Exhibit B

PSD TECHNICAL
SPECIFICATION

DIVISION 25
Integrated Automation

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SECTION 25 00 00 – INTEGRATED AUTOMATION

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   A. New schools and major remodel projects will use all direct digital controls. Controls in minor retrofits will match the existing controls, and be installed by the same contractor that originally installed the system or approved by PSD.
   B. The Controls Contractor shall be a fully owned subsidiary of the control manufacturer or factory authorized installer of the major control components and has been in continuous business for at least fifteen years working for PSD in the last three years.
   C. Design a separate temperature control zone with its own thermostat or control sensor for each student area, classroom or office space.
   D. Minimum Design Requirements for Consultants:
      1. Include the listed temperature control drawings among the final contract drawings and make them the same size and of the same sheet material as the other contract drawings no matter what their source, consultant or installing contractor. The mechanical engineer, not the controls contractor, is responsible to see that control drawings meet this standard.
         i.   Floor and roof plan showing thermostat, sensor locations in duct work, controller locations above ceiling and equipment locations.
         ii. Require point-to-point connection diagrams for wiring and a laminated copy to be placed in the control cabinets
         iii. Schematic instrumentation and control flow diagram labeled accurately and showing the interrelationship of all controls and the areas and equipment served.
         iv. Show the sequence of operation on the control documents. The bill of materials shall appear on the Control Contractor's drawings.

Part 2: Products

2.1   Approved Vendors
   A. LONG Building Technologies (Distech)
   B. BTS Building Technology Systems (Honeywell Spyder)
2.2   Products
   A. CONTROL VALVES
      1. Flanged cast iron in sizes 2-1/2" and larger, otherwise bronze. Seat and inner valve material of

hardened steel. Sizes 2" and smaller with soldered or threaded connections.

2. Spring return to the normal position in the absence of control power, that is, fail with the heating valves open and the cooling valves closed.
3. Modulating electric actuators with adjustable end switches to prevent over stroking are acceptable in sizes <1". Use electric actuators for larger sizes.
4. Use a three-way design at the ends of long runs to keep piping near the service temperature and maintaining pump flow above 25% of design. Otherwise use two-way valves.
5. Size for a 5 PSI maximum drop.

B. DAMPER ACTUATORS
1. Modulating in most applications or two-position in rare cases; i.e., minimum outside air dampers or exhaust dampers.
2. Provide position indication or verification on the outside air, return air and exhaust air dampers of air handling units larger than 15,000 cfm. An example is an analog input to the DDC panel from an actuator with feedback
3. Provide at least one operator for each 16 square feet of damper, or for each length greater than 48".
4. Modulating electric actuators with adjustable end switches to prevent over stroking are acceptable in small dampers associated with unitary equipment like exhaust fans. Consult the District if exceptions are desired or in remodel projects where no instrument air compressor exists.
5. 4-20 mA, 24 vac or 0-10 vdc for electric. Do not use 24 vdc if the actuator position must be reported.
6. Fire dampers spring return to the fire alarm position upon power failure.
7. VAV box actuators: capable of permanent stall operation without damage. Adjustable stop pins for stroke limits. Drive gears of nickel steel, no plastic.

C. INDICATORS
1. Interface each indicator with remote sensor/controller to display measured value.
2. Supply selector switches for multiple indicators that show which variable is being measured.
3. Accurate and repeatable to ±0.5% of the measured variable's maximum value.
4. Electro mechanical device or panel mounted back screen display.
5. Indicators are not required for values that can be reported by the DDC system.

D. TRANSDUCERS
1. Electronic transducer: Accuracy ±1% of maximum value.
2. Fully adjustable (not fixed)0-25psi fixed range.
3. Approved manufacturers: Differential Pressure Transducer-Dwyer 629-03-CH-P2-E5-S1-Submit others to District for approval.

E. SENSORS
1. Temperature: 1K, 10K, 20K type 2 or 3 Thermistor or platinum RTD, Accuracy ±1°F. Do not use RTDs that require transmitters.
2. Differential Building Static pressure: vary output voltage linearly. Range: -0.1 to 0.1" W.C. with an accuracy of 2% of its range, repeatable to 0.5% of range.
3. Duct static pressure: vary output linearly. Range -1 to +4" W.C., accuracy 3% of range, repeatable within 1.5% of range.
4. Air velocity: linear indication of the velocity of air in a duct from 0 to 2000 FPM, Accuracy, ±50 FPM from which the central controller can calculate CFM.
5. Outdoor air temperature: Approved manufacturers: Mamac 205 F, high resistance change versus temperature change, designed for outdoor mounting insulated from the building on north facing wall and out of the sun, minimum range –20 to +110°F, accuracy ±1°F, repeatable within 1/2°F.
6. Room temperature: minimum range 50°F to 95°F, accuracy ±1°F, repeatable 1.5% of range.

7. Duct temperature: minimum range 32°F to 110°F, accuracy ±1°F, repeatable 1.5% of range. Use averaging elements, not bulbs.

8. Liquid temperature: insert in a pipe well and immerse in a substance designed to enhance heat transfer and rapid response. Minimum range 35°F to 220°F, 1% accuracy, repeatable within 1% of range.

F. MISCELLANEOUS DEVICES

1. Smoke detectors

2. Freeze Detection Thermostats (Freeze Stats):
    i. Line voltage liquid-filled type responsive only to the lowest temperature sensed along any one-foot length of its element.
    ii. Adjustable.
    iii. Auto reset.

3. Plastic laminate labels on all panels and major field devices screwed or riveted to the panel faces, no adhesives. Do not attach labels to replaceable devices or room thermostats or sensors. The definition of *major* is left to the consultant.

4. Flow Switches:
    i. Pressure differential type with SPDT contacts. Do not use paddle switches except where required to maintain a chiller or boiler warranty or where other devices would not work reliably. If in doubt, check with the District. The engineer must include a detail of paddle switch installation, if they are used, and assure that the contractor installs them according to manufacturer specification or PSD plumbing spec. Use McDonnell-Miller FS4-3 or approved equal.
    ii. Use current switches to prove low head pump flow where appropriate.

5. Wind dampening "weather head" on each atmospheric pressure sensing point; e.g., Dwyer A-306. Locate above wind eddies caused by the building structure and roof equipment.

6. Shielded cable on critical communication and sensor lines as recommended by the manufacturer or advised by the consultant.

7. Place thermostats or temperature control sensors inside locking transparent plastic covers (in common spaces, and in aluminum covers (Kele ATK04 for gyms) that discourage tampering and vandalism at all locations in Middle and High Schools. Not required in administration spaces, or anywhere in elementary schools except gyms. Use surface mounted sensors with digital display mounted on interior walls, installed with necessary insulation from wall.

8. Use adjustable CT switches on motors to provide fan status input points into the DDC panel.

9. Use adjustable CT on pump motors to provide pump status input points into the DDC

10. Humidity Transducer where applicable acceptable manufacturer: MamacHU-224-2

11. CO_2 sensors
    i. Return sensor acceptable manufacturer: Kele KCD-D
    ii. Room sensor acceptable manufacturer: Kele KCD-W

12. Relays for isolation of point and HOA control acceptable manufacturer: RIBU1S

Part 3: Execution

3.1 Preparation

3.2 Installation

A. The Controls Contractor is responsible for preassembling and installing panels and all hardware with his own employees, proving the system and training District people in its proper function and maintenance.

