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Quell™ Frequently Asked Questions **Issue Date: May 18th, 2007**

1. *Is Quell™ the only option for dry pipe protection of Class III and Group A plastic commodity for storage heights above 25 ft (7.6m) that does not require the use of in-rack sprinkler systems?*

The patent pending Quell™ technology is the ONLY method available for providing dry pipe sprinkler protection to Class III commodity stored above 25 ft (7.6m) that does not require the use of problematic in-rack sprinklers. The commodity classification, storage heights, and ceiling heights that can be protected using Quell™ are constantly expanding, so always contact your Tyco Fire & Building Products Representative for the latest application guidelines.

2. *How do I purchase a Quell™ system?*

To ensure that the high standards of Tyco Fire & Building Products is maintained throughout the design and installation process, Quell™ systems are only available through trained and authorized fire sprinkler professional. For a list of fire protection contractors authorized to design and install Quell™ technology, please contact the nearest Tyco Fire & Building Products Representative. Please see www.tyco-fire.com to find your local branch.

3. *Why isn't the Quell™ system UL Listed or FM approved?*

The NFPA equivalency clause exists to permit the use of new technology before it has been formally recognized by the code, as changes to NFPA standards can take 3 years or longer to complete. Further, 3rd party approval agencies such as Underwriters Laboratories typically rely upon the installation requirements established in the codes to develop approval programs. As a result, gaining 3rd party approval as well as incorporating prescriptive design and installation requirements in NPFA 13 of a substantially new technology such as Quell™ can take as long as 6 to 9 years.

While Factory Mutual does not base approvals on NFPA 13 requirements, there is a corresponding, typically lengthy, internal process through which FM requirements and a resulting approvals program are developed. One significant delay in this process is the availability of the full-scale fire test laboratory at the FM Global Research Campus. FM typically allots only about 20 weeks/year for full-scale approval testing, time which must be shared by all fire suppression equipment manufacturers. The remaining weeks of the year are used for internal FM research and risk assessment work. As virtually all of the available test time is used for approvals associated with existing FM standards, it is extremely difficult to schedule the extensive laboratory time necessary to develop innovative new technology such as Quell™. Between the availability of the full scale fire test laboratory, and the internal FM review process, gaining full FM approval of new technology can take as long as 5 years.

Tyco Fire & Building Products is committed to the 3rd party approval process, but is equally committed to bringing our customers timely solutions to their fire protection problems. The NFPA equivalency clause, while slightly more complex to apply than more “traditional” approaches, allows TFBP to offer the latest technology during the lengthy 3rd party approval and code recognition process.

For more information about Performance Based Design and Alternate Materials and Methods please see the Performance Based Design description available as part of the Quell™ informational package.

It is important to note that all of the individual components used in the design and implementation of a Quell™ system, including valves, sprinklers, couplings, electronic accelerator, and the SprinkFDT™ software are UL Listed/FM approved. It is only the Quell™ design methodology and installation criteria that have not completed the 3rd party approvals process. The use of approved components in the Quell™ system ensures that the highest industry quality and performance standards are met.

4. *I understand that only trained contractors can offer Quell™ systems. What is included in the Quell™ training program?*

The first part of the Quell training program is designed to educate system designers and installers about the key performance aspects of the Quell™ system and the parameters that are critical to the successful deployment of a Quell™ system. This portion of the training program focuses on existing protection methods and the test programs used to develop these methods. Specifically, the testing used to develop the storage density curves in NFPA 13 are discussed to provide a basis of comparison for the validation of currently accepted prescriptive methods compared to the level of testing undertaken during development of the performance based Quell™ system. Questions regarding the need for application of the “equivalency clause” in NFPA 13 to the acceptance of Quell™ systems are answered.

The second part of the Quell™ training program focuses on the specific components and design requirements specified in TFBP technical data sheet TFP370. Examples of typical system designs are demonstrated using the SprinkFDT™ software.

