Part II

Model Commissioning Plan
--Design Phase--

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Design Intent and Basis of Design
of Energy- and Comfort-Related Systems

Project: __________________________

Approved:

Name __________________________ Owner's Representative __________________________ Date __________

Name __________________________ Commissioning Authority __________________________ Date __________

Overview

Following are the primary areas related to energy use and comfort for which the design intent and basis of design should be defined. The design intent provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner, coming out of the programming and conceptual design phases. The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The format below merges the salient parts of the design intent and basis of design. The design intent evolves from more general descriptors during the conceptual design, to more specific descriptors during actual design, to in-depth and specific descriptors during the specifying stage, which are finalized during the as-built phase. As part of the design narrative, one-line CAD drawings shall be developed for the systems listed in the Design-Phase Commissioning Plan.

Under each area or building system is an outline of pertinent questions and data needed. Sequences of operation for all outlined dynamic systems and components should be clearly documented. Attaching equipment manufacturers’ sequences may acceptable, but will generally require additional narrative.

To the right of the heading for each section, the party responsible for providing the design intent is indicated, as is the phase of the design construction process during which design documentation should be established. Refer to the Instructions section, just previous in this Appendix for full instructions.

The following abbreviations are used:
### Contents

The following systems and issues are included in this document in this order:

1. General building design and function
   - Overview
   - Sustainable construction and environmental compatibility
   - Indoor environmental quality—thermal, air distribution, acoustics, air quality, visual quality
   - Landscaping
2. HVAC systems—General
   - Overview
   - Design conditions and load assumptions
3. Chiller system (chillers, cooling towers, pumps, piping)
4. Boiler and heating water system
5. Roof top packaged System, including all components
6. VAV terminal units (cooling only)
7. VAV terminal units (reheat)
8. Heat recovery unit
9. Computer room AC unit
10. Daylighting controls
11. Lighting sweep control
12. Building automation system
13. Split air conditioner or heat pump
14. Emergency power system

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**Model Commissioning Plan and Guide Specifications**

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Heading Format Used at the Beginning of Each Section:

X.X  Issue to be Documented  Responsible Party  When To Do It

1  General Building Design, Function, and Landscaping

1.1 General Building Design and Function  Architect  Design Dev

What are the general design objectives regarding energy efficiency?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Comfort and indoor environmental quality?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Sustainability and environmental compatibility?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Other:

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Sequences  Architect  Spec Dev

What are the main control sequences for the watering systems that ensure water conservation?

____________________________________________________________________________
____________________________________________________________________________

Maintenance  Architect  Spec Dev

Are there any special instructions as to the care of the landscape elements that will enhance or degrade their energy and comfort benefits? (refer to O&M manual sections, if applicable)

____________________________________________________________________________
____________________________________________________________________________

Model Commissioning Plan and Guide Specifications

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1.2 Sustainable Construction and Environmental Compatibility

**Design Intent**

What are the objectives regarding sustainability and environmental compatibility?

____________________________________________________________________________
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**Basis of Design**—General Description and Function

How will the building/grounds systems meet the design intent?

____________________________________________________________________________
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1.3 Indoor Environmental Quality

**Design Intent**

What are the general objectives for indoor environmental quality?

____________________________________________________________________________
____________________________________________________________________________
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____________________________________________________________________________

**Thermal Comfort**—General Description and Function

Record the occupant activity and design temperatures for the various spaces in Table 1.

**Air Distribution**

What issues were considered in choosing diffusers?

____________________________________________________________________________

Is the return air (RA) ducted of open-plenum? Why?

____________________________________________________________________________

Are the RA grills in every room? Why?

____________________________________________________________________________
What special considerations are being given to spaces with high solar load regarding cooling, large glazed areas, cold-air convective drafts, etc.? What solutions were used?

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Acoustics

Mech Engr Const Doc

What is the design NC (noise criteria) sound level? Provide this information in Table 1. Are there any special acoustical considerations for any areas (areas close to the AHU, private areas, open office areas, etc.)? How will this criteria be met? (flexible duct, duct lining, fan type, lead wraps, diffuser type, TU damper type, etc.)

Noise class (NC) 35-40 for closed offices and 41-43 for open offices, recommended by ASHRAE

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Air Quality

Mech Engr Const Doc

For the general building and individual spaces, what is the desired outside air fraction or cfm per person and the number of persons per square foot? (Provide this information in Table 1). Is the outside air (OSA) controlled by CO2 monitors? Explain.

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Can occupants adjust ventilation? How and what limits apply to what areas?

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Are there any special indoor pollutant source concentrations? How are they handled? List areas served by exhaust fans, the fan size, air changes per hour and operational control.

