The Owner.

2.3.3 FACILITY CONFIGURATIONS. In general, for control and safety, separate the three types of filling stations. For a relatively small installation or one on which there is a limited amount of activity expected at one time, it may not be practical to provide totally separate facilities. In those cases, separate the functions as much as possible to minimize mixing traffic of commercial-type vehicles from tactical vehicles and, more importantly, from mixing tactical refuelers which are being loaded with relatively large quantities of fuel from other vehicles which are being fueled for their own engine (motive fuel). Filling stations must be configured to comply with all NFPA 30A siting and storage requirements.

2.3.4 SHELTERS. For staffed facilities, provide a shelter for personnel, records, and tools.

2.3.5 CONCRETE FUELING AREA – FILLING STATIONS. Create a fueling area constructed of concrete by surrounding fueling islands with a concrete slab graded at a minimum of 1 percent away from the islands.

2.3.6 CONCRETE FUELING AREA –REFUELER TRUCK LOADING FACILITIES. Provide concrete spill containment areas and concrete remote spill containment systems.

2.3.7 CANOPIES.

2.3.7.1 CANOPIES TO PROTECT FIXED ASSETS. Provide a canopy for protection from the elements of fixed facility assets and equipment as directed by The Owner, for all pumps, meters, strainers, filters, control panels, electrical panels, and motor control centers (MCCs).

2.3.7.2 CANOPIES TO REDUCE STORMWATER AT REFUELER TRUCK LOADING FACILITIES. Do not provide a canopy to preclude rain from reaching the containment area unless it is required by federal, state, or local regulations; or it is economically justified by reducing the size of the concrete remote spill containment or spill treatment system; or if directed by The Owner. Ensure that the underside of the canopy is high enough to provide operator head room when walking on top of the truck.

2.3.7.3 CANOPIES TO REDUCE STORMWATER OF FILLING STATIONS. Do not provide a canopy to preclude rain from reaching the concrete fueling area unless it is required by federal, state, or local regulations; or a concrete remote spill containment or treatment system is required by federal, state, or local regulations and it is economically justified by reducing the size of the remote spill containment or spill treatment system; or if directed by The Owner.

2.3.8 REGULATIONS.

Design must comply with NFPA 30, NFPA 30A, and API RP 1615.

2.3.9 BOTTOM LOADING. The bottom loading of refuelers is required if the refuelers are equipped for it. However, there are refuelers which are not equipped for bottom loading and which will be in inventory for several years. Therefore, consult The Owner before providing top loading at tactical refueler fillstands.

2.3.10 TRUCK OFFLOAD AND LOADING FACILITIES. Design of service station truck offload and loading facilities must comply with NFPA 30, NFPA 30A and 40 CFR Part 112. Also, do not locate truck offload or tactical refueler loading facilities closer than 25 feet (7.6 m) from above ground tanks, buildings, roads, overhead power lines, pad-mounted transformers, and property lines. With the exception of overhead power lines, these minimum separation distances may be permitted to be reduced to 15 feet (4.6 m) for Class II or III liquids.

2.4 STORAGE TANKS. For ground products fueling facilities underground, horizontal tanks are preferred. Follow federal, state, and local regulations when determining use of AST or UST.

2.5 PIPING SYSTEMS.

2.5.1 PIPING SYSTEM – TACTICAL REFUELER FACILITIES. For systems serving tactical refueler fillstands see appropriate references.

2.5.2 ABOVEGROUND PIPING SYSTEM – FILLING STATIONS. Follow state or local regulations when they exceed these requirements. When they do not exceed them, provide as described with the following exceptions:

a) Piping 4 inches (100 mm) and larger shall be buttwelded or socket welded. Use flange connections for joining pipe to equipment.
b) Piping smaller than 4 inches (100 mm) may be buttwelded, or socket welded. Use flange connections, or socket weld connections with unions for joining pipe to equipment. Threaded end connections may be used only where buttwelded or socket welded connections cannot physically be provided.
c) Branch outlet fittings do not have to be designed to be radiographed.

2.6 EQUIPMENT DESCRIPTIONS.

2.6.1 FILLING STATIONS.

2.6.1.1 FUEL DISPENSERS. Use a commercially available dispenser with a self-contained electric motor and pumping unit or a remote pumping type where the pump and motor are located in the storage tank. If an in-tank type of pump is used, ensure that it is equipped with a reduced start volume as a leak check. Provide a meter for each dispenser. Dispenser flow rates are typically a maximum of 10 gpm (0.6 L/s); follow state and local regulations for actual maximum. Designer shall check with state and local regulations for limitations on dispenser flowrates. Dispensing system will include management control system, printers, computers, and microprocessors. Equip fuel dispensers with an inline filtration system capable of sediment removal to 10 mg/L or less. Add emergency break-away hose connections at each fuel dispenser in accordance with NFPA 30A. Where liquid is supplied to the dispenser under pressure, provide an emergency shutoff valve, incorporating a fusible link, in the supply line at the base of each dispenser as required by NFPA 30A. Equip dispensing islands with impervious spill containment pans under the dispensers.

