

SECTION 13966

TOTAL FLOODING ECARO-25™ CLEAN AGENT FIRE EXTINGUISHING SYSTEM



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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Total flood ECARO-25 clean agent clean agent fire suppression system with an addressable detection and control system.

1.2 RELATED SECTIONS

- A. Division 9 - Finishes: Assemblies and materials comprising the enclosure of the protected area, including sealing required to maintain pressurization for minimum required time.
- B. Division 15 - Mechanical: HVAC actuators and system operation controlled shutdown by control panel.
- C. Division 16 - Electrical: Power supply to the system control panel; interlock wiring and conduit for shutdown of HVAC, dampers, and electric power; connection to fire alarm system.

1.3 SYSTEM DESCRIPTION

- A. Total flooding ECARO-25 fire extinguishing system: The system shall include necessary mechanical and electrical installation, required detection and control equipment, agent storage containers, agent, system actuation equipment, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/ advisory signs, functional checkout and testing, training and other operations necessary for a fully functional UL Listed and/or FM Approved clean agent system.
- B. Design Requirements: Clean agent extinguishing system designed in accordance with equipment manufacturer's guidelines.
 - 1. Provide a total flooding clean agent fire extinguishing system with automatic detection and control for the following protected areas:
 - a. _____:
 - b. _____:

2. Locate control panel.
 - a. Control Panel shall be UL Listed and/or FM Approved for releasing services.
 - b. Provide battery stand-by power supply, to power complete discharge in the absence of building power, taking into consideration the power requirements of all alarms, initiating devices and auxiliary components under full load conditions.
 - c. Mount graphic annunciation panel adjacent to the control panel.
3. Locate extinguishing agent supply within each protected area or as nearby as possible, to reduce the amount of pipe and fittings required. Cylinders should be placed in a secure controlled environment that maintains an ambient temperature range of 60-80F or as specified in the System Manufacturers Design, Installation and Maintenance Manual.
4. Locate automatic actuation within the enclosure space away from discharge nozzles.

Nozzles are to be placed in accordance to System Manufacturers Design, Installation and Maintenance manual to ensure proper physical coverage of the protected space and away from exits, where nozzles will not present a hazard or danger during discharge to evacuating personnel.
5. Locate manual actuation by manual release devices located at each hazard exit.
 - a. Manual actuation shall bypass the time delay and abort functions, shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.
 - b. A manual release or manual pull switch shall be located at each exit from the protected hazard and shall have an advisory sign provided at each location.
 - c. A manual release shall be located as close to the storage containers as permitted given consideration for convenience of operation and egress from the hazard area.
 - d. Provide abort station adjacent to each manual release device.
 - e. Provide countdown timer adjacent to each manual release device.
6. Locate audible and visual alarms.
 - a. Strobe or Horn/Strobe device shall be placed outside and above each exit door from the protected space. Provide an advisory sign at each visual alarm location.
7. Locate cautionary and advisory signs.
 - a. Provide one visual alarm sign at each visual alarm over entrance/exit from protected space;
 - b. Provide one manual release sign at each manual release station;
8. Cabinets shall be key locked and locks shall be keyed alike.

C. Performance Requirements:

1. The detectors shall be spaced and installed in accordance with the manufacturer's specifications and the guidelines of NFPA No. 72.
 - a. The system shall be actuated by a combination of ionization and/or photoelectric detectors installed at a maximum spacing of 250 sq.ft. (23.2 sq.m.) per detector, in both the room, under floor and above ceiling protected spaces. The detection should be sequential, guaranteeing that system discharges only upon two detectors, alarm and verification giving way to pre-discharge countdown and discharge. If the airflow is one air change per minute or greater, photoelectric detectors only shall be installed at a spacing not to exceed 125 sq.ft. (11.6 sq.m) per detector.

