DESIGN AND PROTECTION FOR EMERGENCY AND STANDBY POWER SYSTEMS

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1.0 SCOPE

The purpose of this data sheet is to describe the types, operation, maintenance, and protection of emergency and standby power systems, and to provide guidelines for their application. An emergency power system can range from systems designed to provide limited power demands aimed at building evacuation in the event of an emergency, to systems designed to supply full power needs to keep critical operations functioning for extended periods of time. This data sheet does not cover power generation processes that are used to supplement or fulfill daily power needs for a facility.

The necessity of an emergency power system is based on occupancy and location-specific conditions. See the relevant occupancy-specific data for guidance on the need to provide emergency power.

Recommendations are included for the arrangement and protection of fuel supplies feeding emergency and standby power systems. Although diesel fuel is commonly used as an example, the recommendations in this data sheet apply to any liquid fuel used for emergency and standby power systems.

The use of other fuels, such as propane or natural gas, are not covered in detail within this document. The design, installation, and maintenance of alternative fuel-fired emergency and standby power generation should be carried out in accordance with the appropriate FM data sheets and applicable local codes.

Not all types of emergency and standby power generation are appropriate for all scenarios, and the type of equipment to use depends on the application. Refer to Sections 2.7.2 and 3.1 for generator rating and selection guidance.

1.1 Changes

January 2022. Interim revision. Significant changes include the following:

A. Changed the title of the data sheet.

B. Added a recommendation on the arrangement of diesel engine exhaust systems.

C. Added a recommendation for inspection and maintenance of diesel engine exhaust systems.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 General

2.1.1 Use only the type and grade of fuel specified by the engine manufacturer.

2.1.2 Do not use fuels with flash points below 100°F (38°C), such as gasoline.

2.1.3 Do not use biodiesel fuels in emergency and standby power systems; these fuels are prone to stability problems when they are stored for extended periods of time.

2.2 Construction and Location

2.2.1 Locate power systems and their associated fuel supply systems outside important buildings.

2.2.1.1 Arrange outdoor fuel tanks in accordance with Data Sheet 7-88, *Outdoor Ignitable Liquid Storage Tanks*.

2.2.2 If the main fuel tanks must be located inside important buildings, isolate them by using fire-rated, liquid-tight construction, containment, and emergency drainage in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.2.2.1 Secondary containment (double-walled) tanks or tanks encased in concrete are not considered an alternative to containment and emergency drainage. The construction of the tank will not have an impact in limiting potential release scenarios, including a release during filling and a leak in a discharge line.

2.2.3 Isolate fuel pumps and generators located inside buildings as follows:

A. For fuel pump(s) and generator(s) located at or above grade level, provide a minimum 1-hour fire-rated cutoff room located along an outside wall with openings accessible to firefighters. Design cutoff rooms in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

B. For fuel pump(s) and generator(s) located below grade level, provide a 3-hour fire-rated, liquid-tight, concrete or masonry vault.

2.2.4 Provide a containment and emergency drainage system for the generator/pump rooms or vaults, regardless of location, in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*. This can be achieved through localized containment around individual pieces of equipment (ensuring all potential leak points such as flanges and threaded connections are inside containment), or through wider area containment such as at the room perimeter.

2.2.5 Protect building structural elements that can be immersed in a liquid pool fire in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.2.6 In 500-year or less earthquake zones, provide restraint and appropriate flexibility in piping connections for diesel emergency generators and associated fuel tanks, and piping systems per Data Sheet 1-11, *Fire Following Earthquake*s.

2.2.7 In 500-year or less earthquake zones, provide FM Approved emergency shutoff valves arranged to close automatically and shut down pumping from the main storage tank during a seismic event.

2.2.8 Locate all equipment above the predicted 0.2% annual exceedance (500-year) flood elevation and include at least 1 to 2 ft (0.3 to 0.6 m) of freeboard.

2.2.9 Locate and protect fuel truck unloading areas in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.2.10 Route tank breather vents and overflow piping to a safe location outside the building.

2.2.11 Do not use fuel headers in place of tanks or for additional fuel storage capacity.

2.2.12 Locate electrical switchgear and transfer switches in a separate room from generators and fuel supply systems. Design the room with a minimum 1-hour fire rating. If the electrical room is adjacent to the generator or pump room, provide liquid-tight construction to prevent exposure from a fuel spill in the compromising room.

