SECTION 23 09 93

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

B. Work Included:

1. Sequence of Operations for HVAC Systems

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 05 00 – Common Work Results for HVAC
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 09 00 – Instrumentation and Control for HVAC
7. Section 23 20 00 – HVAC Piping and Pumps
8. Section 23 30 00 – HVAC Air Distribution
9. Section 23 70 00 – Central HVAC Equipment
10. Section 23 80 00 – Decentralized HVAC Equipment

1.2 GENERAL REQUIREMENTS

A. Programming shall be provided in accordance with commonly accepted industry standards and practices to ensure proper and efficient control of all equipment and systems.

B. Control sequences shall be accomplished in accordance with control drawings and the sequences specified in this section and described on the drawings. It is the intent of this section to utilize sequences included in pre-programmed controllers when such sequences provide the intended operation. Where factory programming is incapable of providing the sequence specified in the Contract Documents, a custom controller with custom programming shall be provided.

1.3 SUBMITTALS

A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

1.4 WARRANTY

A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

1.5 COMMISSIONING OF HVAC SYSTEMS:

A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL SEQUENCE REQUIREMENTS:

A. Set points: All control setpoints shall be provided with appropriate deadbands where necessary to prevent the excessive cycling of equipment, valves, dampers, etc.

B. Failure of Digital Control System: The control system shall be installed to fail safe to the heating mode.

1. All air handling and air conditioning units shall fail on with outside air damper closed, heating valves open to the coil and the reset valve open to the boilers.
2. Night setback shall fail to day (occupied) mode.
3. Heating water system shall fail with boiler energized to boiler control and heating water pump on.
4. All interlocked exhaust fans shall be de-energized with the dampers closed.

C. Unoccupied Period Freeze Protection: When outdoor air temperature falls below 35°F during unoccupied periods, the following sequence shall occur.

1. Heating (and chilled) water pumps shall be energized (pumps should be energized whenever any space requires heat).
2. All air unit heating (and cooling) valves shall be fully open when the fan is off.
3. All outdoor air dampers shall be closed and verified.
4. All exhaust fans shall be de-energized with dampers closed (should already be de-energized during unoccupied periods).

D. Unoccupied Periods: At times when the building is unoccupied, the DDC shall control all systems to maintain an adjustable night setting for both heating and cooling. Unless otherwise specified, all outside air dampers shall be closed and all exhaust fans shall be de-energized. The DDC shall stagger the occupied/unoccupied schedules for all air handling units to prevent large fluctuations in heating or cooling demand. Activation of the manual override on a space temperature sensor, where applicable, shall result in the following: the space temperature setpoint shall be indexed to the occupied setpoint for

that space and the system serving that space shall be indexed to the occupied mode. All other spaces shall be maintained at unoccupied temperature setpoints.

E. Morning Warm-up: All air systems shall bring space up to occupied temperature before opening outside air dampers as part of the optimal start sequence.

F. System Start-up: Following any type of system shutdown, the DDC shall stagger the starting of all electrical loads to reduce electric peak demand.

G. System Shut-down: At any time air systems are de-energized, the DDC shall disable all ancillary systems dependent upon air movement such as electric heaters, humidifiers and direct expansion cooling. Ancillary systems required for freeze protection (except electric coils) shall remain operational.

H. Direct Expansion (DX) Cooling: Where the Sequence of Operation calls for DDC control of refrigeration compressors, condensing units or packaged compressor-cooling, the DDC shall provide “minimum-on” and “minimum-off” times in accordance with the equipment manufacturer’s recommendations.

I. Duty/Standby and Lead/Lag Control: All equipment indicated to be operated as duty/standby or lead/lag shall be sequenced based on run time and alternated bi-monthly or as otherwise required in accordance with the Owner’s preferred schedule. Sequencing shall occur as scheduled without the need for shutdown, if necessary. Sequencing for individual equipment shall occur so as not to impact the operation of the entire system. The DDC shall automatically energize the standby or lag device in the event of a failure in the duty or lead equipment.

J. Smoke Detection Control: Upon activation of an air handling unit duct smoke detector, all fan powered VAV boxes associated with that unit shall be deenergized.

K. Refer to the Electric Sequence Controls Schematics on the drawings for automatic control of fans, ancillary heating equipment, and other similar items. The following hard-wired interlocks shall be provided in addition to any others indicated on the Electric Sequence Controls Schematics:
   1. Activation of duct smoke detectors shall de-energize associated supply fans and return/relief fans (where applicable).
   2. Low air flow condition indicated by the air flow switch shall prevent the operation of electric heating coils.
   3. Cooling coil condensate drain pans shall be provided with safety switches to de-energize the unit and alarm the DDC upon accumulation of water.

L. All screen graphics for systems with economizers shall show calculated values of enthalpy for outdoor air and return air.

3.2 SEQUENCE OF OPERATION: Refer to Drawings

END OF SECTION 23 09 93

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