RiskTopics

Guide for the use of the Tyco QUELL™ Fire Sprinkler System
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This Risktopic provides guidance on the application of the Tyco QUELL™ Fire Sprinkler System for the protection of refrigerated storage spaces as well as unheated storage spaces that may be periodically subject to freezing temperatures.

Introduction

Automatic sprinkler protection for refrigerated storage raises concerns for both building owners and insurers. Building owners are concerned with accidental sprinkler leakage should a pallet load of stock strike in-rack sprinkler piping. Insurers are concerned with system reliability issues such as ice plugging. The Tyco QUELL™ Fire Sprinkler System, also registered under the trade name VanQuishTM in the Asia/Pacific Region, has been developed to address these concerns and more.

Discussion

The QUELL™ Fire Sprinkler System was developed using the concept of "performance based design". While the QUELL™ design is not specifically addressed within the prescriptive requirements of NFPA 13, the equivalency paragraph in the standard (paragraph 1.5) does permit performance based designs that meet or exceed the requirements of the standard.

The QUELL™ design combines the:

- Tyco Ultra K17 141°C (286°F) CMSA (control mode specific application) sprinkler
- Tyco QRS electronic accelerator
- Tyco SprinkFDT QTM dry pipe system water delivery software
The design concept is to delay water delivery until an appropriate number of CMSA sprinklers have operated so that an optimum number of sprinklers are discharging onto the storage that is burning, as well as pre-wetting the surrounding storage.

**Special note:** The Tyco Ultra K17 CMSA sprinkler is UL listed for use in wet-pipe sprinkler systems only. Its use with the QUELL™ preaction and dry system is part of the overall QUELL™ performance based design. The Tyco Ultra K17 CSMA sprinkler is not considered acceptable for any dry-pipe application that is not part of a QUELL™ design.

### System considerations

**Designer and installer**

The QUELL™ system is to be designed and installed by a QUELL™ Licensee sprinkler contractor.

**System components**

The QUELL™ system is comprised of UL listed components including a Potter 4410 RC control panel used to release the system.

**System type**

The QUELL™ is a preaction and dry system (double interlocked).

**System volume**

The QUELL™ system maximum volume is 15,900 liters (4,200 gallons).

**System release**

Tyco recommends the use of the SAFE Fire Detection Inc. ThermoCable® line-type heat detector to release the preaction valve. ThermoCableTM was specifically tested during the QUELL™ full-scale fire tests, and ThermoCableTM is UL listed for use with the Potter 4410 RC control panel. The line-type heat detection system is to be installed with the same spacing as the sprinkler system branch lines so that the heat detector will operate before sprinklers.

**Water delivery calculations**

Tyco SprinkFDT QTM software is used to verify the water delivery time of the system. This UL listed software calculates:

- Minimum water delivery of the 4 least hydraulically remote sprinklers
- Maximum water delivery of the 4 most hydraulically remote sprinklers
- Sequential sprinkler operation of the first, second, third, and fourth least hydraulically remote sprinklers
- Sequential sprinkler operation of the first, second, third, and fourth most hydraulically remote sprinklers
When the water delivery calculation method is used to size the volume of a dry-pipe sprinkler system protecting high piled storage, NFPA 13 requires water delivery to the four most remote sprinklers within 40 seconds.

**Fittings**

Tyco Technical Data Sheet TFP370 states, “Where gasketed grooved type couplings are being utilized, the gasket type must be capable of closing off the gap between the pipe ends”. Examples offered are the Grinnell grooved couplings with Tri-Seal Grade E EPDM gaskets.

**Pipe**

Per NFPA 13, piping is to be internally galvanized; however, the QUELL™ design does allow the use of black steel pipe where the following conditions are met:

- The black steel piping is located in a space kept below 0oC (32oF)
- An acceptable air supply (see below) is provided
- Periodic system trip tests do not introduce moisture into the piping

The QUELL™ permissive to use black steel pipe is based upon past research. The research indicted that in sub-freezing temperatures, moisture was in a frozen state and did not pose a corrosion exposure.

**Air supply**

NFPA 13 (paragraph 7.9.2.4) provides three air supply options for a dry system protecting a refrigerated space as follows:

1. Air from the room of lowest temperature (not recommended by Tyco)
2. A listed air compressor with air dryer
3. A source of compressed nitrogen

Zurich agrees with Tyco that option 1 should not be permitted for QUELL™ systems. The concern is that option 1 can still expose the sprinkler system to the extremely serious condition of ice-plugging.

