**SECTION 21 50 00**

**DRY AND PREACTION FIRE SPRINKLER SYSTEMS**

**CORROSION MANAGEMENT SPECIFICATION**

**PART 1 GENERAL**

1.01 DESCRIPTION OF WORK

1. Provide all required labor, materials, equipment and services necessary for a complete and operational Corrosion Management Program for the fire protection systems (FPS) as hereinafter described [and as indicated on the drawing(s)]. Specific manufacturer installation guidelines shall be adhered to.
2. Basis of Design: Engineered Corrosion Solutions.
3. Corrosion Management Work may include the following listed products and services:
4. Corrosion Management Products shall be as specified herein:
	1. ECS Advanced**IQ** Nitrogen Generator (AG Series)
	2. Air Compressor
	3. Air Maintenance Device
	4. ECS Standard Vent (PAV-D)
	5. ECS SMART Vent (PSV-D)
	6. ECS Advanced**IQ** Vent Controller (AVC)
	7. ECS In-Line Corrosion Detector (ILD-X)
	8. ECS Protector Remote Gas Sampling Port (PGSP-1)
	9. ECS Handheld Gas Analyzer (PHGA-1)
5. Installation of air compressor and FPS air maintenance device.
6. Installation of corrosion management products.
7. Miscellaneous piping, fittings, couplings, valves, etc. as required.
8. Coordination of work and schedules with other trades.
9. System pressure testing.
10. System commissioning.

1.02 REFERENCES

1. All corrosion management work shall be designed, installed, inspected, tested and maintained in accordance with all applicable codes, referenced standards, documents listed herein, the manufacturer’s instructions and the provisions of this specification:
2. NFPA 13, Standard for the Installation of Sprinkler Systems
3. NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

1.03 QUALITY ASSURANCE

1. Equipment and components not specifically specified shall be FM Approved or listed by Underwriter's Laboratories, Inc. for FPS installation.
2. All fire sprinkler system components shall be installed free of rust/corrosion or visible damage. All items not complying with this requirement shall be replaced at no cost to the Owner.

1.04 REGULATORY REQUIREMENTS

1. All work shall meet the requirements of Section 1.02, References.
2. The fire sprinkler contractor shall not pursue any interpretations of the Corrosion Management Program except through the Engineer.

**PART 2 PRODUCTS**

2.01 PIPING

1. Dry Pipe or Preaction FPS:
2. In accordance with national and local requirements, and NFPA 13.
3. All piping shall have a Corrosion Resistance Ratio (CRR) greater than or equal to 1.00. Refer to the current UL Fire Protection Equipment Directory – Steel Sprinkler Pipe for acceptable manufacturers, sizes and joining methods.
4. All dry pipe FPS (including preaction systems in heated areas) shall be pitched at least as prescribed by NFPA 13.

2.02 JOINING OF PIPE AND FITTINGS

1. Dry Pipe or Preaction FPS:
2. Fittings shall be 175 psi screwed, roll grooved, or mechanical fittings. Where roll grooved or mechanical fittings and couplings are used together, they shall be of the same manufacturer.
3. All gaskets shall be Victaulic Flush Seal or equivalent.

