Division 230900 Instrumentation and Control for HVAC

DESIGN GUIDE

1 General

1.1 General

A. The Building Automation System in this section shall be referred to as the BAS.

B. The controls are direct digital controls, web-based system.

C. The controls for each building report to a central server and service technicians access the control system through any PC with web access through remote desktop controls or through phones. Consequently, projects to not require computers, operator workstations, or laptop service tools.

D. All functions and displays shall be available for remote control at any remote desktop.

E. It is the University's intent to eventually have all its mechanical systems connected to the BAS

F. All BAS controls shall conform to BACNET standards and shall be fully compatible with the existing campus Energy Management network (by Alerton Company).

1.2 Submittals

A. The Architect/Engineer shall provide complete Sequence of Operations (SOP) for each mechanical system, specify a control point list for each

SOP in the project document, and include schematic of system with location of control devices.

B. The contractor shall provide:

1. Material/product submittals
2. Wiring diagrams
3. System schematic with sensor locations, SOP, panel details.
4. Floor plans with locations of control devices including terminal units and wall switches/sensors.
5. Communication risers indicated network trunks and associated controllers on trunks.

C. Mid-Point of Construction

1. The contractor shall provide screenshots of proposed graphic pages for CWU HVAC Manager to review. The intent is to have graphical software to be developed similar to existing graphics when applicable.

1.3 Identification

A. Provide valve, conduit, controller and equipment tagging in accordance with 230553.

B. Equipment Nomenclature. Provide in accordance with 230553.

C. Laminated wiring diagrams in control panels. See 230553.

1.4 Power

A. All control power shall be provided from dedicated control circuits.

B. Transformers shall be minimum 90vA and shall be distributed through the facility to minimize control wiring. Provide no less than one transformer per floor.

C. See 230500 for systems required to be placed on backup power. All controls associated with systems identified to be on generator power shall be obtained from sources backed by a generator. All global

controllers shall additionally be backed from generator backed power when available at the building.

1.5 Construction Services

A. The engineer shall specify, on major capital projects, a control summit in the construction phase. It is preferred that the meeting occurs on campus unless a virtual meeting is prearranged and approved by the MHM.

1. Required attendance: Design engineer, Control Contractor, MHM, Commissioning Agent and representatives from construction team.
2. Schedule: Occur at the end of the first control submittal to discuss review comments from the Engineer, MHM, and Commissioning Agent.
3. Scope: Review engineer review comments and discuss comments from MHM and CX Agent.
4. The engineer shall be responsible for recording final review comments for the submittal after meeting discussions.
5. Supplemental scope with additional cost (if needed) shall be issued by engineer as a formal change to the project documents.

B. The engineer shall work with the CPPM and MHM to determine minimum level of desired project management support from the control contactor in the construction phase. It is suggested on major capital projects ($15M and greater) or projects with a significant control scope that the control contractor be represented at a minimum of one construction meeting on-site per month from the time that HVAC rough-in begins through project closeout. The control contactor shall advise the MHM in advance of these meeting dates.

2 Materials

2.1 Control System

A. Manufacturer: Alerton, Ascent Version. No substitutions permitted.

B. Installer: ATS (Renton Office). No substitutions permitted.

C. 100% native BACnet

2.2 Variable Frequency Drives

A. Manufacturers

1. ABB
2. Danfoss
3. Eaton

B. Do not provide BACnet interface at VFDS due to bandwidth issues. All controls shall be performed by discrete inputs and outputs (on/off, speed, alarm, status).

C. Equipment shall be designed and selected so that VFD's do not operate at more than 60 hertz.

2.3 Lab Controls and Fume Hood Controls

A. Phoenix as furnished by ATS Renton Office. No substitutions permitted.

2.4 Equipment BACnet Interface

A. Provide at manufacturer's control panels for:

1. Chillers
2. Boilers
3. Meters

B. Do not provide BACnet interface for variable frequency drives.

2.5 Meters

A. Hydronic Flow Meters

1. Flow meters for hydronic applications shall be Onicon and shall be magnetic style. Turbine insertion meters are not allowed.
2. When flow meters are used to measure energy such as facility chilled water consumption, provide with microprocessor based btuh meter with BACnet interface and LCD display.