2.6.1.2 CARD AND KEY LOCKS. Consider the possible economic and operational advantages of using an electronic card or key system which permits 24-hour unmanned operation of the facility. These types of systems are comprised of a card/key reader which is located near the service pump. The reader is activated by a card or key and accumulates issues and customer data which is downloaded to a central computer on a periodic basis.

2.6.2 REFUELER TRUCK LOADING FACILITIES. Equip similar to truck loading facilities except provide a grounding reel in lieu of the high-level shutoff/ground detecting system. Verify the type of nozzle required by the user.

2.6.3 VALVES. For systems serving refueler fillstands see the requirements for tank truck loading facilities. The below requirements apply to filling station only.

2.6.3.1 MATERIALS OF CONSTRUCTION. Require valves to have carbon steel bodies and bonnets. Do not allow valves with aluminum, cast iron, or bronze materials. Use only API fire-safe valves.

2.6.3.2 ISOLATION VALVE TYPES.

a) Ball Valves: These are the only approved quick opening/frequent opening isolation valves. Ball type, lockable, valves designed so that if the synthetic seating material is burned out in a fire, a metal-to-metal seat will remain to affect closure and comply with API Std 607. Use Teflon or Viton synthetic seals or seating material. Valves should comply with API Std 608.

b) Double Block and Bleed Isolation Valves: Do not provide unless directed by the Owner.

c) Lubricated Plug Valves: Lubricated plug valves are not allowed.

d) Gate Valves: Gate valves are not allowed.

e) Butterfly Valves: Butterfly valves are not allowed.

2.6.3.3 ISOLATION VALVE OPERATORS. Manually operate valves not specified for remote, automatic, or emergency operation. Use geared operators for ball valves larger than 6 inches (150 mm). Provide locking tabs on isolation valves to allow padlock to be used to lock out the valves during maintenance. Provide chain operators on valves which are located 72 inches (1800 mm) or higher above grade.

2.6.3.4 ISOLATION VALVE LOCATIONS. Provide isolation valves in piping systems to control flow and to permit isolation of equipment for maintenance or repair, or as necessary to conduct a valid hydrostatic test. As a minimum requirement, provide isolation valves at the following locations:

a) Where piping goes underground or comes aboveground and requires periodic pressure testing.

b) At all subsurface and aboveground piping connections to storage tanks.

c) On the suction side and discharge side of each pumping unit, except the suction side of vertical centrifugal pumps installed in underground tanks.

d) On the inlet and outlet connection of each line strainer, meter, diaphragm control valve, and other equipment that requires periodic servicing. One inlet valve and one outlet valve may be used to isolate more than one piece of adjacent equipment which are connected in series.

2.6.4 DIAPHRAGM CONTROL VALVES. These valves are not required in filling stations.

2.6.5 OTHER VALVES.

2.6.5.1 CHECK VALVES. Use check valves to prevent backflow through pumps, branch lines, meters, or other locations where runback or reverse flow must be avoided. Check valves may be of the swing disk, globe, dual plate hinged disk, spring-loaded poppet, ball, or diaphragm-actuated types. Use checks of soft-seated non-slamming type with renewable seats and disks. Ensure check valves conform to API Spec 6D.

2.6.5.2 THERMAL RELIEF. Provide thermal relief valves around isolation and check valves to relieve excessive pressures caused by thermal expansion of liquid trapped between shutoff points. See figures 1, 2, 3 and 4.

2.7 VAPOR RECOVERY. Provide vapor recovery in accordance with guide specifications unless there are more stringent federal, state, and local codes or regulations. Some requirements are in 40 CFR Part 60 Subpart XX. If gasoline is being handled, provide, as a minimum, Stage I vapor recovery and the piping for Stage II. If Stage II is not required by local or state regulations at time of installation, cap the vapor return pipe at the dispenser.

