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SECTION 28 34 00 FUEL DETECTION SYSTEM FOR LIQUID HYDROCARBON FUEL DETECTION SYSTEM TO MEET FM APPROVAL STANDARD 7745

PART 1 GENERAL

1.1. SUMMARY

A. Section Includes

1. nVent RAYCHEM TraceTek Leak detection system for liquid hydrocarbons fuels, including diesel fuel, utilizing point sensors, interconnecting cable and a controller necessary for a complete installation of an integrated Leak Detection & Location System as described in Factory Mutual Approval Standard 7745.
2. The nVent RAYCHEM TraceTek leak detection system shall be selected and used for indoor mechanical areas where multiple sensing points are required to quickly detect a liquid hydrocarbon fuel leak. The system is supplied with sensor interface module(s) for each area, suitable for stand-alone operation and operation with other electronic event reporting equipment (e.g. a building management system or a digital control system) through normally open or normally closed relay contact closure; or 4-20 mA signal, or RS-485/232 Modbus.
3. A typical leak detection and location system will monitor one or more of the following areas:
 - a. Emergency generators
 - b. Liquid hydrocarbon fuel day tanks, or
 - c. Liquid hydrocarbon fuel piping
 - d. Emergency Generator - fuel connections
 - e. Liquid hydrocarbon fuel pump connections
 - f. Day Tank Fuel connections
 - g. Fuel Filter connections
 - h. Dual Source Boilers connections

B. Related Requirements (provided when applicable)

1. Common work results for Electrical – Section 26 05 00
2. Low-Voltage electrical power conductors & cables – Section 26 05 19
3. Communication Services – Section 27 05 13
4. Hangers and Supports for Communications Systems – Section 27 05 29
5. Conduits and Back boxes for Communications Systems – Section 27 05 33
6. Fuel-oil detection and alarm control, GUI, and logic systems – Section 28 34 13
7. Fuel-oil detection and alarm integrated audio evacuation systems – Section 28 34 23
8. Fuel-oil detection sensors – Section 28 34 33

1.2. REFERENCES

A. Reference Standards

1. NFPA 70 (NEC) – US National Electric Code
2. CSA C22.1 – Canadian Electrical Code
3. NEMA 250 – Enclosures for Electrical Equipment
4. FM Global Approval Standard 7745 – Hydrocarbon leak detection



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1.3. SUBMITTALS

A. Product Data

1. Provide product submittals data for liquid hydrocarbon fuel leak detection point sensors, hydrocarbon cable sensors, sensor interface modules, modular connectors & main control panel.
2. Provide manufacturers installation & operation manual for hydrocarbon fuel leak detection, sensor interface module & main control panel.

B. Shop Drawings

1. Provide a hydrocarbon leak detection circuit layout drawing detailing the following information for each circuit:
 - a. Point sensors & location
 - b. Cable sensors & location
 - c. Sensor interface modules & location
 - d. Main control panel & location
2. Shop drawings shall include a floor plan map of the building with sensor location & resistance reading at point sensor and cable sensor.

1.4. QUALITY ASSURANCE

A. Qualifications

1. Manufacturers
 - a. All manufacturers shall have a minimum of six years of experience in the manufacturing of liquid hydrocarbon fuel leak detection point sensors, twenty five years of experience in the manufacturing of sensing cables, controls & equipment.
2. Installers
 - a. All installers shall be professionally trained and experienced in the installation of liquid hydrocarbon fuel leak detection systems.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements

1. Point sensors, sensing cables, and controllers shall be stored in a clean and dry location prior to installation of the liquid hydrocarbon fuel leak detection system.
2. Take precautions necessary to prevent damage from contact with sharp objects to cables & sensors.

1.6. FIELD [OR] SITE CONDITIONS

A. Leak Detection Site Conditions

1. Floor area in and around where the liquid hydrocarbon fuel sensors will be installed shall be cleaned, prepped, sealed and painted prior to the installation of the hydrocarbon fuel sensors.

1.7. WARRANTY

A. Manufacturer Warranty – Contractor shall provide standard manufacturer’s warranty of 24 months from the date of purchase of the leak detection system.

B. Extended Warranty – Contractor shall submit all system testing records to manufacturer to qualify for manufacturer extended five year warranty on the following products:

1. TT5000 Sensing Cables



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PART 2 PRODUCTS

2.1. LIQUID HYDROCARBON FUEL LEAK DETECTION SYSTEM

A. Manufacturers

1. Product specification is based on the TraceTek brand of liquid hydrocarbon fuel leak detection products by nVent.

B. Contractor shall provide a complete FM approved liquid hydrocarbon fuel leak detection system designed for the areas listed below. Contractor to submit system design & system drawings to owner's agent, general contractor or lead facility engineer for approval.

