SECTION 23 09 00 - INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 GENERAL

1.1 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the automatic temperature control system indicated. The system shall be an electric/electronic (Direct Digital Control) with touch screen human interface panel to provide the sequences as described in these specifications. The ATC system shall be complete with required components including, low voltage and line voltage wiring and conduit. Wiring shall be in accordance with Division 16 of the specifications and NFPA 70, National Electrical Code.

B. The automatic temperature controls system shall be provided and installed by trained control mechanics regularly employed in the installation and calibration of ATC equipment by the manufacturer of such equipment. Control installation by any Contractor not listed below, whose principle business is not direct manufacture and installation of Automatic Control Systems is prohibited.

1.2 ACCEPTABLE MANUFACTURERS / INSTALLERS

A. Maine Controls.
B. Basix Automation / Andover.
C. Siemens Industry, 66 Mussey Road, Scarborough, ME. 04074
D. Northeast Controls (Circon).
E. Honeywell, Inc., Westbrook, ME
F. IB Controls (Delta / Johnson).

1.3 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 09 00 "Common Work Results for HVAC" and SECTION 26 00 00 “ELECTRICAL” are hereby made a part of the work of this section.

B. SECTION 019113 - BUILDING COMMISSIONING

1.4 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00 relative to competition and the (ONLY) notation. Familiarity with this section shall be achieved before reading the PRODUCTS section of this specification.

B. The items for which the shop drawings paragraph in Section 23 05 00, Common Work Results for HVAC, apply are as follows:

1. Temperature control system schematic including variables, flow diagrams, ladder diagrams, and point to point wiring diagrams, indicating set points, reset ranges, throttling ranges, controller gains, differentials, operating ranges, normal positions, controller action, dial ranges, voltages, currents, mounting locations, indicators, and terminal strip points.

2. Sequence of operation for each system and function.

3. Generic, functional description of each control component indicated.

4. Equipment interlocks required by sequence of operation.

5. Automatic valve schedule showing flow, Cv, and pressure drop.

6. Manufacturer's Data:

   a. Dampers, valves and operators.
   b. Controllers, including wiring and connection diagrams.
   c. Thermostats, temperature sensors, including wiring and connection diagrams.
   d. Temperature and pressure indicators.
   e. Pressure sensors, including wiring and connection diagrams.
   f. Switches, relays, transmitters, transformers, including wiring and connection diagrams.

7. Operator’s interface terminal.

PART 2 PRODUCTS

2.1 CONTROL PANELS

A. In general, relays, transformers, or other control devices (not including room thermostats or duct-mounted instruments) shall be grouped and mounted in a factory-built cabinet enclosure.

2.2 AUTOMATIC CONTROL DAMPERS

A. Automatic dampers not furnished with equipment shall be furnished under this paragraph. Automatic dampers shall be constructed and installed in accordance with the following specifications:

1. Damper Blades: All automatic dampers, including dampers for static pressure control, shall be of the balanced type, factory-fabricated, with fully gasketed galvanized steel airfoil blades, mounted in welded frames. Damper blades shall be not more than 8 inches wide, shall have interlocking edges, edge and jamb seals and be capable of operation against 4" static pressure differential. Dampers shall be Arrow "Arrow-Foil" Model PBDAF-206, OBDAF-207, Ruskin Model CD-60 or Tamco Series 1000.

2. Modulating Dampers: All modulating dampers shall be of the opposed blade type.

3. Damper Size and Bearings: Damper blades shall have steel trunnions mounted in oil-impregnated bearings. Dampers shall be not more than 48 inches in length between bearings.

4. Frames: Damper frames shall be of welded channel or angle-iron, with heavy steel corner gussets and braces or stiffened with steel tie-rods where necessary. Frames shall be painted with aluminum paint to prevent rusting.

5. Dampers shall be guaranteed to close tightly, and shall provide substantially the full area of the opening when open. All outdoor air intakes and all exhaust ducts to outside and all fresh air, return air and exhaust air dampers in systems shall have damper blades with inflatable seals or other devices to guarantee low leakage, not to exceed 4 CFM/SF at 1 in. WG pressure differential.

6. Damper Linkages: Damper-operating links shall be cadmium plated steel or brass rods, adjustable in length with ball and socket joints and of such proportions that they will withstand, without appreciable deflection, a load equal to not less than twice the maximum operating force of the damper motor. Linkages shall be concealed in the frame.

B. Damper Actuators: For each automatically controlled damper, a suitable damper actuator or actuators shall be provided in accordance with the following specifications:

1. Actuator: Damper actuators shall be electronic, direct-coupled, spring-return type and have a rating of not less than twice the torque needed for actual operation of the damper.

2. Adjustments: Provide adjustable stops for the open and closed positions.

3. Mounting: Damper actuators shall be direct-coupled over the shaft. The damper actuators and mounting base shall not be mounted directly on cold or insulated ducts and casings, but shall be mounted outside the insulated covering in such a manner as to prevent sweating and interference with the insulation.

4. Where indicated, damper actuators shall be provided with an auxiliary switch rated at 120 V AC, and accept a 4 to 20 ma input.

2.3 AUTOMATIC CONTROL VALVES (HOT WATER, 250^{O}F MAX.)

A. Valves shall have removable composition discs with monel stem. Bodies two inches or smaller shall be bronze with screwed ends. Bodies 2-1/2 inches and larger shall be cast-iron with flanged ends. Valve bodies, trim and stuffing boxes shall be designed for not less than 125 psi working pressure. Valve packing shall be non-lubricated teflon packing suitable for hot water service, as required.

B. Valve performance shall be as scheduled.

C. Modulating valves shall be sized for maximum pressure drop of 1.5 to 4.0 psi and shall meet the performance indicated on the Control Valve Schedule.

D. Automatic control valve differential shut-off pressure shall be a minimum of 35 psig.

E. Heating valves shall fail to the "normally-open" position with a manual override switch.

F. Valves shall have a clearly marked position indicator as part of the operating linkage.

G. Actuator: Shall be electronic, direct-coupled, spring-return type and have a rating of not less than twice the torque needed for actual operation of the valve.

2.4 TEMPERATURE SENSORS

A. Temperature Sensors: RTD Elements, accuracy of ±0.1% at 70°F, sensors shall be securely attached to a single gang electrical box or other suitable base, securely mounted on the wall or other building surface. Each sensor shall be located where shown or, if not shown, where it will respond to the average temperature in the room. Sensors, generally, shall be mounted 48 inches above the floor within ADA reach guidelines, and shall not be mounted on outside walls if other locations are possible. If located on an outside wall, it shall have an insulated base. Sensors shall have adjustment devices, by means of which the operating points can be adjusted through a range of not less than 10 degrees above and below the operating points specified.

B. Room temperature sensors shall be similar to Honeywell CT8775 Digital Wall Module, or equal, with temperature adjustment and LCD display for temperature and setpoint status.

C. No devices containing mercury are permitted.

2.5 OPERATOR INTERFACE PANEL

A. Operator Interface Panel shall be a wall mounted interface panel by Honeywell or equal. Each screen shall be capable of displaying and changing all controlled variables. The terminal shall be capable of displaying the system point name (up to 30 characters), current value, priority and status. It shall trend and display alarms. The display shall be an LCD screen displaying a minimum 40 character per line and 2 lines. The terminal shall include an integral alphanumeric keypad.

1. Locate in Mechanical room or as indicated on drawings.

2. System shall be web enabled and trending capable.

2.6 VARIABLE FREQUENCY DRIVES

A. Unless specified and furnished with packaged equipment under other sections of the specifications (Section 23 00 00), variable frequency drives shall be furnished and installed under this section. Drives shall be Toshiba, Yazgawa, Square D or Danfoss, 208 volt, 60 Hz, 3 phase, have microprocessor based adjustment of three phase motor, utilize a vector torque control strategy to regulate motor flux to optimize motor torque without the need for encoders. Drives requiring voltage, dwell and current adjustments to achieve improved torque control are not acceptable. The controller shall be rated to control the scheduled fans / pumps.

B. The drives shall be pulse width modulated design converting the utility input voltage and frequency to a variable voltage and frequency output via a two step operation. Insulated gate bipolar transistors shall be used in the invertor section.

C. The drives shall have an efficiency that exceeds 97% at 100% speed and load. The efficiency shall exceed 80% at 50% speed and load. The drive shall maintain the line side displacement power factor no less than 0.95 regardless of speed and load. The drives shall have a one minute overload current rating of 110% and shall be capable of operating NEMA B induction motor.