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

How will the fresh air rate be maintained at low supply air volumes of the VAV system? Are perimeter zones treated differently than interior zones (reheat box damper settings, etc.)?

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Where are the outside air intakes located? Are they near any potential sources of pollutants?
Are full-drain condensate pans used in the air handler units?  ☐ Yes / ☐ No

What other special IAQ issues were considered?

____________________________________________________________________________
____________________________________________________________________________

**Visual Quality**  Arch, Ltg Des,  Design Dev

What are the design footcandle levels for the various spaces? (Provide this information in Table 1). Why? Is additional task lighting assumed?

____________________________________________________________________________
____________________________________________________________________________

Do any spaces have special glare requirements?  ☐ Yes / ☐ No

How will they be met? (special light fixtures and lenses, fixture layout, special CRT screens, etc.)

____________________________________________________________________________
____________________________________________________________________________

How will glare be controlled in daylit areas?

____________________________________________________________________________
____________________________________________________________________________

What are the parameters and sequences of operation for the daylighting controls and dimming lights? How will occupants interact with the system (overrides, education, etc.)?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

**1.4 Landscaping**  Architect  Design Dev

**Design Intent**

Describe the objectives and the elements of the specific landscape design that contribute to energy efficiency, water conservation, and comfort?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

*Number of sheets attached to this section: _____*
1.5 **Interior Conditions Basis of Design**

Table 1

Reception, records, conference room, closed offices, open offices, exercise room, lunch room, inventory, stock, etc.

<table>
<thead>
<tr>
<th>Space</th>
<th>Use / Activity</th>
<th>Occupant Type</th>
<th>Num of Occs</th>
<th>Operating Hours per Day</th>
<th>Design Cooling DB</th>
<th>Design Heating DB OSAT</th>
<th>OSA CFM / Person or CO2</th>
<th>Design Noise Level (NC)</th>
<th>Design Light Level (FC)</th>
<th>Special Pressure Relationship (note)</th>
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</table>
2 HVAC Systems and Design Parameters

2.1 General

Mech Engr
Design Dev

General description of the main HVAC systems and areas served.

<table>
<thead>
<tr>
<th>System</th>
<th>Areas Served</th>
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Why were the above particular systems chosen?

____________________________________________________________________________
____________________________________________________________________________
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Describe the level of priority given to energy conservations for the system.

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

2.2 Specific System Descriptions

Mech Engr
Const Doc

<table>
<thead>
<tr>
<th>System</th>
<th>Heating / Cooling / Both</th>
<th>Areas Served</th>
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</table>
What is the rationale for the way the HVAC and lighting were zoned?
____________________________________________________________________________
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2.3 Load Calculations

What outdoor design conditions were assumed for load calculations?
Summer: DB_____ WB_____ Winter: DB_____
What indoor design conditions were assumed for load calculations?
Summer: DB_____ RH_____ Winter: DB_____ RH_____
People/100 sf: _____ Btu/hr/person: sensible _____, latent _____
Ventilation: _____cfm/person. Basis (code, etc.): ____________________________
Infiltration: □ _____cf/sf wall area, or □ _____ air changes per hour.

Glazing:

<table>
<thead>
<tr>
<th>Orientation</th>
<th>% of Wall Area</th>
<th>Overall U</th>
<th>SC</th>
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</table>

What overall safety factor was used and how much diversity was assumed for the heating, cooling plant and fan size?
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

For redundant equipment, what redundancy criteria were used?
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Number of sheets attached to this section: _____
3 Chiller System (Chillers, Cooling Towers, Pumps, Piping)

3.1 Design Intent

What is this chiller system used for? ☐ Supplies chilled water to air handler units to cool building space. ☐ Computer room AC units. ☐ Process chilled water
☐ Heat recovery for: __________________________________________________________
Other: ______________________________________________________________________

What areas of the building do the chillers serve? ___________________________________
____________________________________________________________________________

List the areas that the chillers do not serve? _________________________________________
____________________________________________________________________________

What types of air conditioning equipment serve the areas not served by the chillers?_________
____________________________________________________________________________

What vibration and noise considerations are given to the location of the chillers? ___________
____________________________________________________________________________

What energy efficiency objectives are there for the chiller system? ☐ Highly efficient,
☐ Moderately efficient, ☐ Standard efficiency

What level of automatic control features are desired for this chiller system relative to automatic staging, optimization, central building automation system monitoring and control capabilities, etc.? ☐ Highly automated, ☐ Moderately automated, ☐ Minimally automated

What type of refrigerant will be used and why? ________________________________________
____________________________________________________________________________

