SECTION 23 09 01 – CONTROL SYSTEM INTEGRATAION

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 23 09 23 - Direct Digital Control (DDC) System for HVAC

B. Section 23 09 24 - Graphical User Interface Integration

C. Control Sequences: Refer to drawings

1.2 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

B. ASHRAE FUN IP - (2017) Fundamentals Handbook, I-P Edition

C. ASHRAE 135 - (2016) BACnet - A Data Communication Protocol for Building Automation and Control

D. BACnet Testing Laboratories BACnet Building Controller (BTL B-BC) requirements.

E. Networks (ANSI Approved)

F. UL 916 – Energy Management Equipment

G. NFPA 70 – (2017) National Electric Code.

H. 2017 National Electric Code

1.3 DEFINITIONS

A. The following abbreviations, acronyms, and definitions may be used in addition to those found elsewhere in Contract Documents.

1. Actuator: Control device to provide motion of valve or damper in response to control signal.
2. AI: Analog Input
3. AO: Analog Output
4. Analog: Continuously variable state overstated range of values
5. Auto-Tune: Software routine used to adjust tuning parameters based on historical data.
6. BAS: Building Automation System (aka BAS)
7. BAS Administrator: BASAdmin@dfwairport.com, dlumpkin@dfwairport.com
8. BACNet: Communications protocol for Building Automation System (BAS) networks per ASHRAE, ANSI, and ISO 16484-5 standard protocol
9. BACNet TCPIP: TCP/IP family of protocols
10. BBMD: Broadcast Management Device
11. BMS: Building Management System (aka BAS)
12. B-BC: BACnet Building Controller

13. BTL: BACnet Testing Laboratories
14. DDC: Direct Digital Control
15. DDCP: Direct Digital Control Panel
16. Discrete: Binary or digital state
17. DI: Discrete Input (Sometimes referred to as Binary Input BI)
18. DO: Discrete Output (Sometimes referred to as Binary Output BO)
19. EIOS Enterprise Integration and Operations System – A Tridium Niagara based Airport Platform for BAS presentation and analysis.
20. EIOS Administrator: See BAS Administrator
21. EMCS: Energy Management and Control System (Typically interchangeable with BAS or BAS)
22. E/P: Voltage to pneumatic transducer (Often solenoid valve is referred to as an E/P transducer)
23. FA: Field Adjustable
24. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
25. FMS: Facility Management System linking two or more BAS aka EIOS at the Owner's location.
26. FO: Fail Open position of control device or actuator. Device moves to open position on loss of control signal or energy source.
27. I/P: Current to pneumatic transducer
28. Instrument: Device used for sensing input parameters or used for actuation.
29. JACE: The JACE 8000 is a compact controller and server platform for connecting multiple and diverse devices and sub-systems.
30. MSTP: Master/Slave Token Passing (BACnet)
31. Modbus: Serial communications protocol
32. Modulating: Movement of control device through an entire range of values proportional to an infinitely variable input value.
33. Motorized: Control device with actuator
34. NC: Normally Closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
35. NFPA: National Fire Protection Association.
36. NO: Normally Open position of switch after control signal is removed or normally open position of manually operated valves or dampers.
37. Node: DDCP, operator workstation, or other control device connected to communications network.
38. Operator: Same as actuator for motorized devices. Also refers to an individual who physically "operates" facility.
39. PC: Personal Computer
40. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each share its database values with other devices connected to network.
41. P: Proportional control, control mode with continuous linear relationship between observed input signal and final controlled output element.
42. PI: Proportional - Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controlled variable (reset control).
43. PID: Proportional - Integral - Derivative control, control mode with continuous correction of final controlled output element versus input signal based on proportional error, its time history (reset), and rate at which its changing (derivative).
44. Point: Analog or discrete instrument with addressable database value.
45. Self-Tune: Same as Auto-Tune
46. Solenoid: Electric two-position actuator. (See E/P.)
47. TAB: Test and Air Balance
48. TCC: Temperature Control Contractor (Same as Control Contractor)