B. Condensate

1. Honeywell/Elster/AMCO M190 hot water MultiJet impeller meter.
2. Rated for hot water up to 266 degrees F and pressures up to 230 psi.
3. Meter includes a strainer.
4. Local display with additional pulser output for flow monitoring by the BAS.

C. Irrigation flow meters

1. Irrigation meters are to be provided on each new construction site and major renovation with site work. Meters are part of the Calsense Irrigation system as part of the landscape scope and have no interface with the building automation system.

D. Domestic water meters

1. See 221100. Interface meters with the building automation system.

E. Electric Meters

1. Meters provided by Division 26.
2. Meters report to BAS (230900).

F. Gas Utility Meters

1. Refer to 231000. Meters provided by the utility company shall be provided with auxiliary contacts for monitoring of on-site gas usage by the BAS.
2. Interface any submetering provided in 231000 with the building automation system.

2.6 Terminal unit control valves

A. Belimo. No substitutions permitted.

B. For re-heat circulating systems, two (2) way control valves are allowed at terminal units. However, three (3) way valves are required at the end of branch circuits to maintain warm pipes for heating availability.

2.7 Damper Actuators

A. Belimo. No substitutions permitted.

2.8 Wiring/Cable

A. The BAS communication data trunk cable shall have purple jacket insulation.

B. All cable not installed in conduit shall be plenum rated.

2.9 Low Limit Controls

A. Locate on all coils without anti-freeze protection that have connection to outside air (including DOAS units). Provide hardwired safety shutdown. Provide software bypass for winterization.

2.10 Terminal Unit Controls

A. Provide air filter on air flow sensing line prior to entering controller for Alerton VAV and CAV air terminal unit controllers.

3 Execution

3.1 Wiring/Power

A. Install in accordance with NEC

B. All wiring shall be installed in conduit. Wiring in accessible ceilings may be installed without conduit provide cabling is plenum rated and neatly installed J-hooks with frequent spacing to prevent sagging of cable.

C. All Global Controllers shall obtain power backed by generators or other back-up source to the electrical utility system.

3.2 Training

A. See 230500. Provide at project completion and again at one month prior to the full one-year guarantee.

3.3 Unique CWU Requirements

A. All systems provided by Division 23 will be operated and monitored by the BAS system.

B. The following items are items that are unique to CWU. The design engineer should incorporate these project requirements into the contract documents.

1. Glycol Feeders and Hydronic System Water Makeup

    a. Glycol feeders shall be monitored for low levels. Coordinate with 232500.

    b. Direct water make up feeds for non-glycol systems have meters provided by Division 22. The BAS shall monitor make up water.

2. Smoke Dampers-Monitoring

    a. Damper positions shall be monitored. The BAS shall alarm when dampers are closed and command associated AHU to hold the current fan speed as the maximum speed to prevent over pressurization. Speed command shall be reset after damper reset.

    b. Dampers in close proximity may be monitored with single BAS point in daisy chain fashion provided dampers are on the same floor.

    c. Do not have more than 10 dampers in a single BAS point.

d. In the graphics, indicate the location of all dampers programmed to the BAS point.

3. Generator

   a. Monitor Generator Status

   b. Monitor transfer switch position

   c. Monitor trouble condition.

4. Lighting

   a. Occupancy sensors are provided by Division 26 and are provided with dual contacts with one contact monitored by the Division 26 lighting control system and the other contact monitored by the BAS System.

   b. At the contractor's option, the contractor can monitor status through a BACnet or serial communications interface at the lighting control panel.

   c. Occupancy sensors can be used for airflow setback, temperature adjustments and other means either at the time of installation or in the future.

   d. The design engineer shall identify how occupancy sensors are to be used in the control diagrams.

5. Domestic Hot Water

   a. Control circ pump per Washington State Energy Code and monitor pump status.

   b. Monitor return water temperatures on recirculating system.

6. Air Filters

   a. Monitor differential pressure across filter bank as an analog point. Units with pre and final filters across a filter bank may utilize a single DP.

   b. Indicate clean pressure on the BAS graphics and provide alert on changeout pressure.