3.2 Basis of Design—Components Description and Methods for Meeting Design Intent

Chillers

Briefly describe the chiller system.
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
Part II. Model Commissioning Plan—Design Phase
Appendix 1. Design Documentation Form

☐ Centrifugal  ☐ Screw
☐ Hermetically sealed
☐ Heat recovery
☐ Refrigerant type: __________
☐ Air cooled  ☐ Water cooled
☐ Evaporative cooled
☐ Capacity control type:
☐ Prerotation vanes
☐ Other: ____________________

☐ Reciprocating chiller
☐ Heat recovery
☐ Refrigerant type: __________
☐ Air cooled  ☐ Water cooled
☐ Evaporative cooled
☐ Stages of unloading: __________
☐ Other: ____________________

How many chillers of each size are there? (size and number of each size): ______________
____________________________________________________________________________

Is there a standby / redundant chiller during design conditions? ______

Are there isolation valves for when only one chiller is running? ________________________

What method was used for determining the design cooling load? ________________________
____________________________________________________________________________

Attach load calculations and assumptions, if not given in a previous section. (Diversity, safety factor, outdoor DB, WB, indoor DB, lighting W/sf, plug loads W/sf, people/100 sf, ventilation cfm/person, infiltration rate, glazing % of wall, overall U; SC).

Describe any provisions in the chiller system for accommodating future building or load expansion.
____________________________________________________________________________
____________________________________________________________________________

What evidence can be provided to show the chillers are not oversized? __________________
____________________________________________________________________________

Why were they chosen to be different or equal size? _________________________________
____________________________________________________________________________

Was variable compressor speed seriously considered? If not, why not? ______________
____________________________________________________________________________

Was heat recovery for the chiller analyzed? ________ Why or why not? ______________
____________________________________________________________________________

What were the results of the analysis? _____________________________________________
____________________________________________________________________________

What vibration and noise considerations are given to the model and features of the chosen chillers? _______________________________________________________________________

____________________________________________________________________________

What is the rated efficiency of each chiller at full load and the APLV, in kW/ton? __________
____________________________________________________________________________
What rationale was used to select these efficiencies with the sizes? Were more efficient models analyzed?

___________________________________________________________

___________________________________________________________

___________________________________________________________

Attach engineering or energy simulation and economic calculations for the selections.

Are the chillers intended to be staged back and forth, depending on load, to minimize energy use?

Will staging occur manually or automatically?

What special control strategies will be employed with the chiller system?

___________________________________________________________

___________________________________________________________

___________________________________________________________

What controls will be in place to allow the lowest economical entering condenser water temperature to be realized? What other options were considered besides this strategy?

___________________________________________________________

___________________________________________________________

Fully describe the interface that the building automation system has with the chiller system:

___________________________________________________________

___________________________________________________________

___________________________________________________________

What control will the building automation system (BAS) have over the chiller system?

- BAS enables/disables the chiller,
- assigns the lead chiller,
- assigns the lead primary chilled water pump,
- assigns the lead secondary chilled water pump,
- assigns the lead condenser pump,
- assigns the lead cooling tower

The BAS monitors the following:

- LCHWT,
- RCHWT,
- ECDWT,
- LCDWT,
- CDW flow,
- CHW primary flow,
- Secondary CHW flow,
- Cooling tower bypass valve,
- Chiller alarms that report to BAS (list):

- Other

The BAS can change the following:

- LCHWT setpoint,
- Reset parameters,
- ECDWT setpoint,
- Cooling tower fan staging parameters,
- Chilled water pumping pressure setpoints,
- Pressure reset parameters,
- Demand limits,
- Other
### Cooling Tower

**Mech Engr**

**Const Doc**

Describe the cooling tower (cross flow, counterflow, etc.)

What are the sizes of the cooling towers?

What is the approach temperature rating of the cooling tower?

Why was a lower approach not chosen?

Attach energy and economic analyses.

Were oversized cooling towers analyzed to improve chiller efficiency? Why or why not?

Attach analysis.

How many motors are there per tower fan?

Are the motors premium efficiency?

How is the fan speed controlled?

How do the sizes of the chillers affect the sizes of the cooling towers selected? Are they paired?

Can two cooling towers serve one chiller?

How are the cooling towers staged?

Will condenser water flows be monitored? If not, explain why.

Will the cooling tower be used in winter? Why?

---

### Air or Evaporative Cooled Condenser

**Mech Engr**

**Const Doc**

- [ ] Air cooled
- [ ] Evaporative cooled

Why was an air-cooled condenser chosen over a cooling tower?
Why was an air-cooled condenser chosen over an evaporative condenser? ________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Describe main features of the condensers and the chillers they serve. ____________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Were more efficient models analyzed? (attach analysis) ________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Describe the staging features __________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

---

**Chilled and Condenser Water Pumps and Piping**

What pressure drop range was the piping system designed to:

- [ ] Very low pressure drop,
- [ ] Moderately low pressure drop,
- [ ] Standard pressure drop.