49. TCP: Temperature Control Panel

1.4 ACCEPTABLE CONTROL CONTRACTORS

A. Control Contractor shall have full-service office within 100 miles of project site and shall have at least 10 years of experience installing similar control systems of type and size required by these contract documents. Full-service office is defined as being home office of applications engineers, supervisors, and field technicians, having complete parts inventory and having required test and diagnostic equipment. Control Contractors shall be factory authorized Tridium N4 agent or dealer of controllers and control hardware and software as manufactured or provided by (for example but not limited to)

1. Distech Controls
2. Johnson Controls
3. Schneider Electric
4. Vykon

1.5 ACCEPTABLE

A. The Building Automation System (BAS) as provided in this Division shall be based on an open licensed Niagara Framework (or “Niagara”), version 4.10 or greater, a framework developed by Tridium. Systems (Graphics Server and Building Level Controllers) not developed on the Niagara Framework platform are unacceptable.

B. Control system shall be Direct Digital Control (DDC).

C. System architecture shall include “Open Licensed” Niagara JACE 8000 or equivalent controllers that fully supports a multi-vendor environment and be able to integrate third party systems via BACnet or Modbus. Any other protocols must be approved by owner.

D. BAS installation will consist of the application of JACE controllers and subordinate components to provide a fully functional building automation and control system.

E. The JACE controllers shall be integrated into the airport’s enterprise EIOS system.

1.6 SCOPE OF WORK (BAS)

A. Provide all labor and materials for complete fully functioning control systems in accordance with Contract Documents including this Section plus:

1. Section 23 09 23 – Direct Digital Control System for HVAC
2. Section 23 09 24 - Graphical User Interface Integration

B. The drawings and Specifications are complementary to one another - meaning that what is called for one is to be considered called for in both. Where conflicts exist between the Specification and/or drawings, the more onerous requirement shall apply.

C. Engineering services shall be performed by certified Factory Trained Engineers. System shall be installed either by trained technicians directly employed by Control Contractor or by subcontractors who are under direct supervision of Control Contractor's representative.

D. Control Contractor's Project Managers, Engineers and Digital System Programmers shall have previously performed in capacity that qualifies them to successfully engineer system of scope and magnitude like this Project.

E. Control Contractor's Labor shall include, but not be limited to:

1. Engineering services to produce requested submittals and working construction drawings and record drawings as specified here within.
2. Engineering services for required software programming.
3. Engineering services for graphics programming specified.
4. Project management services as single point of contact to coordinate construction related control activities.
5. Field technicians for installation of control wiring and related control devices.
6. Field technicians to startup, calibrate, adjust, and tune control loops.
7. Field technicians to perform system checkout and testing, and to complete required reports.
8. Field supervisor during controls installation and startup.
9. Field technicians to assist Mechanical Contractor and Testing and Balancing (TAB) Contractor in adjusting controls and determining setpoints related to TAB work.
10. Field representatives and/or classroom instructors to provide Owner training as specified.

F. Control Contractor shall be responsible for complete installation of control devices (except as noted), including wiring terminations at controller and sensor locations to accomplish control sequences specified in project manual or on drawings. Control Contractor is required to provide power for air terminal controllers and other field mounted devices that require 24 VAC, 60 Hertz and shall be powered from 120 to 24 VAC transformers provided by Control Contractor. (120V by Division 26) Control Contractor shall also be responsible for additional instrumentation described in point schedules found in Contract Documents, which may not be directly related to specified control sequences.

G. Mechanical Contractor shall provide wells, taps, dampers, and other mechanical interfaces required for control equipment mounting into piping systems. Mechanical Contractor shall install in-line mounted devices, such as valves, flow meters, static pressure probes, etc., furnished by Control Contractor. Control Contractor shall be responsible for installation of other control devices, such as actuators, linkages, sensors, air terminal controllers, flow transducers, remote mounted control devices, control panels, control transformers, etc.