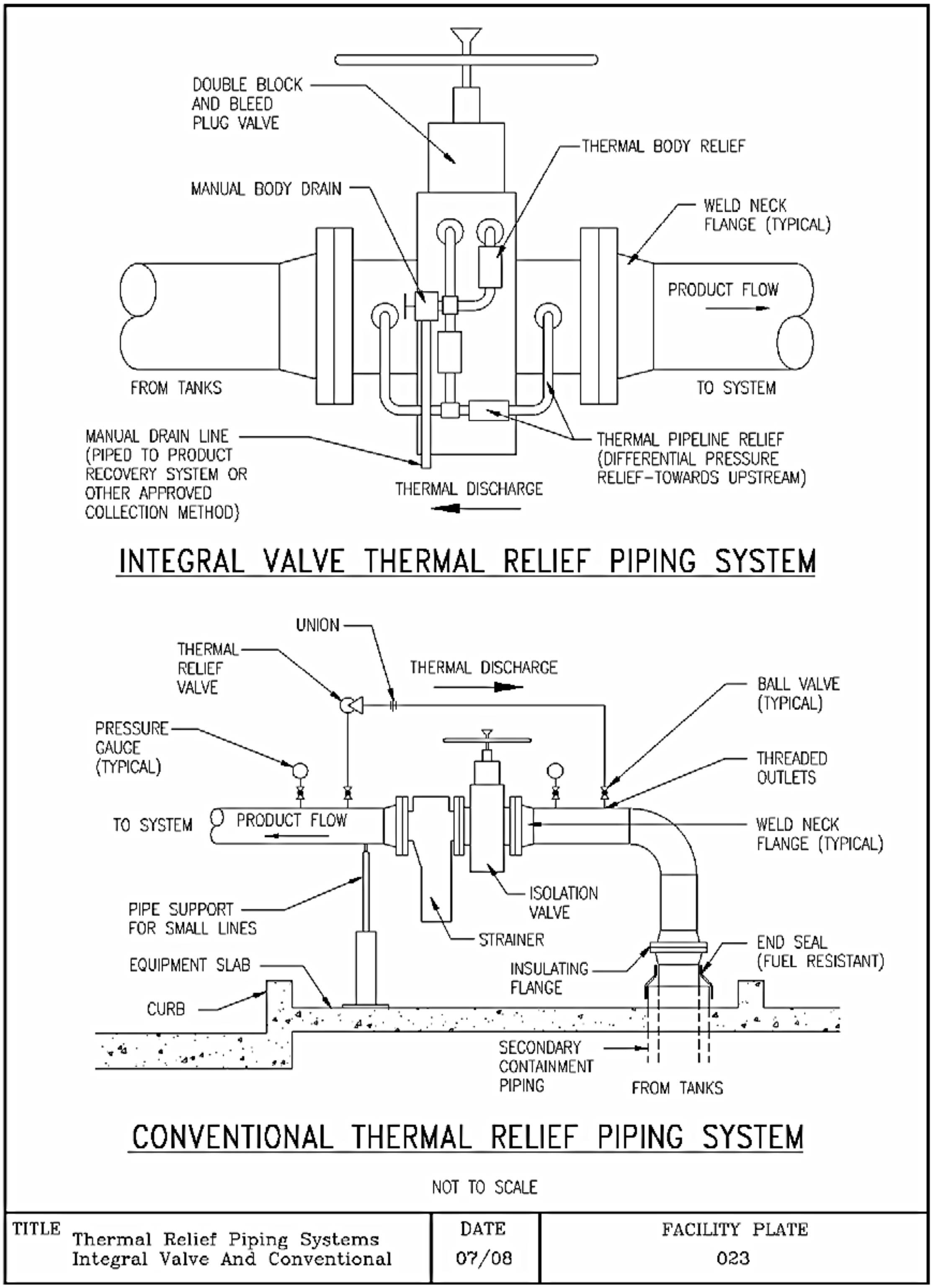

DOUBLE BLOCK AND BLEED PLUG VALVE
THERMAL BODY RELIEF
MANUAL BODY DRAIN
WELD NECK FLANGE (TYPICAL)
PRODUCT FLOW
FROM TANKS
TO SYSTEM
MANUAL DRAIN LINE (PIPED TO PRODUCT RECOVERY SYSTEM OR OTHER APPROVED COLLECTION METHOD)
THERMAL DISCHARGE
THERMAL PIPELINE RELIEF (DIFFERENTIAL PRESSURE RELIEF–TOWARDS UPSTREAM)
INTEGRAL VALVE THERMAL RELIEF PIPING SYSTEM
UNION
THERMAL RELIEF VALVE
THERMAL DISCHARGE
BALL VALVE (TYPICAL)
PRESSURE GAUGE (TYPICAL)
THREADED OUTLETS
TO SYSTEM
PRODUCT FLOW
WELD NECK FLANGE (TYPICAL)
ISOLATION VALVE
PIPE SUPPORT FOR SMALL LINES
STRAINER
EQUIPMENT SLAB
INSULATING FLANGE
END SEAL (FUEL RESISTANT)
CURB
SECONDARY CONTAINMENT PIPING
FROM TANKS
CONVENTIONAL THERMAL RELIEF PIPING SYSTEM
NOT TO SCALE
TITLE
Thermal Relief Piping Systems
Integral Valve And Conventional
DATE
07/08
FACILITY PLATE
023