Was an analysis performed for using a lower pressure drop to reduce pump size and energy use? ____________________________________________________________________________________ Attach analysis. How were pipe losses determined? ___rule of thumb, ___detailed take-off and calculation, ___other.

Are pipe circuits designed to be close to being self-balanced proportionally, to minimize the restriction (head loss) of balancing valves and circuit setters?

Describe the pumps chosen. Primary: ______________________________________________________
____________________________________________________________________________________
Secondary: ____________________________________________________________________________
____________________________________________________________________________________
Condenser pumps _______________________________________________________________________
____________________________________________________________________________________

Are they equipped with premium energy-efficient motors? ________________________________
Why or why not? ______________________________________________________________________

How large of safety factor was used in the pump sizing? _________________________________
What was the over-sizing rationale for the pumps? [ ] Potential system expansion, [ ] Safety factor,
[ ] Both of above.

ASHRAE 90.1 doesn’t allow flow throttling with a balancing valve more than 3 hp. Will this system comply? __________________________________________________________

Would a more detailed head loss calculation likely result in a smaller safety factor and pump?

Describe any standby or redundant pumps and their operation. ______________________________
____________________________________________________________________________________
____________________________________________________________________________________
Will the control sequences allow for automatic changeover to the lag or standby pump upon pump failure and similarly for cooling tower fan failure or will manual valving be required? Upon failure, does the lag pump or tower start or does the chiller go down and lag chiller start. Explain fully for each:

Primary chilled water pumps: ____________________________________________________

Secondary chilled water pumps: __________________________________________________

Condenser water pumps: ________________________________________________________

Cooling tower fans:____________________________________________________________

How is the secondary chilled water capacity controlled? □ Variable speed drives (VFD) on pumps, □ Bypass valve. If by bypass valve, explain the rationale for not using variable speed drives and attach the economic analysis. ___________________________________________

For VFD’s, how will the pump speed be controlled? □ Constant water pressure setpoint, □ Reset water pressure setpoint. If the pressure is not reset, why not?____________________

For a VFD on pressure reset, how low of speed will the pump be allowed to go? Is this as low as possible? Explain._____________________________________________________

Will chilled water flows be monitored? □ Primary flow, □ Secondary flow. If not, explain. _

### Integration of Control and Monitoring Points With the BAS

<table>
<thead>
<tr>
<th>Chiller Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
<th>Chiller Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
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Chiller System Sequence of Operations and Operating Parameters

Attach a full and comprehensive sequence of operations, including but not limited to the following conditions and systems, including all interactions:

Chiller, Cooling Tower and Pumps

- List parameter conditions that initiate start-up.
- Provide a detailed narrative of the full sequence and status and action of EACH component during EACH stage of start-up: low load, medium load, high load, staging to next chiller, up to full load on all chillers, and then back down again to OFF condition. List all setpoints, delays, parameters, conditions, etc., that are required to pass through each stage. The components for which status will be given at each stage are: chiller stage and load, primary, secondary and condenser pump status, speed and flow, cooling tower stage, cooling tower bypass valve, cooling tower fans and speed, pipe pressures and setpoint resets.

Describe the sequences for the following:
- Chiller optimization staging.
- Temperature lockouts.
- Status and sequence at power outage and fire alarm.
- Effects of manual shutoff or failure of chiller, primary pump and secondary pump, condenser pump, cooling tower fan, vibration alarm.
- List all alarms.
- Include full sequences and setpoints for capacity and pressure control of the secondary chilled water system.
- Include full sequences and setpoints for condenser water temperature control and cooling tower fan control parameters.
- Cooling tower sump heater sequences, parameters and setpoints.
- List the full sequence of operation for all energy conserving strategies, including their setpoints and parameters.
- Weekend operation.
- Normal occupied and unoccupied modes.
Equipment manufacturers’ sequences and control drawings may be included, but will generally require additional narrative. Flow charts may be used if sufficiently detailed. Narrative and flow chart examples are found in Section 4 of the instructions.

For the chiller, cooling tower and pumps, the sequences are expected to be about five single-spaced, typewritten pages.

Number of sheets attached to this section: ______
4 Boilers and Heating Water System

4.1 Design Intent

**Hot Water.** What is this heating water system used for? □ Supplies hot water to air handler units to ___ heat building space, ___ preheat incoming cold air. □ Supplies hot water to ___ perimeter VAV reheat terminal units, ___ core VAV reheat terminal units.