B. Wiring, conduit placement and the installing of actuators and related linkage may be subcontracted to a District approved installer but in this case the controls contractor shall label and connect all wiring terminations and be responsible for the subcontractor's work.

C. DEMONSTRATION AND TRAINING

1. 12 hours at each elementary or 18 hours at each middle or high school to demonstrate the controls to District personnel and answer questions.
2. Optionally 24 hours minimum of formal classroom training to District personnel in the theory, function and application of each hardware and software element and each component in the control system, plus 8 hours of telephone consultation.
3. The consultant shall confer with the District at the time of design to determine how much training will be required by the construction documents.

D. Control cabinets shall have
1. Accurately labeled terminal strips representative of the control drawings
2. Labeled wires to exterior devices and on interior cabinet wiring
3. Labeled relays, transformers and safeties
4. Controller labeled to corresponding device/s
5. GFI protected outlet for computer charging station
6. Power supply disconnect for the entire cabinet
7. Transformers to have a resettable overload
8. PSD freeze alarm relay to have points available to land to the PSD burglar alarm panel (landed by PSD personnel)
9. Properly sized wire tracking
10. Controllers need to have HOA's for ease of testing
11. Ethernet cable to be provided by PSD to meet IT spec (if required for Jace connection)
12. Jace controllers shall be Tridium 8000 unless otherwise approved by PSD (if a Jace enclosure), with no NDIO board attached to the Jace unless approved by PSD
13. See attached picture 1A

E. Plenum rated cable inside of plenums. Wiring suspended neatly from the overhead structure. Do not support on top of ceiling tiles. Minimum wire size, 18 AWG stranded.

F. Number or color code wiring terminals and provide a cross reference to ease later checkout and diagnosis.

G. Place exposed control wiring in conduit with proper identification.

H. Controllers above ceiling shall be in a PSD approved enclosure and approved location only when necessary

I. SENSORS
1. Surface mount with standard plastic covers with exposed knobs only in classrooms to permit a ±3° deviation from setpoint.
2. Install liquid temperature sensors inside of pipe wells with an appropriate heat transfer compound inside the well.

J. ACCESSIBILITY
1. Install all control devices in "Readily Accessible" locations not above any hard lid ceilings unless within 2 feet of the access hatch.
2. All devices (sensors, VAV controllers, remote controllers) accessible from a 6 ft ladder, or approved by PSD personnel
3. Above ceiling controllers shall be located on the equipment or as close to equipment as possible, to be approved and located by PSD personnel
4. Corresponding transformers shall be mounted on the outside of the controller enclosure with the wiring step down inside the enclosure
5. Sensor and controller locations to be labeled with adhesive labels on the drop ceiling grid, and identified on the construction drawings

3.3   Cleaning and Protection

END OF SECTION 25 00 00

SECTION 25 09 23 – DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

Part 1: General

1.1 Summary

    A. The need for computers and related software to be located outside the controlled building must be decided in conference with the District at the time of design of the new building or remodel. The consultant is required to consult the District prior to issuing the schematic design submittal.

    B. SCOPE

        1. Central DDC Panel.

    C. Software to monitor and control HVAC operations.

    D. The term *Central DDC Panel* refers in this document to the main DDC controller in the controlled building that acts as the hub for communication with individual equipment controllers holds most or all the control software, connects directly to the modem and resides in the Communications Room. Actual nomenclature will differ among manufacturers.

1.2 Related Sections

1.3 Definitions

1.4 Submittals

1.5 Quality Assurance

1.6 Scheduling

1.7 Delivery, Storage, and Handling

1.8 Regulatory Requirements

1.9 LEED Requirements

Part 2: Products

2.1 Manufactures

    A. Tridium Niagara N4

    B. Distech

    C. Honeywell Spyder

2.2 Products

    A. CENTRAL DDC PANEL

        1. Connect direct to field data points or individual equipment controllers.

        2. Electrically isolate and otherwise protected against voltage transients, sudden drops, spikes, and power surges unless this protection is provided to the DDC system from outside itself.

        3. Removable circuit boards and plug-in terminal for ease of servicing.

        4. Permit special global commands such as date, time of day, history, night setback, setpoint adjustments, or summer/winter setpoint changeover that will automatically apply to all subsidiary (individual equipment) controllers.

        5. 24 hours of battery backup with a programmed alarm after expiration of the recommended battery life to prompt replacement.

        6. If more than one panel is required to comprise the central DDC controller, seamlessly connect them such that they will be addressable as if only a single DDC controller were operating the system.

        7. Power connections

        8. NEMA 1 cabinet(s) assembled, furnished and installed by the Controls Contractor.

    B. House the microprocessor, communication interface, all controllers (except those required for individual equipment), relays, indicators, clocks, switches, pilot lights, override timers, etc. to allow quick access for adjustment and troubleshooting.

    C. CENTRAL DDC CONTROLLER SOFTWARE

        1. Multi-tasking menu driven in plain English. If programming code is used, eg, C or Pascal, provide

a translator or explanatory remarks in the code so that a user unfamiliar with programming codes can understand the program. An intelligent user shall be able to add, delete, or modify any control sequence, value, schedule or assignment without additional software or proficiency in a programming language.

2. Include but do not limit functions to:
   i. Universal inputs and outputs
   ii. Digital Inputs and outputs
   iii. Momentary Digital Outputs.
   iv. Accumulate Pulsed Inputs, eg, KW demand.
   v. Analog Inputs.
   vi. Analog Outputs with clamping.
   vii. Time Functions:
      a. Weekly clock: 24 hours, 8 days.
      b. Yearly clock: 365 days for holiday schedule.
   viii. demand limiting.
   ix. Control Functions.
   x. Analog to Digital Converter.
   xi. Math and Logic Functions:
      a. Add, Subtract, Multiply, Divide.
      b. Minimum, Maximum, Average.
      c. And, Or, Exclusive or.
      d. Not and, Nor, Exclusive nor.
      e. Square root.
      f. Absolute value.
      g. Sign value.
      h. Equal or not equal to.
      i. Exponentiation.
   xii. Accumulation Function:
      a. Run Time Totalization with automatic alarm and reset.
      b. Analog Integration with automatic alarm and reset.
   xiii. Alarm Functions:
      a. Digital, Analog and Hi/Lo settings and dead band.
      b. Conditional Alarms with If/Then/Else logic.
      c. Alarm Inhibiting.
      d. Fluttering Alarm Suppression.
      e. Customized Alarm Messages of at least 70 Characters.
      f. Auto dial of any alarm condition to the dumb Epson printer/modem combination or up to 5 phone numbers.
      g. Provide dry contact closures for up to seven alarms that can be wired by the owner to the security panel. Install a 1" conduit with a nylon pull line from the point where alarms are gathered to the security panel. (i.e. District freeze alarms)

3. Produce the necessary reverse acting or direct acting PID signals as required by the control sequence of the equipment being controlled.
4. Include self-diagnostic procedures for checking the LED digital displays (if any) and verify the integrity of the CPU memory and database.
5. Provide sequences to accommodate power failure, operate under emergency power and restart after power has been restored.
6. Compare up to 100 analog readings to preset high and low limits, unique to each data point, and annunciate each time a value exceeds a limit.
7. Where applicable assign each alarm points a return-to-normal dead band.

8. Any analog value resulting from a mathematical calculation shall be assignable as an alarm.
9. An alarm point can be inhibited by another digital point if desired. The condition of the digital point when the inhibit condition occurs can be operator programmed for either an open contact or a closed contact.
10. Provide time delays for alarms that are easily changed by the user.
11. Allow the operator to design, test, then implement desired ("What if") control strategies on-line without harming controlled equipment. Once satisfied with a control strategy, the user can release the controls to automatic and monitor the performance of the system.
12. Reports:
    i. Name: Returns all points with their assigned English names.
    ii. Type: Returns all points with their types such as analog or digital.
    iii. Address: Returns a list of controller addresses.
    iv. Status: Returns all points with a specific status; e.g., all zones in heating, all zones in cooling, all zones unoccupied, or all zones in manual override control.

       Value: Returns all points greater to, equal to or less than a specified value. For example lists all zones with a temperature greater than 76°F.
    v. History: Displays the history of a value over a specified time at specified intervals.
13. Allow "wild cards" or similar procedures to group points and functions.
14. Diagnostics:
    i. Capable of self-diagnosing without a query by an operator.
    ii. Alarm a power failure or a communication failure with any controller to the dumb Epson printer/modem via telephone. Repeat alarms at programmable intervals while the situation remains unattended and unacknowledged. Acknowledging and silencing alarms shall be a simple procedure from a remote PC or the central controller.
15. Password Security:
    i. Level 1—Proprietary: All functions available. Retained by the manufacturer and given to the District.
    ii. Level 2--Super: All functions available. May read or change passwords including but no higher than itself. Give to the District's project manager or mechanical engineer in a sealed envelope and do not reveal during training and demonstration sessions.
    iii. Level 3—Working: All functions available (Read, write and invoke). May read or change passwords including but no higher than itself. May be revealed during training and demonstrations.
    iv. Levels 4, 5 & 6: Functions assignable by higher passwords.
    v. Level 7: Read only does not allow invoke or write ability
16. To simplify error checking and reprogramming write software in logical groups or subroutines each serving one piece of equipment or an intuitive collection. Add nonfunctional remarks in the software to explain the function of each group and identify the equipment controlled. As much as possible reuse standard routines that have been proven effective by experience and duplicate them for identical equipment.

Part 3: Execution
3.1   Preparation
3.2   Installation
    A. Graphics are to be separate per unit, no relativized graphics permitted on PSD systems
    B. No subcontractors permitted for programming or graphic creation on PSD systems
    C. Programming contractor has standard programs, unique to PSD standardization practices that are adjusted as needed to fit the current control sequence
    D. Contractor uses an in house second person verification process to assure programs meet PSD standardization and can be readily edited and understood. This includes the points having alarms,

trends, graphics are all configured correctly

    E. Provide a printed and electronic copy of the final sequence of operations and a point assignment list to the PSD Building Automation Controls Department.

    F. Present 16 training hours in the proprietary software in addition to controls training required elsewhere. The consultant shall confer with the District prior to issuing construction documents to determine the amount of training desired.

3.3   Cleaning and Protection

END OF SECTION 25 09 23

SECTION 25 09 33 – ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

Part 1: General

1.1   Summary

    A. Electronic analog or direct digital automatic temperature controllers for individual HVAC equipment.

1.2   Related Sections

1.3   Definitions

1.4   Submittals

1.5   Quality Assurance

1.6   Scheduling

1.7   Delivery, Storage, and Handling

1.8   Regulatory Requirements

Part 2: Products

2.1   Manufactures

2.2   Products

    A. ALL INDIVIDUAL EQUIPMENT (APPLICATION SPECIFIC) CONTROLLERS

      1. Function independently on loss of communication with the central DDC controller.

      2. Capable of program changes or displaying data while in communication with:

        i. A portable computer plugged into the central DDC controller.

        ii. A remote computer via telephone modem through the central DDC controller.

      3. Locally adjustable address, setpoints and sensor scaling.

      4. Control by proportional, integral, derivative or combination.

      5. Proportional heating and cooling with adjustable dead band.

      6. Either 0 to 10 vdc or 4 to 20 mA proportional output (except VAV boxes).

      7. Internal switches (or software) for each output to change from direct to reverse acting.

    B. MAJOR EQUIPMENT CONTROLLERS

      1. Locally and centrally control each item of equipment such as an air handling unit, boiler, chiller or tower by a controller mounted on or near that piece of equipment. Preferably boiler plants or the chiller/tower combination may be operated from one controller or directly from the central DDC controller.

      2. Equipment requires separate controller/s NDIO to the Jace is not acceptable unless approved by PSD

      3. If not in the specification, PSD shall be consulted about required points for the equipment not listed

      4. Each individual equipment controller shall have the below listed data (as applicable) readable and command able at the individual equipment controller with the plug-in computer, at the central DDC controller or from a remote computer, as applicable. Design an EIA-232

communication bus or similar capability among major equipment controllers so that the foregoing is possible.

5. Percentage data readings must state percent open. NOTE: * = Read only
    i. Current building KW demand *.
    ii. Administration area cooling unit on or off.
    iii. Each air-handling unit:
        a. Supply fan on/off.
        b. Exhaust fan on/off.
        c. Outside air damper percent open.
        d. Return air damper percent open.
        e. Exhaust air damper percent open.
        f. Heating coil valve percent open.
        g. Cooling coil valve percent open.
        h. Discharge air pressure using the same pressure sensor used to set the inlet vanes.
        i. Inlet vane percent open.
        j. Discharge air temperature.
        k. Smoke detector alarm *.
        l. Freeze stat alarm *.
        m. Mixed air temperature.
        n. Return air temperature.
    iv. Outside air temperature using the sensor which resets heating water temperature*.
    v. Heating system:
        a. Each boiler on or off.
        b. Boiler pump on or off if applicable
        c. Heating water pumps on or off.
        d. Heating pump VFD speed if applicable
        e. Heating system differential pressure if applicable
        f. Combustion air damper position
        g. HWS DP setpoint and reading
        h. Heating water supply temperature.
        i. Heating water return temperature *.
        j. Boiler room temperature
        k. Alarm status *:
            1. No heating water flow.
            2. Flame failure
            3. Heating water temperature out of limits.
            4. PSD freeze alarm (below 100-degree HWS and below 30 degrees OAT)
    vi. Cooling system
        a. Chiller on or off.
        b. Chilled water supply temperature.
        c. Chilled water return temperature *.
        d. Chilled water pump on or off *.
        e. Cooling tower off, on low or high speed or VFD feedback *.
        f. Condenser water supply temperature.
        g. Condenser water return temperature *.
        h. Condenser water pump on or off *.
        i. Alarm status *:
            1. Chiller off when commanded on or chiller on when commanded off.
            2. No chilled water flow when needed.
            3. No condenser water flow when needed.

4. Report any other chiller alarm as a "Chiller General Alarm ~~Problem~~".

vii. Condenser Water System (cooling tower)
a. Cooling tower fan on or off
b. Cooling tower fan VFD feedback
c. Cooling water system pumps on or off
d. Cooling tower spray pump on or off
e. Cooling tower pump on or off
f. Condensed water supply temperature
g. Condensed water return temperature
h. Change over valve position if applicable
i. Alarm status
1. Cooling tower alarm
2. Vibration alarm if applicable
3. Water treatment alarm

viii. Heat pumps
a. Supply fan on or off
b. Supply air temp sensor
c. Supply air temp active DAT
d. Mixed air temp
e. Iso valve status
f. Compressor start stop
g. Compressor status
h. Reversing valve status
i. Safety status form the heat pump
j. Space temperature
k. Cooling set point
l. Heating set point
m. ERV serving the heating pump supply air temperature

ix. Energy recovery roof top unit
a. Supply fan on or off
b. Supply fan VFD speed
c. Exhaust fan on or off
d. Exhaust fan VFD speed
e. Evap cooling on or off if applicable
f. Evap leaving temperature
g. Exhaust air temperature before cooling section
h. Heat wheel on or off
i. Heat wheel leaving air temperature
j. Freeze stat status
k. Smoke detector status
l. Supply duct high limit status
m. Supply air temperature
n. Supply air temperature setpoint
o. Duct static pressure setpoint
p. Duct static pressure inches water column +/-.01
q. Supply air humidity percentage

x. Roof top unit with or without DX
a. Supply fan on/off.
b. Exhaust fan on/off.
c. Outside air damper percent open.

       d. Return air damper percent open.

       e. Exhaust air damper percent open.

       f. Heating coil valve percent open.

       g. Cooling coil valve percent open.

       h. Discharge air pressure using the same pressure sensor used to set the inlet vanes.

       i. Discharge air temperature.

       j. Smoke detector alarm *.

       k. Freeze stat alarm *.

       l. Mixed air temperature.

       m. Return air temperature.

       n. DX on or off if applicable

       o. DX cooling capacity if applicable

       p. Co2 return sensor if applicable

       q. Duct static pressure inches water column adjustable +/-.01

       r. Duct static setpoint

       s. Supply fan VFD speed if applicable

xi. Vertical unit ventilators VUV

       a. Supply fan on start or stop

       b. Supply fan speed if applicable

       c. Low limit status

       d. DX command on or off if applicable

       e. Mixed air damper position percent open if applicable

       f. Outside air damper position percent open if applicable

       g. Hot water valve position percentage open

       h. Chilled water valve position percentage open if applicable

       i. Supply air temperature

       j. Supply air temperature setpoint

       k. Exhaust fan on or off if applicable

       l. Outside air DX lock out set point if applicable

       m. Space temperature (read only)

       n. Motion off delay timer if applicable

xii. Fan coils

       a. Supply fan start or stop

       b. Supply fan status

       c. Supply air temperature

       d. Supply air temperature active DAT

       e. Lox limit or freeze stat status

       f. Hot water valve position percent open

       g. Mixed air temperature

       h. Mixed air damper position percent open

       i. Mixed air damper minimum position percent open

       j. Return air temperature

       k. Space temperature

       l. Active cooling set point

       m. Active heating set point

xiii.Exhaust fans

       a. Fan start or stop

       b. Fan status

       c. Fans on wall switches will have no alarms unless fan is for kitchen hoods

xiv.VAV BOX CONTROLLERS (if applicable)

a. Pressure independent control.
b. Separate adjustable heating, cooling, and fan maximum and minimum volume setpoints, if applicable.
c. Modulate the heating control valve (two-position valves are not permitted).
d. Each VAV box locally and centrally controlled by a single controller mounted accessible and near the box.
e. Readable and adjustable at each VAV box controller, the central DDC controller or from a remote computer:
f. Room heating setpoint temperature, occupied/unoccupied.
g. Room cooling setpoint temperature, occupied/unoccupied.
h. Maximum cooling velocity or cfm.
i. Minimum cooling velocity or cfm.
j. Minimum heating velocity or cfm.
k. Box fan on-off trip point (as applicable).
l. Actual supply air velocity or cfm (read only).
m. Box fan status (read only, if applicable).
n. Actual room temperature (read only).
o. Heating valve percent open.
p. Actual supply air temperature downstream of the heating coil (read only).
q. Active supply temperature setpoint with an override
r. Actual supply air temperature (RTU supply temperature) upstream of the VAV box (read for diagnostics only).

xv. IN-DUCT blower coil heating and cooling
a. Supply fan on or off
b. Supply air temperature setpoint
c. Supply air temperature
d. Chilled water valve percent open
e. Heating water valve percent open
f. Mixed damper position (percentage open if applicable)
g. Room temperature
h. Room cooling setpoint
i. Room heating setpoint
j. Motion sensor status if applicable
k. Motion sensor off delay time if applicable
l. Window switch status if applicable
m. Smoke damper position pulled to a chart for ease of review on the DDC system

xvi. IN-DUCT TERMINAL HEATING (or COOLING) CONTROLLERS (for constant volume systems)
a. Modulate the heating or cooling control valve (two-position valves are not permitted).
b. Each heating or cooling control valve locally and centrally controlled by a single controller mounted accessible and near the heating or cooling coil
c. Readable and adjustable at each controller, the central DDC controller or from a remote computer:
   1. Room heating setpoint temperature, occupied/unoccupied.
   2. Room cooling setpoint temperature, occupied/unoccupied.
   3. Actual room temperature (read only).
   4. Control valve percent open.
   5. Actual supply air temperature downstream of the coil (read only).
   6. Actual supply air temperature set point downstream of the coil

7. Actual supply air temperature upstream of the coil (read for diagnostics only).

    xvii.   Mode: Occupied, unoccupied, warmup *.

        a. Fan mode continuous or occupied where applicable (CPU labs)

C. BOILER PLANT CONTROLLER
1. Use the central DDC control panel to sequence the boilers and reset heating water temperature.
2. Use the central DDC outside air temperature sensor to reset heating water temperature. If a second one is provided for the boiler plant, it remains the consultant's responsibility to specify a location out of the sun and away from any other source of error-producing heat.
3. Follow the guidelines above for major equipment controllers.

D. COOLING PLANT OR DX CONTROLLER
1. The chiller/tower/pump combination will usually be supplied with a central controller factory designed to smoothly integrate with each component in the system and this is preferred. It is the Consultant's responsibility to ensure that between the DDC system and the cooling plant controller there are no gaps or overlaps. The DDC system will in most but not all cases be limited to enabling the cooling plant and reading water temperatures but in this case probably not starting pumps.
2. The DX controller will usually be part of the air handling unit controller but if not, a separate controller for the condensing unit will be required.
3. Follow the guidelines above for major equipment controllers.

E. INDIVIDUAL EQUIPMENT CONTROLLER SOFTWARE
1. Routinely report to the central DDC controller.
2. Continuously poll data for changes at minimum intervals of 100ms.
3. Continuously accumulate data pulses up to two per second.
4. Digital outputs in four forms; pulsed, sustained, pulse width modulated and binary staged closures.
    i. Pulsed closures: 200 milliseconds.
    ii. Keep sustained closures in the commanded state until receipt of a contrary command.
    iii. Vary pulse width modulation from 100ms to 255 seconds.
    iv. Permit up to 25 levels of staging, e.g., boiler modules.

Part 3: Execution
3.1   Preparation
3.2   Installation
    A. Locate each individual equipment controller near the equipment served (inside the building) and label its function.
3.3   Cleaning and Protection

END OF SECTION 25 09 33

SECTION 25 13 00 – INTEGRATED AUTOMATION CONTROL AND MONITORING NETWORK (DASHBOARDS)

Part 1: General
1.1   Summary
   A. Provide requirements that will ensure that *buildings* are constructed or altered in a way that will provide the capability for their energy use, production and reclamation to be measured, monitored and reported. This includes the design of energy distribution systems to isolate load types, the installation of or ability to install in the future *meters,* devices and a data acquisition system, and the installation of or the ability to provide for public displays and other appropriate reporting mechanisms in the future.
   B. All forms of energy delivered to the *building* and *building site*, produced on the *building site* or in the building and reclaimed at the *building site* or in the *building* shall be *metered* and all energy load types measured.
   C. The intent of these requirements is to provide for the ongoing metering, measuring, reporting and display of the energy use, energy demand and emissions associated with the energy use of the whole *building* and its systems
1.2   Related Sections
1.3   Definitions
1.4   Submittals Required
   A. Product Data:
   B. Samples:
1.5   Quality Assurance
1.6   Scheduling
1.7   Delivery, Storage, and Handling
1.8   Regulatory Requirements

Part 2: Products
2.1   Manufacturers
2.2   Products
   A. **Energy distribution design requirements and load type isolation.** Energy distribution systems within, on or adjacent to and serving a *building* shall be designed such that each primary circuit, panel, feeder, piping system or supply mechanism supplies only one energy use type as defined. The load type served by each supply mechanism shall be clearly designated with the use served, and adequate space shall be provided for installation of *metering* equipment or other data collection devices, temporary or permanent, to measure these loads. The energy distribution system shall be designed to facilitate the collection of data for each of the *building* energy use categories and for each of the end use categories listed. Where there are multiple *buildings* on a *building site,* each *building* shall comply separately.
      1. **Exception:** *Buildings* designed and constructed such that the total usage of each of the load types described shall be permitted to be measured using installed sub- *meters* or other equivalent methods as *approved*.
      2. **HVAC system total energy use.** This category shall include all energy used to heat, cool, and provide *ventilation* to the *building* including, but not limited to, fans, pumps, boiler energy, chiller energy and hot water.
      3. **Lighting system total energy use.** This category shall include all interior and exterior lighting used in occupant spaces and communal areas.
      4. **Energy used for building operations.** This category includes all energy use by vertical transportation systems, automatic doors, motorized shading systems, ornamental

fountains and *fireplaces*, swimming pools, snow-melt systems, and all other *building* operations.

5. **Miscellaneous loads.** Loads other than those specified.

B. **Energy type metering.** *Buildings* shall be provided with the capability to determine energy use and peak demand for each of the energy types. Utility energy *meters* shall be permitted to be used to collect whole *building* data, but, shall be equipped with a local data port connected to a data acquisition system.

1. **Gaseous fuels.** Gaseous fuels including, but not limited to, natural gas, LP gas, coal gas, hydrogen, landfill gas, digester gas and biogas shall be capable of being *metered* at the *building site* to determine the gross consumption and peak demand of each different gaseous fuel by the *building* and each *building* on a *building site*. The installation of gas *meters* and related piping shall be in accordance with the *International Fuel Gas Code*.

2. **Liquid fuels.** Liquid fuels including, but not limited, to fuel oil, petroleum based diesel, kerosene, gasoline, bio diesel, methanol, ethanol and butane shall be capable of being *metered* at the *building site* to allow a determination of the gross consumption and peak demand of each liquid fuel use by the *building* and each *building* on a *building site*. The installation of *meters* and related piping shall be in accordance with the *International Mechanical Code.*

3. **Solid fuels.** Solid fuels including, but not limited to coal, charcoal, peat, wood products, grains, and municipal waste shall have their use determined at the *building site* to allow a determination of the gross consumption and peak demand of each solid fuel use by the *building* and each *building* on a *building site*.

4. **Electric power.** Electric power shall be capable of being *metered* at the *building site* to allow a determination of the gross consumption and peak demand by the *building* and each *building* on a *building site.* The installation of electric *meters* and related wiring shall be in accordance with NFPA 70.

5. **District heating and cooling.** Hot water, steam, chilled water, and brine shall be capable of being *metered* at the *building site*, or where produced on the *building site*, to allow a determination of the gross consumption of heating and cooling energy by each *building* on a *building site*. Energy use associated with the production of hot water, steam, chilled water or brine shall be determined based on the fuel used.

6. **Combined heat and power.** Equipment and systems with a connected load greater than 125,000 *Btu*/hr providing combined heat and power (CHP) shall be capable of being *metered* to allow a determination of the gross consumption of each form of delivered energy to the equipment. The output of CHP shall be *metered* based on the form(s) of output from the CHP.

7. **Renewable and waste energy.** Equipment and systems providing energy from renewable or waste energy sources, or from which energy is included in the determination of the *building TANEU* shall be capable of being *metered* to allow a determination of the output of such equipment and systems.

   i. **Solar electric.** Equipment and systems providing electric power through conversion of solar energy directly to electric power shall be capable of being *metered* such that the peak electric power (kW) provided to the *building* and its systems or to off-site entities can be determined at 15-minute intervals and the amount of electric power (kWh) provided to the *building* and its systems can be determined at a minimum of hourly intervals.

   ii. **Solar thermal.** Equipment and systems providing heat to fluids or gases through the capture of solar energy shall be capable of being *metered* such that the peak thermal

energy (*Btu*/hr) provided to the *building* and its systems or to off-site entities can be determined at 15-minute intervals and the amount of heat captured (*Btu*) for delivery to the *building* and its systems can be determined at a minimum of hourly intervals.

    iii. **Waste heat.** Equipment and systems providing energy through the capture of waste heat shall be capable of being *metered* such that the amount of heat captured and delivered to the *building* and its systems can be determined at a minimum of hourly intervals.

    iv. **Wind Power Systems.** Equipment and systems providing electric power through conversion of wind energy directly to electric power shall be capable of being *metered* such that the peak electric power (kW) provided to the *building* and its systems or to off-site entities can be determined at 15-minute intervals and the amount of electric power (kWh) provided to the *building* and its systems can be determined at a minimum of hourly intervals.

    v. **Other renewable energy electric production systems.** Equipment and systems providing electric power through conversion of other forms of renewable energy directly to electric power shall be capable of being *metered* such that the peak electric power (kW) provided to the *building* and its systems or to off-site entities can be determined at 15-minute intervals and the amount of electric power (kWh) provided to the *building* and its systems can be determined at a minimum of hourly intervals.

C. **Energy load type sub-metering.** For buildings that are 25,000 square feet in total building floor area and larger, all the Energy Load Types as defined above shall be metered using sub-meters or other approved, equivalent methods.

    1. **Buildings less than 25,000 square feet.** For *buildings* that are less than 25,000 square feet in *total building floor area*, the energy distribution system shall be designed and constructed in such a way as to accommodate the future installation of sub-*meters* and other *approved* devices. This includes, but is not limited to, providing access to distribution lines and ensuring adequate space for the installation of sub-*meters* and other *approved* devices.

D. **Minimum energy measurement and verification.** *Meters* sub-*meters*, and other *approved* devices installed shall be connected to a data acquisition and management system capable of storing not less than 36 month's of data collected by all *meters* and other *approved* devices and transferring the data in real time to a display.

    1. **Annual emissions.** The data acquisition and management system shall provide the data necessary to calculate the annual *CO2e emissions* associated with the operation of the *building* and its systems using the results of annual energy use measured. The calculation shall be based on energy measured for each form of energy delivered to the site on an annual basis.

E. **Energy display.** A permanent, readily accessible and visible display shall be provided adjacent to the main *building* entrance or on a publicly available internet website. The display shall provide all the following:

    1. The current energy demand for the whole *building* level measurements, updated for each fuel type at the intervals specified above.

    2. The average and peak demands for the previous day and the same day the previous year,

    3. The total energy usage for the previous twelve (12) months.

Part 3: Execution

Part 2: Products
A. ALL INDIVIDUAL EQUIPMENT (APPLICATION SPECIFIC) CONTROLLERS
1. Function independently on loss of communication with the central DDC controller.
2. Capable of program changes or displaying data while in communication with:
    i.   A portable computer plugged into the central DDC controller.
    ii. A remote computer via telephone modem through the central DDC controller.
3. Locally adjustable address, setpoints and sensor scaling.
4. Control by proportional, integral, derivative or combination.
5. Proportional heating and cooling with adjustable dead band.
6. Either 0 to 10 vdc or 4 to 20 mA proportional output (except VAV boxes).
7. Internal switches (or software) for each output to change from direct to reverse acting.

B. MAJOR EQUIPMENT CONTROLLERS
1. Locally and centrally control each item of equipment such as an air handling unit, boiler, chiller or tower by a controller mounted on or near that piece of equipment. Preferably boiler plants or the chiller/tower combination may be operated from one controller or directly from the central DDC controller.
2. Equipment requires separate controller/s NDIO to the Jace is not acceptable unless approved by PSD
3. If not in the specification, PSD shall be consulted about required points for the equipment not listed
4. Each individual equipment controller shall have the below listed data (as applicable) readable and command able at the individual equipment controller with the plug-in computer, at the central DDC controller or from a remote computer, as applicable. Design an EIA-232 communication bus or similar capability among major equipment controllers so that the foregoing is possible.
5. Percentage data readings must state percent open. NOTE: * = Read only
    i.   Current building KW demand *.
    ii. Administration area cooling unit on or off.
    iii. Each air-handling unit:
         a. Supply fan on/off.
         b. Exhaust fan on/off.
         c. Outside air damper percent open.
         d. Return air damper percent open.
         e. Exhaust air damper percent open.
         f. Heating coil valve percent open.
         g. Cooling coil valve percent open.
         h. Discharge air pressure using the same pressure sensor used to set the inlet vanes.
         i. Inlet vane percent open.

        j. Discharge air temperature.

        k. Smoke detector alarm *.

        l. Freeze stat alarm *.

       m. Mixed air temperature.

        n. Return air temperature.

   iv. Outside air temperature using the sensor which resets heating water temperature*.

   v. Heating system:

        a. Each boiler on or off.

        b. Boiler pump on or off if applicable

        c. Heating water pumps on or off.

        d. Heating pump VFD speed if applicable

        e. Heating system differential pressure if applicable

        f. Combustion air damper position

        g. HWS DP setpoint and reading

        h. Heating water supply temperature.

        i. Heating water return temperature *.

        j. Boiler room temperature

        k. Alarm status *:

            1. No heating water flow.

            2. Flame failure

            3. Heating water temperature out of limits.

            4. PSD freeze alarm (below 100-degree HWS and below 30 degrees OAT)

   vi. Cooling system

        a. Chiller on or off.

        b. Chilled water supply temperature.

        c. Chilled water return temperature *.

        d. Chilled water pump on or off *.

        e. Cooling tower off, on low or high speed or VFD feedback *.

        f. Condenser water supply temperature.

        g. Condenser water return temperature *.

        h. Condenser water pump on or off *.

        i. Alarm status *:

            1. Chiller off when commanded on or chiller on when commanded off.

            2. No chilled water flow when needed.

            3. No condenser water flow when needed.

            4. Report any other chiller alarm as a "Chiller General Alarm ~~Problem~~".

   vii. Condenser Water System (cooling tower)

        a. Cooling tower fan on or off

        b. Cooling tower fan VFD feedback

        c. Cooling water system pumps on or off

        d. Cooling tower spray pump on or off

        e. Cooling tower pump on or off

        f. Condensed water supply temperature

        g. Condensed water return temperature

        h. Change over valve position if applicable

        i. Alarm status

            1. Cooling tower alarm

            2. Vibration alarm if applicable

            3. Water treatment alarm

   viii.   Heat pumps

a. Supply fan on or off
    b. Supply air temp sensor
    c. Supply air temp active DAT
    d. Mixed air temp
    e. Iso valve status
    f. Compressor start stop
    g. Compressor status
    h. Reversing valve status
    i. Safety status form the heat pump
    j. Space temperature
    k. Cooling set point
    l. Heating set point
    m. ERV serving the heating pump supply air temperature
  ix. Energy recovery roof top unit
    a. Supply fan on or off
    b. Supply fan VFD speed
    c. Exhaust fan on or off
    d. Exhaust fan VFD speed
    e. Evap cooling on or off if applicable
    f. Evap leaving temperature
    g. Exhaust air temperature before cooling section
    h. Heat wheel on or off
    i. Heat wheel leaving air temperature
    j. Freeze stat status
    k. Smoke detector status
    l. Supply duct high limit status
    m. Supply air temperature
    n. Supply air temperature setpoint
    o. Duct static pressure setpoint
    p. Duct static pressure inches water column +/-.01
    q. Supply air humidity percentage
  x. Roof top unit with or without DX
    a. Supply fan on/off.
    b. Exhaust fan on/off.
    c. Outside air damper percent open.
    d. Return air damper percent open.
    e. Exhaust air damper percent open.
    f. Heating coil valve percent open.
    g. Cooling coil valve percent open.
    h. Discharge air pressure using the same pressure sensor used to set the inlet vanes.
    i. Discharge air temperature.
    j. Smoke detector alarm *.
    k. Freeze stat alarm *.
    l. Mixed air temperature.
    m. Return air temperature.
    n. DX on or off if applicable
    o. DX cooling capacity if applicable
    p. Co2 return sensor if applicable
    q. Duct static pressure inches water column adjustable +/-.01
    r. Duct static setpoint

  s. Supply fan VFD speed if applicable

xi. Vertical unit ventilators VUV
- a. Supply fan on start or stop
- b. Supply fan speed if applicable
- c. Low limit status
- d. DX command on or off if applicable
- e. Mixed air damper position percent open if applicable
- f. Outside air damper position percent open if applicable
- g. Hot water valve position percentage open
- h. Chilled water valve position percentage open if applicable
- i. Supply air temperature
- j. Supply air temperature setpoint
- k. Exhaust fan on or off if applicable
- l. Outside air DX lock out set point if applicable
- m. Space temperature (read only)
- n. Motion off delay timer if applicable

xii. Fan coils
- a. Supply fan start or stop
- b. Supply fan status
- c. Supply air temperature
- d. Supply air temperature active DAT
- e. Lox limit or freeze stat status
- f. Hot water valve position percent open
- g. Mixed air temperature
- h. Mixed air damper position percent open
- i. Mixed air damper minimum position percent open
- j. Return air temperature
- k. Space temperature
- l. Active cooling set point
- m. Active heating set point

xiii. Exhaust fans
- a. Fan start or stop
- b. Fan status
- c. Fans on wall switches will have no alarms unless fan is for kitchen hoods

xiv. VAV BOX CONTROLLERS (if applicable)
- a. Pressure independent control.
- b. Separate adjustable heating, cooling, and fan maximum and minimum volume setpoints, if applicable.
- c. Modulate the heating control valve (two-position valves are not permitted).
- d. Each VAV box locally and centrally controlled by a single controller mounted accessible and near the box.
- e. Readable and adjustable at each VAV box controller, the central DDC controller or from a remote computer:
- f. Room heating setpoint temperature, occupied/unoccupied.
- g. Room cooling setpoint temperature, occupied/unoccupied.
- h. Maximum cooling velocity or cfm.
- i. Minimum cooling velocity or cfm.
- j. Minimum heating velocity or cfm.
- k. Box fan on-off trip point (as applicable).
- l. Actual supply air velocity or cfm (read only).

   m. Box fan status (read only, if applicable).

   n. Actual room temperature (read only).

   o. Heating valve percent open.

   p. Actual supply air temperature downstream of the heating coil (read only).

   q. Active supply temperature setpoint with an override

   r. Actual supply air temperature (RTU supply temperature) upstream of the VAV box (read for diagnostics only).

  xv. IN-DUCT blower coil heating and cooling

   a. Supply fan on or off

   b. Supply air temperature setpoint

   c. Supply air temperature

   d. Chilled water valve percent open

   e. Heating water valve percent open

   f. Mixed damper position (percentage open if applicable)

   g. Room temperature

   h. Room cooling setpoint

   i. Room heating setpoint

   j. Motion sensor status if applicable

   k. Motion sensor off delay time if applicable

   l. Window switch status if applicable

   m. Smoke damper position pulled to a chart for ease of review on the DDC system

  xvi. IN-DUCT TERMINAL HEATING (or COOLING) CONTROLLERS (for constant volume systems)

   a. Modulate the heating or cooling control valve (two-position valves are not permitted).

   b. Each heating or cooling control valve locally and centrally controlled by a single controller mounted accessible and near the heating or cooling coil

   c. Readable and adjustable at each controller, the central DDC controller or from a remote computer:

    1. Room heating setpoint temperature, occupied/unoccupied.

    2. Room cooling setpoint temperature, occupied/unoccupied.

    3. Actual room temperature (read only).

    4. Control valve percent open.

    5. Actual supply air temperature downstream of the coil (read only).

    6. Actual supply air temperature set point downstream of the coil

    7. Actual supply air temperature upstream of the coil (read for diagnostics only).

  xvii. Mode: Occupied, unoccupied, warmup *.

   a. Fan mode continuous or occupied where applicable (CPU labs)

C. BOILER PLANT CONTROLLER

 1. Use the central DDC control panel to sequence the boilers and reset heating water temperature.

 2. Use the central DDC outside air temperature sensor to reset heating water temperature. If a second one is provided for the boiler plant, it remains the consultant's responsibility to specify a location out of the sun and away from any other source of error-producing heat.

 3. Follow the guidelines above for major equipment controllers.

D. COOLING PLANT OR DX CONTROLLER

 1. The chiller/tower/pump combination will usually be supplied with a central controller factory designed to smoothly integrate with each component in the system and this is preferred. It is the Consultant's responsibility to ensure that between the DDC system and the cooling plant controller there are no gaps or overlaps. The DDC system will in most but not all cases be limited to enabling the cooling plant and reading water temperatures but in this case probably not

starting pumps.
2. The DX controller will usually be part of the air handling unit controller but if not, a separate controller for the condensing unit will be required.
3. Follow the guidelines above for major equipment controllers.

E. INDIVIDUAL EQUIPMENT CONTROLLER SOFTWARE
1. Routinely report to the central DDC controller.
2. Continuously poll data for changes at minimum intervals of 100ms.
3. Continuously accumulate data pulses up to two per second.
4. Digital outputs in four forms; pulsed, sustained, pulse width modulated and binary staged closures.
   i. Pulsed closures: 200 milliseconds.
   ii. Keep sustained closures in the commanded state until receipt of a contrary command.
   iii. Vary pulse width modulation from 100ms to 255 seconds.
   iv. Permit up to 25 levels of staging, e.g., boiler modules.

Part 3: Execution
3.4 Preparation
3.5 Installation
   A. Locate each individual equipment controller near the equipment served (inside the building) and label its function.
3.6 Cleaning and Protection

END OF SECTION 25 09 33

SECTION 25 13 00 – INTEGRATED AUTOMATION CONTROL AND MONITORING NETWORK (DASHBOARDS)

Part 1: General
1.9 Summary
   A. Provide requirements that will ensure that *buildings* are constructed or altered in a way that will provide the capability for their energy use, production and reclamation to be measured, monitored and reported. This includes the design of energy distribution systems to isolate load types, the installation of or ability to install in the future *meters,* devices and a data acquisition system, and the installation of or the ability to provide for public displays and other appropriate reporting mechanisms in the future.
   B. All forms of energy delivered to the *building* and *building site*, produced on the *building site* or in the building and reclaimed at the *building site* or in the *building* shall be *metered* and all energy load types measured.
   C. The intent of these requirements is to provide for the ongoing metering, measuring, reporting and display of the energy use, energy demand and emissions associated with the energy use of the whole *building* and its systems
1.10 Related Sections
1.11 Definitions
1.12 Submittals Required
   A. Product Data:
   B. Samples:
1.13 Quality Assurance
1.14 Scheduling
1.15 Delivery, Storage, and Handling
1.16 Regulatory Requirements