Figure 1

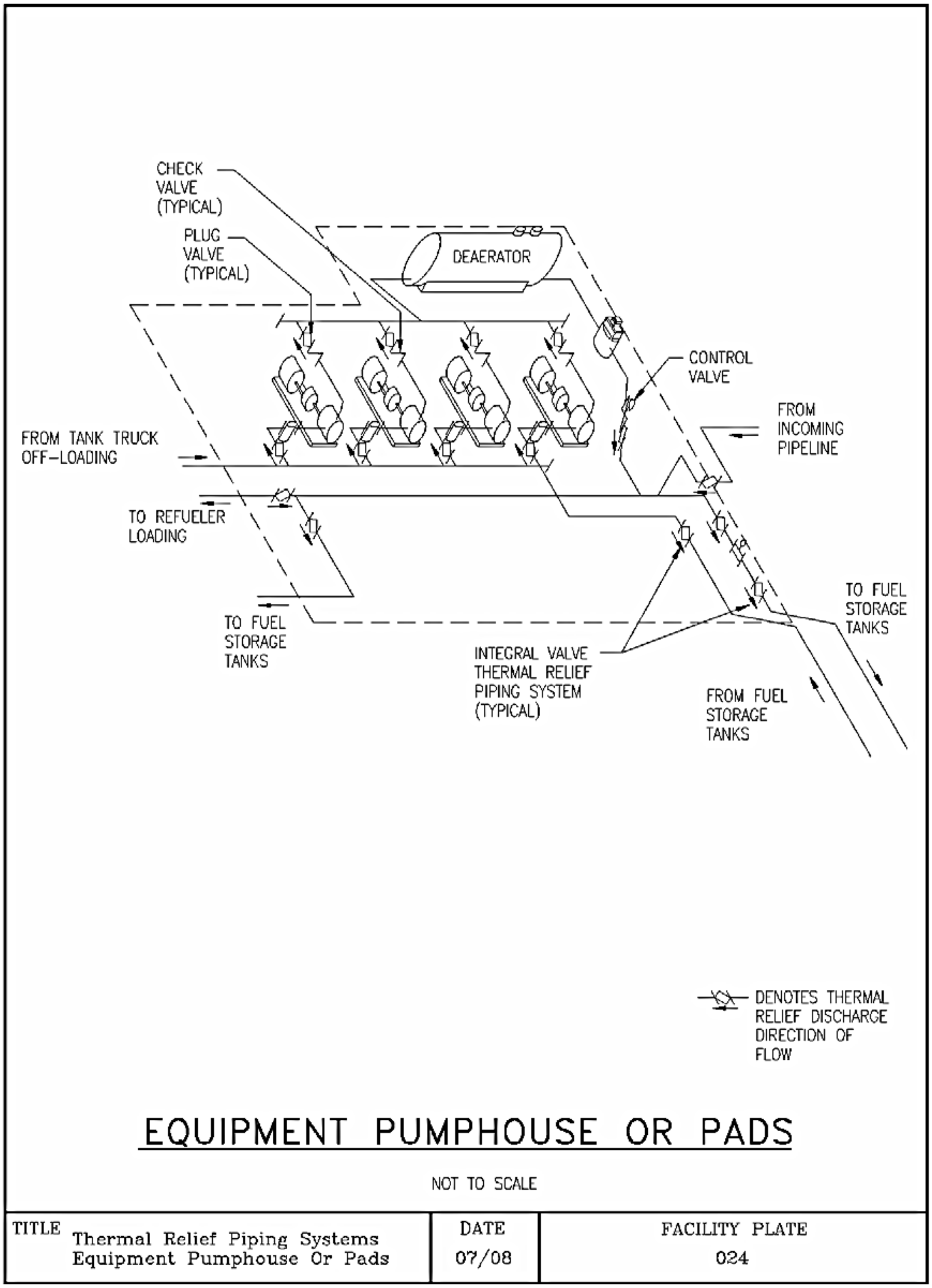

CHECK VALVE (TYPICAL)
PLUG VALVE (TYPICAL)
DEAERATOR
CONTROL VALVE
FROM INCOMING PIPELINE
FROM TANK TRUCK OFF–LOADING
TO REFUELER LOADING
TO FUEL STORAGE TANKS
INTEGRAL VALVE THERMAL RELIEF PIPING SYSTEM (TYPICAL)
TO FUEL STORAGE TANKS
FROM FUEL STORAGE TANKS
DENOTES THERMAL RELIEF DISCHARGE DIRECTION OF FLOW
EQUIPMENT PUMPHOUSE OR PADS
NOT TO SCALE
TITLE
Thermal Relief Piping Systems
Equipment Pumphouse Or Pads
DATE
07/08
FACILITY PLATE
024