D. The drives shall limit harmonic distortion level as defined by IEEE 519 for general system applications. Harmonic attenuation shall be provided by the addition of drive line reactance. Harmonic calculations shall be provided upon request and shall be calculated based on the kVA capacity, X/R and impedance of the transformer supplying the drive.

E. The drives shall be capable of operating into a spinning motor and shall be capable of determining motor speed and direction and resume operation without tripping.

F. Operating conditions shall be:

1. Incoming Power: 208 volt, three phase, 60 Hz.

2. Frequency stability of +0.5% for 24 hours with voltage regulation of +2.0% of maximum rated output voltage.

3. Motor slip dependent speed regulation of 1.0%.

4. Five cycle carry over during utility loss.

5. Temperature range 32 - 105°F. Humidity range 0 - 95%.

G. Drive control function shall be adjustable from a digital operator keypad located on the front of the drive. Drive parameters shall include the following: Programmable keypad speed and start command; forward or reverse start; stop and digital speed control; maximum and minimum frequency limits; two acceleration and deceleration times; critical frequency avoidance lockout zones; electronic overload and torque limit; multiple attempt restart; jog and preset speeds; spinning motor functions; two digital output relays; analog output relay; DC injection braking time; programmable PI process control; digital potentiometer.

H. The drives shall have the following system interfaces:

1. Inputs: Process control speed reference interface to receive either a 0-10 Vdc; 4-20 mAdc or speed potentiometer signal; remote mode start and stop contacts; remote forward and reverse contacts; remote preset speed contacts; remote external stop contact; remote reset contact; remote jog contact.

2. Outputs: Two programmable digital relays N.O. contact; Form C contact to indicate protective function trip; two programmable analog output signals.

I. Drives shall have a two line sixteen character each display indicating output current, output frequency, motor RPM, output voltage, power, load, elapsed time, cause of trip.

J. The drives shall contain the following protection functions; over current, over/under voltage, over frequency, phase loss, over temperature, ground fault and short circuit.

K. Drives shall have a 3 year warranty (parts and labor) and be started up by a factory-authorized technician. Drive enclosures shall be NEMA 1 rated.

L. Provide one drive for each fan or pump (as indicated).

2.7 SEQUENCE OF CONTROL

A. Provide and install electronic/electric components to enable the mechanical system to operate in the following sequences:

1. Hot Water Reset: Reset the supply water temperature from outside air temperature. The minimum temperature shall be 120 Deg. F. at 60 Deg. F. outside air temperature (adjustable). The maximum shall be 160 deg F at 0 deg F outside air temperature. Hot water reset shall be controlled by the packaged boiler controls (see Specification Section 230500). On a call for domestic hot water, the boiler(s) shall go to high fire and the boiler pump shall operate until the domestic hot water load is satisfied or the high limit setpoint (180^{o}F.) is reached.

2. Main Heating Hot Water Circulators (CP-3 & CP-4): Operate Lead/Lag - if lead circulator fails the Lag circulator shall run. The lead-lag pumps shall be alternated based on runtime. At outside air temperatures above 60^{o}F, CP-3 and CP-4 shall be de-energized. The pumps shall operate again under the following conditions: The outside air temperature drops below 60^{0}F. and / or any space sensor temperature drops below 72^{0}F. Once the pumps start they shall operate continuously to maintain a constant differential pressure at the location indicated on the drawings by proportioning the variable frequency drive controlling each pump with a minimum speed of 20HZ.

3. Secondary Heating Hot Water Circulators (CP-1, CP-2): Shall operate in a "Lead-Lag" sequence. On a call for heat from the reset controller or domestic hot water the "lead" pump shall start and the respective burner shall start and proportion to maintain the setpoint. On a further call for heat the second boiler shall sequence on and fire as required to maintain the setpoint. Once all boilers are firing, they shall modulate up or down as required to satisfy the hot water supply setpoint. On a call for heat from the domestic hot water system, the boilers and their respective pumps shall operate to satisfy the domestic hot water load. A time delay shall keep the pumps operating for approximately one (1) minute after the respective burner stops firing with a minimum of one (1) minute of pump and burner runtime per cycle (adjustable). The "lead" and "lag" pumps and boilers shall be alternated based on runtime. During periods where there is no call for heat, the boilers shall be off. Boiler sequencing / cascading shall be performed by the packaged boiler controls (see Specification Section 230500).

4. Domestic Hot Water Pumps:

    a. CP5 and CP6 shall cycle on a call for heat from immersion temperature sensors in their respective hot water indirect-fired water heater (IFWH-1, 2).