**Steam.** What is the steam used for? □ Supplied to air handler units to ___ heat building space, ___ preheat incoming cold air. □ Supplies hot water to ___ perimeter, ___ core VAV reheat terminal units. □ Is converted to hot water in a converter before being used by the building.

Other: ______________________________________________________________

What areas of the building do the boilers serve? ______________________________________________________________

List the areas that the boilers do not serve? ______________________________________________________________

What types of heating equipment serve the areas not served by the boilers? ____________________________

What vibration and noise considerations are given to the location of the boilers? ____________________________

What energy efficiency objectives are there for the boiler system? □ Highly efficient, □ Moderately efficient, □ Standard efficiency

What level of automatic control features are desired for this boiler system relative to automatic staging, optimization, central building automation system monitoring and control capabilities, etc.? □ Highly automated, □ Moderately automated, □ Minimally automated

What type of fuel will be used and why? □ Natural gas, □ Fuel oil, □ Other _________________

4.2 Basis of Design—Components Description and Methods for Meeting Design Intent

**Boilers**

The boiler is a □ Condensing, □ Forced draft, □ Atmospheric burner, □ Packaged, □ Other:

Briefly describe the boiler system.

______________________________________________________________________________________________

How many boilers of each size and type are there? (list number and size): ____________________________

Is there a standby / redundant boiler during design conditions? ______
What method was used for determining the design heating load? ________________________
____________________________________________________________________________

Attach load calculations and assumptions, if not given in a previous section. (Diversity, safety factor, outdoor DB, WB, indoor DB, lighting W/sf, plug loads W/sf, people/100 sf, ventilation cfm/person, infiltration rate, glazing % of wall, overall U; SC).

Describe any provisions in the boiler system for accommodating future building or load expansion.
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

What evidence can be provided to show that the boilers are not oversized? ______________
____________________________________________________________________________
____________________________________________________________________________

Why were they chosen to be different or equal size? _________________________________
____________________________________________________________________________
____________________________________________________________________________

What vibration and noise considerations are given to the model and features of the chosen boilers? _____________________________________________________________________
____________________________________________________________________________

How many total stages of capacity does each boiler have? (burner beds and stages of fire)____

What is the rated efficiency of each boiler? _________________________________________
____________________________________________________________________________
____________________________________________________________________________

What rationale was used to select these efficiencies with the sizes? Were more efficient models analyzed?____________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Attach engineering or energy simulation and economic calculations for the selections.
Are the boilers intended to be staged back and forth, depending on load, to minimize energy use?
____________________________________________________________________________

Will this be done manually or automatically? _______________________________________
____________________________________________________________________________

What special control strategies will be employed with the boiler system?__________________
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Part II. Model Commissioning Plan—Design Phase
Appendix 1. Design Documentation Form

Fully describe the interface that the building automation system has with the boiler system:
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

What control will the building automation system (BAS) have over the boiler system?
☐ BAS enables/disables the boiler, ☐ assigns the lead boiler, ☐ assigns the lead primary boiler pump, ☐ assigns the lead secondary boiler water pump.

The BAS monitors the following:
☐ boiler alarm status, ☐ pump status, ☐ internal water temperature, ☐ steam pressure, ☐ HW primary flow, ☐ secondary HW flow, ☐ three-way mixing valve, ☐ boiler alarms that report to BAS (list):
____________________________________________________________________________
____________________________________________________________________________

Other _______________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

The BAS can change the following:
☐ LHWT setpoint, ☐ Reset parameters, ☐ Boiler water pumping pressure setpoints, ☐ Pressure reset parameters, ☐ Demand limits, ☐ Other ______
____________________________________________________________________________
____________________________________________________________________________

Will the boilers have low water cutout controls? _____________________________________

4.3 Heating Water Pumps and Piping  Mech Engr  Const Doc

What pressure drop range was the piping system designed to:
☐ Very low pressure drop, ☐ Moderately low pressure drop, ☐ Standard pressure drop. Was an analysis performed for using a lower pressure drop to reduce pump size and energy use? Attach analysis. How were pipe losses determined? ___rule of thumb, ___detailed take-off and calculation, ___other.

Are pipe circuits designed to be close to being self-balanced proportionally, to minimize the restriction (head loss) of balancing valves and circuit setters?
Describe the pumps chosen. Primary: _____________________________________________
____________________________________________________________________________
Secondary:___________________________________________________________________
____________________________________________________________________________

Are they equipped with premium energy-efficient motors?___________________________
Why or why not?

How large of safety factor was used in the pump sizing? _________________________ What was the over-sizing rationale for the pumps? ☐ Potential system expansion, ☐ Safety factor, ☐ Both of above.