2.3 Equipment and Processes

2.3.1 General

2.3.1.1 Arrange and protect fuel pumps located inside buildings by providing one or more of the safeguards listed below. The intent is to minimize the release of the tank contents in the event of a broken pipe or leak. Appropriate safeguards will vary depending on the emergency fuel system configuration.

A. Provide positive displacement pumps sized to provide the needed flow rate. Weld the supply side of the pump to the supply pipe to ensure the liquid content is maintained in the piping between the tank and the pump.

B. Connect all piping to the top of the fuel tank. Elevate the piping and pumps above the top of the fuel tank, at a minimum (i.e., locate the tank liquid level below the point of use to prevent flow due to gravity), or provide an anti-siphon valve. Locate the anti-siphon valve as close to the tank outlet as possible. Install and maintain this equipment in accordance with the manufacturer's recommendations.

C. For piping or pumps located below the tank's liquid level, or when the pump is a centrifugal type, provide an automatic means of shutting off the fuel in the event of a fire and/or leak. If the pump is located in a separate room/vault from the tank, locate the shutoff device at the tank outlet.

D. Provide a pressure-relief valve downstream of the positive displacement pump, piped back to the supply tank.

2.3.2 Fuel Distribution Systems

2.3.2.1 In general, isolate, construct, and arrange fuel piping and transfer systems in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*. Specific recommendations for emergency and standby power generation fuel systems are as follows:

A. Provide minimum thickness schedule 40 (or equivalent) steel pipe and fittings, with welded fittings in all areas outside of the tank room, pump room, and generator room.

B. If welded fittings are not used, locate piping in sealed pipe chases/shafts with at least a 2-hour fire rating. Install a drainpipe at the base of shafts enclosing the supply and overflow piping. Arrange the drainpipe so it leads to an open sight drain or to an open sump. Slope horizontal chases to drain into a shaft. Do not penetrate pipe chases/shafts with other piping or ducts. Do not install other piping or ducts within the chases/shafts for fuel piping.

If this alternative arrangement is used, design the drainpipe to be a maximum of 3/4 in. (19 mm). Provide leak detection at the bottom or low point of the drain or sump, arranged to sound an alarm at a constantly attended location.

C. Do not use threaded pipe fittings.

D. Minimize the use of flexible hoses in fuel supply systems. Where these are present, design in accordance with Data Sheet 7-32, *Ignitable Liquid Operations.*

2.3.2.2 Protect and arrange fuel distribution systems located inside important buildings as follows.

2.3.2.2.1 Arrange the fuel distribution system (including storage tank filling operations) to automatically shut down the flow of fuel in the event of a fire or leak in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*. Provide notification of fuel shut down to a constantly attended location.

2.3.2.2.2 Provide FM Approved automatic leak detection in the following locations:

A. Main fuel storage tank room/vault

B. Fuel pump room/vault

C. Generator room floor in diked areas surrounding day tanks.

D. Within all double-walled piping systems (low-point interstitial drains also meet the intent of this recommendation)

E. In all pipe chases/shafts, except where pipe is fully welded

2.3.2.2.3 Provide a manual remote shutoff for the fuel pumps and safety shutoff valves in a readily accessible location under fire conditions (e.g., outside pump, tank, or generator rooms and at the main alarm panel).

2.3.2.2.4 Arrange pumps to operate on low day tank level plus generator operation. This arrangement may require that pumps be arranged to run manually to top-off tanks after engine tests. Arrange manual pump operation via a “dead-man” switch.

2.3.2.3 If continuity of operations is so critical that emergency or standby power systems cannot automatically be shut down under any circumstances, provide multiple generators in isolated areas, with each location and system configured as outlined in this data sheet.

2.3.2.3.1 Provide multiple main fuel pumps, as necessary, to independently supply fuel to each generator. With this arrangement, if one system is automatically shut down due to a fire the other will remain available to operate critical systems.

2.4 Occupancy

2.4.1 Provide ventilation and exhaust, where applicable (e.g., the generator room), to prevent overheating of equipment and air for combustion.

2.4.1.1 Design ventilation systems according to the generator and/or engine manufacturer’s recommendations.

2.4.1.2 Interlock the ventilation system (louvers, fans, etc.) with operation of the generator.

2.4.2 Maintain pump room temperature above 40°F (4°C) and the diesel engine cooling water above 70°F (20°C) for reliable starting. An acceptable alternative is to provide lubricating oil and cooling water heating.