5. Hot Water Recirculation Pump (CP-7): Pump shall operate continuously.

6. 3-way valve (V-1): The control valve shall be normally open to allowing flow thru the heating loop. If the loop supply water temperature exceeds the setpoint, the 3-way mixing valve shall proportion to divert flow from the main heating loop.

7. Fintube Radiation (V-5): The zone valve shall cycle as required to satisfy the zone temperature setpoint.

8. Unit Heaters/Cabinet Unit Heaters: On a call for heating by the room thermostat, the fan shall operate subject to the pipe mounted aquastat to satisfy the heating setpoint (72°F, adjustable).

9. Wall Heaters (WH): The room sensor shall cycle the 2-way control valve and the fan shall start subject to the pipe-mounted aquastat.

10. Energy Recovery Ventilators (ERV's):

    a. The supply and exhaust fans shall operate continuously.

    b. The energy recovery wheel shall operate continuously subject to an enthalpy economizer. The BAS shall enable economizer operation and send a signal to the unit to stop the wheel from rotating or operate at a minimum speed per the unit manufacturer.

    c. Discharge temperature control:

        1) The supply air temperature shall be inversely reset based on the return air temperature such that at a 70°F return air, supply air shall be 72°F, at 78°F return air, supply air shall be 65°F. The supply air reset controller shall proportion the 3-way control valves (V-2). The 3-way control valves shall proportion to maintain a minimum leaving water temperature of 60F. Coil circulating pumps CP8 and CP9 shall operate continuously when the outside air temperature is below 55°F.

    d. Freeze Protection: A manual reset freezestat shall shutdown the fans and close the outside air and exhaust air dampers if the discharge air drops below 45°F. or the leaving water temperature drops below 50°F. The 3-way valve (V-2) shall go to full coil heat.

    e. Wheel Rotation Sensor: A wheel rotation sensor shall shutdown the fans and close the outside air and exhaust dampers if the wheel stops rotating.

    f. Motorized Dampers: Outside air and exhaust air dampers shall close upon unit shutdown.

    g. Smoke Detection: A smoke detector in the supply air stream shall de-energize the unit and close the outside air damper. The smoke detector shall be wired to the fire alarm system.

11. Combination Fire / Smoke Dampers: Shall be electrically interlocked via end switches with the respective Energy Recovery Ventilator to open prior to the fans starting and to shut down the units prior to the dampers going closed. If smoke is detected by any of the duct smoke detectors, the dampers shall close and that systems fans shall shut down and an alarm sent to the BAS. See Specifications Section 233000.

12. Exhaust Fans / Motorized Dampers:

    a. Exhaust fans EF1 and EF3 shall be cycled on a call for cooling from their respective temperature sensor (set 80F.). EF1 shall be interlocked with the respective motorized intake damper.

    b. EF2 shall operate continuously.

    c. EF4 shall be controlled on a time schedule as follows: 6AM to 8PM, continuous operation. 8PM to 6AM, OFF.

13. Solar Domestic Hot Water Performance Reporting: The following data points shall be logged on a 15 minute interval (date and time stamped) and emailed to Maine State Housing Authority (MSHA) in the form of an Excel spreadsheet, on a daily basis. Coordinate the required email address with the MSHA field representative.

    a. "FLOW-T" = Total domestic hot water flow in Gallons.
    b. "FLOW-S" = Domestic solar pre-heat flow in Gallons.
    c. "TEMP-IN" = Domestic solar pre-heat temperature in °F.
    d. "TEMP-OUT" = Domestic solar pre-heat temperature out °F.

14. Solar Preheat Recirculation Pump (CP-R): At solar pre-heat tank temperatures above 140°F, CP-R shall be enabled.

15. Snowmelt system: The system shall be "enabled-disabled" based on a signal from the ice/snow sensor and outside air temperature (below 40F.).

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the automatic temperature control and system may be installed in strict accordance with pertinent codes and regulations and the reviewed Shop Drawings.

3.2 INSTALLATION

A. Provide wiring, and conduit to connect the ATC components for an operational ATC system. Wiring and installation shall conform to NFPA 70.

B. Identification: Label or code each field wire at each end. Permanently label or code each point of field terminal strips to show the instrument or item served. Color-coded cable with annotated cable diagrams may be used to accomplish cable identification.

C. Temperature Sensors: Stabilize sensors to permit on-the-job installation that will require minimum field adjustment or calibration. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application to allow quick, easy replacement and servicing without special tools or skills. Strap-on sensor mountings, using helical screw stainless steel clamps, shall be permitted on new piping for unit heater or other on-off operation only, after pipe is cleaned to bright metal. Strap-on bulb and pipe shall be insulated after installation. Strap-on sensor mountings are also permitted for hot water piping sizes up to 2 inches. Other liquid temperature sensors shall be provided with wells.

D. Duct Sensors: Provide sensors in ductwork; specific location within duct shall be selected to accurately sense air properties. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Installation shall be within the vibration and velocity limits of the sensing element. Where an extended surface element is required to sense the average or lowest air

temperature, position and securely mount sensor within duct in accordance with sensor manufacturer's recommendations. Temperature sensing elements shall be thermally isolated from brackets and supports. Provide separate duct flange for each sensing element; securely seal ducts where elements or connections penetrate duct. Seal penetrations of duct insulation vapor barrier with vapor barrier coating compound to provide a vapor-tight covering. Mount sensor enclosures to allow easy removal and servicing without disturbance or removal of duct insulation or vapor barrier. On downstream side of each sensor, provide access doors.

E. Pipe Sensors: Provide wells for sensors measuring temperatures in pressure vessels or in pipes. Wells shall be noncorrosive to the medium being measured and shall have sufficient physical strength to withstand the working and test pressures and velocities. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in the piping at elbows to effect proper flow across the entire area of the well. Wells may either look upstream or downstream. Provide thermal transmission material within the well to speed the response of temperature measurement. Provide wells with sealing nuts to contain the thermal transmission material and allow for easy removal. Wells shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area. Increase piping size as required to avoid restriction.

3.3 ADJUSTMENTS

A. Adjust controls and equipment to maintain the conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.4 INSTRUCTING OPERATING PERSONNEL

A. Upon completion of the work and when designated by the Architect, furnish the services of a competent technician regularly employed by the temperature control manufacturer for the instruction of Owner in the operation and maintenance of each automatic space temperature control system. The period of instruction shall be for not less than one 4 hour period and shall include video tape demonstration of controllers.

3.5 FIELD INSPECTION AND TESTS

A. Tests shall be performed or supervised by employees of the ATC system or manufacturer of the ATC system, or by an authorized representative of the ATC manufacturer. Give Architect 14 calendar days advance written notice prior to the date of the field acceptance testing. If the Architect witnesses tests, such tests shall be subject to approval. If the Architect does not witness tests, provide performance certification.

B. Plan for Inspections and Tests: Furnish a written inspections and tests plan at least 60 days prior to the field acceptance test date. This plan shall be developed by the manufacturer of the ATC system. The plan shall delineate the inspections and testing procedures required for the ATC system to demonstrate compliance with the requirements specified. Additionally, the test plan shall indicate how ATC system is to be tested, what variables will be monitored during test, names of individuals performing tests, and what criteria for acceptance should be used. Indicate how operation of H&V system and ATC system in each seasonal condition will be simulated.

C. Field Acceptance Testing: Upon completion of 72 hours of continuous H&V and ATC systems operation and before final acceptance of work, test the automatic temperature control systems in service with the heating, ventilating and air conditioning systems to demonstrate compliance with

contract requirements. Test controls through each cycle of operation, including simulation of each season insofar as possible. Test safety controls to demonstrate performance of required function. Adjust or repair defective or malfunctioning automatic space temperature control equipment or replace with new equipment. Repeat tests to demonstrate compliance with contract requirements.

* END OF SECTION *

ERV INTEROPERABILITY POINTS LIST

Carel	Modbus-RTU (RS485) Network Address: 1	BACnet IP / BACnet Ethernet / BACnet MSTP Device Instance: 77000 (default)				Lonworks FTT-10A			Type	Read (Unit to BMS signal) Write (BMS to Unit signal)	Description
Address	Address	Address	Name	Units		Address	Name NV	Type NV			
1	40002	1	A001	° F		1	nvoOutsideTemp	105	Analog	R	Outside Air Temp (###.#°F)
2	40003	2	A002	° F		2	nvoSupplyTemp	105	Analog	R	Supply Air Temp (###.#°F)
3	40004	3	A003	° F		3	nvoColdCoilDisch	105	Analog	R	Cooling Coil air Temp (###.#°F)
4	40005	4	A004	° F		4	nvoRoomTemp	105	Analog	R	Room Air Temp (if Installed) (###.#°F)
11	40012	11	A011	° F		11	nv(0/i)TempSetPt	105	Analog	R/W	Temperature Set Pt (read/write) (###.#°F) *(Please refer to Controller IOM)*
1	40130	1001	I001	no-units		1	nvoStatus	81	Integer	R	Note 1
2	40131	1002	I002	percent		2	nvoHeating	81	Integer	R	Heater output (0-100%)
3	40132	1003	I003	percent		3	nvoCooling	81	Integer	R	Cooling output (0-100%)
4	40133	1004	I004	percent		4	nvoWheel	81	Integer	R	Energy recovery wheel speed (5 speed) (defrost & economizier)
5	40134	1005	I005	percent		5	nvoHotGasReheat	81	Integer	R	Hot Gas reheat output (0-100%)
				Inactive_Text	Active_Text						
1	10002	1	D001	Off	On	1	nvoOnOffStat	95	Digital	R	Unit ON/Off
2	10003	2	D002	Off	On	2	nvoSupplyFan	95	Digital	R	Supply fan status
3	10004	3	D003	Off	On	3	nvoExhaustFan	95	Digital	R	Exhaust fan status
4	10005	4	D004	Unoccupied	Occupied	4	nvoOccupancyStat	95	Digital	R	Occupancy Status (0=Unoccupied, 1=Occupied)
5	10006	5	D005	Off	On	5	nvoCompressor1	95	Digital	R	Compressor #1 ststus
6	10007	6	D006	Off	On	6	nvoCompressor2	95	Digital	R	Compressor #2 status
7	10008	7	D007	Off	On	7	nvoDeFrostMode	95	Digital	R	Defrost mode status
10	10011	10	D010	Stop	Start	10	nv(o/i)StartStop	95	Digital	R/W	Unit start/stop command
11	10012	11	D011	Don't Reset	Reset Alarms	11	nv(o/i)ResetAlarms	95	Digital	R/W	Reset alams command
12	10013	12	D012	Occupied	Unoccupied	12	nv(o/i)OccUnocc	95	Digital	R/W	Occupied/unoccupied command (0=occupied, 1=unoccpied)
20	10021	20	D020	Off	Alarm	20	nvoGlobalAlrm	95	Digital	R	Global alarm indication (active when there is at least one alram)
21	10022	21	D021	Off	Alarm	21	nvoSupplyFanAlm	95	Digital	R	Supply air proving alarm
22	10023	22	D022	Off	Alarm	22	nvoWhlPressurAlm	95	Digital	R	High Wheel pressure (high airflow or dirty wheel)
23	10024	23	D023	Off	Alarm	23	nvpWhlRotateAlm	95	Digital	R	Wheel rotation alarm
24	10025	24	D024	Off	Alarm	24	nvoExhaustFanAlm	95	Digital	R	Exhaust air proving alarm
25	10026	25	D025	Off	Alarm	25	nvoFilterAlm	95	Digital	R	Dirty filter alarm
26	10027	26	D026	Off	Alarm	26	nvoCompTripAlm	95	Digital	R	Compressor trip alarm
27	10028	27	D027	Off	Alarm	27	nvoCompLockedAlm	95	Digital	R	Compressor locked out alarm
28	10029	28	D028	Off	Alarm	28	nvoSipplyTempAlm	95	Digital	R	Supply air temperature low limit alarm
29	10030	29	D029	Off	Alarm	29	nvoB1Alm	95	Digital	R	Sensor#1 out of range (outside air temperature)
30	10031	30	D030	Off	Alarm	30	nvoB2Alm	95	Digital	R	Sensor#2 out of range (supply air temperature)
31	10032	31	D031	Off	Alarm	31	nvoB3Alm	95	Digital	R	Sensor#3 out of range (cold coil leaving air temperature)

Note: 1) Unit status index: 0=system off; 1=initial delay; 2=opening dampers; 3=exhaust fan starting; 4=supply fan starting; 5=system on; 6=defrost mode active; 7=system on-economizer; 8=system on-heating; 9=system on-cooling; 10=system on dehumidifying; 11 system on-dehumidifying & reheat; 12=unoccupied-unit off; 13=unoccupied-heating; 14=unoccupied-cooling; 15=Manual override; 16=remote off; 17=Alarm

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