ASHRAE 90.1 doesn’t allow flow throttling with a balancing valve more than 3 hp. Will this system comply?
Would a more detailed head loss calculation likely result in a smaller safety factor and pump?
___________________________________________________________________________

Describe any standby or redundant pumps and their operation. ________________________________
____________________________________________________________________________
____________________________________________________________________________

Will the control sequences allow for automatic changeover to the lag or standby pump upon pump failure or will manual valving be required? Explain fully.
____________________________________________________________________________

Primary heating water pumps: ___________________________________________________
____________________________________________________________________________

Secondary heating water pumps: _________________________________________________
____________________________________________________________________________

How is the secondary heating water capacity controlled? ☐ Variable speed drives (VFD) on pumps, ☐ Bypass valve(s). If by bypass valves, explain the rationale for not using variable speed drives and attach the economic analysis. ________________________________
____________________________________________________________________________

For VFD’s, how will the pump speed be controlled? ☐ Constant water pressure setpoint, ☐ Reset water pressure setpoint. If the pressure is not reset, why not? ________________________________
____________________________________________________________________________

For a VFD on pressure reset, how low of speed will the pump be allowed to go? Is this as low as possible? Explain. ________________________________
____________________________________________________________________________

Will heating water flows be monitored? ☐ Primary flow, ☐ Secondary flow. If not, explain. ________________________________
____________________________________________________________________________

How is supply water temperature controlled? ☐ 3-way mixing valve, ☐ Other _____________
____________________________________________________________________________

<table>
<thead>
<tr>
<th>Boiler Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
<th>Boiler Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>
4.4 Boiler System Sequence of Operations and Operating Parameters

Attach a full and comprehensive sequence of operations, including but not limited to the following conditions and systems, including all interactions:

- List parameter conditions that initiate start-up.
- Provide a detailed narrative of the full sequence and status and action of EACH component during EACH stage of start-up: low load, medium load, high load, staging to next boiler, up to full load on all boilers, and then back down again to OFF condition. List all setpoints, delays, parameters, lockouts, conditions, etc., that are required to pass through each stage. The components for which status will be given at each stage are: boiler stage and load, primary, secondary pump status, speed and flow, pipe pressures and setpoint resets.

Describe the sequences for the following:

- Boiler optimization staging.
- Temperature lockouts.
- Status and sequence at power outage and fire alarm.
- Effects of manual shutoff or failure of boiler, primary pump and secondary pump.
- List all alarms.
- Include full sequences and setpoints for capacity and pressure control of the secondary heating water system.
- List the full sequence of operation for all energy conserving strategies, including their setpoints and parameters.
- Weekend operation.
- Normal occupied and unoccupied modes.
- Warm-up mode

Equipment manufacturers’ sequences and control drawings may be included, but will generally require additional narrative. Flow charts may be used if sufficiently detailed. Narrative and flow chart examples are found in Section 4 of the instructions.

For the boiler and pumps, the sequences are expected to be about _____ single spaced, typewritten pages.
Number of sheets attached to this section: ______
5 Roof Top Packaged System(s) (RTU)

5.1 Design Intent

What is this system or component used for?

<table>
<thead>
<tr>
<th>Systems Description</th>
<th>Mech Engr</th>
<th>Const Doc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Briefly describe the system:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Heat pump</td>
<td>☐ Steam</td>
<td></td>
</tr>
<tr>
<td>☐ Gas pack</td>
<td>☐ Constant volume</td>
<td></td>
</tr>
<tr>
<td>☐ AC only</td>
<td>☐ Dual duct</td>
<td></td>
</tr>
<tr>
<td>☐ Resistance coil</td>
<td>☐ Multizone</td>
<td></td>
</tr>
<tr>
<td>☐ Hot water</td>
<td>☐ Other</td>
<td></td>
</tr>
<tr>
<td>☐ VAV</td>
<td>☐ Other</td>
<td></td>
</tr>
<tr>
<td>List equipment and areas served:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2 Basis of Design—Components Description and Methods for Meeting the Design Intent

Give size, quantity, and other specific information and the areas served, and how it will meet the objectives.

**Plant**

Number of units of this type: _____  EER (cooling): _____  Tons cooling each unit:_____
Accumulated capacity for all units of this type:  Total tons cooling: ______
MBtu heating: ____________  Heat Pump COP: _____  Gas efficiency: _____
Areas served: ________________________________________________________________

**Supply Fans and Capacity Control**

Total CFM for packaged systems of this type: __________
☐ Inlet vanes  ☐ VFD  ☐ Vane axial  ☐ Outlet damper  ☐ Other: ________________
Motor efficiency: ____Std. effic.,  ____Premium effic.