5. *Most of the Quell™ tests have been conducted on double row rack arrangements? Can Quell™ be used to protect multiple row rack or piled storage?*

It has been recognized through extensive fire testing conducted at both Underwriters Laboratories and Factory Mutual that double row rack storage presents a greater fire challenge than other standard forms of storage such as multiple row “pushback” racks, or piled storage. As such, much of the Quell™ system testing was performed with the double row rack storage arrangement. However, to verify that the assumption that double row rack represented the most severe challenge, one test was conducted with multiple row racks. The results of this test indicate that multiple row rack storage results in a less severe fire than double row rack storage when all other variables are equal.

6. *Why were Quell™ fire tests not conducted under more realistic conditions, such as at very low temperatures? What effect does temperature play on fire growth?*

All of the Quell™ fire testing was conducted in one of the largest and most technologically advanced full scale fire testing facilities in the world, Underwriters Laboratories Large-Scale fire test facility located in Northbrook, IL. One aspect of this facility is that smoke is extracted and cleaned in a regenerative thermal oxidizer at a rate of 36,000 to 55,000 ft³/min (1000 to 1500 m³/min) to permit very large scale testing to be conducted in an environmentally responsible manner. Further, the facility is not insulated to allow dissipation of the heat generated during fire testing, as well as to limit the presence of potentially combustible materials in the structural design of the building. As a result of both of these factors, it is not possible to reach and maintain sub-freezing temperature as part of the test protocol. There is no facility available in the world today capable of generating sub-freezing temperature and withstanding the conditions generated during a 20 MW or larger fire.

Despite the inability to directly evaluate the impact of temperature on warehouse fire growth, it is long recognized that the temperature of a material has a significant impact upon its rate of fire propagation, with cold temperatures leading to slower fire growth. Preliminary estimates developed by TFBP’s

research staff indicate that a material at -30°F ($^{\circ}\text{C}$) will burn at a rate APPROXIMATELY one class lower than that same material burned at a typical “ambient” temperature. For example, a class III commodity at -30°F will have a fire growth rate similar to a class II commodity at ambient temperature. However, as standard test commodity cannot exactly mimic the fire behavior of all “real” materials in that class, the reduction in fire growth rate attributable to decreased temperatures is appropriately viewed as one of the many safety factors built into the Quell™ system.

7. *Has the performance of Quell™ systems installed to protect freezers constructed of Polyurethane sandwich panels been evaluated?*

During the extensive full scale fire testing conducted as part of the Quell™ development program, Polyurethane sandwich panels were not specifically evaluated. The full-scale tests were conducted largely at Underwriters Laboratories full-scale fire test facility, which has a test pad of more than 10,000 ft² (929 m²). This test facility is specifically constructed to withstand repeated exposure to the intense fire environment of large warehouse fires. The use of specific construction features is not part of the routine sprinkler qualification program, nor was it considered during the testing used to develop the protection criteria specified in NFPA 13 today, therefore it was not directly included in the Quell test program

Additionally, given the large variation in type, material, assembly method, and fire performance of the commercially available sandwich panel systems, specific tests of any single panel would not necessarily apply to other styles of panel. However, unlike the protection criteria specified in NFPA 13 or other prescriptive requirements, the Quell™ technical literature includes all of the full-scale fire test data, including measured ceiling and steel beam temperatures for the duration of the each test. This information can be used by structural and fire protection engineers to specifically evaluate the need to address polyurethane sandwich panel construction as part of the overall fire risk analysis of the facility.

8. *In the System Components section of the datasheet you reference three different permissible air supply method. Could you explain these options?*

For dry and preaction systems protecting spaces that are continuously subjected to freezing, it is critical to ensure that the air or nitrogen supply used in the system is very dry to eliminate the potential for formation of ice blockages. Section 7.9.2.4 of the 2007 edition of NFPA 13 provides several ways of accomplishing this objective to ensure the highest level of system dependability. The three options that TFBP accepts for use in Quell™ systems include;

- The use of “standard” air compressors drawing air from the coldest protected space, and routing compressed air supply piping back through the freezer prior to connection to the system riser as described in NFPA 13:2007 Section 7.9.2.4(1). There are several figures located in the body of the NFPA text which describes how to configure compressors in this manner. When standard compressors are used, TFBP requires the inclusion of an air filtration and drying device, such as a combination coalescing filter and desiccant dryer, configured as shown in Figure A.7.9.2.4 found in the Appendix of NFPA 13:2007. The appendix figure is referenced because it clearly demonstrates the use of a desiccant dryer, which will aid in removing moisture from the compressed air supply. The figure found in the body of the standard does NOT show an air dryer and is therefore not suitable for use in a Quell™ system.
- The use of a listed air compressor which incorporates an air dryer as described in NFPA 13:2007 Section 7.9.2.4(2). The advantage of this option is that listed compressors, such as the General Air Products Dry Air Pac, do not typically need to draw air from the freezer. This eliminates the complex and costly process of preparing a freezer penetration to accommodate the inlet pipe

required when normal compressors are used. Additionally, listed compressors such as the General Air DAP use “regenerative” desiccant dryers which require less maintenance than a typical dryer.

- The use of compressed nitrogen as described in NFPA 13:2007 Section 7.9.2.4(3). Compressed nitrogen is provided in a very dry form, thus additional measures to remove water are not required. The disadvantage of this approach is that the nitrogen cylinders must be periodically removed from the system and refilled.

9. *Can you explain why black pipe is only allowed under the very specific circumstances described in the Quell™ technical datasheet?*

TFBP requires galvanized pipe in Quell systems except when ALL of the following conditions have been met

- a. Piping is in areas maintained below 32°F/0°C
- b. A listed air compressor is provide per NFPA 13 7.9.2.4(2) or a compressed nitrogen supply is provided per NFPA 13 7.9.2.4(3)
- c. The system is to be trip tested in a manner that does not introduce moisture into the system piping, i.e. a supervised system shutoff valve is provided above the preaction valve

Dry systems which are above freezing, and which are regularly filled with water such as during annual trip testing develop internal environments which rapidly corrode black steel pipe, necessitating the use of internally galvanized pipe to ensure the lifespan and dependability of the system. However, when the pipe is held continuously at sub-freezing temperatures and moisture is not regularly introduced into the system through either the compressed air supply or through trip testing corrosion rates are expected to be very low and black steel pipe is acceptable.

The prerequisites for the use of black steel pipe have been selected by TFBP to ensure that the pipe network remains dry and experiences a very slow rate of corrosion, both of which are necessary to ensure the dependability and lifespan of Quell™ systems. When the complete list of requirements cannot be fulfilled, the use of galvanized piping is highly recommended.

10. *Are all Quell™ systems required to be double interlock preaction systems or can a less complex single interlock or dry pipe system be utilized?*

Quell™ systems installed in areas that are continuously subjected to temperatures below approximately 40 °F (4.4 °C) should always utilize double interlock configurations to minimize the chance of an inadvertent valve trip and system fill. When a system installed in an area continuously operated at temperatures below freezing fills with water, it is extremely difficult to drain the system before water filled piping freezes. When this occurs, there are typically only two options are available for returning the fixed fire suppression system to service.

Option 1 requires removing all frozen or perishable commodity from the freezer, heating the space until all ice has thawed, and then draining, drying the system and replacing any operated sprinklers or other damaged components. After the sprinkler system has been returned to service, the freezer can be brought back down to operating temperature and the commodity returned.

Option 2 does not require that the freezer be taken out of service, but instead the entire sprinkler system is disassembled, moved to a heated area for thawing, then reassembled. In a cold storage environment, this is a very time consuming and costly process due to the limited time a laborer can remain in the freezer prior to mandatory “warm up” intervals.

In the event of an actual fire of any significant magnitude, it is likely that the freezer will be taken out of service to repair fire damage and mitigate any smoke damage. These activities typically require shutdown of the freezer, providing an opportunity to thaw out and reset the sprinkler system.

The purpose of a double interlock system is to minimize the chance that the sprinkler system will fill with water due to a non-fire event, which would necessitate taking one of the actions described above to restore the system to service.

In areas that are only occasionally subjected to freezing conditions such as an unheated warehouse in moderate climates, a single interlock system or dry system may be utilized. Single interlock or dry pipe systems are appropriate only in areas that are typically above 40 °F (4.4 °S) but that might on rare occasions be subject to freezing. Even in these cases however, there are significant benefits to the double interlock system that should be considered before a final selection is made.

11. What type of fire detection is recommended for use with Quell™ systems?

In theory, any type of fire detection that is guaranteed to operate prior to the first sprinkler is suitable for use as the detection component in a Quell™ double interlock system. In practice the two preferred fire detection methods are linear heat detecting wire or aspirating smoke detection.

SAFE ThermoCable linear heat detection wire offers the simplest and most robust option and has been specifically tested during Quell™ full scale fire tests. As this is the only method of detection that has been fully evaluated during the Quell™ development process, TFBP highly recommends the use of SAFE ThermoCable linear heat detection installed in accordance with TFP370 and the SAFE ThermoCable design & installation manual. SAFE ThermoCable is available from Tyco Fire & Building Products as part of the complete Quell™ package, further simplifying the ordering process.

One advantage of using the TFBP recommended linear heat detecting wire is that this detection device is currently UL Listed/FM Approved for use with the Potter 4410 RC releasing panel deployed as part of the QRS electronic accelerator. As such, a single releasing panel can provide all of the system monitoring, fire detection and electronic accelerator functions for its associated zone, and can be easily integrated with the overall building fire alarm system.

Aspirating smoke detection represents a second option to linear heat detection, with the advantage of typically providing a comparably earlier warning than the linear wire. However, this improved sensitivity requires more complex equipment, and can result in a greater frequency of nuisance alarms. A properly installed and maintained aspirating smoke detection system can be used in lieu of linear heat detection when a more responsive fire detection option is desired.

12. How should fire pumps be connected to Quell™ systems?

As Quell™ systems typically protect high challenge scenarios with correspondingly high water discharge rates, fire pumps are frequently required to meet the hydraulic demand of the fire suppression system. To ensure that the pump startup time does not contribute to a delay in water delivery, it should be automatically started upon activation of the fire detection system. Full scale fire tests demonstrate that the time difference between activation of a linear heat detector and activation of the first sprinkler head is between 5 and 10 seconds, which provide adequate time for a fire pump controller to bring an electric pump up to full speed.

Activation of the fire pump can be accomplished by fitting the fire alarm panel with an auxiliary relay interconnected to the remote start terminals on the fire pump controller. The fire pump should be installed in accordance with NFPA 20 or equivalent national installation code.

13. *How should the Quell™ protection method be applied under mechanical penthouses?*

Many large freezers are built using refrigerators and heat exchangers located on the roof of the building in so-called “penthouse” arrangements. These arrangements typically use ducted air discharge outlets to distribute chilled air evenly throughout the freezer, with return air being supplied simply through the use of grated flooring between the “ceiling” of the freezer and the “floor” of the penthouse.

This arrangement presents a significant challenge to any “ceiling only” fire suppression system, as the grated flooring will not allow accumulation of sufficient heat to activate the sprinklers. Further, the design of penthouses varies considerably from facility to facility. Variables such as the volume and height of the penthouse, the arrangement of storage racks under and near the penthouse, and the location of ductwork and other obstructions around the penthouse all impact the layout of UltraK17 sprinklers in this area.

While no universal recommendation is possible due to the wide range of penthouse configurations, several recommendations can be provided which will improve the thermal sensitivity of sprinklers located below mechanical penthouses.

Factory Mutual recommends the installation of a suspended ceiling below, and extending somewhat beyond, the area of each penthouse opening. Sprinklers are then installed below the suspended ceiling, which keeps heat from escaping into the penthouses during a fire thus ensuring that sprinkler operation is not delayed.