H. Electrical work required as integral part of control work is the responsibility and under the direction of the Control Contractor:

1. Electrical Contractor will provide circuit breakers, conduit, and wiring required to provide electrical power to controllers.
2. Control Contractor is responsible for providing final power connections to control devices from the appropriate electrical distribution.
3. 120 to 24 VAC transformers shall be provided by Control Contractor and mounted adjacent to controller panels or in Equipment Intermediate Distribution Frame (EIDF) rooms and powered from dedicated electrical circuit.
4. Should any change in number of controllers or addition of other electrical equipment after Contracts are awarded, Control Contractor shall immediately notify Electrical Contractor of change.
5. Coordinate with Electrical Contractor for additional power requirements.

I. BAS Ethernet network, including all hardware (routers, switches, firewalls, patch panels, patch cords, cabinets, network cabling, etc), is responsibility of the owner.

1. Cabling Contractor shall provide all network cabling from device to IDF Room and terminate to patch panel. All network cabling work shall be performed by an existing DFW IT Communications contractor. Available contractors include the following:
    a. E2 Optics.
    b. Real Networks.
2. BAS Ethernet network shall employ network/data communications security requirements per NIST Special Publication 800-53, Revision 3 – Information Security.
3. Cabling Contractor shall be responsible to provide locations of all necessary Building Automation System data drops (from EIDF room patch panel to field jacks/patch panels) with the owner PM.
4. Owner BAS administrator shall be responsible for providing IP address list for all devices that require Ethernet connection.

J. BACnet Network and Instance ID will be provided by the Owner's BAS Administrator and must follow the Owner's numbering convention.

K. Materials shall be as specified unless approved through procedures for product substitution specified in Division 01. Control Contractor shall provide components not specifically indicated or specified, but necessary to make system function within the intent of specification.

L. If during the installation period any of the factory equipment or material provided in the system is found to be defective in material or workmanship, it shall be replaced or repaired by Contractor at no additional cost to the owner within 24 hours from the time the problem was reported/discovered.

M. Any part/device or equipment installed as part of this contract found to be malfunctioning or defective during the warranty period shall be replaced by Contractor within 24 hours from the time the problem was reported.

N. Electrical products shall be listed and labeled by UL and comply with NEMA Standards.

O. Provide weather protection cover or weatherproof control devices where required for control devices located outdoors.

P. Provide tamper resistant screws and fasteners for equipment located in accessible and/or public areas.

Q. Factory Acceptance Test (Vendor Site)

1. Prior to installation, the factory bench testing shall include pre-testing of all graphics, programmable logic and mapped inputs and outputs to demonstrate compliance with the sequence of operations.

R. Commissioning Scope: In addition to the commissioning scope indicated herein and in the individual System Sections, the Controls Contractor shall work and cooperate fully with the Owner's Third-Party Commissioning Agent in demonstrating that the BAS is in compliance with the approved design. The BAS programmer shall be familiar with the site and have access to the DFW EIOS system during commissioning to assist in testing of programmed sequences.

1.7 SCOPE OF WORK (BAS TO EIOS INTEGRATION REQUIREMENTS)

A. BAS contractor shall coordinate with the BAS Administrator to provide a fully integrated system that meets the following requirements:

1. BTL-listing – The BAS shall include at least one BTL-listed B-BC device with BACnet/IP "data link" communications and support for BBMD (BACnet/IP Broadcast Management). Additionally, the B-BC device(s) shall support BACnet Clause 6 routing (i.e., between MS/TP and BACnet/IP) if the devices are connected to other DDC controllers, factory-installed controls, etc. via MS/TP data link communications.
2. Open Licensing – For DFW-purchased systems DFW shall be the named license holder of all DDC Device and Operator Interface software/firmware provided on the project. The purpose of this requirement is to provide an open system such that BAS products from various suppliers can be integrated into this BAS.
3. Point, Setpoint, etc. Objects – Points, setpoints and other parameters shall be exposed using BACnet objects.