2.03 CORROSION MANAGEMENT PRODUCTS

1. ECS Advanced**IQ** Nitrogen Generator (AG):
2. The nitrogen generator shall be sized to provide all dry and preaction fire sprinkler systems with supervisory nitrogen gas. Sizing shall be based on the total volume of all fire sprinkler systems being served by the nitrogen generator as determined by hydraulic calculations for each system. Documentation of the calculations and nitrogen generator sizing must be provided with the submittals. Where the quantity of systems, total cumulative volume of systems or physical location of system risers require multiple nitrogen generators, multiple nitrogen generators shall be supplied.
	1. Models:
		1. AG-675 Wall Mount: up to 675 Gallons (2,555 Liters)
		2. AG-950 Wall Mount: up to 950 Gallons (3,596 Liters)
		3. AG-2000 Wall Mount: up to 2,000 Gallons (7,571 Liters)
		4. AG-3500 Wall Mount: up to 3,500 Gallons (13,249 Liters)
		5. AG-6500 Standalone: up to 6,500 Gallons (24,605 Liters)
		6. AG-11000 Standalone: up to 11,000 Gallons (41,640 Liters)
		7. AG-18500 Standalone: up to 18,500 Gallons (70,030 Liters)
		8. AG-25000 Standalone: up to 25,000 Gallons (94,635 Liters)
3. The nitrogen generator shall be FM 1035 Approved.
4. The nitrogen generator shall be electronically controlled with the capability to adjust system operating pressure settings without the requirement of any additional equipment.
5. The nitrogen generator shall be supplied with compressed air sized in accordance with the manufacturer’s requirements.
6. The nitrogen generator shall be designed to achieve a nitrogen concentration of 98% or greater within fourteen (14) days of start-up and maintain that concentration within all fire protection systems continuously.
7. The nitrogen generator shall not require a nitrogen storage tank or refrigerated dryer.
8. The nitrogen generator shall include an LCD display screen to monitor and control the nitrogen generator locally that includes nitrogen purity, hours, cycles, air bypass signal, leak monitor signal.
9. The nitrogen generator shall include locally stored data logging capability with a minimum of 180-day storage capacity.
	1. Data logging information shall include system operating parameter changes, system operating alarms signals, and logging of supply line pressure value.
10. The nitrogen generator shall include internet connectivity to monitor complete operation of the nitrogen generator via internet and transmit alerts via email.
11. The nitrogen generator shall provide the following monitoring output points, nitrogen generator running mode, bypass mode, nitrogen generator on (presence of power), common trouble.
12. The nitrogen generator shall have a connection to attach and sample the purity of nitrogen within the FPS. Purity sampling device can be portable or fixed.
13. The nitrogen generator shall be equipped with a filtration system with programmable automatic drain to remove residual water and hydrocarbons (if needed) from the compressed air stream.
14. The nitrogen generator shall be equipped with an automatic nitrogen bypass assembly and bypass alarm to prevent long term oxygen exposure in the fire sprinkler system.
15. The nitrogen generator shall be powered by a 120-240 VAC power supply. Coordinate power requirements and location with electrical contractor. The nitrogen generator power supply shall be in accordance with national and local requirements, and NFPA 70.
16. Wall Mount Generator Compressed Air Source: [**NOTE:** Choose one - wall mount/ standalone]
17. The nitrogen generator shall be wall mounted with an integral oil-less air compressor, rated for continuous duty with an output pressure rating of 100 psig (6.9 bar), sized in accordance with the manufacturer’s requirements.
18. [**NOTE:** remove if alternate supervisory gas source will be used to meet the 30-minute fill requirement] The integral air compressor shall be capable of producing a continuous volume of compressed air that is sufficient to fill the largest FPS being supplied by the air compressor to operating pressure within thirty (30) minutes in accordance with NFPA 13 requirements and meet the compressed air requirements of the nitrogen generator it is supplying.
	1. Models:
		1. AG-675: 240 Gal. @ 40 psig (908 Liters @ 2.8 bar)

530 Gal. @ 20 psig (2,006 Liters @ 1.4 bar)

* + 1. AG-950: 240 Gal. @ 40 psig (908 Liters @ 2.8 bar)

530 Gal. @ 20 psig (2,006 Liters @ 1.4 bar)

* + 1. AG-2000: 800 Gal. @ 40 psig (3,028 Liters @ 2.8 bar)

1,800 Gal. @ 20 psig (6,814 Liters @ 1.4 bar)

* + 1. AG-3500: 800 Gal. @ 40 psig (3,028 Liters @ 2.8 bar)

1,800 Gal. @ 20 psig (6,814 Liters @ 1.4 bar)

