## PRODUCT GUIDE SPECIFICATION

# FIREYE NXF4000
# ADVANCED BURNER MANAGEMENT SYSTEM with INTERNAL FLAME SAFEGUARD

## GENERAL OVERVIEW

1.1.1. Each burner shall be equipped with a Micro-processor Based Burner Management Flame Safeguard Control System. The control shall provide: (1) automatic sequencing of the boiler system through pre-purge, pilot trial for ignition (PTFI), main trial for ignition (MTFI), run (AUTO), and post purge. (2) flame proving and lockout on flame failure during PTFI, MTFI, and AUTO. (3) parallel positioning of the AIR, FUEL, and FGR dampers during operational sequence and burner load management.

1.1.2. The control system shall be provided by Fireye or written approved equal.

1.1.3. The control system shall be made in the U.S.A.

### 2. PARALLEL POSITIONING AND FLAME SAFEGUARD

2.1.1. The Parallel Positioning and Flame Safeguard capabilities shall be integrated into the burner management controller to realize an all-in-one system. The control shall be constructed utilizing surface mount technology thus reducing panel space requirements.

2.1.2. The control system and accessories shall be provided by Fireye or written approved equal.

### 3. CODES AND STANDARDS

3.1.1. The control shall be listed by Underwriters Laboratories in accordance with US and Canadian standards.

**Underwriter's Laboratories Inc.:**

File MP1537, Vol. 30
- BURNER MANAGEMENT SYSTEMS & CONTROLS, PRIMARY SAFETY.

3.1.2. The control shall be in compliance with ASME/CSD-1.

3.1.3. The control shall be in compliance with NFPA 85, Boiler and Combustion Systems Hazards code.

## INTEGRATED BURNER MANAGEMENT SYSTEM

### 4. SYSTEM HARDWARE

4.1.1. Each burner shall be equipped with a microprocessor based fully functional integrated system of surface mount design to reduce cabinet space. The control system shall be capable of performing parallel positioning, burner sequencing, load management, and flame proving.

4.1.2. The integrated controller shall be interlocked with the non-recycle limit chain. The terminal input shall be wired in such a manner as to assure a safety shut down and lockout in the event of a safety related fault.

4.1.3. The integrated controller shall be capable of powering up to four servo-motors directly from the main controller, six additionally using a low voltage external power supply. Servo-motors will be of the low voltage type and controlled by secure ModBus communications via two wire cable.

4.1.4. Servo-motors in the following torque ranges shall be available; 3 ft/lb, 15 ft/lb, 37 ft/lb. Servo-motors will be of NEMA 4 design and will be available with or without quick disconnects for ease of installation.

4.1.5 The basic system shall include sequencing for up to six boilers without need for an external “plant master” controller. The sequence of boilers shall be adjustable and allow for different sequences depending on which boiler is designated as lead. Adjustable on and off delays shall be included to prevent short cycling. The sequencing system will include fully adjustable lag start and stop points based upon lead firing rate. Adjustable internal timers shall be available to reduce lag boiler short cycling.

4.1.6. The integrated controller shall include Cold Start Thermal Shock Protection for the boiler that includes low fire and segmented firing methods. Cold start thermal shock protection shall provide this adjustable control of the burner, firing rate on a cold start, thereby limiting mechanical stress due to thermal differences.

4.1.7. The integrated controller shall contain a Real Time Clock that enables time stamping for fault events and history. This shall enable time switching functions, like night setback to be initiated via the internal time clock.

4.1.8. Each integrated control will have up to four independent fuel profiles. Profiles will not be limited to specific fuels. That is, all four could utilize the same servo-motors for various operating conditions or fuel availability. Each profile shall have up to a maximum twenty four (24) points.

4.1.9. Two independent PID control loops shall be available to optimize the response of the combustion control to various load conditions.

4.1.10. All connections to the main controller will be via un-pluggable terminal blocks eliminating the need for a separate wiring base.

4.1.11. The main controller shall be capable of mounting in any orientation without compromising system temperature ratings. The control system shall operate within the following limits:

Voltage 120 VAC (+10%, -15%) 50/60 Hz
Power Consumption: 15 VA
Temperature Rating: 32°F to 140°F (0°C to +60°C)
Humidity: 0% to 85% Non-condensing
Vibration: 0.5G continuous vibration

4.1.12. Fifteen safety rated digital/analog inputs shall be provided on the main controller. These inputs shall be configurable for, but not limited to, the following; Burner ctrl, Low Fire Hold, Manual Modulation, Setpoint 2 Select, Alarm Reset, Forced Setback, Setback Override, Gas valve proving, Airflow switch proving, Force Sequencing Master, Track On, Purge Hold, Proof of Closure, etc.