    a. All I/O points shall be represented by object types that match the associated I/O point types (i.e., AI, AO, BI, BO). Output points (e.g., AO & BO) shall be writeable and commandable. The "points" exposed shall include:

        1) All points terminated on the BACnet B-BC device(s).
        2) All other points included in the BAS (i.e., those terminated on other types of DDC controllers).
        3) All points from BAS Subsystems (see definition below).

    b. All setpoints, parameters and other control settings to be exposed via BACnet objects shall be indicated in the sequence of operation (e.g., via the term "adj.") or some other method (e.g., an object list).

        1) These include data from BAS Subsystems.

    c. "BAS Subsystems" are systems/equipment with controls that are not provided by the BAS contractor, and which are specified to be integrated to the BAS. BAS Subsystems include VFD's; factory provided controls on such equipment as chillers, boilers, AHU's, RTU's, CRAC's, jet bridge PCA units, etc.; and electrical systems/equipment such as lighting controls, PLC's, UPS's, etc.

4. Start/Stop Scheduling – The BAS shall expose all system start/stop scheduling data using BACnet Schedule and Calendar objects that are writeable.

    a. BAS Subsystems need not support BACnet Schedule and Calendar objects (nor even BACnet). The BAS shall be used for the start/stop scheduling of these controls (where applicable) such that the Schedule and Calendar objects for these controls shall be exposed via BACnet.

5. Alarming to the EIOS shall be via Alarm and Event Services from the BAS. Either the Intrinsic or Algorithmic Change reporting mechanisms shall be used.

    a. This requirement shall be used for alarms from BAS Subsystems regardless of their communications protocols or the alarm handling mechanisms (i.e., the BAS shall convert the BAS Subsystems' alarm data into BACnet Alarm messages).
    b. Set up alarms and alarm priorities based on the EIOS alarming standards. Consult with the EIOS Administrator about these standards.

6. Trending – The BAS design shall specify the set-up of trend logging, including:

    a. A list of data to be accumulated/stored as historical trend logs.
    b. Trend log files shall be exposed to the EIOS via BACnet Trend Log objects.
    c. Coordinate with EIOS Administrator for polling frequency and data storage duration of trend data.

7. Run Timers – Set up run timer AV objects for equipment per the EIOS standards. Consult with the BAS Administrator.
8. Change of Value Reporting – All BAS BACnet objects shall use the BACnet Alarm and Event Service's COV (change of value) reporting mechanism to communicate changes in

state or value of the objects to the EIOS. Polling of the BAS via regular Read_Property service requests by the EIOS shall not be required.

a. This requirement shall be used for COV reporting of data from BAS Subsystems regardless of their communications protocols or the change of value handling mechanisms used (i.e., the BAS shall, if needed, regularly poll BAS Subsystems for changes of state or value and, when they occur, report these to the EIOS via BACnet COV reporting).

9. BBMD – The BAS contractor shall coordinate with the BAS Administrator to determine if the BAS's BACnet/IP controller(s) shall be set up as a BBMD.
10. Output Point Command Prioritization – The BAS contractor shall inform the EIOS Administrator of the BACnet Command Priority Level that the EIOS shall use when writing to (i.e., overriding) output points (i.e., AO's & BO's). The BAS contractor shall also indicate whether the BAS also supports command prioritization of other objects (i.e., AV's & BV's).
11. Point/Object Naming – The BAS contractor shall follow the naming convention set up by the BAS Administrator.
12. Device ID's, Network Numbering and other Communications Settings (e.g., device addresses) - The BAS contractor shall use values for these settings as provided by the EIOS Administrator.
13. The above BACnet communications functionality is also applicable to Tridium FOX communications in an equivalent manner (i.e., the BACnet terminology as-is does not apply; however, the performance described does apply).

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION