SECTION 23 09 00 – ENERGY MANAGEMENT SYSTEM

PART 1: GENERAL

1.1 PURPOSE:

A. This standard is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. The responsibility of the engineer is to apply the principles of this section such that the University of Texas at Dallas may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be justified through LCC analysis and submitted to UT Dallas for approval.

1.2 REFERENCES:

A. ASME B 40.1 - Gages - Pressure Indicating Dial Type - Elastic Element

B. ASME B40.3 – Bimetalllic Actuated Thermometers

C. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance

D. ASTM E 77 - Standard Test Method for Inspection and Verification of Thermometers

E. FCI 70-2 - Fluid Controls Institute, Control Valve Seat Leakage (Supersedes ANSI B16.104)

F. ISA 75.01 - Flow Equations for Sizing Control Valves

G. ISA 75.02 – Control Valve Capacity Test Procedures

H. ISA TR75.04.01 – Control Valve Stability

I. ISA 75.05 - Control Valve Terminology

J. ISA 75.13 – Method of Evaluating the Performance of Positioners with Analog Input Signals and Pneumatic Output

K. ISA 75.19.01 - Hydrostatic Testing of Control Valves

L. ISA 75.25.01 – Test Procedure for Control Valve Response Measurement from Step Inputs

M. ISA TR75.25.02 – Control Valve Response Measurement from Step Inputs.

N. NEMA 250 – Enclosures for Electrical Equipment (1000Volts Maximum)

O. NFPA 70 - National Electrical Code

P. National Institute of Standards – QM-1, Quality Manual for Measurement Services

Q. Underwriter's Laboratories – (specify individual standards per project application)

1.3 REQUIREMENTS:

A. Provide identical field devices for existing facility modifications where possible.

B. Provide verification that instruments and control valves supplied are properly sized per industry and manufacturer's standards to meet specified performance criteria for the intended application.

C. Provide instruments including pipe, tubing, manual valves, supports, pipe and tube fittings, wire/cable, conduit, tray, terminations, racks, mounting stands, mounting plates, and other accessories as needed to complete a working and operable instrumentation and control system.

D. Provide intrinsic safety barriers for instruments and valve controllers that are installed in hazardous areas as defined by NFPA 70.

E. Protect equipment from entry of foreign materials by using temporary covers, caps, closures and store equipment in environmentally controlled space until installation of equipment are complete.

F. Verify manufacturer and model number of equipment listed herein as to availability. Substitutions require UT Dallas approval.

G. Input Sensor accuracy:

1. Temperature:

a). Space – +/- 0.8F, over 0 to 130F range
b). Duct Air – +/- 0.8F, over 0 to 130F range
c). Outside Air - +/- 1F, over -30 to 130 range
d). Water – +/- 0.5F, over 0 to 230F range
e). Delta-T – 0.1F

2. Relative Humidity – +/- 2%, over 20 to 95RH range

3. Carbon Dioxide – 5%

4. Flow:

a). Fluid – +/- 1% of range
b). Air – +/- 2% of range

5. Pressure:

a). Static Duct – +/- 0.1" W.G., over 0-5" range
b). Filter status dp – +/- 0.1" WG, over 0-2" range
c). Switches: +/- 1% of range

6. Level:

a). Cooling Tower Basin – 1"
b). Tanks – 0.5"

7. Electrical:

a). KWH - +/- 1% of range
b). KW - +/- 1 % of range

PART 2: PRODUCTS

2.1 CONTROL VALVES:

A. Approved control valves are: VSI V-Ball valves or UT Dallas approved equal.

B. Preference for mounting of temperature control valves is for serviceability from floor without the use of ladder maximum height 5'0" AFF. Where control valves are above serviceability height, locate over equipment in an accessible location such that top of equipment can be used for service platform. Other types of service valves shall be similarly located. Where service valves are mounted 8' above the floor (or other walkway) and not over service platform provide with Rotohammer chain wheels and safety- trimmed chains.

C. Valves shall have a manual means of operation independent of the actuator.

D. Provide valves with the manufacturer's name, pressure rating and flow direction clearly marked on the outside of the valve body.

E. Control valves of the same type shall be of the same manufacturer unless approved by UT Dallas.

F. Size valves in accordance with ISA 75.01 flow equations with valve sized to pass 110% of maximum flow.

G. Control valve noise limit shall be 65 dBA at 3'.

H. Valve failure mode shall be designed to ensure safe operation and shut down of the appropriate process equipment.

I. Control valve terminology shall comply with ISA 75.05.

J. Valve leakage shall comply with FCI 70-2, Class IV.

K. Provide valves with equal percentage or modified equal percentage flow characteristics for modulating applications.

L. Valves shall be hydrostatically tested at the factory simulating dead end service at the design pressure in psig.

M. Hydronic system control valves shall be:

1. Valves 3" and smaller shall be characterized v-ball with a notch, full- port, 3-piece, with stainless steel trim.

2. Valves larger than 3" shall be high performance globe type with resilient seated with bronze or stainless steel discs, bubble-tight, lug- type and gear operated.

N. Steam system control valves shall be globe style where renovations for pneumatic actuation characterize v-ball.

2.3 VALVE AND DAMPER ACTUATORS:

A. Valve and damper control actuators shall be electronic except renovation applications.

B. Valve and damper actuators shall be provided with stall protection to prevent actuator damage throughout the actuator's rotation.

C. Isolation valve actuators shall be provided with position feedback as follows:

1. Open/Close: limit switches (full open and full close), contact closures.
2. Modulating: 0-100% feedback, 0-10 V DC, 4-20mA signal.

D. Actuators used for power-failure or safety applications shall be equipped with an internal spring return mechanism or an uninterruptible power supply (UPS).

E. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and have a 2-10 Vdc or 4-20 mA operating range.

F. Valve actuators shall provide the following minimum close off pressure ratings 150% of total system (pump) head. Belimo VS series or approved equal.

G. Actuators shall feature the ability for Operators to manually position each actuator when actuator is not powered. Non-spring return actuators shall feature an external manual gear release. Spring return actuators with more than 60"-lb torque capacity shall feature a manual crank.

H. Provide a minimum of one actuator for each damper and one actuator for each 16 sf of damper area. Belimo F series, Siemens Open Air G, or approved equal.

I. Dampers 16 sf and smaller shall be driven by an externally mounted damper actuator. Dampers larger than 16 sf shall have each section independently driven by a separate externally mounted damper actuator. Actuators on multi-section dampers shall operate smoothly and in unison.

2.4 BUILDING METERING:

A. Chilled or Hot water BTU meters:

1. Rosemount Magnetic flow-meter (model 8705 w/8721D remote transmitter)

2. Flow tube should be sized to operate within a velocity range of 2'-15'/sec.

3. Differential temperature to use Rosemount transmitter (model 3144) with matched pair of RTD temperature sensors on supply and return lines.

4. BTU calculations to be calculated with Kessler-Ellis Products (KEP) Supertrol II energy meter.

B. Domestic water meters:

1. Sensus turbine meter (model W-1000 DR w/impulse contactor).
2. SRH Compound turbine water meters are to be used for 4"-6" applications.
3. Local display:

a). Volumetric rate
b). Totalizer

4. Output shall be scaled pulse transmitter for flow rate to BAS.
5. Water meter strainers of AWWA type shall be used.

C. Electrical power meters:

1. Square D Power Logic
2. Local Display:

a). Amperage
b). Voltage (per phase and phase-to-phase
c). KW
d). Power Factor

3. Output shall be Modbus TC/IP data link

D. Condensate Meters:

1. For condensate pipe sizes for 1" to 2" use the Spirax Sarco PhD inline vortex meter.

2. For condensate pipe sizes above 2", use the Spirax Sarco Mass Tracker insertion turbine mass flow meter. Inside a building use M-TMP-600 and for meters outside in the elements use M-TMP-900.

3. Output shall be scaled pulse transmitter for flow rate to BAS

E. Steam Meter:

1. For steam pipe sizes from 1" to 2" use the Spirax Sarco PhD inline vortex meter.

2 For steam pipe sizes above 2", use the Spirax Sarco Mass Tracker insertion turbine mass flow meter. Inside a building use M-TMP-600 and for meters outside in the elements use M-TMP-900.

2.5 FIELD INPUT DEVICES:

A. Provide same manufacturer's equipment for similar type installations, (e.g.: pressure transmitters shall be supplied from one manufacturer.)

B. Provide local process gauges with dial sizes between 3" to 5" in diameter unless location is further away than 3' when 6" to 8" or larger gauges will be required. Gauges shall use ½ NPT connections.

C. Provide analog process gauge scales so that the expected normal operating value is approximately ½ of full-scale range. Working pressure in all cases shall be limited to 75% of full-scale range.

D. Provide transmitters so that the maximum expected process value is approximately 90% of the calibrated range.

E. Provide remote sensing electronics for transmitters with local indication if needed to mount at a location accessible by plant operators as close as possible to sensing point. Output signal to be 4m-20mA unless otherwise specified.

F. Provide transmitters with required environmental ratings for service duty, for process and location (indoor or outdoor) temperature and pressure ratings.

G. Provide transmitters with integral display units.

H. Provide process instruments with wetted parts that are compatible with the intended service.

I. Field sensors measurement methodology (type of sensor) dependent upon system service conditions and application. Typical applications are included below.

J. Provide ½" brass body, stainless steel ball isolation valves at locations where sensor lines tap into fluid.

K. Switch contacts shall be rated for 120 VAC at 5 amperes.

L. Provide field calibration of sensors:

1. Calibrate analog instruments to verify accuracy and linearity in accordance with standard industry practices or manufacturer's recommendations.

2. Calibrate digital sensors to verify accuracy, dead bands, and repeatability in accordance with standard industry practices or manufacturer's recommendations.

3. Test equipment shall have accuracy 2 times or better than equipment being tested, traceable to NIST.

4. Calibration and installation records shall be prepared and maintained with the following information:

a. Tag number.
b. Date component received.
c. Purchase order number.
d. Serial number.
e. Calibration data, minimum of 3 points.
f. Date of calibration.
g. Person performing calibration.
h. Date component installed.
i. Test Equipment: Manufacturer, model number, date calibrated calibration lab, and accuracy.
j. Attach calibration sticker to the instrument. Submit sample calibration stickers to Owner for approval. Coordinate sticker location on each type of instrument with Owner. Sticker content:

1). Date calibrated.
2). Calibration due date.
3). Initials of person performing calibration.

k. Provide field calibration kits for carbon monoxide and dioxide sensors.

M. Temperature:

1. Provide 3-wire thermistor Type II or Type III (bead coated with glass, covered in metal sheath, encapsulated with moisture proof epoxy) probe temperature sensors as required to meet accuracy and service owner's approval.

2. Provide matched pair of sensors where differential temperature measurements are made.

3. Provide sensor type and mounting material compatible with environment and service conditions.

4. Room Sensor: Thermistor encased in a wall mounted enclosure for mounting on a standard electrical box. Sensor housing and wall cover plate shall be 1 piece. Siemens Series 2200 or approved equal.

5. Duct Sensor: Encapsulated moisture proof coated thermistor Type II or Type III Material. All sensors in ducts shall be of the single point type. Precon model ST-R3R, ST-D3, or approved equal.

6. Averaging Sensor: Employed in ducts which are larger than 24". The averaging sensor tube must contain at least 1 sensor for every 3', with a minimum tube length of 12'. Precon model ST-FZ or approved equal.

7. Outside Air Sensor: Approved thermistor, sheathed in stainless steel tubing and mounted inside a ventilated, treated, shield to minimize radiant energy and wind effects. Precon model ST-03 or approved equal.