C. Hydrocarbon Fuel Point Sensors

1. Contractor shall select nVent RAYCHEM TraceTek TT-FFS Fast Fuel Sensors from TT-FFS data sheet (nVent document H57977) for installation in the following areas:
[Select from one or more of the areas listed below]
 - a. Emergency Generator – fuel connections
 - b. Diesel Fuel Pump connections
 - c. Day Tank Fuel connections
 - d. Fuel Filter connections
 - e. Dual Source Boilers connections
 - f. Other – Specify
2. The hydrocarbon fuel sensor probes shall be able to detect liquid hydrocarbons such as gasoline, jet fuel, diesel, crude oil, etc. No more than a 2 mm of liquid hydrocarbon fuel in contact with the sensor probe at any point on its active length shall be required to cause the system to detect the presence of the liquid hydrocarbon spill.
3. The sensor probe shall not react to water from rain, snow melt, ground water, condensation, etc. The probes shall be mounted in a low point of a containment sump or containment area such that fuel leaking from the primary pipe, flange, valve, or other fitting on to the floor or into the sump containment system shall accumulate in the vicinity of the probe.
4. The hydrocarbon fuel sensing probe shall respond to gasoline, jet fuel, or diesel in less than 30 seconds. The probe shall be resettable, reusable and testable.
5. All hydrocarbon fuel point sensors must be approved by FM Global and compliant with the FM7745 Standard.
6. The hydrocarbon fuel sensor probe shall be approved for installation in hazardous areas per the classification of the installation locations and also be approved by FM or other agency having jurisdiction.
7. **Contractor shall include a 2'-0"W x 2'-0"L weir, fabricated from ¾" angle iron and painted safety yellow to capture hydrocarbons and ensure rapid detection on any fuel leaks. [optional]**
8. The number of hydrocarbon fuel point sensors & their location shall be shown on the shop drawing & submitted to owner agent for approval prior to installation of the sensors.
9. All hydrocarbon fuel sensor probes shall be installed on floor mounted brackets and fastened securely to the floor with approved fasteners. The installation bracket shall be model nVent RAYCHEM TraceTek TT-FFS-MOUNTING-BRACKET, or approved similar and shall allow for quick removal of the sensor for cleaning and/or maintenance.
10. The hydrocarbon fuel probe sensors shall be wired with TraceTek model leader cable (nVent RAYCHEM TraceTek TT-MLC-MC-BLK), modular branch connectors (nVent RAYCHEM TraceTek



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TT-MBC-MC-BLK) & jumper cables. Soldering, wire nuts or crimping of interconnecting wires is prohibited.

D. Hydrocarbon Fuel Sensing Cables

1. Contractor shall select nVent RAYCHEM TraceTek model TT5000 hydrocarbon fuel sensing cables from Table A and Table 1 in H53147 Design Guide, and install around the perimeter of the following areas:

[Select from one or more of the areas listed below]

- a. Generator room
 - b. Fire pump room
 - c. Day tank
 - d. Boiler room
 - e. Transfer piping from external storage tank to inside of building and within the building
 - f. Other – Specify
2. Hydrocarbon fuel sensing cables shall be a four (4) wire design, with two (2) sensing wires, one (1) alarm wire and one (1) continuity wire which can sense the presence of liquid hydrocarbon fuels at any point along its length and will not react to water. The sensing cable design shall have the ability to provide continuous verification of sensing circuit integrity. The core of the hydrocarbon fuel sensing cable shall consist of sensing wires jacketed with a conductive fluoropolymer and shall be constructed with no metal parts exposed to the environment for corrosion resistance.
 3. The cable shall have a rugged construction with the core encased in a radiation crosslinked conductive-polymer jacket and surrounded with a fluoropolymer braid.
 4. When installed around the perimeter of a room or equipment, the hydrocarbon fuel sensing cable shall be installed with TraceTek model TT-HDC-1/2 cable hold down clips.
 5. When installed on fuel piping, the hydrocarbon fuel sensing cable shall be installed with Velcro straps that wrap around the hydrocarbon sensing cable and the pipe. The installer shall secure the sensing cable to the pipe every 18 inches along its entire length. The sensing cable must be attached to the pipe system at the **lowest point where any liquid leak is most likely to drip from the pipe. Usually this will be the 6 o'clock** position on horizontal piping. For tracing vertical or angled piping, the sensing cable should be spiraled around the pipe and secured with straps.
 6. The length of hydrocarbon fuel sensing cables & their location shall be shown on the shop drawing & submitted to the **owner's agent for approval prior to installation.**

E. Sensor Interface Modules

1. Contractor shall furnish and install for each leak detection circuit a TraceTek model:

[Select from the following]

