HYBRID FIRE-EXTINGUISHING SYSTEMS

1. PART 1 - GENERAL
   1. RELATED DOCUMENTS
      1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   2. SUMMARY
      1. Section Includes:
         1. Hybrid fire-extinguishing systems.
         2. Pipe and fittings.
         3. Fluid Panels/Combination Panels.
         4. Extinguishing-agent containers.
         5. Fire-extinguishing agent.
         6. Discharge Emitters.
         7. High Pressure Manifold/ Piping
         8. Fire control panels.
         9. Detection devices.
         10. Manual stations.
         11. Transducers.
         12. Alarm devices.
   3. DEFINITIONS
      1. EPO: Emergency Power Off.
   4. ACTION SUBMITTALS
      1. Product Data: For each type of product indicated.
         1. 70.03- VICTAULIC® VORTEX™ HYBRID FIRE EXTINGUISHING SYSTEM SERIES 951 PANELS
         2. 70.07- ACTIVE RELEASE MANIFOLD SYSTEM - FEATURING SERIES 950 3000 PSI NITROGEN SUPPLY CYLINDERS AND CYLINDER STORAGE For USE WITH VICTAULIC VORTEX™ 2000 FIRE SUPPRESSION SYSTEMS
         3. 70.12- VICTAULIC VORTEX™ 2000 HYBRID FIRE EXTINGUISHING SYSTEM SERIES 953 AND SERIES 954 HYBRID EMITTERS
         4. 70.16- VICTAULIC VORTEX™ SERIES 953 FLOW CARTRIDGE AND STRAINER KIT
      2. Sustainable Design Submittals:
         1. No ozone depletion potential or Global Warming Characteristic shall be accepted
      3. Shop Drawings: Prepare in accordance with requirements of the applicable FM Datasheets (Including FM 7-7) or NFPA 770, to include, but not be limited to, the following:
         1. Plans, elevations, sections, and attachment details.
         2. Design calculations.
         3. Details of equipment assemblies. Indicate dimensions, weights, loads, manufacturer-required clearances, method of field assembly, components, and location and size of each field connection.
         4. Diagrams for power, signal, and control wiring.
         5. Permit-Approved Documents: Working plans and hydraulic calculations approved by authorities having jurisdiction.
      4. Delegated-Design Submittal: For Hybrid fire-extinguishing systems indicated to comply with performance and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   5. INFORMATIONAL SUBMITTALS
      1. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades in accordance with FM Datasheets (Including FM 7-7) or NFPA 770 requirements.
   6. CLOSEOUT SUBMITTALS
      1. Operation and Maintenance Data: For Hybrid fire-extinguishing system to include operation, and maintenance manuals.
   7. MAINTENANCE MATERIAL SUBMITTALS
      1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
         * 1. Container Valves: Not less than [10] <Insert number> percent of amount of each size and type installed.
           2. Emitters: Not less than [20] <Insert number> percent of amount of each type installed.
2. PART 2 - PRODUCTS
   1. PERFORMANCE REQUIREMENTS
      1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
      2. Seismic Performance: Fire-suppression piping shall withstand the effects of earthquake motions determined in accordance with Applicable FM Datasheets (Including FM 7-7) or NFPA 13.
         1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[ and the unit will be fully operational after the seismic event]."
   2. HYBRID SYSTEMS
      1. VICTAULIC VORTEX™ 2000 FIRE SUPPRESSION SYSTEM
         1. Source Limitations: Obtain Hybrid systems from single source from single manufacturer.
         2. Description: Unless otherwise specified, protection shall be by an engineered hybrid, Victaulic Vortex™ 2000 hybrid media system. The system shall be designed, installed and tested in accordance with Victaulic Vortex™ 2000 as described in the Victaulic’s Vortex™ 2000 Design, Installation and Maintenance Manual. The Victaulic Vortex™ 2000 System shall incorporate separate pressurized streams of nitrogen and water which are combined and discharged as a hybrid inert gas fog into the fire hazard.
            1. Delegated Design: Design Hybrid fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for protection of wet bench applications and similar processing equipment as appropriate for areas being protected and include safety factor.
         3. Performance Requirements: Discharge Hybrid Fire Fighting Media within 2 minutes.
      2. System Capabilities:
         * 1. Piping Requirements

In accordance with Section 5 of this specification

Piping size and fittings sized for required nitrogen/ water flows and delivery per appropriate I-Vortex manual

Pressure rating:

Nitrogen piping

Minimum 3000 psig minimum working pressure upstream of fluid/ combination panel

Lower ratings permissible with lower pressure nitrogen supplies protected by an appropriately sized relief valve

Minimum 175 psig from outlet of combination or zone panel to emitters

Minimujm 175 psig from fluid panel outlet to zone panel inlet

Protect fluid to zone panel piping with appropriately sized pressure relief valve

Water piping

Minimum 175 psig

* + 1. System Operating Sequence:
       1. Passive Release-
          1. Upon activation of the detection system, a release signal from the agent-releasing FACP is routed to the Combination or Fluid Panel. The signal is then sent to the primary solenoid release assembly. The primary solenoid release assembly allows pressure from the primary cylinder into the connected pilot line, which provides a conduit for the pressure to enter the upper chambers of the remaining cylinder valves. When the upper chamber becomes pressurized, the cylinder valve opens, (indicated by the upward movement of the valve position indicator located on top of the cylinder valves). The open cylinder valves allow nitrogen gas to pressurize the manifold. The Victaulic Vortex system is designed to begin to discharge upon application of the second 24V release signal to the automatic regulation valve. When nitrogen flow starts, a downstream of the panel (combination or fluid) the pressure transducer senses pressure within the system piping. The pressure transducer provides a continuous signal to the ARV during actuation to maintain constant system pressure until the pressure in the cylinders is depleted.
       2. Active Release-
          1. Upon activation of the detection system, a release signal from the agent-releasing FACP is routed to the Combination or Fluid Panel. The signal is then sent to the primary solenoid release assembly. The primary solenoid release assembly allows pressure from the primary cylinder into the connected pilot line, which provides a conduit for the pressure to enter the upper chambers of the remaining cylinder valves. When the upper chamber becomes pressurized, the cylinder valve opens, (indicated by the upward movement of the valve position indicator located on top of the cylinder valves). The open cylinder valves allow nitrogen gas to pressurize the manifold. The Victaulic Vortex system is designed to begin to discharge upon pressure detected at the inlet of the panel. When nitrogen flow starts, a downstream of the panel (combination or fluid) the pressure transducer senses pressure within the system piping. The pressure transducer provides a continuous signal to the ARV during actuation to maintain constant system pressure.
       3. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.
       4. Manual stations shall immediately discharge extinguishing agent when activated
       5. Operating abort switches (if applicable) will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release hand pressure on the switch to cause agent discharge after the time delay has expired.
       6. EPO: Will terminate power to protected equipment immediately on actuation.
       7. Low-Nitrogen Pressure Switch: Initiate trouble alarm if sensing less than set pressure.

1. VALVES AND DEVICES
   1. Valves and Devices- The valves used shall be in accordance with the I-VORTEX manuals and use one of the following in conjunction with the pressure transducer:
      1. Single Zone Options (multiple single zone options can be used for multizone systems)
         1. Combination Panel Dry Contact Panel with Automatic Drain Valve
            1. Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive
            2. Alarm current: 3 amps maximum
            3. Standby current: 210 mA
            4. Supervisory connections: 500 mA @ 30 VDC resistive load
            5. NEMA 12/ IP52
         2. Combination Panel Active Release Panel with Automatic Drain Valve
            1. Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive
            2. Alarm current: 3 amps maximum
            3. Standby current: 210 mA
            4. Supervisory connections: 500 mA @ 30 VDC resistive load
            5. NEMA 12/ IP52
      2. Multi-Zone Options (Fluid Panel is Nitrogen Only, Zone Panel is Water only)
         1. Fluid Panels and Zone Panels Dry Contact
            1. Fluid Panel Electrical Requirements-

Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive

Alarm current: 3 amps maximum

Standby current: 210 mA

Supervisory connections: 500 mA @ 30 VDC resistive load

* + - * 1. Zone Panel Electrical Requirements-

Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive

Alarm current: 4 amps maximum

Standby current: 45 mA

Supervisory connections: 500 mA @ 30 VDC resistive load

* + - 1. Fluid Panels and Zone Panels Active Release
         1. Fluid Panel Electrical Requirements-

Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive

Alarm current: 3 amps maximum

Standby current: 210 mA

Supervisory connections: 500 mA @ 30 VDC resistive load

* + - * 1. Zone Panel Electrical Requirements-

Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive

Alarm current: 4 amps maximum

Standby current: 45 mA

Supervisory connections: 500 mA @ 30 VDC resistive load

* + 1. Pressure Transducer- Used with Combination and Fluid Panels

Operating voltage: 24 VDC nominal, polarity sensitive

Output: 4-20 mA (0 - 100 psi/0 - 6.9 Bar)

Connections: 18 AWG shielded, twisted pair

3.8 - 4.2 mA at atmospheric pressure

Operating Pressure 25 – 50 psi/1.7 – 3.4 Bar

1. Discharge Emitters / Flow Cartridge – Water Pressure 30-psi/2.1-Bar minimum and 100-psi/6.9-Bar maximum
   1. Total flooding protection of protection of wet bench applications and similar processing equipment applications
      1. 1/4” Series 953 Cavity Foil with .26 gpm Water Flow Cartridge at a nitrogen design pressure of 38 – 42 psi/2.6 – 2.9 Bar
2. PIPE AND FITTINGS
   1. See I-Vortex Manuals for applications of pipe, tube, fitting, and joining materials.
   2. Piping: Comply with types and standards listed in FM Datasheets (Including FM 7-7) or NFPA 770 and the I-Vortex Manuals.
      1. High Pressure Nitrogen Piping- Fittings meeting or exceeding AFME B31.1 with a pressure rating of at least 3000 psi
      2. Low Pressure Nitrogen Piping- Minimum Schedule 10 carbon steel pipe and/or galvanized pipe or Schedule 5 stainless steel pipe for 3-inch/88.9- mm and smaller diameter piping.
      3. Alternative Nitrogen piping materials, may be used, provided that the pipe is rated for this service, is protected from external damage, and is allowed by the AHJ and all applicable codes and standards.
      4. Water Distribution Piping- Comply with types and standards listed in FM Datasheets (Including FM 7-7) or NFPA 770 (Which references NFPA 13)
      5. Water Piping from Flow Control Cartridge- copper tubing or stainless steel tubing
      6. Alternative water piping/tubing piping materials, may be used, provided that the pipe is rated for this service, is protected from external damage, and is allowed by the AHJ and all applicable codes and standards.
   3. Steel Pipe: ASTM A53/A53M, Type S, Grade B or ASTM A106/A106M, [Grade A] [and] [Grade B]; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.
      1. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for Hybrid service, and matching steel-pipe dimensions. Include ASTM A536, ductile-iron housing, elastomer rubber gasket, and ASTM A449 compliant steel bolts and nuts.
         1. Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13.
            1. Installation-Ready for complete installation without field disassembly with center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth. Basis of Design: Victaulic Style 009N, 109 or 107N.
            2. Victaulic Style 005H.
         2. Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Installation-Ready Style 177 or Style 75/77.
      2. Threaded Fittings:
         1. Malleable-Iron Fittings: ASME B16.3, Class 3000.
         2. Fittings Working Pressure: 620 psig (4278 kPa) minimum.
         3. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
         4. Steel, Grooved-End Fittings: FM Approved, UL Listed and NRTL listed, ASTM A47/A47M malleable iron or ASTM A536 ductile iron, with dimensions matching steel pipe and ends factory grooved in accordance with AWWA C606.
3. VALVES
   1. General Fluid Panel Requirements:
      1. Approved by the Authority Having Jurisdiction
      2. Container Valves: Solenoid and manual-release handwheel, capable of immediate and total agent discharge and suitable for intended flow capacity.
      3. Valves in Sections of Closed Piping and Manifolds: Fabricated to prevent entrapment of liquid or install valve and separate pressure relief device.
      4. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.
4. EXTINGUISHING-AGENT CONTAINERS
   1. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
      1. Finish: GLOSS BLACK, Gillespie P2100 or equivalent.
      2. Manifold: Single Piece Carbon Steel High Pressure Nitrogen manifold, painted for corrosion resistance.
      3. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
      4. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
   2. The Victaulic Vortex™ 2000 Fire Suppression System may also use a bulk nitrogen supply, consisting of either high-pressure nitrogen tubes or a low-pressure nitrogen lank.
      * 1. Victaulic can provide custom-sized ASME rated high-pressure manifolded tubes for the nitrogen supply. DOT tube packs may be used if approved by the AHJ, in accordance with applicable local codes and standards. Contact Victaulic for sizing and site-specific solution.
5. FIRE-EXTINGUISHING CLEAN AGENT
   * 1. Nitrogen Clean Agent: 99.9% quality of nitrogen.
6. FIRE CONTROL PANELS
   1. Description: FM Approved, including equipment and features required for testing, supervising, and operating fire-extinguishing system in accordance with the local AHJ.
   2. Power Requirements: 120/240 V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
   3. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
   4. Mounting: [Recessed flush with surface] [Surface].
   5. Supervised Circuits: Separate circuits for each independent hazard area.
      1. Detection circuits equal to required number of zones, or addressable devices assigned to required number of zones.
      2. Manual pull-station circuit.
      3. Alarm circuit.
      4. Release circuit.
      5. Abort circuit.
      6. EPO circuit.
   6. Control-Panel Features:
      1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
      2. Automatic switchover to standby power at loss of primary power.
      3. Storage container, low-pressure indicator.
      4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.
   7. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless steel or aluminum enclosure.
   8. Standby Power: [Sealed lead calcium] [Sealed, valve-regulated, recombinant lead acid] [Vented, wet-cell pocket, plate nickel cadmium] batteries with capacity to operate system for 72 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.
7. DETECTION DEVICES
   1. Description: Comply with FM Datasheets (Including FM 7-7) or NFPA 770, and NFPA 72; 24 V dc, nominal.
      1. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
      2. Photoelectric Detectors: LED light source and silicon photodiode receiving element.
      3. Remote Air-Sampling Detector System: Includes air-sampling pipe network, laser-based photoelectric detector, sample transport fan, and control unit.
         1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
         2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.
         3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05-inch wg (12.5 Pa) at all sampling ports.
         4. Other detection devices installed in accordance with their Listing with approval from the AHJ
   2. Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.
   3. Signals to the Central Fire-Alarm Control Panel: Any type of local system trouble is reported to central fire-alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to central fire-alarm control panel as separately identified zones.
8. MANUAL STATIONS
   * 1. Description: [Surface] [Semirecessed] FM Approved, with clear plastic hinged cover, 120-V ac or low-voltage compatible with controls. Include contacts for connection to control panel.
     2. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
   1. Abort Switch: "ABORT" caption, momentary contact, with green finish.
   2. EPO Switch: "EPO" caption, with yellow finish.
9. SWITCHES
   * 1. Description: FM Approved, where available, [120-V] <Insert value> ac or low- voltage compatible with controls. Include contacts for connection to control panel.
        1. Low-Agent Pressure Switches: Pneumatic operation.
        2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
        3. Disconnect Switch installed in accordance with FM Datasheets (Including FM 7-7) or NFPA 770 and NFPA 72
10. ALARM DEVICES
    1. Description: FM Approved, low voltage, and surface mounting. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" or Section 284621.13 "Conventional Fire-Alarm Systems" for alarm and monitoring devices.
       1. Bells: Minimum 6-inch (150-mm) diameter.
       2. Horns: 90 to 94 dBA.
       3. Strobe Lights: Translucent lens, with "FIRE" or similar caption.
       4. Oxygen Deficiency Monitor.
       5. Sampling Method and Range: Diffusion, zero to 25 percent O2.
          1. 24 V dc.
          2. Wall mounted with bracket.
          3. Built-in audible alarm 90 dBA.
          4. Backlit LCD.
11. PART 3 - EXECUTION
    1. EXAMINATION
       1. Examine areas and conditions, with Installer present, for compliance with enclosure integrity requirements, installation tolerances, and other conditions affecting performance of the Work in accordance with FM Datasheets (Including FM 7-7) or NFPA 770.
       2. Proceed with installation only after unsatisfactory conditions have been corrected.
    2. HYBRID SYSTEM INSTALLATION
       1. Install Hybrid containers, piping, and other components level and plumb, in accordance with manufacturers' written instructions.
       2. Hybrid Container Mounting:
          1. Install Hybrid containers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in- Place Concrete."
          2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
          3. Comply with requirements for vibration isolation devices specified in Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment."
       3. Grooved Piping Joints: Groove pipe ends in accordance with AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant in accordance with manufacturer's written instructions.
       4. Install pipe and fittings, valves, and discharge Emitters in accordance with requirements listed in FM Datasheets (Including FM 7-7) or NFPA 770, Section "Distribution."
    3. Install valves designed to prevent entrapment of liquid or install pressure relief devices in valve sections of piping systems.
    4. Support piping using supports and methods in accordance with NFPA 13.
    5. Install seismic restraints for extinguishing-agent piping systems.
    6. Install control panels, detection system components, alarms, and accessories, in accordance with requirements listed in FM Datasheets (Including FM 7-7) or NFPA 770, Section "Detection, Actuation, and Control Systems," as required for supervised system application.
12. PIPING CONNECTIONS
    1. Drawings indicate general arrangement of piping, fittings, and specialties.
       1. Where installing piping adjacent to equipment, allow space for service and maintenance.
13. ELECTRICAL CONNECTIONS
    1. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
    2. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
    3. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
    4. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
    5. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Section 284621.11 "Addressable Fire-Alarm Systems" or Section 284621.13 "Conventional Fire-Alarm Systems."
14. CONTROL CONNECTIONS
    1. Install control and electrical power wiring to field-mounted control devices.
    2. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
15. IDENTIFICATION
    1. Identify system components and equipment. Comply with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
    2. Identify piping, extinguishing-agent containers, other equipment, and panels in accordance with FM Datasheets (Including FM 7-7) or NFPA 770.
    3. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a Hybrid fire-extinguishing system.
    4. Install signs at entry doors to advise persons outside the room the meaning of horn(s), bell(s), and strobe light(s) outside the protected space.
16. FIELD QUALITY CONTROL
    * 1. Testing Agency: [Owner will engage] [Engage] a qualified integrator testing agency to perform tests and inspections.
      2. Manufacturer's Field Service: Engage a factory-authorized integrator to test and inspect components, assemblies, and equipment installations, including connections.
      3. Perform tests and inspections [ with the assistance of a factory-authorized service representative].
      4. Tests and Inspections:
         1. After installing Hybrid fire-extinguishing system, and after electrical circuitry has been energized, test for compliance in accordance with requirements listed in FM Datasheets (Including FM 7-7) or NFPA 770, Section "Approval of Installation."
         2. Hybrid fire-extinguishing system and associated protected enclosure will be considered defective if either does not pass required tests and inspections.
         3. Prepare test and inspection reports in accordance with requirements listed in FM Datasheets (Including FM 7-7) or NFPA 770, Section "Installation Acceptance."
    1. CLEANING
       1. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing Emitters or discharge devices.
    2. OPERATIONAL CONDITION SYSTEM FILLING
       1. Preparation:
          1. Verify that Hybrid fire-extinguishing system and protected enclosure have passed all required tests and inspections in accordance with FM Datasheets (Including FM 7-7) or NFPA 770.
          2. Verify that Hybrid fire-extinguishing piping system installation is completed and cleaned.
          3. Verify complete enclosure integrity.
          4. Verify operation of ventilation and exhaust systems.
       2. Filling Procedures:
          1. Fill Hybrid fire-extinguishing containers with extinguishing agent,and pressurize to indicated charging pressure.
          2. Install filled containers.
          3. Energize circuits.
          4. Adjust operating controls.
    3. DEMONSTRATION
       1. [Engage a factory-authorized integrator representative to train] [Train] Owner's maintenance personnel to adjust, operate, and maintain Hybrid fire-extinguishing systems.
    4. END OF SECTION 212200

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| Revision History | | |
| A | 7/14/2022 | Spec rewritten to current product line / standards. |