2.4.3 Install internal combustion engine exhaust piping in accordance with Data Sheet 7-78, *Industrial Exhaust Systems*.

2.4.4 Arrange exhaust systems to exit the building in the shortest, most direct route.

2.5 Protection

2.5.1 Provide automatic sprinkler protection in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.5.2 Automatic sprinkler protection may be supplemented with an FM Approved fixed special protection system in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, to limit fire damage or as an alternative to an emergency drainage system.

2.5.3 Provide automatic fire detection in the main fuel storage tank room/vault, fuel pump room/vault, generator room, and areas containing fuel piping, including enclosed pipe shafts or chases. Use of water flow alarms or heat, smoke, or flame detection is an acceptable means of detecting a fire.

2.6 Operation and Maintenance

2.6.1 Conduct inspection, testing, and maintenance of generators, and manual and automatic transfer switches in accordance with Data Sheet 5-20, *Electrical Testing*.

2.6.2 Keep static devices (including inverters, exciters, and voltage regulators) clean, cool, and dry. Inspect them for loose connections at least annually.

2.6.3 Conduct inspection, testing, and maintenance of internal combustion engines in accordance with Data Sheet 13-26, *Internal Combustion Engines*.

2.6.4 Where evidence of wet stacking or accumulation of residue exists, conduct an internal inspection and cleaning of exhaust piping and ducts as needed.

Wet stacking occurs when an engine runs unloaded or with too light a load. To avoid wet stacking, run the engine at minimum loads specified in Data Sheet 5-20, *Electrical Testing*, or by the manufacturer, whichever is more severe.

2.6.5 During a power outage and while the generator is operational, conduct visual inspections every 1 to 3 hours to check for irregularities in operating conditions such as fuel level, operating temperatures, vibrations, abnormal noises, or to detect leaks.

2.6.6 Provide a water separator fuel filter. Fuel oil is regularly contaminated with water.

2.6.7 Provide a visual and/or audible alarm to a constantly attended location indicating the following conditions:

A. System on normal power

B. System on emergency/standby power

C. Failure of emergency/standby power system

2.6.8 Provide drivers with an alarm and/or automatic trip on the following functions, where applicable:

A. Overspeed alarm and trip

B. Low lube-oil pressure alarm and trip

C. High engine cooling water temperature alarm and trip

D. Low battery voltage alarm

2.6.9 Maintain engine starting batteries as follows:

A. Weekly

Check level of electrolyte. Refill to proper level, when necessary, using only water recommended for battery use. Record amount of water used. Abnormal use of water indicates overcharging.

B. Monthly

1. Check and record specific gravity and voltage of the pilot cell on each battery or group of cells to indicate the entire battery's state of charge.
2. Remove any dust or dirt accumulations on the tops of cells, and keep them clean and dry.
3. Give the battery an equalizing charge to ensure it is fully charged.

4. Check specific gravity and voltage of each individual cell. Uneven cell voltages and specific gravity indicate trouble or approaching failure. If trouble is due to undercharging, an equalizing charge will restore all cells to normal.

C. Quarterly

1. Inspect battery terminals and ensure they are clean, tight, and free of corrosion.
2. Check for adequate ventilation in the area where the battery is located.

2.6.10 Strictly control all maintenance, repair, and hot work operations that are conducted on the fuel distribution system in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.6.11 Establish a comprehensive preventive maintenance program designed to ensure that equipment in the fuel storage and distribution system is operating as designed. Refer to Data Sheet 9-0, *Asset Integrity*, to evaluate existing programs or as a guide to developing new programs. Include regular documented testing of safety devices and process control features (such as leak detection, SSOVs, heat detectors, anti-siphon valves, high tank level interlocks, etc.) in accordance with the manufacturer's recommendations.

2.6.11.1 Include the following in preventive maintenance programs for equipment and areas containing ignitable liquids:

A. Mechanical and electrical equipment

B. Piping systems (connect/disconnect points, pumps, fittings, flexible pressure hoses, supports, etc.)

C. System control devices (valves, computer controllers, etc.)

D. Emergency control or relief devices (emergency shutoff valves, float valves, pressure relief devices, etc.)

E. Storage tanks

2.6.11.2 Conduct monthly inspections to detect and repair leakage. health-vapor detectors may be used to locate small leaks in enclosed areas.

2.7 Electrical

2.7.1 Provide emergency or standby power with sufficient capacity for an orderly shutdown or continued operation for any process control and supervisory systems where a serious hazard would result from a loss of power. Some examples of where this might be relevant are as follows:

- Combustion safety controls on large or important boilers, ovens, or furnaces
- Ventilation in any area where flammable vapor may be present, such as in ignitable liquid storage, dispensing, and processing areas
- Turbine lube oil systems
- Temperature and humidity control in areas where such conditions are critical
- Important equipment that could be damaged extensively during a prolonged power outage
- Goods in-process that could be damaged because of a power outage
- Sump pumps and other equipment critical to preventing damage to a facility as the result of flooding, stormwater runoff to low-point drains, or seepage into a facility
- Systems supporting fire protection equipment, such as jockey pumps, compressors, monitoring systems, etc.

2.7.2 Ensure emergency and standby power systems can supply 120% of the calculated load, including starting current and continuous running currents for all critical demand equipment, and all transient loads, for the expected duration of the loss of utilities. Ensure the system has been sized by a competent person. This can be achieved by using the following methods:

A. Provide battery-based energy storage systems. For DC battery systems, refer to Data Sheet 5-28, *DC Battery Systems* or, for lithium-ion batteries, refer to Data Sheet 5-33, *Lithium-Ion Battery Energy Storage Systems.*

B. Provide generator(s). If continuity of power is critical, have generators automatically started. In addition, batteries may be necessary to cover the generator startup period and allow the critical load to be transferred to the emergency source within 10 seconds.

1. Select appropriately designed diesel generators for the application (see Section 3.1 for further information on the following power generation types):

   a. Emergency standby power (ESP). ESP is typically designed for 200 hours of operation per year.
   b. Limited time running power (LTP). LTP is typically designed for 500 hours of operation per year.
   c. Continuous operating power (COP). COP is typically designed for 24 hours per day for 365 days.

2.7.3 Install emergency and standby power systems in accordance with NFPA 70, *National Electrical Code*, or equivalent national or local code.

2.7.4 Provide each load served by an emergency or standby power system with an appropriate overcurrent protective device whenever practical. Ensure a coordination study has been completed for the electrical system(s) that will be powered from the emergency or standby power system.

2.7.5 Ensure the generator neutral bonding to ground scheme is compatible with the site's electrical system neutral bonding scheme (i.e., for the electrical load that will be powered from the emergency or standby power system).

2.7.6 When used, provide transfer switches of a type that prohibit the connection of the ac line and auxiliary supply simultaneously.

2.7.7 Ensure emergency and standby power systems that connect to the site's industrial control systems meet the recommendations in Data Sheet 7-110, *Industrial Control Systems*.

2.8 Batteries

2.8.1 Provide batteries and battery racks constructed in accordance with Article 480 of NFPA 70, *National Electrical Code*.

2.8.2 Provide sufficient ventilation to prevent an explosive accumulation of hydrogen gas.

2.8.3 Maintain the battery room or area as close to 77°F (25°C) as possible to limit the production of hydrogen.

2.8.4 Provide overcurrent protection by means of fuses or molded case circuit breakers.

2.8.5 Provide battery chargers with both undercharge and overcharge protection.

2.8.6 Locate batteries where they will not be exposed to mechanical damage, heat dust accumulations, or hazardous processes.

2.8.7 Ensure governors and regulators are of a type that will maintain the frequency and voltage within the limits required by the load served.

2.8.8 Provide emergency electrical systems for healthcare facilities in accordance with NFPA 99, *Health Care Facilities Code*.

2.9 Human Factor

2.9.1 Train personnel on standard operating procedures of emergency or standby power systems in accordance with Data Sheet 10-8, *Operators*.

2.9.1.1 Ensure employees who are responsible for the maintenance and operation of the fuel system understand the hazard created by the system and know how to respond to emergency conditions in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.9.2 Provide a written procedure for the filling of the bulk storage of generator fuel.

2.9.2.1 Ensure operators are appropriately and regularly trained in this procedure, including relevant safeguards on the fuel transfer system.