- a. TTSIM-1 Sensor Interface Module

LED Indicators for	Power	Leak	Service	Communication
Communications	RS-485 up to 4000 ft.			
Protocols	Modbus	OptoMux	Johnson Metasys	
Max Cable Length	5000 feet			
Precision	0.1% of sensor length			
Voltages [select]	24VAC	12VDC	24 VDC	
Mounting	Din rail mounting			



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b. TTSIM-1A Sensor Interface Module with integrated Form C Relay

LED Indicators for	Power	Leak	Service	Communication
Communications	RS-485 up to 4000 ft.			
Protocols	Modbus	OptoMux	Johnson Metasys	
Max Cable Length	500 feet			
Precision	0.5% of sensor length			
Voltages [select]	24VAC	120VAC	230VAC	12/24 VDC
Relay – Form C	SPDT	NO or NC	2A @ 250VAC	Software selectable
Mounting	Din rail mounting			

c. TTSIM-2 Sensor Interface Module with integrated Form C Relay and LCD display

LED Indicators for	Power	Leak	Service	Communication
Display	LCD with leak location			
Communications	RS-485 up to 4000 ft.			
Protocols	Modbus	OptoMux	Johnson Metasys	
Max Cable Length	500 feet			
Precision	0.5% of sensor length			
Voltages [select]	24VAC	120VAC	230VAC	12/24 VDC
Relay – Form C	SPDT	NO or NC	2A @ 250VAC	Software selectable
Mounting	Din rail mounting			

d. TTA-SIM-1A Sensor Interface Module with integrated Form C Relay and Audible Alarm

LED Indicators for	Power	Leak	Service	Communication
Communications	RS-485 up to 4000 ft.			
Protocols	Modbus	OptoMux	Johnson Metasys	
Max Cable Length	500 feet			
Precision	0.5% of sensor length			
Voltages [select]		120VAC	230VAC	
Relay – Form C	SPDT	NO or NC	2A @ 250VAC	Software selectable
Audible Alarm	60 decibels at 1 ft., with Silence Button			
Enclosure	Rugged polycarbonate, NEMA1/ IP20 rated			
Mounting	4 holes for mounting to any convenient vertical surface			

e. TTA-SIM-2 Sensor Interface Module with integrated form C relay, LCD display, and audible alarm

LED Indicators for	Power	Leak	Service	Communication
Display	LCD with leak location			
Communications	RS-485 up to 4000 ft.			
Protocols	Modbus	OptoMux	Johnson Metasys	
Max Cable Length	500 feet			



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Precision	0.5% of sensor length			
Voltages [select]		120VAC	230VAC	
Relay – Form C	SPDT	NO or NC	2A @ 250VAC	Software selectable
Audible Alarm	60 decibels at 1 ft., with Silence Button			
Enclosure	Rugged polycarbonate, NEMA1/ IP20 rated			
Mounting	4 holes for mounting to any convenient vertical surface			

2. The sensor interface module shall continuously monitor the sensor cable for continuity faults. The loss of continuity in any of the wires shall result in an LED indication of the trouble condition, and optional actuation of the alarm relay by user.
3. Each Sensor Interface Module shall be capable of interfacing with up to three (3) nVent RAYCHEM TraceTek TT-FFS fast fuel sensors. The number and location of the Sensor Interface Module shall be indicated on the system drawing.

F. Central Control Panel – CCP

[Select from one of the following]:

1. **[Option 1]** TTDM-128 control panel with LCD display
 - a. The CCP shall be powered by (24 Vdc / 24 Vac / 120 Vac / 230 Vac) **[select one]**
 - b. The CCP shall be capable of polling data from up to 127 external Sensor Interface Modules via RS-485 serial data communications using MODBUS, OptoMux or Metasys protocols.
 - c. The CCP shall provide at a minimum a 4 x 20 character LCD display that shall inform the user of the status of each connected Sensor Interface Model and its associated sensor cable circuit. Conditions reported shall include, NORMAL, LEAK DETECTED with LEAK LOCATION, LOOP BREAK, LOOP IMBALANCE, CABLE BREAK, and LOST COMMUNICATIONS.
 - d. The CCP shall maintain a user settable real time clock with time recorded to the nearest minute. All significant systems events including leak detection, locations, leak cleared, and alarm relay reset, etc. shall be recorded to an Event History log and shall include a date and time stamp. The Alarm panel shall maintain a log of the most recent 2048 events.
 - e. The CCP shall be equipped with Status LEDs for NORMAL (Power on); LEAK; TROUBLE; and SERVICE NEEDED.
 - f. The CCP shall be equipped with summary status relays for LEAK DETECTED, TROUBLE and SERVICE NEEDED. Relay contacts shall be Form-C, Double Pole, Double Throw and rated to at least 5A at 250 VAC.
 - g. The CCP shall scan for all connected Sensor Interface Modules at power up and automatically commence polling of all discovered channels. Any user configuration settings shall be maintained in non-volatile memory. The Alarm Panel shall automatically recover from any loss of power and restart with full functionality without loss of user specific set-up options or event history. For any loss of power exceed 5 minutes, the Alarm Panel shall record a power loss event and a system restart event to the Event History.
 - h. The CCP shall be equipped with a user selectable RS232/RS485 serial port for external communications. The CCP shall be capable of acting as a Modbus slave device and the manufacturer shall provide a Modbus register map allowing a Modbus master device (PC, PLC, DCS, etc.) to access all current status information for any connected SIM including leak detections and locations; all event history; user adjustable set-up parameters and alphanumeric channel and region tags.
 - i. The CCP shall be UL/FM approved.