- b. Detectors shall be wired in Sequential Detection method of operation, standard Cross-Zoned detection, or single detector release. No other detection / wiring arrangements will be acceptable.
 - 2. The ECARO-25 system shall provide a minimum design concentration of 8.0 percent by volume, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected area. Per NFPA 2001, the system design shall not exceed a maximum exposure limit concentration level of 11.5 percent, by volume, unless provisions for room evacuation, before agent release, are provided. All personnel should be able to leave the protected space prior to the discharge or at least within 5 minutes of the commencement of discharge.
- D. Operational Requirements: Provide automatic operation in each protected area as follows:
 - 1. Actuation of any single detector shall result in:
 - a. Illumination of the "ALARM" lamp on the control panel face.
 - b. Activation of audible alarm. (ie Bell, Horn.)
 - c. Activation of visual indicator. (ie Strobe, Horn/Strobe)
 - d. Activation of audible and visual indicator at the control panel.
 - e. Transfer sets of 5 Amp rated auxiliary contacts which can perform auxiliary system functions such as:
 - 1) Release of door holders on entrance/exit doors.
 - 2) Transmission of signal to fire alarm system.
 - 3) Closing of HVAC dampers located in protected area enclosure.
 - 4) Shut down of HVAC air handling equipment serving protected area.
 - f. Illumination of corresponding lamp on graphic annunciator.
 - 2. Actuation of a second detector shall result in:
 - a. Illuminate the "PRE-DISCHARGE" visual indicator on the control panel face.
 - b. Energize a pre-discharge Audible alarm (ie Horn/Bell).
 - c. Energize a pre-discharge Audible/Visual alarm (ie Horn/Strobe device.)
 - d. Closing of HVAC dampers located in protected area enclosure.
 - e. Shut down of HVAC air handling equipment serving protected area.
 - f. Start of time-delay sequence for discharge (not to exceed 60 seconds).
 - g. System abort sequence is enabled at this time.
 - h. Illumination of corresponding visual indicator on graphic annunciator.
 - 3. After completion of the time-delay sequence, the extinguishing agent shall be discharged and the following shall occur:
 - a. Illumination of "SYSTEM FIRED" visual indicator on the control panel face.
 - b. Shut down of all power to high-voltage equipment.
 - c. Activation of visual indicators outside the area in which the discharge occurred.
 - d. Activation of "System Fired" audible device(s). (ie Horns / Bells)
 - 4. The system shall be capable of being actuated by manual discharge devices located at each hazard exit. Operation of a manual device shall duplicate the sequence description above except that the time delays and abort functions shall be bypassed. The manual discharge station shall be of the electrical actuation type and shall be supervised at the main control panel.
 - 5. The system shall be capable of providing a "PRE-ALARM" feature that can give advanced warning of a possible alarm condition.

1.4 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NFPA 72 - National Fire Alarm Code.

- C. NFPA 2001 - Standard on Clean Agent Fire Extinguishing Systems.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Submit product data, isometric drawings of intended mechanical and electrical work, hydraulic calculations (complete UL FM Approved Computer Flow Calculations unless an approved Pre-Engineered system, sequence of operation description to the local Fire Prevention Agency, owners Insurance Underwriter, and all other authorities having jurisdiction before starting installation. Submit approved plans to the Architect for record purposes.
- C. Quality Assurance Submittals: Submittal of manufacturer and installer qualifications.
- D. Product Data: Manufacturer's data sheets for each component and the control system.
- E. Project Drawings: Show complete system on drawings at a scale of not less than 1/8 inch to 1 foot (1:100).
 - 1. Show location of all clean agent storage tanks, pipe runs including pipe sizes and lengths, control panels, detectors, manual pull stations, abort stations, audible and visual alarms, etc.
 - 2. Provide auxiliary details and information for maintenance panels, door holders, special sealing requirements and equipment shutdowns.
 - 3. Provide separate drawings for:
 - a. Each level (i.e. room, under floor, above ceiling).
 - b. Mechanical work, including proposed pipe runs and sizes.
 - c. Isometric details of agent storage containers and mounting details, and proposed pipe runs and sizes.
 - d. Electrical work, including the location of all devices, point-to-point conduit runs, description of the methods used for detector mounting, and interfaces to building electrical and fire protection systems.
 - e. Internal control panel wiring diagram, including power supply requirements and field wiring termination points.
 - f. Graphic annunciator wiring schematics and dimensioned of display panel.
- F. Hydraulic Flow Calculations: Complete hydraulic flow calculations, from Fike's UL/FM Approved ECARO-25 Flow Calculation Program, shall be provided for all Engineered Clean Agent systems. Include in the calculations:
 - 1. The individual sections of pipe and each fitting to be used, corresponding to Isometric drawings.
 - 2. Total clean agent discharge volume and time by zone.
- G. Provide calculations for the battery stand-by power supply taking into consideration the power requirements of all alarms, initiating devices and auxiliary components under full load conditions. As per NFPA 72 for Clean Agent Extinguishing Systems
- H. Sequence of Operation Description: Describe in detail the complete sequence of operation, including alarm functions, shutdown functions, remote signaling, damper operation, time delay and agent discharge for each zone or system.