Part 2: Products
2.3 Manufacturers
2.4 Products
   A. **Energy distribution design requirements and load type isolation.** Energy distribution systems within, on or adjacent to and serving a *building* shall be designed such that each primary circuit, panel, feeder, piping system or supply mechanism supplies only one energy use type as defined. The load type served by each supply mechanism shall be clearly designated with the use served, and adequate space shall be provided for installation of *metering* equipment or other data collection devices, temporary or permanent, to measure these loads. The energy distribution system shall be designed to facilitate the collection of data for each of the *building* energy use categories and for each of the end use categories listed. Where there are multiple *buildings* on a *building site,* each *building* shall comply separately.
      1. **Exception:** *Buildings* designed and constructed such that the total usage of each of the load types described shall be permitted to be measured using installed sub- *meters* or other equivalent methods as *approved*.
      2. **HVAC system total energy use.** This category shall include all energy used to heat, cool, and provide *ventilation* to the *building* including, but not limited to, fans, pumps, boiler energy, chiller energy and hot water.
      3. **Lighting system total energy use.** This category shall include all interior and exterior lighting used in occupant spaces and communal areas.
      4. **Energy used for building operations.** This category includes all energy use by vertical transportation systems, automatic doors, motorized shading systems, ornamental

fountains and *fireplaces*, swimming pools, snow-melt systems, and all other *building* operations.

5. **Miscellaneous loads.** Loads other than those specified.

B. **Energy type metering.** *Buildings* shall be provided with the capability to determine energy use and peak demand for each of the energy types. Utility energy *meters* shall be permitted to be used to collect whole *building* data, but, shall be equipped with a local data port connected to a data acquisition system.

1. **Gaseous fuels.** Gaseous fuels including, but not limited to, natural gas, LP gas, coal gas, hydrogen, landfill gas, digester gas and biogas shall be capable of being *metered* at the *building site* to determine the gross consumption and peak demand of each different gaseous fuel by the *building* and each *building* on a *building site*. The installation of gas *meters* and related piping shall be in accordance with the *International Fuel Gas Code*.

2. **Liquid fuels.** Liquid fuels including, but not limited, to fuel oil, petroleum based diesel, kerosene, gasoline, bio diesel, methanol, ethanol and butane shall be capable of being *metered* at the *building site* to allow a determination of the gross consumption and peak demand of each liquid fuel use by the *building* and each *building* on a *building site*. The installation of *meters* and related piping shall be in accordance with the *International Mechanical Code.*

3. **Solid fuels.** Solid fuels including, but not limited to coal, charcoal, peat, wood products, grains, and municipal waste shall have their use determined at the *building site* to allow a determination of the gross consumption and peak demand of each solid fuel use by the *building* and each *building* on a *building site*.

4. **Electric power.** Electric power shall be capable of being *metered* at the *building site* to allow a determination of the gross consumption and peak demand by the *building* and each *building* on a *building site.* The installation of electric *meters* and related wiring shall be in accordance with NFPA 70.

5. **District heating and cooling.** Hot water, steam, chilled water, and brine shall be capable of being *metered* at the *building site*, or where produced on the *building site*, to allow a determination of the gross consumption of heating and cooling energy by each *building* on a *building site*. Energy use associated with the production of hot water, steam, chilled water or brine shall be determined based on the fuel used.

6. **Combined heat and power.** Equipment and systems with a connected load greater than 125,000 *Btu*/hr providing combined heat and power (CHP) shall be capable of being *metered* to allow a determination of the gross consumption of each form of delivered energy to the equipment. The output of CHP shall be *metered* based on the form(s) of output from the CHP.

7. **Renewable and waste energy.** Equipment and systems providing energy from renewable or waste energy sources, or from which energy is included in the determination of the *building TANEU* shall be capable of being *metered* to allow a determination of the output of such equipment and systems.

   i. **Solar electric.** Equipment and systems providing electric power through conversion of solar energy directly to electric power shall be capable of being *metered* such that the peak electric power (kW) provided to the *building* and its systems or to off-site entities can be determined at 15-minute intervals and the amount of electric power (kWh) provided to the *building* and its systems can be determined at a minimum of hourly intervals.

   ii. **Solar thermal.** Equipment and systems providing heat to fluids or gases through the capture of solar energy shall be capable of being *metered* such that the peak thermal

energy (*Btu*/hr) provided to the *building* and its systems or to off-site entities can be determined at 15-minute intervals and the amount of heat captured (*Btu*) for delivery to the *building* and its systems can be determined at a minimum of hourly intervals.

iii. **Waste heat.** Equipment and systems providing energy through the capture of waste heat shall be capable of being *metered* such that the amount of heat captured and delivered to the *building* and its systems can be determined at a minimum of hourly intervals.

iv. **Wind Power Systems.** Equipment and systems providing electric power through conversion of wind energy directly to electric power shall be capable of being *metered* such that the peak electric power (kW) provided to the *building* and its systems or to off-site entities can be determined at 15-minute intervals and the amount of electric power (kWh) provided to the *building* and its systems can be determined at a minimum of hourly intervals.

v. **Other renewable energy electric production systems.** Equipment and systems providing electric power through conversion of other forms of renewable energy directly to electric power shall be capable of being *metered* such that the peak electric power (kW) provided to the *building* and its systems or to off-site entities can be determined at 15-minute intervals and the amount of electric power (kWh) provided to the *building* and its systems can be determined at a minimum of hourly intervals.

C. **Energy load type sub-metering.** For buildings that are 25,000 square feet in total building floor area and larger, all the Energy Load Types as defined above shall be metered using sub-meters or other approved, equivalent methods.

   1. **Buildings less than 25,000 square feet.** For *buildings* that are less than 25,000 square feet in *total building floor area*, the energy distribution system shall be designed and constructed in such a way as to accommodate the future installation of sub-*meters* and other *approved* devices. This includes, but is not limited to, providing access to distribution lines and ensuring adequate space for the installation of sub-*meters* and other *approved* devices.

D. **Minimum energy measurement and verification.** *Meters* sub-*meters*, and other *approved* devices installed shall be connected to a data acquisition and management system capable of storing not less than 36 month's worth of data collected by all *meters* and other *approved* devices and transferring the data in real time to a display.

   1. **Annual emissions.** The data acquisition and management system shall provide the data necessary to calculate the annual *CO2e emissions* associated with the operation of the *building* and its systems using the results of annual energy use measured. The calculation shall be based on energy measured for each form of energy delivered to the site on an annual basis.

E. **Energy display.** A permanent, readily accessible and visible display shall be provided adjacent to the main *building* entrance or on a publicly available internet website. The display shall provide all the following:

   1. The current energy demand for the whole *building* level measurements, updated for each fuel type at the intervals specified above.
   2. The average and peak demands for the previous day and the same day the previous year,
   3. The total energy usage for the previous twelve (12) months.

Part 3: Execution

3.4   Preparation
3.5   Installation
3.6   Cleaning and Protection

END OF SECTION 25 13 00

Integrated Automation