1. Wall mount nitrogen generators with integral air compressors shall not require an air receiver tank.
2. Air Compressor (simplex): [**NOTE:** Choose one – wall mount/ stand alone. STANDALONE: Select either simplex or duplex compressor]
3. The fire sprinkler contractor shall furnish and install a simplex air compressor to supply air to the nitrogen generator.
	1. Integral air compressor shall be oil-less
	2. Separate air compressor shall be splash lubricated with an on-board after cooler and be rated by the manufacturer for continuous duty service.
4. The air compressor shall have an output pressure rating of 100 psig (6.9 bar) for oil-less compressors or 175 psig (12.1 bar) for splash lubricated compressors.
5. The air compressor shall be capable of producing a continuous volume of compressed air that is sufficient to fill the largest FPS being supplied by the air compressor to operating pressure within thirty (30) minutes in accordance with NFPA 13 requirements and also meet the compressed air requirements of the nitrogen generator it is supplying.
	1. Models:
		1. COMP-5: 1,150 Gal. @ 40 psig (4,353 Liters @ 2.8 bar)

2,300 Gal. @ 20 psig (8,706 Liters @ 1.4 bar)

* + 1. COMP-7.5: 2,025 Gal. @ 40 psig (7,666 Liters @ 2.8 bar)

4,050 Gal. @ 20 psig (15,331 Liters @ 1.4 bar)

* + 1. COMP-10: 2,900 Gal. @ 40 psig (10,978 Liters @ 2.8 bar)

5,800 Gal. @ 20 psig (21,955 Liters @ 1.4 bar)

1. Splash lubricated air compressor shall be equipped with an air receiver tank with a minimum sixty (60) gallons (228 liters) and be equipped with an adjustable electronic automatic blow down device that empties condensate from the air receiver tank. This water discharge shall be piped to a floor drain or building exterior in accordance with national and local requirements.
2. Non-integral air compressors shall be connected to the nitrogen generator with a minimum of 1/2 in. diameter black steel or galvanized piping.
3. Each compressor power source shall include a service disconnect installed adjacent to the air compressor sized as required by the air compressor manufacturer. Coordinate power requirements and location with electrical contractor. The air compressor power supply shall be in accordance with national and local requirements, and NFPA 70.
4. Air Compressor (duplex): [**NOTE:** Choose one – wall mount/stand alone. STAND ALONE: Select either simplex or duplex compressor]
5. The fire sprinkler contractor shall furnish and install a duplex air compressor to supply air to each nitrogen generator.
	1. The air compressor shall be splash lubricated, have an on-board after cooler, integrated alternating lead-lag controller and be rated by the manufacturer for continuous duty service.
6. The air compressor shall have a minimum output pressure rating of 175 psig (12.1 bar).
7. The air compressor shall be capable of producing a continuous volume of compressed air that is sufficient to fill the largest FPS being supplied by the air compressor to operating pressure within thirty (30) minutes in accordance with NFPA 13 requirements and also meet the compressed air requirements of the nitrogen generator it is supplying.
	1. Models:
		1. COMP-5-2: 2,880 Gal. @ 40 psig (10,902 Liters @ 2.8 bar)

5,760 Gal. @ 20 psig (21,804 Liters @ 1.4 bar)

* + 1. COMP-7.5-2: 4,050 Gal. @ 40 psig (15,331 Liters @ 2.8 bar)

8,100 Gal. @ 20 psig (30,662 Liters @ 1.4 bar)

* + 1. COMP-60-2: 5,800 Gal. @ 40 psig (21,955 Liters @ 2.8 bar)

11,600 Gal. @ 20 psig (43,911 Liters @ 1.4 bar)

1. The air compressor shall be equipped with an air receiver tank of at least 120 gallons (454 liter) and be equipped with an adjustable electronic automatic blow down device that empties condensate from the air receiver tank. This water discharge shall be piped to a floor drain or building exterior in accordance with national and local requirements.
2. Air compressor shall be connected to the nitrogen generator with a minimum 1/2 in. diameter black steel or galvanized piping.
3. Each compressor power source shall include a service disconnect installed adjacent to the air compressor sized as required by the air compressor manufacturer. Coordinate power requirements and location with electrical contractor. The air compressor power supply shall be in accordance with national and local requirements, and NFPA 70.
4. Air Maintenance Device:
5. The fire sprinkler contractor shall furnish and install an approved air maintenance device for each dry or preaction fire sprinkler system.
6. The air maintenance device shall be equipped with a field adjustable pressure regulator for use in setting the maximum system pressure.