When installation of a suspended ceiling is not possible, the “open” or grated area of the floor should be kept to the minimum size needed to provide makeup air to the mechanical equipment located in the space. This can be accomplished by fastening metal sheets over the grated flooring to retain as much heat below the penthouse as possible.

When sprinkler heads other than the UltraK17 are installed at the ceiling of the penthouse, they should be 286 °F (141 °C) rated to ensure that they do not operate prior to the UltraK17 sprinklers located below.

14. *How can the freezer operation be restored after a fire has been controlled by a Quell™ system*

Restoring the operation of a freezer protected by a Quell™ system after a fire is largely the same as restoring a freezer protected with traditional Dry, Single or Double Interlock systems. The major difference with Quell™ is that there are no in-rack sprinklers to thaw, drain and/or inspect.

15. *Since there is only low-pressure air or nitrogen in the pipes normally, why do I need to use tri-seal gaskets? I've used standard gaskets in freezers before and they worked fine.*

When standard gaskets are employed, a small annular “groove” is left between the ends of the two pipes to be coupled. This annular gap can fill with water any time the system is flooded, such as during hydrostatic or water delivery time testing. It is virtually impossible to remove this water, which will then freeze when the freezer is placed into operation. The expansion of the water as it freezes can damage the gasket, and in severe cases even damage the coupling or even lead to premature joint failure. Tri-seal gaskets provide additional gasket material to fill and seal the gap between the pipe ends to ensure that water cannot accumulate and freeze in this area. The use of tri-seal gaskets helps to ensure a trouble free system with a long service lifetime.

16. *The QRS Electronic Accelerator required by the Quell™ system documentation is only available with a Potter PFC 4410RC releasing panel, which is not CE marked. Can other panels be substituted?*

TFBP has evaluated the compatibility of several CE marked panels for compatibility with the QRS switch and SAFE ThermoCable. See your local Tyco Fire & Building Products Representative for further details on alternate panels which meet local regulatory or jurisdictional requirements.

17. I want to verify the results of the SprinkFDT water delivery calculations with a field test, how accurate can I expect the calculations to compare to the field test?

During the listing process, Underwriters Laboratories required that the SprinkFDT calculations be within 10% of the measured water delivery time. As such, the SprinkFDT calculations should not be more than 10% of the measured value. Like all simulations, the accuracy of the output of SprinkFDT is closely tied to the accuracy of the inputs used. The accuracy of input factors such as the water supply curve and the physical piping arrangement should be carefully considered during the design process. In most cases, when care is taken to ensure that model inputs are accurate, the difference between the simulated and measured water delivery values is less than 2 seconds.

18. How large can each individual system be and still meet the 25 or 30 second water delivery time found in the technical datasheet.

It is important not to exceed the maximum water delivery times found in the technical datasheet. Further, to ensure that water delivery times are maintained over the life of the system it is recommended that the systems be designed to deliver water to the most hydraulically remote area 2 to 3 seconds faster than the maximum water delivery times recommended by TFBP.

As water delivery time depends upon a large number of variables, including water supply and piping configuration, it is not possible to provide an absolute rule of thumb regarding maximum system volume. However, it is not uncommon to have systems with volumes exceeding 3000 gallons (11,000 liters) with a water delivery time of 22 to 23 seconds.

19. When additional sprinklers are required to be installed below obstructions such as ducts, platforms, etc., is it required to add any of these sprinklers to the recommended number of sprinklers to be calculated per the Quell™ technical data sheet?

NFPA 13:2007 Section 22.4.4.6.3 states “The requirements of 22.4.4.6.1 to include every sprinkler in the design area in the system discharge shall not apply where spray sprinklers and large drop sprinklers are provided above and below obstructions such as wide ducts or tables. The water supply for one of the levels of sprinklers shall be permitted to be omitted from the hydraulic ceiling design calculations within the area of application.”

TFBP feels that it is reasonable to maintain these recommendations for Quell™ systems, and as such the additional sprinklers below obstructions would not need to be added to the ceiling hydraulic demand.

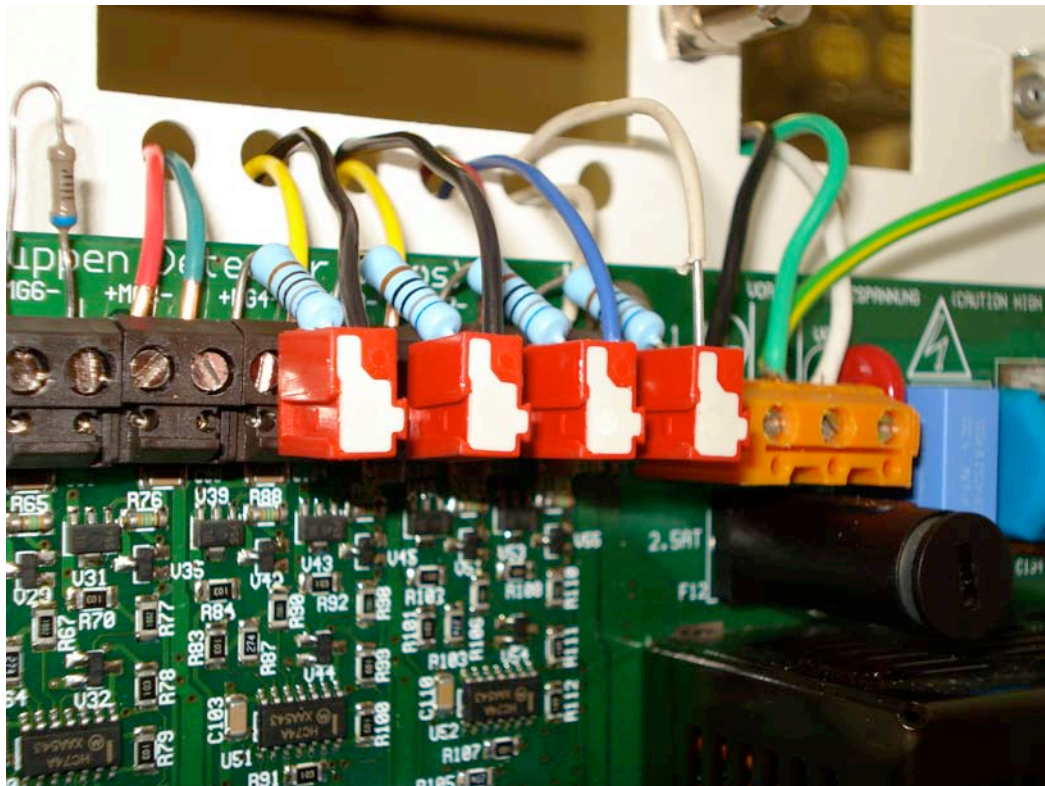
SPECIFIC EUROPEAN ISSUES

20. Why are “in-line” resistors required with the QRS as part of the UMBRA training? How should these be installed?

The Umbra Panel, unlike the Potter PFC-4410 used in the U.S., interprets a change in resistance as an alarm signal, and a short circuit as a supervisory condition. Detection devices provided by Umbra

include the resistor required to cause the panel to enter an alarm state. However, devices like linear heat detector wire, TFBP tamper switches, and the QRS switch that are not manufactured by UMBRA do not have this resistance integrated into the devices. By including the in-line resistors AT THE PANEL as shown in the datasheet these devices will function properly with the BMX-54 panel. The omission of the in-line resistors will keep the panel from discriminating between an alarm signal and a supervisory signal.

The recommended installation technique for the in-line resistors is to attach one lead on the resistor directly to the terminal located in the BMX-54 panel. The second lead on the resistor should be cut so that it is just long enough to fully seat in the provided push wire connector. One lead of the alarm system wiring should be attached directly to the appropriate panel terminal, while the second lead should be fully seated in the push wire connector as shown in the figure below.



It is important to keep all exposed wire as short as possible, as exposed leads can short against each other or to ground, causing the panel to enter an alarm state.