- I. Test Plan: Submit a test plan describing procedures to be used to test the system. Include a step-by-step description of all tests to be performed and the type and location of test apparatus to be employed.
- J. Operation and Maintenance Data: Describe all aspects of system operation and maintenance.
 - 1. Submit to Owner as a condition of final acceptance.
 - 2. Submit 4 copies for each individual system, assembled into ring-bound manuals.
 - 3. Include piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawings illustrating control logic and equipment used in the system, checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures.
 - 4. Include manufacturer's Data Sheets for each component installed, including parts lists.
 - 5. Identify manufacturer-authorized repair and maintenance agency and location of parts-stocking warehouse.
- K. Project Record Drawings: Document actual installation details including equipment locations, agent containers, detectors, alarms, manual release devices, piping and conduit routing details; show actual arrangement of protected area enclosure, doors, and dampers.
 - 1. Submit to Owner as a condition of final acceptance.
 - 2. Provide one reproducible copy of each drawing.
 - 3. Submit 4 copies for each individual system, assembled into operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. System Manufacturer Qualifications: A firm having a minimum of 10 years experience in the design and manufacture of similar types of control systems, detection devices, and related components. Provide list of similar installations evidencing satisfactory service.
- B. Installer Qualifications: An experienced firm regularly engaged in the installation of automatic fixed clean agent fire extinguishing systems similar to that specified, under typical code requirements.
 - 1. Trained by the manufacturer to design, install, test and maintain fire extinguishing systems.
 - 2. Having minimum of 5 years experience in the design, installation and testing of similar fire extinguishing systems; provide a list of installations of similar nature and scope on request.
 - 3. Employ a NICET-certified special hazard designer, level 2 or above, to be responsible for this project.
 - 4. Provide minimum \$2,000,000.00 liability and completed operations insurance policy for this work.
 - 5. Maintaining or having access to an extinguishing agent recharging station. Demonstrate ability to recharge the largest extinguishing agent system specified within 24/48 hours after discharge.
 - 6. Authorized stocking distributor of manufacturer's equipment to provide immediate replacement of parts from inventory.
 - 7. Provide demonstrable emergency service on twenty-four hour, seven-day-a-week basis.
- C. Product Qualifications:

1. Manufacturer's name, part number and serial number shall appear on major components.
 2. Devices, components and equipment shall be the products of the same manufacturer.
 3. Devices, components and equipment shall be new, standard products of the system manufacturer's latest design and suitable to perform the functions intended.
- D. The design, equipment, installation, testing and maintenance of the system shall be in compliance with the applicable requirements set forth in the latest edition of the following codes, standards, and third party approval agencies:
1. NFPA No. 2001 – Standard on Clean Agent Fire Extinguishing Systems.
 2. NFPA No. 70 - National Electrical Code.
 3. NFPA No. 72 - National Fire Alarm Code.
 4. Factory Mutual (FM)
 5. Underwriters Laboratory (UL)
 6. Requirements of the Authority Having Jurisdiction (AHJ).

1.7 MAINTENANCE

- A. Provide two maintenance inspections during the first year of service.
1. Inspect at 6 month intervals commencing when the system is first placed into normal service.
 2. Conduct inspections in accordance with the manufacturer's guidelines and the recommendations of NFPA 2001.
 3. Submit documents certifying satisfactory system operation to Owner upon completion of each inspection.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturer: FIKE Corporation, 704 South 10th Street, Blue Springs, MO 64015. ASD. Tel: (816) 229-3405. Fax: (816) 229-4615. Web: <http://www.FIKE.com>. Email: marketing@FIKE.com.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01600.
- C. Substitutions: Not permitted.

2.2 EQUIPMENT REQUIREMENTS

- A. The system shall be a FIKE ECARO-25 clean agent system utilizing HFC-125 as the fire extinguishing agent.
- B. Materials and equipment shall be standard products of the supplier's latest design and suitable to perform the functions intended. When one or more pieces of equipment must perform the same function, they shall be duplicates produced by one manufacturer.

2.3 MATERIALS AND EQUIPMENT

- A. Control Panel: Cheetah Analog Addressable Control Panel, P/N 10-052-X-X.

1. Power source: 120 VAC at 50/60 Hz.
 2. Power source: 208/220 VAC at 50/60 Hz.
 3. UL listed and FM approved for releasing service. Designed for Deluge and Pre-action sprinkler service.
 4. Compatible with 7 Ah, 18 Ah, 33 Ah, or 65 Ah battery standby power supplies.
 5. Microprocessor based with hardware and software integration designed to guarantee reliability.
 6. Support Cross Zone, Counting Zone, Single Detector Release and Manual Release detection/actuation methods.
 7. Red finish. Or Gray finish.
 8. Provide the following capabilities and functions:
 - a. Two Class B (Style Y), indicating appliance circuits rated for 2.0 amps at 24 VDC.
 - b. Two Signal Line Circuits, Style 4/6 (Class A/B). Communicates to up to 127 addressable devices per circuit.
 - c. Two auxiliary supply circuits rated 2A at 24Vdc, each.
 - d. One resettable auxiliary supply circuit rated 2A at 24 Vdc.
 - e. Three Form "C" relays, rated 2 amps at 30 Vdc providing alarm, trouble, and supervisory annunciation.
 - f. Relay module (CRM4): (P/N 10-2204). Provide four programmable contacts rated 2A at 30 Vdc. Control panel shall support up to two CRM4 modules.
 - g. Supplemental loop module (SLM): (P/N 10-2203) provides two signal line circuits, style 4/6 (Class A/B). Communicates to up to 127 addressable devices per circuit.
 - h. Power supply: 5.0 amps at 24 VDC to operate high current draw horns and strobes. Capable of supporting 65 Ah of standby batteries.). External normal standby current of 1.0A and control panel external alarm current of 5.0A. Supports up to 65 Ah of standby battery capacity.
 - i. Power supply module: (P/N 10-2201-p). Operates from 120Vac, 50/60 Hz (p=1) or 208/240Vac, 50/60 Hz (p=2). External normal standby current of 2.0A and control panel external alarm current of 10.0 A. Provides two auxiliary supply circuits rated 2A at 24 Vdc, each. Supports up to 65 Ah of standby battery capacity.
 - j. Eight Status LEDs plus alpha-numeric display for troubleshooting: AC power; fire alarm; pre-alarm warning; supervisory; trouble; alarm silenced; supervisory silence and trouble silence.
 - k. Programmable pre-discharge and discharge timers.
 - l. Six Abort types.
 - m. Intelligent Transistor protection to prevent noise spikes and microprocessor failure from inadvertently activating release outputs.
 - n. Disarm function to disable release outputs.
- B. Extinguishing Clean Agent Storage and Distribution: The system design can be modular, central storage, or a combination of both design criteria utilizing a fast acting rupture disc valve. The valve shall contain a scored, non-fragmenting, rupture disc to provide immediate total discharge of the ECARO-25 agent.
1. Containers shall be high-strength alloy steel construction complying with NFPA 2001; FIKE P/N 70-XXX Series Agent Storage Containers; super-pressurized with dry nitrogen to operating pressure of 360 psi (2500 kPa) at 70 degrees F (20 degrees C).
 2. Containers shall be actuated by parallel wired Gas Cartridge Actuators through a FIKE P/N 10-1832 Agent Release Module (ARM), located at each agent storage container.