**Return Fans / Exhaust Fans / Relief Dampers**

Describe return fans, exhaust fans, or relief dampers, if any, and their function.

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________
Describe how building static pressure is controlled (setpoints, etc.). ______________________
____________________________________________________________________________
____________________________________________________________________________

**VFD control:**

Which fans does each VFD control?  ☐ Supply  ☐ Return/Exhaust

Location of duct static-pressure sensor (distance from fan and proximity from branch takeoffs up and down stream): __________________________________________________________

Duct static pressure:  ☐ Fixed setpoint /  ☐ Reset or variable

Expected duct static pressure setpoint (or average if reset): ______________________

Total pressure across fan at design flow: _________[discharge pressure - suction pressure (negative)]

Minimum fan capacity (lower frequency limit setting in VFD, % of max.) ____________

Are VFD settings ☐ monitored or ☐ controlled by the BAS system? (check one)

Method used for sizing ducts _____equal friction _____static regain

Note: Equal friction gives smaller ducts and higher pressure requirements. If equal friction was used, was a calculation made to make sure the increased pressure and subsequent increase in energy use by the fan is more than offset by the savings in duct materials?_________

**Compressor(s)**

Number of compressors per RTU: _______. Low ambient compressor package? ____

Number of condenser fans per RTU: ________. Locked out during morning warmup? _____

Compressor capacity control; general description:
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

**Cooling coil**

Provide general description and any special features (high efficiency, face velocity, low pressure drop, etc.). Was a low pressure drop coil analyzed? What were the results?
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

**Dampers**

Describe the dampers and their function. ______________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
Smoke and Fire Dampers
Describe the smoke and fire damper system (location and operation).

Setpoint Temperatures
Supply air (SA): _____  SA reset (see strategy sequence): _____  Mixed air: _____

Filters
Provide general description and any special features (low pressure drop, etc.). Were low pressure drop filters analyzed? What were the results?

Heating System
Describe type, fuel, perimeter reheat, areas served, etc.

Economizer and OSA Dampers
☐ Enthalpy  ☐ Dry Bulb  ☐ Integrated  ☐ Economizer is first stage of cooling
Number of damper positions: ☐_____ or ☐ infinite.
Dampers closed during warm-up?  ☐ Yes / ☐ No
If dry-bulb type: OSA changeover temperature: __________
If enthalpy: OSA enthalpy changeover: ____________________
Other special features of the RTU:

How will the fresh air rate be maintained at low supply air volumes of the VAV system? Are perimeter zones treated differently than interior zones (reheat box damper settings, etc.)?

How is the RTU controlled?
☐ Stand-alone controllers with thermostats in zones
☐ Above, but enabled/disabled by central building automation system (BAS)
☐ Integrated into BAS as below:
### Integration of Control and Monitoring Points With the BAS

<table>
<thead>
<tr>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed air temp.</td>
<td>______</td>
<td>_____</td>
<td>Compressor stage</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>RA temp.</td>
<td>______</td>
<td>NA</td>
<td>Bldg. static pressure</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>SA temp</td>
<td>______</td>
<td>_____</td>
<td>Temp. lockouts</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>SA reset parameters</td>
<td>______</td>
<td>_____</td>
<td>CO₂ for OSA control</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>RA enthalpy</td>
<td>______</td>
<td>NA</td>
<td>Htg. coil position</td>
<td>_____</td>
<td>NA</td>
</tr>
<tr>
<td>DA static pressure</td>
<td>______</td>
<td>_____</td>
<td>Optimum start</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Duct static pressure</td>
<td>______</td>
<td>_____</td>
<td>Night purge</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Supply fan status</td>
<td>______</td>
<td>NA</td>
<td>Demand limit</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Ret./Exh. fan status</td>
<td>______</td>
<td>NA</td>
<td>Alarms (list):</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Supply fan speed</td>
<td>______</td>
<td>NA</td>
<td>-Dirty filter</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Ret./Exh. fan speed</td>
<td>______</td>
<td>NA</td>
<td>-Compressor fail</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Supply fan cfm</td>
<td>______</td>
<td>NA</td>
<td>-Fan loss of air</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Ret./Exh. fan cfm</td>
<td>______</td>
<td>NA</td>
<td>-High DA pressure</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Inlet vane position</td>
<td>______</td>
<td>NA</td>
<td>-Fire/smoke</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Filter Diff. pressure</td>
<td>______</td>
<td>_____</td>
<td>-Emerg. shutdown</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Occup. schedule override</td>
<td>______</td>
<td>_____</td>
<td>OSA compensation for VAV</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Night low limits</td>
<td>______</td>
<td>_____</td>
<td>OSA economizer</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

Describe other equipment tied to the ON/OFF status of the RTU (exhaust fans, etc.)