7. Hydronic Filters

a. Monitor differential pressure across bag filters and side stream filters as an analog point.

b. Indicate clean pressure on the BAS graphics and provide alert on changeout pressure.

8. Auxiliary Equipment

a. For lab applications, monitor air pressure system delivery pressure and compressor alarm.

b. For lab applications, monitor vacuum system delivery pressure and vacuum alarm.

c. For lab waste systems, monitor PH and tank leak detection and over-fill alarm.

9. Fire Alarm System

a. The BAS shall monitor the fire alarm system for alarm.

b. When mechanical systems are not part of a smoke control system, CWU typically stops all air handling units and closes all fire smoke dampers in the event of a general alarm from the fire alarm system. These shutdowns and closures are accomplished through the fire alarm system in the Division 28 scope. The fire alarm system and the dampers are programmed to close with a 30-45 second delay to allow fans to stop and slow down before closing dampers.

c. Upon alarm at the smoke damper smoke detector (detector by Division 28), the fire alarm immediately closes damper and stops the air handling system per requirements of the IMC and the damper UL listing. This condition triggers a general alarm and initiates shutdown and closures of the remaining building systems per item B.

10. Safety Shutdowns

a. Safety shutdowns such as low limit, high static, etc. shall be hardwired and require a manual reset.

b. Safety showdowns shall be coordinated with the electrical engineer (Division 26) and other life safety system shutdowns such as fire alarm (Division 28).

11. System Pumps

    a. Monitor pump suction pressure.

    b. Identify normal fill pressure on pump suction in the graphics.

12. Fans

    a. Monitor status of all fans and provide alarm on fan failure.

13. Unitary Systems

    a. Unitary systems such as a ductless split for a telecom room or elevator machine room: provide auxiliary temperature sensor for monitoring of space temperature by the BAS.

14. Air Terminal Units and Terminal Heating Units

    a. Monitor discharge air temperature.

15. Variable frequency drives

    a. Control through discrete hardwire inputs and outputs (start/stop, status, speed, fault). Do not connect BACnet or serial communications as it bottles down bandwidth of control network.

16. Hoarfrost

    a. When 100% outside air systems are required, the Architect/Engineer shall review Hoarfrost mitigation strategies with the Mechanical HVAC Manager in the design development phase.

    b. Hoarfrost mitigation strategies shall be included in the system design and BAS system.

    c. The campus has a global “hoarfrost” alert that activates hoarfrost mitigation in buildings.

3.4 Metering and Metering Plan

A. This section will be periodically reviewed and updated by the Campus Building Energy Engineer and the Mechanical HVAC Manager.

B. Each project shall provide a metering plan that conforms to the requirements of the Washington State Energy Code that also assists CWU with data collection required for conformance to the Washington State Clean Buildings Performance Standard. The metering plan shall be prepared by the design engineer and included in the construction documents.

C. Each project shall provide metering, collect data and provide reporting as identified in this section and as required by the referenced codes, standards and project LEED requirements.

D. CWU does not currently have energy dashboard software but this section will be modified if the future if energy software is adopted by the campus.

E. Energy Sub-Metering

1. When required by code or if determined to be advantageous through LEED, provide sub-metering.

2. When submetering is required for water heaters by energy code or LEED, energy shall be directly measured at the energy source (gas, electricity, etc.).

F. Fluid meter Installation. Install in accordance with manufacturers recommendations including upstream and downstream straight pipe conditions.

1. Condensate meters: 10 straight pipe diameters upstream and 5 straight pipe diameters downstream.

2. Dual turbine hydronic flow meters: 10 straight pipe diameters upstream and 5 straight pipe diameters downstream.

G. Electrical Meter Installation

1. The installing Division 26 electrical contractor shall verify current transducers are the correct ration and verify arrows point to the load on all phases as applicable.

2. The installing Division 26 contactor shall verify meter readings with an external handheld meter +/-5% prior to demonstration to the commissioning agent.

3. Calibration will be verified in the CX process-even for factory calibrated meters.

H. Subcontractors providing metering shall provide calibration of metering and demonstrate calibration to the CX.

I. The CX agent shall review metering calibration and units of measurement and data collection prior to project closeout.