3. Pressure Gauge: Color coded to provide easy visual indication of container pressure.
 4. Low Pressure Switch: Wired to control panel to provide audible and visual alarm in the event that container pressure drops below 288 psi (19 bar).
 5. Pressure Relief Valve: Provide automatic operation when internal temperature exceeds 150 degrees F (66 degrees C).
- C. Discharge Nozzles: FIKE P/N 85-XXX with FIKE Series 02-XXXX ceiling plates
1. Provide nozzles made specifically for pipe sizes used.
 2. Provide 180 degree and 360 degree distribution patterns.
 3. Optional ceiling plates may be used to conceal pipe entry holes through ceiling tiles.
- D. Distribution piping, and fittings, shall be type and size in accordance with the system manufacturer's requirements, NFPA 2001, ASME B31.1, and approved piping standards and guidelines. The Fire Suppression Systems Association (FSSA) Pipe Design Handbook (No. FSSA PDH -01) for guidance on how to apply the ASME B31.1 Power Piping Code in order to determine the maximum allowable internal working pressure for piping used in special hazard fire suppression systems.
- E. Addressable Devices:
1. Photoelectric Detector : FIKE P/N 63-1021. Provide list of similar installations evidencing satisfactory service.
 2. Ionization Detector: FIKE P/N 67-1032. Detectors shall be supported by 4 inch (10 mm) base 63-1020 and 6 inch (15 mm) base 63-1023.
 3. Thermal Detector: FIKE P/N 60-1028. Detectors shall be supported by 4 inch (10 mm) base 63-1020 and 6 inch (15 mm) base 63-1023.
- F. Agent release Module (ARM): FIKE P/N 10-1832.
- G. Supervise Output Module (SOM): FIKE P/N 55-021
1. The SOM shall be capable of supplying up to 2.0A at 24 Vdc of supervised output current for connection to compatible bells, horns, strobes, etc.
- H. Dual Relay Module (R2M): FIKE P/N 55-023
1. The R2M shall be programmable by the control panel. Relay contact shall be capable of switching up to 2A at 30 Vdc.
- I. Fast Response Contact Module (FRCM): FIKE P/N 55-018, P/N 55-019 and P/N 55-020
1. The FRCM shall be functionally identical; the difference between the three models is the mounting.
 2. The FRCM shall monitor normally open or normally closed contacts and shall be programmed for a variety of input types as defined by the control panel programming.
- J. Manual Release (Electric): Manual Release Switch: FIKE P/N 10-1638 and Manual Pull Station: P/N 02-3710. The Manual Release or Manual Pull shall be connected to a FRCM which is programmed for the intended function.
1. The electric manual release switch shall be a dual action device which provides a means of manually discharging the clean agent system when used in conjunction with the Control System.

2. The Manual Release switch or Manual Pull station shall be a dual action device requiring two distinct operations to initiate a system actuation.
- K. Abort Stations: "Dead Man" type FIKE P/N 10-1639
1. "Locking" or "Keyed" abort stations shall not be permitted.
 2. The Abort Station shall be supervised and shall indicate a trouble condition at the control panel, if depressed, and no alarm condition exists.
 3. The station can be furnished in combination with a Manual Release Switch or in combination with a Manual Release Switch and Digital Countdown Timer.
- L. Countdown Timer (Digital): FIKE P/N 20-046.
- M. Audible And Visual Alarms: Operate from the control panel.
1. Alarm bell, alarm horn and horn/strobe devices: FIKE P/N's 20-XXX or equal. An HFC-125 label shall be attached to the strobe lens when required.
 2. Vertical strobe device: FIKE P/N 20-XXX, or equal. An HFC-125 label shall be attached to the strobe lens when required.
- N. Caution and Advisory Signs: Provide signs necessary to comply with NFPA 2001 and the recommendations of the manufacturer.
1. Entrance Sign: FIKE P/N 02-10314.
 - a. Provide one at each entrance/exit to a protected space.
 2. Manual Release Sign: FIKE P/N 02-10312.
 3. Visual Alarm Sign: FIKE P/N 02-10319 or 02-10313.
- O. Graphic Annunciator Panel: The graphic annunciator shall show a scale layout of the protected area(s) and have indicator lamps to locate each system detector and/or other system components. The panel shall have a lamp test switch located on the panel face. Scale shall not be less than $1/8" = 1'-0"$ (1:100 m).
- P. System and Control Wiring: Provide system wiring.
1. Provide color-coded conductors in sizes as specified by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until enclosure has been properly prepared.
- B. If enclosure preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Before starting installation, verify that the enclosure of the protected areas has been adequately and properly sealed.

3.2 COORDINATION

- A. Fire suppression contractor shall furnish electrical back boxes, and sub frames for rough-in prior to enclosure completion.
- B. Mechanical: Assemble, install and make final connections at actuators and motor controllers to affect HVAC controlled shutdown by control panel.

- C. Electrical: Assemble, install and make final connections at panel boards and motor controllers to affect controlled electrical shutdown by control panel.

3.3 INSTALLATION

- A. Install in accordance with NFPA 70 (except as otherwise permitted for limited energy circuits), NFPA 72, and NFPA 2001, manufacturer's recommendations, and requirements of applicable codes.
- B. Distribution piping, and fittings, shall be installed in accordance with the system manufacturer's requirements, NFPA 2001 and approved piping standards and guidelines. All distribution piping shall be installed by qualified individuals using good, accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations.
- C. Distribution Piping: Install using qualified installers, using accepted good practice.
 - 1. Remove burrs, mill varnish and cutting oils before assembly of piping, by reaming, blowing clear, and swabbing with suitable solvent.
 - 2. Adequately support piping using hangers, brackets, and braces.
 - 3. Anchor piping securely at directional changes and nozzle locations.
 - 4. Seal pipe threads with Teflon tape pipe sealant applied to the male thread ONLY.
- D. System and Control Wiring:
 - 1. System wiring shall be separate from all other building wiring and conduit.
 - 2. Wiring shall be installed in electrical metallic tubing (EMT), or conduit, and must be installed and kept separate from all other building wiring.
 - 3. System components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, installed parallel and perpendicular to walls and partitions.
 - 4. The sizes of the conductors shall be those specified by the manufacturer. Color coded wire shall be used. All wires shall be tagged at all junction points and shall be free from shorts, earth connections (unless so noted on the system drawings), and crosses between conductors. Final terminations between the Cheetah control panel and the system field wiring shall be made under the direct supervision of a factory trained representative.
 - 5. Wiring shall be installed by qualified individuals, in a neat and workmanlike manner, to conform to the National Electrical Code, Article 725, and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72 - 1993 edition. Wiring installation shall meet all local, state, province and/or country codes.
 - 6. The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the National Electrical Code.

3.4 STARTING OF EQUIPMENT AND SYSTEMS

- A. After completion of installation, inspect the system in accordance with the system manufacturer's recommended procedures and applicable NFPA standards.
 - 1. Check all containers and distribution piping for proper mounting and installation.
 - 2. Test electrical wiring for proper connection, continuity and resistance to earth.
 - 3. Test each detector in accordance with the manufacturer's recommended procedures and record test values.
 - 4. Verify that system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. function as required and as designed.

5. Test each control panel circuit by inducing a trouble condition into the system.
- B. Put all functions, including system and equipment interlocks, into proper operation at least five days prior to functional testing.

3.5 FIELD TESTING

- A. Functional Tests: Demonstrate that the entire system functions as designed and intended, with the exception of actual discharge of extinguishing agent.
1. Test all circuits, including automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual overrides.
 2. Verify proper supervision of all panel circuits, including AC power and battery power supplies.
 3. Provide qualified testing personnel.
 4. Submit test plan prior to starting testing; do not conduct tests until test plan has been approved.
 5. Test functionality in the presence of the Owner or his representative.
- B. Enclosure Integrity Test: Conduct a test in each protected space in accordance with NFPA 2001, Appendix C, to discover openings in the protected area enclosure that would adversely affect the agent concentration levels.
1. Use the Retro-Tec Corp. Door Fan system, or equivalent, with integrated computer program.
 2. If enclosure integrity testing indicates openings that would result in leakage or loss of extinguishing agent, notify and instruct the installers of the enclosure of measures that must be taken to properly seal the enclosure.
 3. The enclosure installers are responsible for sealing the enclosure, but the extinguishing system installer is responsible for the success of the room pressurization test.
 4. If the enclosure integrity test is not successful, conduct additional enclosure integrity tests, at no additional cost to the Owner, until a successful test is obtained.
 5. Submit copy of successful test results to Owner for the project record.
- C. Upon satisfactory completion of testing and acceptance by the Owner, place the system into service.

3.6 OWNER-PERSONNEL TRAINING

- A. Provide operational training to each shift of the Owner's personnel.
1. Include in each training session explanation of normal sequence of events for a discharge, explanation of visual and audible alarms, control panel operation, manual functions, abort procedures, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.
 2. Earl – Please add the NFPA 2001 requirements on evacuation? There should be something on the training for the proper protocol for evacuation of the protected space in case of Alarm or Discharge and that doors must be closed upon exiting or remain closed during discharge..
 3. Accomplishment of training is a condition of acceptance by Owner.

END OF SECTION