



TECHNICAL DATA

DELUGE SYSTEM DESIGN

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058

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1. DESCRIPTION

A Deluge System is an empty pipe system that is used in high-hazard areas or in areas where fire may spread rapidly. It can also be used to cool surfaces such as tanks, process lines, or transformers. In this type of application, open sprinklers or spray nozzles are employed for water distribution. The deluge valve is activated by a release system (manual, fixed-temperature, rate-of-temperature rise, radiation, smoke, or combustion gases, hazardous vapors, pressure increase). When the system is tripped, water flows through all spray nozzles or sprinklers simultaneously. The Viking deluge system can be activated by a hydraulic, pneumatic, electric, or manual release system or any combination of these release systems. But, in all cases, the deluge valve itself is activated hydraulically. See the following schematics and the "Equipment" section of the Viking Engineering and Design Data book for complete information regarding individual devices. System design requirements are to be found in rules set forth by various groups including the National Fire Protection Association (NFPA), FM Global (FM), Industrial Risk Insurers (IRI), Loss Prevention Council (LPCB), and the Authorities Having Jurisdiction. Deluge systems require hydraulically-calculated piping.

2. EVALUATION OF THE DESIGN PROBLEM

- When designing a deluge system for a particular installation, consideration must be given to the following:
- Type of hazard
- System's overall purpose
- Approvals required, published standards, and job specifications
- Area to be protected by one deluge system
- Water supply
- Drainage
- Floatable combustible liquids
- Equipment shut-down
- Corrosive atmospheres
- Draft curtains
- The necessity of explosion-proof electrical equipment
- Appropriate equipment

A. TYPE OF HAZARD

Efforts should be made to acquire specific information regarding the hazard to be protected. This information is essential to apply the appropriate standards.

B. SYSTEM'S OVERALL PURPOSE

Given the type of hazard to be protected, determine the purpose and the desired performance characteristics of the system. Should it be designed to cool surfaces only? To extinguish fires only? Or, to both cool surfaces and extinguish fires? Also, determine if water additives such as low-expansion foam and AFFF water wetting agents are required to meet the stated purpose of the system. If so, also refer to the Viking Foam Systems Engineering Design Data book.

C. APPROVALS REQUIRED, PUBLISHED STANDARDS, AND JOB SPECIFICATIONS

Among those things affecting the system design are:

1. Approvals required by various groups. For example: Insurance standards, owner, local and national building codes, insurance underwriter, consulting engineer, and architect.
2. Standards set forth in various publications. For example:
 - a. National Fire Protection Association's National Fire Codes - and Fire Protection Handbook.
 - b. FM Global's Loss Prevention Data.
 - c. Loss Prevention Council rules for Automatic Sprinkler Installation.
3. Job specifications. These should be evaluated to make certain they comply with all rules stipulated by the approval bodies.

D. AREA TO BE PROTECTED BY ONE DELUGE SYSTEM

Some installation standards state that a discharge rate of 3,000 gpm (11 355 L/min) should not be exceeded for a single system. System size may be further limited by the water supply available to the system and/or the hazard classification. If there is any question concerning the adequacy of the deluge system's coverage, seek the advice of the insurance underwriter or a qualified consulting engineering firm.

E. WATER SUPPLY

Since deluge systems are hydraulically-calculated, the static and residual water-pressure characteristics of the water supply should be obtained by conducting an on-site water-flow test. Prior water-supply data may already be available from the following sources: job specifications, consulting engineer, architect, insurance underwriter, owner, or local water department. Prior data must be applicable and may need to be verified. If a fire pump is needed, acquire a pump supply curve from the pump manufacturer. However, be sure to check with authorities having jurisdiction (approving body) regarding pump characteristics (percentage over rated capacity at percentage of rated psi).



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F. DRAINAGE

A deluge system may produce a large volume of water. The owner should be notified as early as possible concerning the total volume of water expected to ensure proper drainage and, where necessary, collection.

G. FLOATABLE COMBUSTIBLE LIQUIDS

If the area being protected contains a large volume of floatable combustible liquid, a safe drainage or diking system should be installed to prevent the possibility of transferring the fire to adjacent areas.

H. EQUIPMENT SHUT-DOWN

Because a deluge system applies water to the total system areas simultaneously, it may be advisable to install equipment that will automatically shut down selected production equipment. Examples of equipment that might be automatically shut down during deluge system operation are:

1. Equipment prone to more severe water damage when "ON" than "OFF".
2. Pumps, pipe lines, and conveyers supplying combustible solids, liquids, or gases to the system area.
3. Equipment that would present a serious electrical hazard if exposed to water (e.g. transformers, generators, conveyers, high-capacity battery chargers, high-amperage motors, etc.)
4. Large-volume air handling systems, if the drafting they create would serve to spread the fire to adjacent areas.

I. CORROSIVE ATMOSPHERES

Request information from the owner or owner's representative regarding the system's environment. Corrosive elements may be present in the system's area requiring a special protective coating for all deluge system components. **Note:** For outside exposed piping or where corrosive atmospheres exist, use steel/galvanized pipe and steel malleable or ductile iron fittings or copper.

J. DRAFT CURTAINS

Draft curtains may be required to separate each deluge system when multiple systems serve a common roofed area. The draft curtains suppress the operation of any system adjacent to the system serving the fire area. Proper placement of draft curtains will prevent the unnecessary use of water otherwise needed to fight the fire.

K. EXPLOSION-PROOF ELECTRICAL EQUIPMENT

If the system protects areas where explosive vapors may be present, explosion-proof electrical equipment is required. Check with the owner or other authorities regarding ratings.

L. EQUIPMENT SELECTION

1. GENERAL

Viking deluge equipment is designed to allow for a variety of release devices. The release system detection device itself may be thermostatic (fixed-temperature/rate-of-temperature-rise) or manual. When the detection device is activated, the deluge valve is tripped.

Note: Because the deluge valve is hydraulically operated, it must not be exposed to freezing temperatures. A heated enclosure may be required.

a. Hydraulic Release Systems

1. Description (refer to data page 203a-i). Hydraulic release systems may utilize rate-of-temperature rise, fixed-temperature, manual releasing devices, or combinations thereof. Hydraulic release systems are normally the least expensive of possible release systems; however, they must not be installed in areas that are subject to freezing. Under certain conditions, when using a hydraulic release system, the deluge valve may be subject to water columning. See paragraph below titled: MAXIMUM ALLOWABLE HEIGHT OF RELEASE LINE ABOVE THE DELUGE VALVE .

2. Hydraulic Release System Design

— Release Lines —

Use galvanized steel pipe or corrosion-resistant tubing, such as copper or brass for release lines. Do not exceed 1,000 ft. (304.8 m) of ½" (15 mm) pipe in a release-line system. In systems over this capacity, larger pipe sizing is required.

— Maximum Allowable Height Of Release Line Above The Deluge Valve —

Hydraulic release system piping must not exceed the maximum elevation allowed for hydraulic release piping above the Deluge Valve. Refer to current Technical Data for the Viking Deluge Valve used.

b. Pneumatic Release Systems

1. Description (refer to data page 202a-i). Pneumatic Release systems may utilize rate-of-temperature-rise, fixed-temperature, manual releasing devices, or combinations thereof. Pneumatic Release systems may be used in most areas. Costs of installation and maintenance are usually higher than a comparable hydraulic release system. Valve trip-time may vary depending on the length of the release line and the air pressure maintained on the release system.

2. Pneumatic Release System Design

— Pressure to be maintained in a Pneumatic Release System —

For recommended pneumatic (air or nitrogen) pressures to be maintained in pneumatic release systems, refer to cur-



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rent Viking Technical Data for the system used. For additional information concerning pneumatic release system equipment, devices, and installation instructions, refer to the *Viking Engineering and Design Data* book section describing Pneumatic Supplies.

— Release Line Restriction —

All pneumatic-release systems must be equipped with a restricted orifice in the air or gas supply to ensure that the automatic air supply cannot replace pneumatic pressure as fast as it escapes when a releasing device operates. This restriction is already incorporated in the Viking air maintenance device and release line air supply assembly.

— Reducing Trip Time —

If the deluge system trip time is excessive, it can be substantially reduced by one or more of the following:

- a. Add a check valve (Circle Seal or equivalent) in branch portions of the release-line system. (Install so flow is toward releasing device).
- b. Install an optional accelerator on the pneumatic release system to provide earlier alarms and/or allow the system to trip faster. An Accelerator may be necessary to meet system discharge time requirements.

— Release Line Dehydrator —

All pneumatic release systems must be provided with an air dehydrator to minimize corrosion and prevent ice plugs.

— Pneumatic Supply —

Refer to Viking Technical Data, System Data, and associated schematic drawings for the deluge system used. Also, refer to the *Viking Engineering and Design Data* book section describing "Pneumatic Supplies" for additional information on pneumatic (air or nitrogen) equipment, devices, and installation requirements.

c. Electric Release Systems

1. **Description (refer to data page 204a-h).** Electric release systems may be rate-of-temperature-rise, fixed-temperature, manual, products of combustion, light, or combinations thereof, and may be used in most areas. Installation and maintenance costs, however, are usually higher than comparable hydraulically or pneumatically operated systems. Also, the electrical release systems requires a stable source of power. A back-up power source should be considered and may be required.

2. Electric Release System Design

— Determine element to be detected —

Determine the physical change to be detected such as fixed-temperature, rate-of-temperature increase, radiation, smoke, pressure, and the level at which the detection should take place. Determine whether two or more elements shall be detected, such as fixed temperature and smoke. Determine the need for explosion-proof components.

— Determine requirements for supervision —

Circuits that are not normally energized can be supervised by passing a small amount of current through them. This current will operate a sensing relay, but is not great enough to allow the controlled device to operate. If a break occurs in the supervised circuit, this supervisory current will be interrupted and a trouble alarm will sound. Detector circuits, release circuits, and alarm circuits are commonly supervised. If bell circuits with more than one bell are to be supervised, polarized bells must be used. Determine the requirements for such supervision.

— Select appropriate detectors —

From the manufacturer's information, determine which detectors satisfy the physical change requirements. Note the electrical characteristics of the devices chosen, the supervision capabilities, and the suitability for the application. Verify that the detector is listed and approved for the application used, and is compatible with all other components. Space in accordance with manufacturer's recommendations.

— Select the appropriate releasing device —

Normally, solenoid valves are used. Note the electrical characteristics of the device chosen. The releasing device must be compatible with the system control panel and other electrical components.

— Determine accessory or auxiliary device requirements —

Often electrical detection systems will be required to sound auxiliary alarms and provide contacts for independent alarm systems. The requirements for these auxiliary services and their need for supervision should be determined and their electrical characteristics considered.

— Consider the power supply and requirements for standby power —

The dependability of the power supply is a critical factor; with interruption of power, the control system will either trip immediately or be unable to trip, depending on its mode or configuration. A mechanical detection system can be designed to provide protection in this event. However, if available power is suspect, standby power in the form of a battery charger and suitable batteries are usually required and must be provided.

— Determine the current requirements of the system —

Determine the current requirements of the sum of components in the system, when it is in the set and tripped condition. Do not exceed rated capacity of the control panel used. Do not exceed the rated capacity of any system circuit.

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— **If a standby power supply is used, determine its capacity** —

Standby power must be provided as long as regular power is out of service. Therefore, this time is dependent upon a large number of factors, including location of the installation, the level of maintenance, the availability of maintenance, and the historical frequency and duration of power outages. A 24-hour standby capability is usually considered the minimum requirement with 100 hours usually the maximum. Multiplying the maximum system current requirements by the time requirements will give the battery capacity and battery charger requirements.

— **Select compatible components** —

From the manufacturer's technical information, determine that the devices selected are compatible with each other. Observe all manufacturer's technical instructions.

— **Wire sizes and maximum resistance** —

Requirements are found on individual Technical Data sheets.

— **Location of release and pressure switch** —

The location of the solenoid valve is shown on the various System Data sheets. Flow through the release must be in the direction indicated. The pressure switch in the release control unit system is located in the alarm line.

d. Manually-Operated Release Systems

Manually operated release systems are usually integrated into one of the other types of release systems. Normally a system will incorporate a manual release at the valve, exits, operator station, or other convenient locations to operate the system during a fire emergency.

3. FLOW CONTROL VALVE SUBSTITUTION FOR DELUGE VALVE

The Viking Flow Control Valve may be used for some deluge applications. This valve offers the same operating features as a deluge valve. In addition, it offers ON-OFF remote control. See the Flow Control Valve section of the *Viking Engineering and Design Data* book for device and trimming requirements.