Figure 2

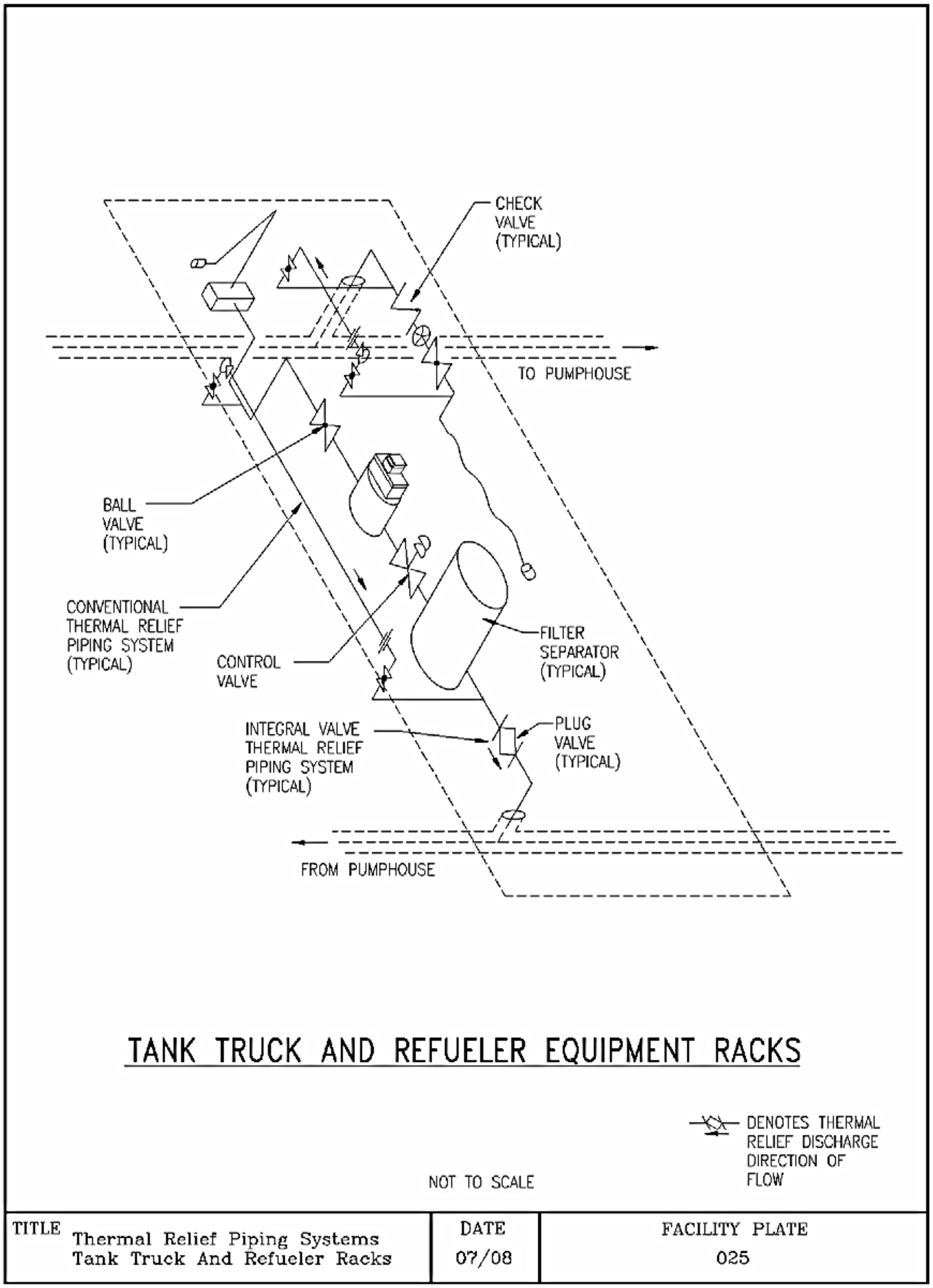

CHECK VALVE (TYPICAL)
TO PUMPHOUSE
BALL VALVE (TYPICAL)
CONVENTIONAL THERMAL RELIEF PIPING SYSTEM (TYPICAL)
CONTROL VALVE
FILTER SEPARATOR (TYPICAL)
INTEGRAL VALVE THERMAL RELIEF PIPING SYSTEM (TYPICAL)
PLUG VALVE (TYPICAL)
FROM PUMPHOUSE
TANK TRUCK AND REFUELER EQUIPMENT RACKS
DENOTES THERMAL RELIEF DISCHARGE DIRECTION OF FLOW
NOT TO SCALE
TITLE Thermal Relief Piping Systems Tank Truck And Refueler Racks
DATE 07/08
FACILITY PLATE 025