8. Thermostats: Programmable, low voltage. Set points and other operator selectable parameters shall be adjustable from the thermostat. Honeywell T8000 or approved equal.

9. Immersion Sensors: Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must with stand the flow velocities in the pipe. Precon model ST-W3-S-XH or approved equal.

10. Temperature Gauges: Bimetallic helix actuated type, and shall have a white dial with black figures, and pointer zero adjustment. Accuracy shall be plus or minus 1% of the range. Gauges shall conform to ANSI/ASME B40.1.

11. Thermowells: Provide 304 Stainless Steel well, sized for ½ the pipe diameter or 6", whichever is less. Well shall be installed with Thread-o-let. Kele WEL-S with thread-o-let or approved equal.

N. Analytical Instruments:

1. Humidity Sensors:

a). Duct mounted sensor shall have a minimum 6" rigid probe. Duct sensors shall be provided with a sampling chamber and calibration adjustments. RE Technology model HD20K or approved equal.

b). Wall mounted devices shall have appearance similar to temperature sensor devices. Siemens 3200 Series or approved equal. Cover shall be tamper-resistant.

c). When temperature element is required for same location, provide a combination sensor (temperature and humidity).

d). Room sensor:

1). Precision control: RE Technology model HW1K or approved equal.
2). General: RE Technology model HW20K or approved equal.

e). Outside sensor: RE Technology HO20K or approved equal.

2. Conductivity:

a). Platinum electrode.
b). Automatic temperature compensation.

3. pH/ORP:

a). Glass electrode
b). Automatic temperature compensation.

O. Freezestats:

1. Provide for freeze protection of all air-handling unit coils using outside air. The freezestat set point shall be determined as a function of outdoor air temperature, amount of outdoor air being introduced to the air-handling unit, return air temperature, and amount of return air to the unit.

P. Carbon Monoxide Sensor:

1. Sensor shall have a local display, analog output, and relay output contacts.

2. Provide aspirated enclosure for duct mounting. Readings from 0 to 200 ppm, Kele model WCO-1B or approved equal.

Q. Carbon Dioxide Sensor:

1. Based on Non-dispersive infrared (NDIR) operating principle. Sensor shall have an analog output, and relay output contacts.

2. Provide duct mounted units only, readings 0 to 2000 ppm, Valtronics model 6289D-D or approved equal.

R. Occupancy Room Sensor:

1. Based on passive infrared operating principle through a segmented Fresnel lens. Sensor shall have a programmable delayed off, adjustable coverage range, and manual override mode.

S. Pressure (Absolute, Gage, Differential):

1. Air pressure measurements in the range of 0” to 10” water column will be accurate to plus or minus 1% using a solid-state sensing element.

2. Differential pressure measurements of liquids or gases shall be accurate to plus or minus 0.5% of range. The housing shall be NEMA 4 rated for outdoor elements.

3. Provide liquid fill for gages on lines with vibrations and snubbers for pulsation protection. Provide needle valve to isolate each gauge.

4. Transmitters:

a). Electronic capacitance or piezioresistive type
b). Accuracy shall be plus or minus 0.5% of the range with overload protection.
c). Provide 3-valve manifold assembly for 0 and span calibration and maintenance of sensor.

5. Pressure Gauges:

    a). Bourdon tube type, and shall have a diaphragm actuated pointer, white dial with black figures, and pointer 0 adjustment.

    b). Accuracy shall be plus or minus 0.5% of the range with overload protection.

    c. Gauges shall conform to ANSI/ASME B40.1.

6. Air Pressure Transducers:

    a). Switch of proof: Select range for minimum flow operations. Dwyer model 1910 with SPDT contacts or approved equal.

    b). Low Differential Pressure: Select range per process condition where control set point is in the top 50% of the sensor range. Provide integral LCD display, Setra model 267 or approved equal.

    c). Instrument/Control Air Monitoring: Self-contained enclosure with pressure transducer and local gauge. Kele model PSS-2 or approved equal.