2.9.3 Ensure the building's emergency response plan (ERP) includes a discussion with the local fire service to address the following for all emergency or standby power systems:

- Location and intended operation of any emergency or standby power systems
- Written details for manual shutdown of fuel transfer systems
- Locations of bulk storage of fuel

2.9.4 Fuel safety shutoff valves should alarm to a constantly attended location. Trained personnel must be available to respond, evaluate the situation and take appropriate action including reopening the valve if there is no concern.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Generator Set Power Ratings

The following descriptions illustrate the difference between the types of generators that are available and explain which application they are most appropriate for.

Emergency standby power (ESP): A generator set designated as an ESP is intended to provide power to a variable load when utility power is lost or is no longer stable enough to supply the load. The ESP is only designed to operate for up to 200 hours of operation per year with maintenance intervals and procedures being carried out as prescribed by the manufacturer. The ESP generator set is not intended for utility paralleling operation.

Limited time running power (LTP): A generator set designated as an LTP is intended to provide power to a constant load when utility power is lost or is no longer stable enough to supply the load. The LTP is designed to operate for up to 500 hours of operation per year with regular maintenance intervals and procedures being carried out as prescribed by the manufacturer. The LTP generator set can exceed 500 hours of operation with increased maintenance however this should only be done under the guidance of the manufacture.

Continuous operating power (COP): A generator set designated as a COP is intended to provide constant power to a constant load when utility power is not present such as on a remote island or far from any grid. A COP generator set is designed to operate for 365 day per year and on a 24 hour per day basis. The COP generator set is also intended for utility paralleling operation.

3.2 Fuel Systems

The fuel systems associated with diesel powered emergency and standby power systems create the potential for a severe ignitable liquid fire. The best location for these systems is outside important buildings. Putting this type of system inside a building creates an ignitable liquid occupancy that needs to be isolated from other, lower hazard building areas and appropriately protected.

The safety shutoff valves discussed in this data sheet function in the event of a fire. These devices will not be effective in limiting an emergency fuel system spill if the entire contents of the system are released prior to ignition. Leak detection, however, will operate in the early stages of a liquid release. In cases where there are large quantities of diesel fuel exposing buildings or occupancies that can represent significant values, efforts to detect leaks before they are ignited should be pursued.

A schematic of a typical emergency fuel system installation, including appropriate safeguards and interlocks, is shown in Figure 3.2-1. Several variations on this arrangement are also provided in Figures 3.2-2 and 3.2-3.