J. The control contractor and subcontractors shall provide a full year of service/repair/calibration of meters with service of the meters one month prior to the end of the one-year warranty period to ensure proper meter operation and calibration.

K. Control contractor shall interface with each meter, collect data and shall provide monthly data collection and monthly/annual reporting for a period of two full years of complete data. Monthly and annual reports shall be submitted to the Owner, CX and Design Engineer.

L. After construction completion of a project past 2024, CWU may have templates available for the month and annual reporting. Consult with CWU.

M. Monthly Reporting. Energy shall be reported and trended by the control subcontractor. The control subcontractor shall submit monthly reports as follows for two years past final completion. Reports shall be provided as follows:

1. Peak hourly demand for each month for each utility entering the building.
    a. Power-kW
    b. Steam condensate-Gallons/Minute, Therms
    c. Chilled Water- GPM, ton/hours
    d. Heating Water-GPM, Therms
    e. Gas-therms
    f. Water
        1) Gallons/hour
        2) Gallons/5-minute interval
2. Monthly consumption for each month as follows:
    a. Monthly consumption by utility

1) Power-kwh, kbtu/mo

2) Steam condensate-kbtu/mo

3) Chilled Water-kbtu/mo

4) Heating Water-kbtu/mo

5) Gas-kbtu/mo

6) Total energy utilities-kbtu/mo

7) Water-gallons/mo

b. Monthly energy consumption by end use

1) When required by LEED strategy or for the Washington State Energy Code…Kbtu/mo

c. Summary of missing data for the month with notes on why and remedial service work to repair meters. If data was interpolated or extrapolated due to meter faults, this shall be indicated.

N. Annual Reporting. The control subcontractor shall submit annual reports as follows for two years past final completion. Reports shall be provided as follows:

1. Summary of each utility monthly energy use and peak usage with totalized annual use and peak for the year. In the second annual report, provide month-by-month comparison of each utility's prior year of monthly use.

2. Summary of missing data for the month/year with notes on why and remedial service work to repair meters. If data was interpolated or extrapolated due to meter faults, this shall be indicated.

3. Total annualized energy usage by utility

a. Power-kwh, kbtu/yr

b. Steam condensate-kbtu/yr

c. Chilled Water-kbtu/yr

d. Heating Water-kbtu/yr

e. Gas-kbtuh/yr

f. Total all energy utilities-kbtu/yr

4. Total Annualized energy usage by utility normalized to building square footage. Obtain official square footage from the Capital Planning Project Manager.

   a. Power-kwh, kbtu/sf/yr

   b. Condensate-kbtu/sf/yr

   c. Chilled Water-kbtu/sf/yr

   d. Heating Water-kbtu/sf/yr

   e. Gas-kbtu/sf/yr

   f. Total all energy utilities-kbtu/sf/yr

5. Weather Normalized Energy Usage

   a. Above data for normalized energy use by utility shall be adjusted for annual weather specific to location though use of Energy Star Portfolio Manager. For supplemental information refer to Washington State Clean Buildings Performance Standard

6. Building Regulated Energy usage

   a. Identify building square footage

   b. Identify building hours of operation per year

      1) 50 or less hours per week

      2) 51-167 hours per week

      3) 168 hours per week

   c. Identify regulated energy usage for the building type with adjustments for the hours of operation and the climate zone. The Washington State Clean Buildings Performance Standard identifies regulated energy use by building type adjusted for the hours of operation per year and the climate zone.

   d. Compare regulated building energy consumption required by Washington State Clean Buildings Performance Standard with

the actual weather normalized measured data in units of kbtu/sf/yr.

e. Indicate if Weather normalized energy usage has passed the building regulated energy usage with Pass or Fail.

7. Energy by End use

   a. When required by LEED strategy or for the Washington State Energy Code…Kbtu/sf/yr

8. Other Utilities

   a. Water-gallons/sf/yr

   b. Summary of monthly water use with totalized numbers: Water-gallons/month and gallons per year

4 Appendix

4.1 Reserved for future.