4.1.13 A sensor input can be configured to allow for remote modulation from Building Automation Systems or other systems.

4.1.14 The main control will contain the means to accept an SD (secure digital) card. The SD card will provide to the user a method to backup and restore all configuration data and profiles, all profiles, and configuration data.

4.1.15 Proof of Closure (POC) shall be directly monitored by the controller using the safety rated digital inputs.

4.1.16 The integrated controller shall support valve proving operation to test for gas leakage of the safety shutoff valves. Various valve proving configurations shall be supported, with or without vent valve or pilot valve connection.

4.1.17 The integrated controller shall be capable of proving the airflow switch independently of the

non-recycle limit chain.

4.1.18 Controller shall support single servo configuration (GAS) with VFD drive control for combustion air.

## 5. USER INTERFACE

5.1.1 Each combustion control system shall be equipped with a NEMA 4 four-line backlit liquid crystal (LCD) keypad display and/or TFT Touchscreen display – offered in 7" and 13" sizes. The display will provide all relevant information during commissioning and operation. The display shall indicate Steam pressure, Boiler firing rate, Boiler status, Boiler set point, Fuel valve position, Air damper(s) position, Sequence states, Modulation status (auto/man) and any Faults present or clearable. All programming of the combustion control shall be done via the keypad or touchscreen display.

5.1.2 The User Interface displays will incorporate three levels of passwords for protection against un-authorized changes. One level shall be for operators and prohibits the access to any safety critical settings.

5.1.3 The User Interface displays will include an INFO screen or page for access to internal variables for system diagnostics, a burner on/ off key and a low fire key to allow operator control of the burner directly from the keypad or touchscreen display.

5.1.4 The touchscreen display will provide the user the option of displaying messages in multiple languages.

5.1.5 The messages shall be clear, concise information concerning system timing, present burner sequence position, lockout causes (including wiring base terminal designations) and historical data.

5.1.6 During the firing cycle, a constant read-out of the flame signal and pertinent information will be displayed.

5.1.7 The LCD keypad display shall operate within the following temperature limits: 32°F to 140°F (0°C to 60°C). The Touchscreen display module shall operate within the following temperature limits: 32°F to 122°F (0°C to 50°C).

5.1.8 The keypad shall have the capability to be locally mounted to a distance of up to 10 feet (3 meters). The Touchscreen shall have the capability to be locally or remotely mounted. Mounting distance can be up to 1000 feet (300 meters).

5.1.9 When mounted, both the Keypad and Touchscreen displays shall provide NEMA 4 protection.

## 6. VARIABLE FREQUENCY DRIVE (VFD)

6.1.1. The combustion control system shall have provisions for utilizing a Variable Frequency Drive to control combustion air, fuel, and/or flue gas recirculation.

6.1.2. The associated VFD controller card shall fit within the combustion control so as not to require additional panel space.

6.1.3. The VFD card shall include two (2) independent channels with each channel providing one (1) 4-20mA analog output, one (1) 4-20mA analog input and one (1) encoder input.

6.1.4. Any channel of the VFD card can be alternately used to provide 4-20mA outputs and mapped to chart firing range, sensor value or servo positions.

## 7. OXYGEN TRIM

7.1.1. The combustion control system shall incorporate an in-situ Zirconia Oxide heated exhaust gas probe. The probe design shall be such that particulate in the flue gas stream does not impact directly on the probe filter thus increasing uptime.

7.1.2. The Zirconia Oxide probe shall not employ any pumps or gas preparation equipment such as solid-state coolers. No probe condensate pumps will be permitted.

7.1.3. The keypad display will indicate; Oxygen level, Gross stack temperature, Combustion efficiency, Ambient air temperature, Calculated CO2 levels and Oxygen target level.

7.1.4. The oxygen probe shall be directly connected to the combustion control via secure communications.

## 8. FLAME SAFEGUARD SYSTEM

The control system shall provide the following capabilities:

8.1.1. A field installable flame safeguard plug-in board shall be supported. The plug-in board shall support the

following amplifier types: Ultra-violet, Infrared, and direct-couple. The associated flame safeguard plug-in card shall fit within the combustion control so as not to require additional panel space.