Figure 3

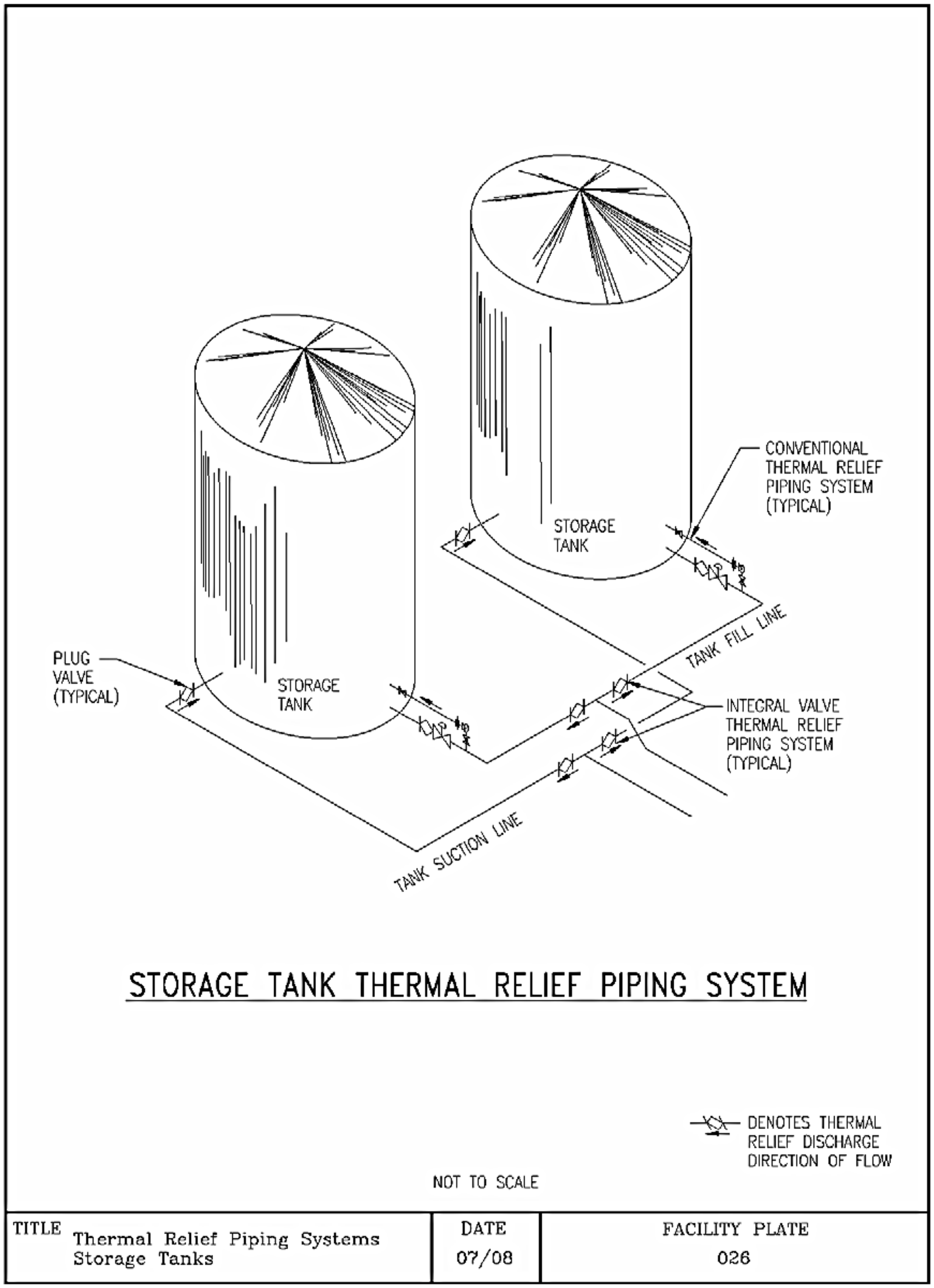
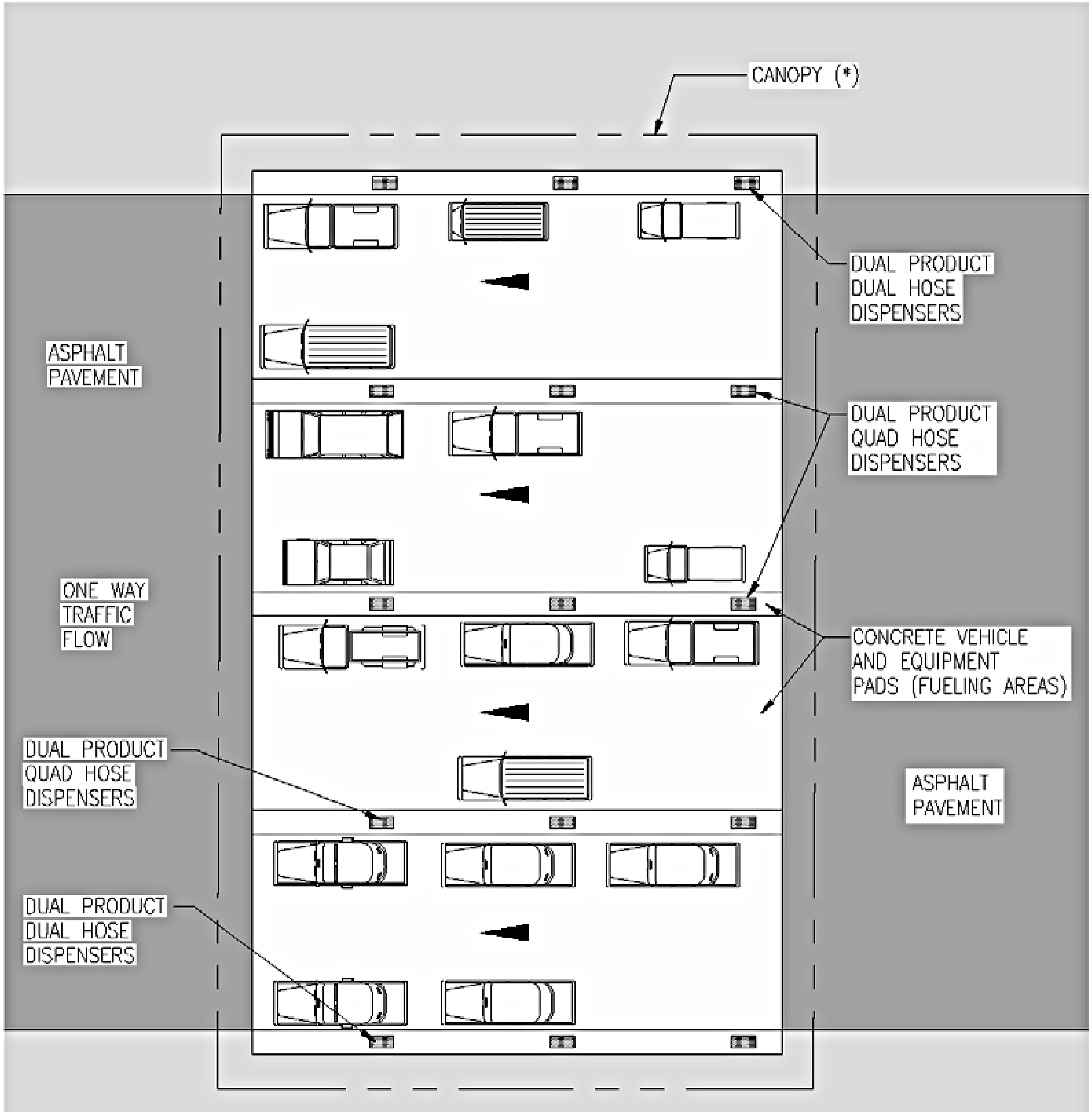
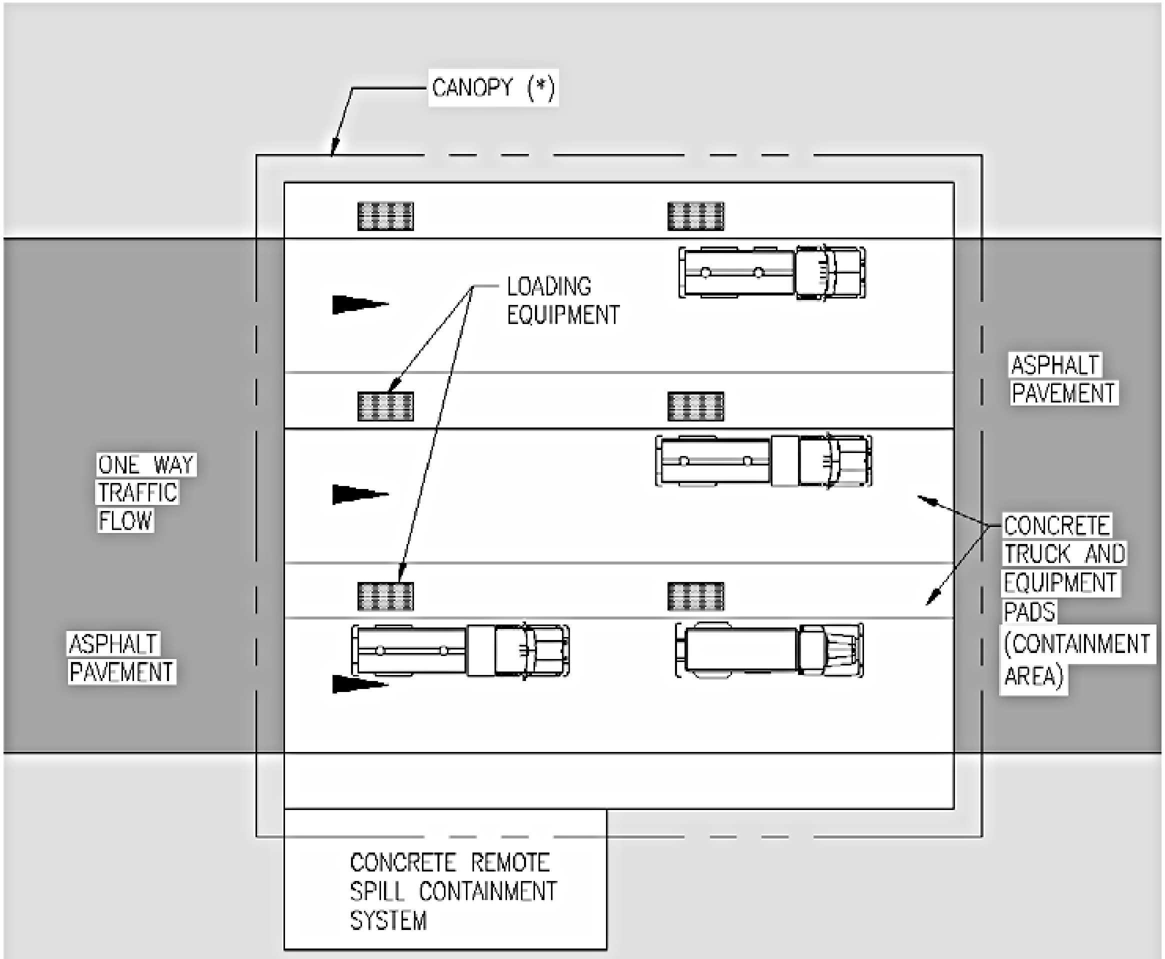

CONVENTIONAL THERMAL RELIEF PIPING SYSTEM (TYPICAL)
STORAGE TANK
PLUG VALVE (TYPICAL)
STORAGE TANK
TANK FILL LINE
INTEGRAL VALVE THERMAL RELIEF PIPING SYSTEM (TYPICAL)
TANK SUCTION LINE
STORAGE TANK THERMAL RELIEF PIPING SYSTEM
DENOTES THERMAL RELIEF DISCHARGE DIRECTION OF FLOW
NOT TO SCALE
TITLE Thermal Relief Piping Systems Storage Tanks
DATE 07/08
FACILITY PLATE 026

Figure 4



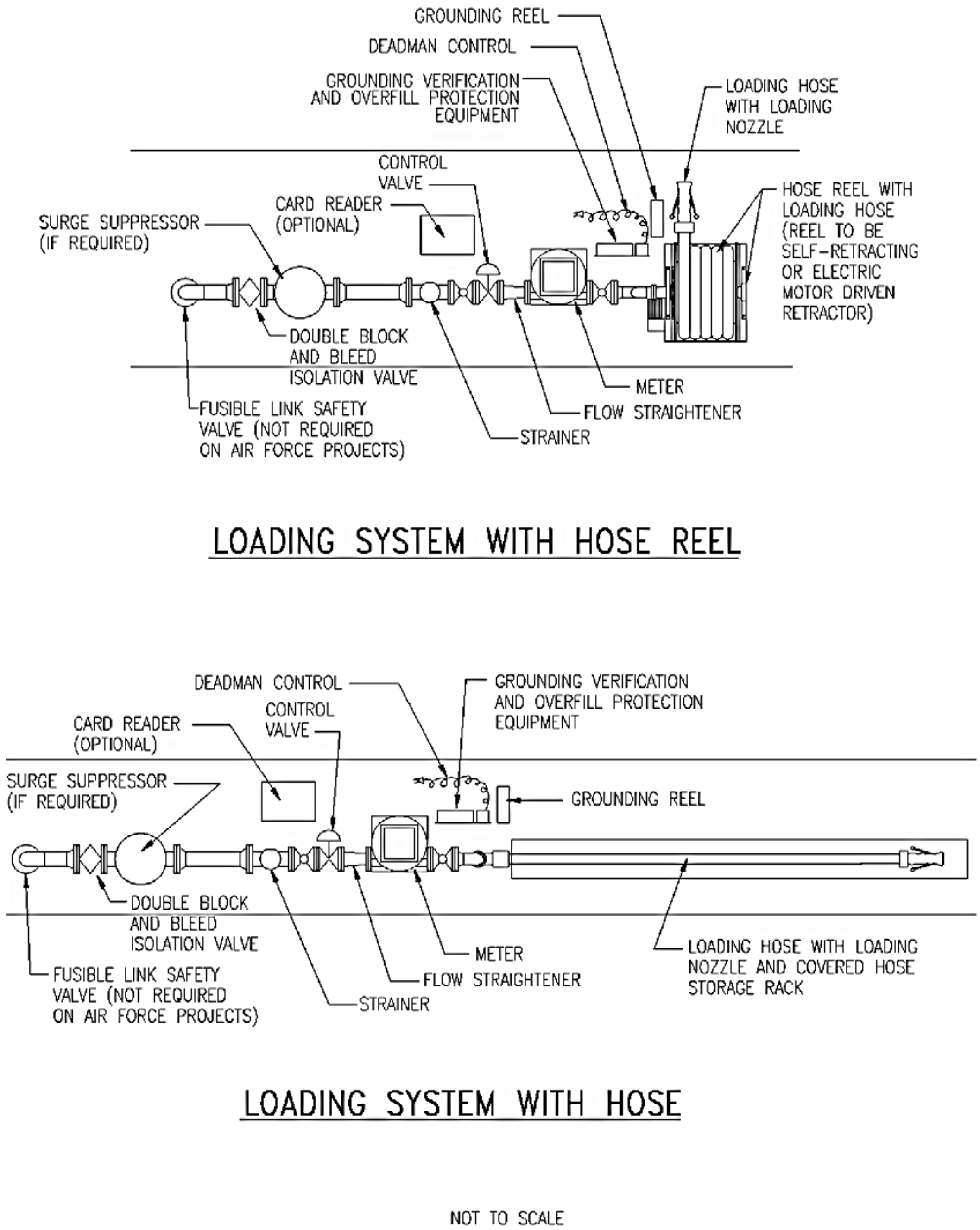
Vehicle Motive Fuel Filling Station Plan

Figure 5



Refueler Ground Product Truck Loading Facility Plan

Figure 6



TITLE Refueler Ground Product Truck Loading Facility Plan	DATE 07/08	FACILITY PLATE 013

Figure 7