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2. **[Option 2]** TT-TS12 control panel with touchscreen display and dynamic leak location map
 - a. Contractor shall install a TraceTek model TT-TS12 central control panel to monitor & manage all leak detection circuits up to a total of 250 external circuits.
 - b. **CCP shall include a 12" full color, high resolution SVGA touch screen display** panel as a user interface panel for control & monitoring of the hydrocarbon leak detection system.
 - c. CCP connection to Sensor Interface Modules shall be RS-485 communication wiring as specified under other sections.
 - d. CCP shall indicate the zone and locations of any leak on the display panel. The display shall feature an interactive and dynamic leak location map, with the location of any leak displayed as a flashing icon positioned over the floor plan, piping layout, or photo of the piece of equipment at the user's discretion.
 - e. CCP shall provide event data logging by circuit in non-volatile memory up to the most recent 5000 events. Each event shall include a date and time stamp.
 - f. CCP shall have 8 integrated relays (5A at 250VAC/30VDC, 4 x Form A, 4 x Form C), with 4 relays in use by the system and 4 relays available for general use.
 - g. CCP shall have the ability to send Email and SMS alerts for LEAK, SERVICE, and TROUBLE events.
 - h. CCP shall provide multi-level password protection for proper protection of leak detection system control
 - i. CCP shall include a MODBUS output for communication to a BMS.
 - j. CCP shall be UL/FM approved.

2.2. ACCESSORIES

- A. Contractor to provide all TraceTek brand modular branch connectors, jumper cables and connectors for a complete leak detection system.
- B. Contractor should also supply a TraceTek model nVent RAYCHEM TraceTek TT-FFS-PROBE-TESTER for testing the TT-FFS Probe for proper operation.

PART 3 EXECUTION

3.1. INSTALLATION

- A. All TraceTek leak detection system components shall be installed in accordance with the manufacturer's installation instructions, NEC, and local code requirements.
- B. Hydrocarbon fuel sensing cables and sensing probes shall be installed after emergency generators, dual fired boilers, all piping, and all other mechanical work has been completed, and prior to installation of other power distribution cabling. Contractor shall prepare floor surface for cable installation, install hold down clips for sensing cable, route and fix the sensing cable, route and fix any interconnect accessories such as jumper cable, sensing probes, branch connectors, leader cables and end terminations.
- C. Hydrocarbon fuel sensing cables shall be installed around the base of the generators, dual fired boilers and day tanks and shall be secured to the floor with hold-down clips (TT-HDC-1/2). Manufacturer recommends **that contractor installs a 7/8" or 1 5/8" Strut Channel over or up against fuel sensing cable to provide protection and containment for fuel sensing application. Strut Channels shall be anchored with 1/4" steel anchors or tapcons** without damaging, perforating or pinching the hydrocarbon fuel sensing cable during anchoring and installation. Silicone shall be used around the



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Strut Channel area to provide protection for the outside of the contained area. Containment shall not be installed over floor drains located within the sensing area. The installer shall be responsible for providing a tested and functional system. The installer shall be responsible for installation of the sensing cables and sensing probes, functional testing, and mapping of the system. Contractor shall supply supervision and training to the end user for the leak detection system.

- D. A graphic display map, prepared from "as-built" drawings, shall be furnished upon completion. The map shall indicate the location of the sensing cables and sensing probes, landmarks such as mechanical equipment, emergency generators, dual fired boilers, piping, floor drains, change of cable direction, and cable distance readings. The map shall be mounted next to the alarm and locating module.

3.2. TESTS

- A. The system shall be tested in accordance with the manufacturer's recommendations and industry standards.

3.3. COMMISSIONING

- A. The system shall be commissioned upon completion of the installation by personnel authorized by the manufacturer in accordance with the manufacturer's instructions. At this time demonstration and basic operation shall be provided to the owner.
- B. At the time of commissioning the system, the system supplier shall provide the Owner or Owners Representative with the name of an authorized manufacturer's Service Contractor who can provide preventive maintenance and service contracts for the leak detection system at least once a year, inclusive of removing debris from sensing cables and sensing probes, ensuring the interconnection and integrity of the electronic components in accordance with the manufacturer's recommendations.

END OF SECTION