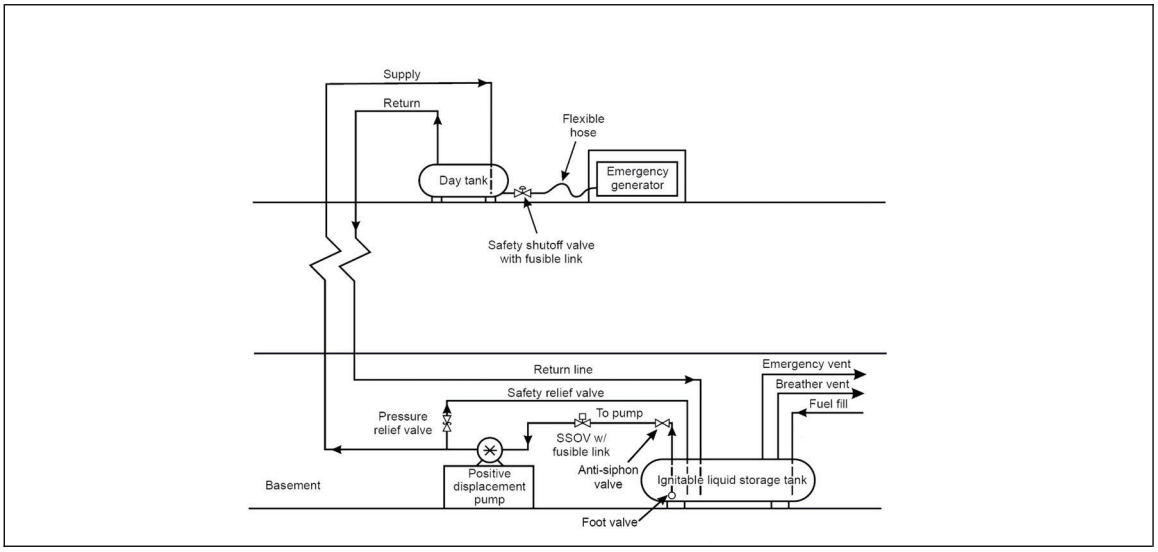

Fig. 3.2-1. Example of an emergency/standby power fuel system

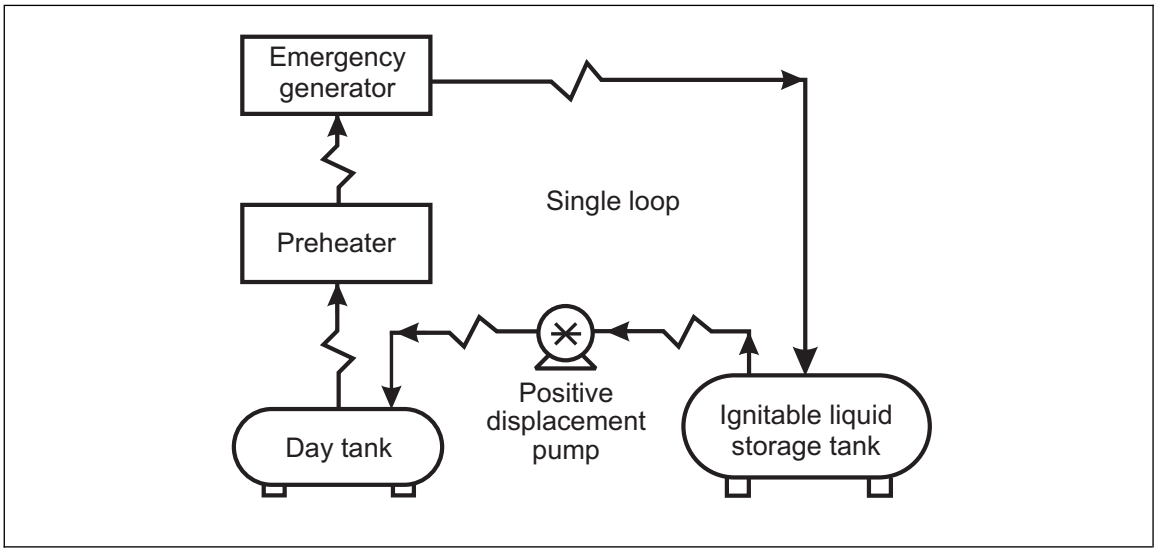

Fig. 3.2-2. Typical emergency/standby power fuel system arrangements

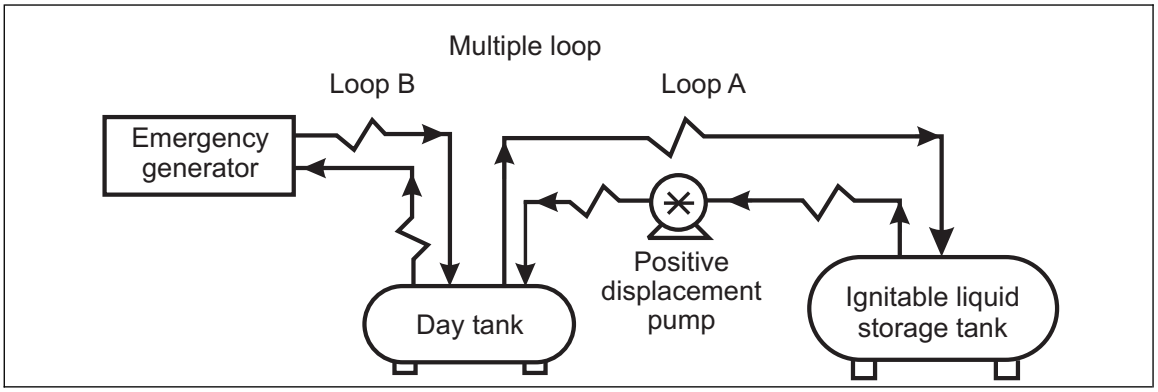

Fig. 3.2-3. Typical emergency/standby power fuel system arrangements

3.3 Main Fuel Storage Tank

It is not recommended to put large quantities of an ignitable liquid inside an important building. Tank storage of ignitable liquid creates the potential for many fire scenarios, including overflow during filling, overpressurization when exposed to fire, leak in a discharge line, or tank failure (a very low likelihood event, but one that has the potential for devastating consequences).

Current guidelines for tanks in Data Sheet 7-32, *Ignitable Liquid Operations*, provide options for indoor tanks. The goals of the recommendations are to isolate the tank from areas not containing ignitable liquid, provide adequate protection for most fire scenarios, and to ensure adequate access to the tank room for firefighters. Since all of the fire scenarios in a tank room involve a liquid release, adequate isolation must include provisions for containment and emergency drainage.

In cases where tanks are not only inside a building, but are also located below or above grade, additional safeguards are needed. Access to these tanks for manual firefighting will be very limited. The overall severity of a liquid release and fire involving the tank will be entirely dependent on what is provided for active and passive protection around the tank. In buildings where the potential loss is significant (e.g., high-rise buildings), there is a need to ensure any potential ignitable liquid release/fire is contained to the tank room. The only reliable way to accomplish this is through the use of a 3-hour fire-rated vault with only limited openings for fresh air. This combination will limit the fire severity and help ensure survival of the room regardless of the size of the liquid release.

3.4 Fuel Pumping and Transfer Systems

The design goal for fuel pumping and transfer systems is to ensure the fuel stays in the piping system and the fuel can be shut down when necessary (e.g., fuel leak or fire). The best way to accomplish this is to use welded steel piping, positive displacement pumps, and safety shutoff valves. The most likely source of leakage is the pump. Pump rooms must be isolated from other occupancies. Since the pumping system creates hazards similar to those of the storage tank, it may be cost-effective to locate the pumps in the tank room/vault. A small fire at the pump can grow because the initial fire will produce additional failures. Sprinklers that are extended from the ceiling to within 2 ft (0.6 m) of the fuel pumps can help prevent those additional failures. Ensure that the feed pump power is also fed from the emergency or standby power generation system to ensure continuity of fuel for the emergency/standby power.

A second potential leak source is flanged or threaded pipe joints/unions. Welded piping systems require the use of flanged joints to permit equipment maintenance and repair. Leaks at flanged joints can be caused by poor maintenance or fire exposure to a gasket that can melt. Threaded joints are inherently weaker because the pipe wall thickness has been reduced.

3.5 Generator Room

There are numerous sources of an ignitable liquid fire in the generator room. These areas contain diesel engines, electrical equipment, fuel piping, day tanks, pipe headers, flexible hoses, and hot surfaces. Possible scenarios include small leaks in flexible hoses producing spray fires, overfilling of the day tank, and an undetected flange failure and liquid release that could involve the entire contents of the main storage tank.

4.0 REFERENCES

4.1 FM

Data Sheet 1-11, *Fire Following Earthquakes*
Data Sheet 1-13, *Chimneys*
Data Sheet 5-20, *Electrical Testing*
Data Sheet 5-28, *DC Battery Systems*
Data Sheet 5-33, Lithium-Ion Battery Energy Storage Systems
Data Sheet 7-32, *Ignitable Liquid Operations*
Data Sheet 7-88, *Outdoor Ignitable Liquid Storage Tanks*
Data Sheet 7-110, *Industrial Control Systems*
Data Sheet 9-0, *Asset Integrity*
Data Sheet 10-8, *Operators*
Data Sheet 13-26, *Internal Combustion Engines*

4.2 Other

ASTM International. *Standard Test Methods for Fire Tests of Building Construction and Materials*. ASTM E119.

National Fire Prevention Association (NFPA). NFPA 70, *National Electric Code*.

National Fire Prevention Association (NFPA). NFPA 99, *Standard for Health Care Facilities*.

National Fire Prevention Association (NFPA). NFPA 110, *Standard for Emergency and Standby Power Systems*.

APPENDIX A GLOSSARY OF TERMS

Anti-siphon valve: An anti-siphon valve essentially functions as a check valve, allowing flow in only one direction. The valve remains normally closed, which prevents the tank from siphoning. When fuel is required from the tank, activation of the pump overcomes a device in the valve to allow fuel flow through the valve. In the event of a ruptured pipe or leak, the anti-siphon valve automatically shuts off to prevent further siphoning and release from the storage tank. Foot valves fall under this definition.

Belly tank: An enclosed diesel fuel storage tank that is integral with the generator, typical in the base of package units. Typically a belly tank is used as a day tank.

Dike: A containment system with liquid tight floor and walls that is designed to hold the entire contents of the fuel tank, plus a minimum 2 in. (50 mm) freeboard.

Emergency or standby power system: A backup power supply system used to provide power to critical facility functions, including life safety, critical operations, and hazards control. This could include the limited duration operation of equipment necessary for the evacuation and protection of the building,(e.g., some lighting, alarms, control panels, and smoke control systems) up to systems designed to ensure the continued operation of critical business functions (e.g., hospital life support equipment, data center operations) for extended periods of time.

FM Approved: Products and services that have satisfied the criteria for FM Approval. Refer to the *Approval Guide*, an online resource of FM Approvals, for a complete listing of products and services that are FM Approved.

Fuel distribution system: Supply piping for diesel fuel extending from the main storage tank to the pumps, from the pumps to day tanks or headers for the generators, and return piping from the generator room to the main tank.

Fuel shutdown: The ability to stop the flow of fuel automatically via reliable leak detection and/or fire detection (sprinkler water-flow, heat, smoke, or flame detection).

Header: A long length of large diameter pipe, used to supply fuel to a generator. They could be located in pipe chases or at the ceiling in the generator room, and are used to store large quantities of diesel fuel. They may be used when the desired storage volume for generator operation exceeds that allowed by code.

Ignitable liquid: Any liquid or liquid mixture that has a measurable flash point. A liquid with just a flash point may not produce a pool fire but may still create a flammable vapor-air mixture. A liquid has the ability to burn in a pool or spill if it has a measurable fire point. Ignitable liquids include flammable liquids, combustible liquids, inflammable liquids, or any other term for a liquid that will burn.

Safety shutoff valve: An FM Approved valve that is a component in the safety control system and which automatically opens or closes to prevent continued system operation depending on if emergency conditions exist, such as a fire. These valves are manual reset only. They are rated for fire exposure for the duration of the fire per the emergency condition scenario (i.e., including no fire rating if appropriate per the scenario).

Vault: An enclosure consisting of a concrete floor and ceiling with full height concrete or masonry walls for the purpose of containing liquid storage tank(s). It is not intended to be occupied by personnel other than for inspection or maintenance of the vault, the storage tank(s), or related equipment. The following must be provided with a 3 hour fire resistance (ASTM E119): the ceiling, floor and walls of the vault, and other building structural elements (columns, beams, etc.) within the vault. Access openings to the vault must be protected by a normally closed fire door with a minimum fire rating of 3 hours and no windows (vision panels) in the door

APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

January 2022. Interim revision. Significant changes include the following:

A. Changed the title of the data sheet.

B. Added a recommendation on the arrangement of diesel engine exhaust systems.

C. Added a recommendation for inspection and maintenance of diesel engine exhaust systems.

July 2021. Interim revision. Significant changes include the following:

A. Revised Section 2.3.2.3.1 to recommend shutdown of the fuel distribution systems in the event of a leak.

B. Revised Section 2.3.2.3.2 to recommend leak detection within double-walled piping systems and in pipe chases/shafts.

July 2020. This document has been completely revised. Significant changes include the following:

A. Addressed inconsistencies with Data Sheets 7-32, *Ignitable Liquid Operations*, and 7-88, *Outdoor Ignitable Liquid Storage Tanks*, as a result of their recent revisions.

B. Clarified the need for drainage and containment.

C. Clarified design for flood exposure.

D. Deleted Appendix D to avoid unnecessary duplication of information with other data sheets.

E. Made the requirements for generator room temperatures consistent with other data sheets.

F. Made frequency of starting battery testing consistent with NFPA 110.

G. Clarified the proper arrangement and capability of an emergency standby power system.

H. Updated boiler and machinery guidance on design, installation, and maintenance.

I. Added and clarified definitions in Appendix A.

April 2017. Interim revision. Clarified recommendation 2.3.3.3.1.

October 2012. This document has been completely rewritten. The following major changes have been made:

A. Reorganized the document to meet current formatting guidelines.

B. Removed references to ″flammable″ and ″combustible″ liquids and replaced this terminology with ″ignitable liquids″ throughout the document.

C. Included guidance on fuel supply systems for emergency and standby power systems consistent with FM Global's loss prevention recommendations for ignitable liquid hazards, including fuel tanks, pumping systems, and generators. Recommendations related to the construction and location of fuel supply systems, equipment, processes, fire protection, and ignition source control are provided.

January 2007. The reference to NFPA standard was corrected under recommendation 2.1.28.

January 2000. This revision of the document has been reorganized to provide a consistent format.