8.1.2. User selectable burner operating parameters such as purge time, PTFI & MTFI time, post purge time, FFRT, valve proving times and specific operation of the various interlocks.

8.1.3. All burner operating parameters can be adjusted or modified with the appropriate password level.

8.1.4. An adaptive Infrared flame scanning detection system is employed where the characteristics of the pilot and main flames are dynamically processed, scaled, and the thresholds are optimized for safety and to avoid nuisance trips.

8.1.5. The control shall be capable of detecting oil fog event in the situation where the combustion flame has extinguished and the atomized combustion oil supply is spraying on a hot surface or refractory.

8.1.5. Flame proving and lockout on flame failure during PTFI, MTFI and AUTO.

8.1.6. The control shall have a non-volatile memory which allows it to remember burner history and present position, even after a power interruption.

8.1.7. The control shall provide a check-run button to allow a qualified service technician to halt the burner sequence in any of five different positions:

High fire purge
Low fire purge
Pilot trial for ignition
Main trial for ignition
Low fire (burner on)

8.1.10. Non-volatile lockout and history files with the last 10 lockouts readable through the display.

8.1.12. The control system shall operate within the following limits:

-2000 VA maximum connected load

## 9. SEQUENCE OF OPERATION

9.1.1. The control shall accomplish a safe start component check during each start. This shall prevent the burner from firing under any condition which causes the flame relay to assume and hold its energized position due to the presence of an actual flame, a flame simulating component failure or mechanical failure.

9.1.2. A purge period with the air servo-motor driven to the open position and an interlock circuit provided to prove air flow rate during the purge period. A starting interlock circuit is required to prove that the burner equipment is in the low fire position at ignition.

9.1.3. The time of ignition, plus an interlock to prove air flow during the purge and firing cycle.

9.1.4. Limited trial-for-ignition of pilot flame restricted to 10 seconds, trial-for-main flame restricted to 10 or 15 seconds (selectable) for oil or gas.

9.1.5. A programmable Flame Failure Response Time (FFRT) shall manage the safety shutdown following flame failure, with fuel and ignition circuits de-energized. Program options shall be 1, 2, 3, or 4 seconds FFRT.

9.1.6. A post purge following a shutdown.

9.1.7. The system shall recycle automatically under control of the operating control and when power is restored following a power failure. Manual reset shall be required following any safety lockout, even after a power failure. When in a lockout condition, power interruptions will not recycle the control.

9.1.8. The control shall provide a check-run button which shall allow a qualified service technician to halt the burner sequence in any of four different positions.

## 10. SAFETY PROVISIONS

10.1.1. A self diagnostic circuit within the control will identify module failures and an appropriate message will be displayed for servicing. This circuit will cause a safety shutdown should any component in the control fail. For example, if the chassis section is malfunctioning, the display module will display the message:

"LOCKOUT INTERNAL ERROR"

10.1.2. The control will continually test the status of all safety critical loads (ignition transformer, pilot fuel valve, main fuel valve) to insure they are operating properly.

## 11. REMOTE COMMUNICATIONS

11.1.1. The burner management system shall operate either as an independent stand-alone control, or as part of a distributed network. In a distributed system network, multiple controllers are connected via a data link (a single twisted shielded pair wire) to a Supervisory Master Controller (e.g.: personal computer, PLC, building management system).

11.1.2. Up to 247 burner management controls can be connected in a multi-drop configuration on a single data link.

11.1.3. The communication protocol for the distributed system network shall be MODBUS-RTU.

11.1.4. The distributed network shall offer selectable baud rates, 4800, 9600, 19200, 38400 or 57600 bits per second.

## 12. WIRING

12.1.1. All wiring shall be in accordance with National Electrical Code and local electrical codes.

12.1.2. The installing contractor shall be responsible for insuring that the conduit size and wire size, type and quantities are applicable for the installation and equipment supplied.

## 17. PRODUCT INFORMATION

| **Parallel Positioning System** | |
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| NXF4000 | Advanced burner management system, with internal flame safeguard, 120 VAC input. |
| NXCESIR | Plug-in Amplifier card, Infra-red detection |
| NXCESUV | Plug-in Amplifier card, Ultra-violet detection, non self-check |
| NXCESDC | Plug-in Amplifier card, Direct-Coupled for intelligent scanners |
| NXD410 | User interface with keypad, 24 VDC operation, 4 line back lit LCD display, panel mount only, includes mounting brackets. |
| 59-562-2 | Cable assembly, 10 feet length, for interfacing NXD410 to NXF4000 |
| NXTSD407 | Touchscreen display, 7” TFT wide color, 800x480 resolution, 24 VDC |
| NXTSD413 | Touchscreen display, 13” TFT wide color, 800x480 resolution, 24 VDC |
| FX04 | Servo motor, 24 VDC operation, 4Nm, 3 lb.-ft torque, **without** connectors, accepts ½ inch NPT fitting, minimum travel time of 30 seconds for 90° |
| FX04-1 | Servo motor, 24 VDC operation, 4Nm, 3 lb.-ft torque **with** connectors, minimum travel time of 30 seconds for 90° |
| FX20 | Servo motor, 24 VDC operation, 20Nm, 15 lb.-ft torque, **without** connectors, accepts ½ inch NPT fitting, minimum travel time of 30 for 90° |
| FX20-1 | Servo motor, 24 VDC operation, 20Nm, 15 lb.-ft, **with** connectors, minimum travel time of 30 seconds for 90° |
| FX50 | Servo motor, 24 VDC operation, 50Nm, 15 lb.-ft. torque, **without** connectors, accepts 1/2-inch NPT fitting, minimum travel time of 30 seconds for 90° |
| FX50-1 | Servo motor, 24 VDC operation, 50Nm, 15 lb.-ft. torque, **with** connectors, minimum travel time of 30 seconds for 90° |
| 59-565-6, -40 | Cord set, 6 feet, ½” NPT connectors on both ends, 40 feet, ½” NPT connectors on both ends, PVC jacket, temperature rating -40°C to 105°C, meets NEMA 1, 3, 4, 6P and IEC67 |
| 129-192 | Connector, field wired. Used for FX04-1, FX20-1, FX50-1 servos with connectors. Use cable 59-561 |
| 129-194 | Servo (male) connector kit for FX04, FX20, FX50 |
| 59-561 | Cable, 2 twisted pair, 2 power wires, suitable for servo hookup |

## 17. PRODUCT INFORMATION CONT'D.

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| BLPS-15, -25, -30 | Pressure transducer, 0-15 psi (0-1030 mb), -14.7 to 25 psi (-1013 to 1720 mb), 0-30 psi (0-2070 mb), 4-20 mA output linear with pressure. ¼" NPTF mounting. Screw terminal connection and conduit adapter cover. |
| BLPS-200, -300 | Pressure transducer, 0-200 psi (0-13.8 Bar), 0-300 psi (0-20.7 Bar), 4-20 mA output linear with pressure. ¼" NPTF mounting. Screw terminal connection and conduit adapter cover. |
| TS350-2, -4, -8 | Temperature sensor, Range 32°F to 350°F (0°C to 176°C), 4-20 mA output, linear with temperature. Insertion length is 2, 4, 8 inches. Stainless steel thermowell included. |
| TS-752-2, -4, -8 | Temperature sensor, Range 32°F to 752°F (0°C to 400°C), 4-20 mA output, linear with temperature. Insertion length is 2, 4, 8 inches. Stainless steel thermowell included. |
| NXCESO2-8, -16, -30 | O2 probe assembly, 8", 16", 30" insertion |
| NXCESO2P42 | Cartridge, probe replacement |
| 35-381-2 | Flange, O2 probe mounting |
| 129-189 | Cover, mounting flange |
| NXCESVFD | VFD Expansion card for NXF4000 |
| UV90L-1 | UV Scanner, front and side viewing, terminal block |
| UV5-1 | UV Scanner, front and side viewing, 78" (2000mm) flying leads |
| UV1AL-3 | UV Scanner, ½" NPT, 36" (915mm) shielded leads |
| UV1AL-6 | UV Scanner, ½" NPT, 72" (1830mm) shielded leads |
| 4-742-1 | Replacement tube for UV90L-1 |
| 48PT2-1003 | Infrared scanner, ½" straight mount, 96" (2438mm) TC-ER cable |
| 48PT2-1007 | Infrared scanner, ½" straight mount, 48" (1219mm) TC-ER cable |
| 48PT2-9003 | Infrared scanner, 90-degree angle mount, 96" (2438mm) TC-ER cable |
| 48PT2-9007 | Infrared scanner, 90-degree angle mount, 48" (1219mm) TC-ER cable |
| 4-263-1 | Replacement infrared cell for 48PT2 |