7. Water Differential Pressure Sensors:

    a). DP Switch: Brass bellow, enclosed SPDT snap acting switch, contact rating per application. Penn P74 or approved equal.

    b). Transmitters: Provide with stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4mA to 20 mA output, required mounting brackets, and 3-valve manifold. Setra model M230 or approved equal.

T. Flow:

1. Provide flow elements in horizontal pipe runs in accordance with good metering practices and in accordance to manufacturer's requirements for upstream and downstream pipe diameters. Coordinate installation requirements with manufacturer.

2. Transmitter:

    a). Air: Averaging Pitot type with multiple sensors for static pressure measurements distributed across the air stream. Kele KMS series or approved equal.

    b). Fluid: Electromagnetic (energy metering), Turbine insertion type, with dual sensor for basic fluid measurements. Onicon F-1210 or approved equal.

3. Switch:

    a). Air: Differential Pressure diaphragm type single snap action switch. Dwyer model 1626 or approved equal.

    b. Fluid: Thermal Dispersion type with adjustable set-point from 15% to 90% of flow range setting. Dwyer TFS or approved equal.

U. Water/Moisture/Flood Detector:

1. UTD Standard analog moisture sensor. Furnished by Owner; installed by contractor.

V. Level:

1. Open Pit Sumps:

a). UT Dallas Standard analog level sensor. Furnished by Owner; installed by contractor.

2. Enclosed Sumps:

a). Float type switch suitable for fluid in which immersed. Switch shall be assembly mounted, designed, and located for ease of maintenance access, removal and level adjustment. GEMS LS1750 stainless steel single station level switches or approved equal.

3. Receiver Tanks:

a). UT Dallas Standard analog level sensor. Furnished by Owner; installed by contractor.

W. Current:

1. Transmitters: Battery powered combination split core, transformer type with built-in rectifier, 0/span adjustment, and 2-wire output.

2. Switches: Battery powered, solid state with adjustable trip, provided for equipment status feedback.

X. Voltage:

1. Transmitters: UL listed AC voltage self-powered single loop, 2-wire type, with 0/span adjust and 4mA-20mA output.

2. Transformers: UL listed rated for 600vac, with enclosed windings, and built-in fuse protection

PART 3: EXECUTION

3.1 INSTALLATION:

A. Install instruments in accordance with manufacturer's requirements and applicable industry standards.

B. Provide details for typical and special equipment installations on construction documents.

C. Provide power surge and transient suppression for power circuits from an electrical panel, located on the incoming power circuit serving the equipment. Kele model DTK-120HW or approved equal.

D. Install field instruments in such a manner and at such a height as to allow convenient access for readings, calibration and maintenance.

E. Install instruments in steam, liquid and liquid sealed service below their process connection point. Connections shall be in accordance with the Manufacturers recommendations.

F. Install instruments in gas and non-condensable vapor service above their process connection point. Slope connections up to the instrument with a slope of 1" per foot.

G. Support instruments and tubing to relieve strain on connections and to prevent excess vibration or movement.

H. Install piping and tubing in a neat appearance, protected from being stepped on, and include provisions for expansion, drainage and without interference to access to valves or other equipment. Tubing bends are to be made with a tool; hand bends are not acceptable.

I. Provide identification tags for field devices using engraved plastic laminated labels (use stainless steel tags for high temperature service conditions). Secure labels to devices using double sided tape for panels or stainless steel ties for field instruments. Nomenclature shall utilize the UT Dallas standard abbreviations and codes and include the following information:

1. Building
2. Floor
3. System
4. Component Type
5. Identification number (including any suffix or prefix used)
6. Functional Description

3.2 TRAINING:

A. Provide training by factory authorized personnel at the Owner's facility for instrumentation and control equipment, including the following topics:

1. Theory of operation.
2. Hardware configuration and software programming.
3. Calibration methods.
4. Preventative and scheduled maintenance.
5. Diagnosis of hardware and software failures.
6. Removal and replacement of serviceable components.
7. Review content of manufacturer's installation, operation and maintenance manual.

END OF SECTION 23 09 00