Approved air maintenance devices are:

* 1. Reliable Model A
	2. Tyco Model AMD-1
	3. Victaulic Series 757
	4. Or approved equal
1. Air maintenance device shall be installed in accordance with the manufacturer’s instructions.
2. ECS Standard Vent (PAV-D): [**NOTE:** Select either Standard, SMART or Advanced**IQ** Controller vent]
3. The fire sprinkler contractor shall furnish and install an oxygen removal vent for each fire sprinkler system.
4. The oxygen removal vent shall be installed on the fire sprinkler riser at the locations shown on the drawings. Installation of the oxygen removal vent outside of the fire sprinkler valve room is not permitted.
5. The oxygen removal vent shall have an adjustable pressure regulator to prevent accidental depressurization of the fire sprinkler system should a disruption occur to the air/nitrogen supply.
6. The oxygen removal vent shall have a connection to attach and sample the purity of nitrogen within the FPS. Purity sampling device can be portable or fixed.
7. The piping between FPS and oxygen removal vent must not create a water trap; the connecting piping must drain when FPS is drained or the oxygen removal vent will not function properly.
8. The oxygen removal vent shall not require any power to properly function.
9. A 1-inch outlet is required to attach the vent assembly to the FPS.
10. ECS SMART Vent (PSV-D/DE): [**NOTE:** Select either Standard, SMART or Advanced**IQ** Controller vent]
11. The fire sprinkler contractor shall furnish and install an electric oxygen removal vent for each fire sprinkler system that will close automatically once the desired nitrogen concentration has been reached.
12. The electric oxygen removal vent shall be installed on the fire sprinkler riser at the locations shown on the drawings. Installation of the electric oxygen removal vent outside of the fire sprinkler valve room is not permitted.
13. The electric oxygen removal vent shall be equipped with a solenoid valve and separate electric control box. The electric oxygen removal vent shall be powered by a 120VAC/60 Hz (200-240 VAC/50 Hz) power supply. Coordinate power requirements and location with electrical contractor.
14. The electric control box shall be wall-mounted and installed adjacent to the oxygen removal vent on the fire sprinkler riser. The electric control box shall be powered by a 120VAC/60 Hz (200-240 VAC/50 Hz) power supply. Coordinate solenoid connection requirements and location with electrical contractor.
15. The solenoid valve shall be wired to the electric control box. Wiring to electric control box and electric oxygen removal vent shall be in accordance with national and local requirements, and NFPA 70.
16. The oxygen removal vent shall have an adjustable pressure regulator to prevent accidental depressurization of the fire sprinkler system should a disruption occur to the air/nitrogen supply.
17. The electric oxygen removal vent shall have a connection to attach and sample the purity of nitrogen within the FPS. Purity sampling device can be portable or fixed.
18. The piping between FPS and electric oxygen removal vent must not create a water trap; the connecting piping must drain when FPS is drained or the electric automatic oxygen removal vent will not function properly.
19. A 1-inch outlet is required to attach the vent assembly to the FPS.
20. ECS Advanced**IQ** Vent Controller (AVC-2 or AVC-6): [**NOTE:** Select either Standard, SMART or AdvancedIQ Controller vent]
	1. The fire sprinkler contractor shall furnish and install an Advanced**IQ** Vent Controller to automatically control oxygen venting in each FPS individually [as shown on the drawings] and as directed by the design engineer.
	2. The vent controller shall be capable of monitoring and controlling the oxygen venting in multiple FPS individually.
		1. Monitor sprinkler system pressure and nitrogen purity as well as perform leak rate, pressure and purity checks.
		2. Automatically control of the oxygen venting process.
		3. Store all information in removeable data storage.
		4. Internet connectivity to monitor complete operation and transmit alerts via email.
	3. The controller shall include an LCD display to access all functions of the vent controller including the data storage on an individual system basis.
	4. The controller shall include a common supervisory output signal.
	5. The controller shall be installed in the fire sprinkler valve room to sample gas from oxygen removal vents on multiple FPS in accordance with manufacturer’s instructions.
	6. Each FPS shall be supplied with a PAV-DQ oxygen removal vent installed on the sprinkler riser at the locations shown on the drawings.
		1. The oxygen removal vent shall have an adjustable pressure regulator to prevent accidental depressurization of the fire sprinkler system should a disruption occur to the air/nitrogen supply.
		2. The oxygen removal vent shall have a connection to attach and sample the purity of nitrogen within the FPS.
		3. The piping between FPS and oxygen removal vent must not create a water trap; the connecting piping must drain when FPS is drained, or the oxygen removal vent will not function properly.
		4. A 1-inch outlet is required to attach the vent assembly to the FPS.
	7. The contractor shall mount the vent controller to a vertical wall within fifty (50) feet of all of the oxygen removal vents connected to the controller.
	8. The vent controller shall be powered by a 120-240VAC/50-60 Hz power supply. Coordinate power requirements and location with electrical contractor. The vent controller power supply shall be in accordance with national and local requirements, and NFPA 70.
	9. The contractor shall attach and affix 5/32 in. gas supply tubing from push fitting on the oxygen removal vent to corresponding push fitting on the vent controller. Gas supply tubing provided by manufacturer.
	10. The oxygen sensing element of the fixed gas analyzer shall have a minimum useful life of ten (10) years.
	11. Optional Monitoring:
		1. The contractor shall connect the vent controller output to the [building monitoring system (BMS)/Fire Alarm Control Panel (FACP)]. Coordinate BMS/FACP interface with the controls and instrumentation contractor/electrical contractor/fire alarm contractor.
21. ECS In-Line Corrosion Detector (ILD-X):
22. The fire sprinkler contractor shall furnish and install an In-Line Corrosion Detector (ILD) [on each FPS/as shown on the drawings] and as directed by the design engineer. Install in accordance with manufacturer’s instructions.
23. The ILD shall be U.L. 2987 listed for use in a fire sprinkler system and sized to align with sprinkler system piping so that ILD does not impact the sprinkler system’s hydraulic performance.
24. Device location shall be determined by design engineer, equipment manufacturer or as shown on drawings.
25. The ILD shall be a minimum of eighteen (18) inches (457 mm) long and equipped with rolled groove ends for installation within the FPS piping network.
26. The ILD corrosion detection surface shall be a minimum of six (6) inches (152 mm) long covering the entire circumference of the pipe and be no more than thirty-five (35) thousandths of an inch (.889 mm) thick.
27. The ILD shall match the FPS pipe material (black/galvanized), pipe schedule, and pipe diameter at the installation location.
28. The ILD shall be equipped with DPDT Form C contacts that is capable of indicating when the ILD has been activated.
29. The ILD shall be provided with a local battery powered annunciator. The annunciator shall be capable of surface or flush mounting and have a push-to-test function.
30. Optional monitoring.
	1. The contractor shall connect the ILD output to the [building monitoring system (BMS)/Fire Alarm Control Panel (FACP)/remote annunciator]. Coordinate BMS/FACP interface with the [controls and instrumentation contractor/electrical contractor/fire alarm contractor]. Coordinate BMS/FACP interface with the [controls and instrumentation contractor/electrical contractor/fire alarm contractor].
31. ECS Protector Gas Sampling Port (PGSP-1): [**NOTE:** Include if remote gas sampling ports required and is specified.]
	1. The fire sprinkler contractor shall furnish and install Gas Sampling Ports (PGSP-1) [on each FPS/as shown on the drawings] as directed by the design engineer. Install in accordance with the manufacturer’s instructions.
32. ECS Handheld Gas Analyzer (PGHA-1):
	* + 1. The fire sprinkler contractor shall furnish a handheld gas analyzer with each nitrogen generator or as directed by the design engineer.
			2. The handheld gas analyzer shall be equipped with a quick connect fitting compatible with gas sampling ports on all nitrogen generation system equipment and oxygen removal vents.
			3. The handheld gas analyzer shall include a one button calibration feature.
			4. The oxygen sensing element of the handheld gas analyzer shall have a minimum useful life of two (2) years.

**PART 3 EXECUTION**

3.01 COORDINATION WITH OTHER TRADES

1. Coordinate closely with the General Contractor, other trades and the Owner to expedite construction, commissioning and avoid interference.

3.02 SUPERVISION AND TRAINING

1. [**NOTE:** include if on-site commissioning is included in the project]The fire sprinkler contractor shall provide on-site ECS Commissioning Services Package which shall include an ECS certified representative on-site for a minimum of one (1) day to verify the installation of the equipment and provide training to the Owner and Owner’s Representative.
2. The fire sprinkler contractor shall provide one (1) printed copy and an electronic file of the Owner’s Installation and Operations Manual for all corrosion control equipment. The Owner’s Manual shall include protocols for operation and maintenance of all equipment installed as part of this scope of work.

3.03 CORROSION PRODUCTS/SYSTEM COMMISSIONING PROTOCOL

1. Dry Pipe and Preaction FPS: [**NOTE:** Select applicable statements based on scope of work]
2. The fire sprinkler contractor shall confirm the operation of the system air compressor and connect air compressor and nitrogen generator to the FPS.
3. The fire sprinkler contractor shall determine the operating pressure range for the dry/preaction FPS and set the system air maintenance device for each FPS.
4. The fire sprinkler contractor shall document the twenty-four (24) hour leak rate, in psig/hour (bar/hour), of each FPS and provide documentation as part of the As-Built document submittal.
5. The fire sprinkler contractor shall install all of the oxygen removal vents at the locations shown on the approved shop drawings.
6. The isolation ball valve of oxygen removal vent shall be closed during hydrostatic and/or air pressure testing of the FPS and then placed in the open position for the commissioning and operation of the system.
7. The fire sprinkler contractor shall confirm the condensate water discharge from the air compressor drain and the nitrogen generator drain are piped to a floor drain or building exterior in accordance with national and local requirements.
8. [**NOTE**: include if remote monitoring of nitrogen generator is included in the project]
9. The fire sprinkler contractor shall provide an ethernet connection to the nitrogen generator from the local area network (LAN) for connection of the nitrogen generator to the internet.
10. All connections have been made as specified and as indicated in the manufacturer’s installation instructions.
11. The fire sprinkler contractor shall coordinate and verify proper operation of the LAN connection with local internet provider or building IT Services Manager.
12. [**NOTE**: include if Advanced**IQ** Vent Controller is included in the project]The fire sprinkler contractor shall install the vent controller at the locations as shown on the approved shop drawings.
	1. [**NOTE**: include if Advanced**IQ** Vent Controller is monitored by building monitoring system in the project]The fire sprinkler contractor shall confirm that the vent controller(s) has been connected to the monitoring system, as shown on the approved shop drawings.
	2. All connections have been made as specified and as indicated in the manufacturer’s installation instructions.
	3. [**NOTE**: include if Advanced**IQ** Vent Controller is monitored remote through internet in the project]Thefire sprinkler contractor shall provide an ethernet connection to the nitrogen generator from the local area network (LAN) for connection of the nitrogen generator to the internet.
	4. The fire sprinkler contractor shall coordinate and verify proper operation of the LAN connection with local internet provider or building IT Services Manager.
13. [**NOTE:** include if In-Line Corrosion Detector is included in the project]The fire sprinkler contractor shall confirm the In-Line Corrosion Detector is installed in the locations shown on the approved shop drawings.
	1. [**NOTE**: include if In-Line Corrosion Detector is monitored by building monitoring system in the project]The fire sprinkler contractor shall confirm that the In-Line Corrosion Detector(s) has been connected to the building monitoring system, as shown on the approved shop drawings.
	2. All connections have been made as specified and as indicated in the manufacturer’s installation instructions.
14. [**NOTE:** Include if additional Gas Sampling Ports are included in the project]The fire sprinkler contractor shall confirm the additional Gas Sampling Ports are installed in the locations shown on the approved shop drawings and the ball valve has been left in the closed position.
15. [**NOTE:** include if on-site commissioning is included in the project]The fire sprinkler contractor shall coordinate with the nitrogen generator manufacturer to schedule the on-site commissioning package at a time that has been coordinated with the General Contractor, Owner and Owner’s Representative.
16. [**NOTE:** include if dry oxygen removal vent is included in the project]The fire sprinkler contractor shall close all oxygen removal vents that are not equipped with electronic activation once the FPS nitrogen concentration has reached 98% or greater within fourteen (14) days. Continuous venting is not permitted.

**END CORROSION MANAGEMENT SPECIFICATION**