NFPA 13 section 7.2.6.2 applies to air supplies for those QUELL™ systems serving spaces other than refrigerated spaces.

**Fire pump start**

Where a QUELL™ Fire Sprinkler System is supplied by a fire pump, the fire pump should be arranged to start upon fire detection via a remote signal from the Potter 4410 RC control panel. The objective is to avoid any delay in the delivery of water to the optimum number of operating sprinklers.
Storage considerations

Based upon full-scale fire testing by Tyco conducted at Underwriters Laboratories, the QUELL™ Fire Sprinkler System can be designed to protect the following commodities and storage arrangements:

- Class I, II, and III commodities stored in single, double or multiple row rack up to an overall storage height of 12.2 m (40 ft) in a 14.6 m (48 ft) building.
- Cartoned Group A Plastic commodities stored in single, double or multiple row rack up to an overall storage height of 9.1 m (30 ft) in a 10.7 m (35 ft) building.

Complete design guidelines are contained in Tyco Technical Data Sheet TFP370, "QUELL™ Systems Preaction and Dry Alternatives For Eliminating In-Rack Sprinklers".

Refrigerated space considerations

Chillers and heat exchangers for refrigerated storage spaces will typically be located in rooftop penthouses. Chilled air will be delivered to the refrigerated space using ductwork, and air will return to the penthouse through a grate floor located in the ceiling of the refrigerated space.

The open grating at the ceiling presents a challenge collecting sufficient heat at the ceiling to activate sprinklers. To address this challenge, Tyco offers the following:

- Provide a suspended ceiling below the grated opening. Position sprinklers under the suspended ceiling
- Limit the size of any grated opening by closing as much area as possible with sheet metal
- Provide a draft stop around the grated opening and avoid storage under the grated opening

Tyco also recommends using 141°C (286°F) temperature rated sprinklers in the Penthouse to avoid Penthouse sprinklers operating before sprinkler in the storage space.

Zurich position

New systems

- New Tyco QUELL™ Fire Sprinkler Systems are acceptable subject to the following:
  - The system is designed and installed by a QUELL™ Licensee sprinkler contractor
  - The submittal to Zurich includes the following:
    - Shop drawings
    - Hydraulic calculations
    - Component literature
    - Wiring schematics for the detection and release system
    - Water delivery calculations (including delivery to the inspector’s test connection orifices)
    - Treatment of Penthouse grated floors
  - Complete system acceptance test including a full-flow trip test to verify water delivery time
• Tyco supports conducting a full-flow acceptance of each QUELL™ system. In addition to confirming the performance of all system components, Tyco notes that the actual water delivery time to the inspector’s test connection orifices should agree with times determined by the Tyco SprinkFDT QTM software. Deviations indicate an installation issue such as:
  – Piping not installed per the design drawings
  – Available water supply deviates from water supply curve used for design
  – A control valve partially closed
  – An orifice with incorrect k-factor in the inspector’s test connection

• Tyco notes that thousands of dry systems have been designed using the Tyco SprinkFDT QTM software, and acceptance testing has validated software accuracy and performance.

• It is essential that a complete set of QUELL™ system design and acceptance test documentation be retained by the building owner or operator for future reference.

**Existing systems**

Where an existing QUELL™ Fire Sprinkler System is encountered, acceptance will be based upon:

• Verification that the system was designed and installed by a QUELL™ Licensee sprinkler contractor

• A review of system design documentation including:
  – Shop drawings
  – Hydraulic calculations
  – Component literature
  – Wiring schematics for the detection and release system
  – Water delivery calculations (including delivery to the inspector’s test connection orifices)
  – Treatment of Penthouse grated floors

• A review of system acceptance test records including the results of full-flow trip testing

**Modifications to existing systems**

Where an existing QUELL™ Fire Sprinkler System is to be modified, it is essential that no changes or modifications be permitted without:

• Design and installation by a QUELL™ Licensee sprinkler contractor

• Complete update of all system documentation

• Complete system acceptance retest including a full-flow trip test to verify the new water delivery time
References

- NFPA 13 “Standard for the Installation of Sprinkler Systems”.


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