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
5.3 RTU Sequence of Operations and Operating Parameters

Provide a full and comprehensive sequence of operations, including but not limited to the following conditions and systems, including all interactions:

<table>
<thead>
<tr>
<th>Systems</th>
<th>Conditions or Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>supply fans</td>
<td>start-up</td>
</tr>
<tr>
<td>exhaust fans</td>
<td>shut-down</td>
</tr>
<tr>
<td>return air and exhaust dampers</td>
<td>normal occupied &amp; unoccupied periods</td>
</tr>
<tr>
<td>supply air capacity control</td>
<td>warm-up</td>
</tr>
<tr>
<td>economizer and OSA dampers</td>
<td>temperature lockouts</td>
</tr>
<tr>
<td>building static pressure control</td>
<td>compressor and condenser staging</td>
</tr>
<tr>
<td>coil valve operation</td>
<td>override sequences</td>
</tr>
<tr>
<td>CO₂ sensor OSA control</td>
<td>winter/summer changeover</td>
</tr>
<tr>
<td>smoke dampers</td>
<td>weekend operation</td>
</tr>
<tr>
<td></td>
<td>normal operation heating</td>
</tr>
<tr>
<td></td>
<td>normal operation cooling</td>
</tr>
<tr>
<td></td>
<td>through deadband ranges</td>
</tr>
<tr>
<td></td>
<td>alarms: fire, smoke, shutdown, equip.</td>
</tr>
<tr>
<td></td>
<td>failure, temp. and pressure limits, etc.</td>
</tr>
<tr>
<td></td>
<td>all energy conserving strategies</td>
</tr>
<tr>
<td></td>
<td>(optimum start/stop, resets, etc.)</td>
</tr>
<tr>
<td></td>
<td>fire alarm</td>
</tr>
</tbody>
</table>

Include the position or status at which each component resides at start-up, what occurs at fire alarm, provide all setpoints and control parameters, including all time delays. In the sequences, describe what controls what. That is, what components must be ON or at certain conditions in order for others to operate. Equipment manufacturers’ sequences and control drawings may be included, but will generally require additional narrative. Flow charts may be used if sufficiently detailed. Narrative and flow chart examples are found in Section 4 of the instructions.

For this RTU system, these sequences are expected to be about ____ single spaced, typewritten pages.

*Number of sheets attached to this section: _____*
6 VAV Terminal Units—Air Conditioning Only (TU_AC)

6.1 System Description

Briefly describe the TU: ____________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Number of TU_ACs: ______ Type of area served: _____________________________________

TU type: ☐ pressure independent / ☐ pressure dependent
Minimum air damper position: ____% open.
Are these fan powered? ______. ☐ Parallel, ☐ Series. Why? __________________________
______________________________________________________________________________

TU measures air flow via total and static pressure sensors. Y/N ____.
☐ Cross, ☐ Linear flow station? Other flow method: _________________________________
Describe TU controller type: _____________________________________________________

Damper actuator type: ☐ Electric, ☐ Pneumatic.
What noise considerations were used when specifying the TU’s? _______________________
______________________________________________________________________________

Integration of Control and Monitoring Points With the BAS

<table>
<thead>
<tr>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
</tr>
</thead>
<tbody>
<tr>
<td>TU air flow</td>
<td>_______</td>
<td>_______</td>
<td>TU air flow max.</td>
<td>_______</td>
<td>_______</td>
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<tr>
<td>TU air flow min.</td>
<td>_______</td>
<td>_______</td>
<td></td>
<td>_______</td>
<td>_______</td>
</tr>
</tbody>
</table>

6.2 TU_AC Sequence of Operations and Operating Parameters

Provide a full and comprehensive sequence of operations (including all sequences, deadband,
alarm actions, etc.) on a separate sheet(s) and attach to this section of the form.

Number of sheets attached to this section: _____
7 VAV Terminal Units—Reheat (TU_RH)

7.1 System Description

Briefly describe the TU: ________________________________________________________
____________________________________________________________________________

Number of TU_RHs: _______ Type of area served: _________________________________

TU type: ☐ pressure independent / ☐ pressure dependent, ☐ VAV, ☐ constant volume

Are these fan powered?_______. ☐ Parallel, ☐ Series. Number of fan speeds?_____
Why?______________________________________________________________________
____________________________________________________________________________

What provisions will be made to minimize reheat? ________________________________
____________________________________________________________________________

What provisions will be made to minimize system simultaneous heating and cooling? ______
____________________________________________________________________________

TU measures air flow via total and static pressure sensors. Y/N ____.

☐ Cross, ☐ Linear flow station? ☐ Other flow method: ______________________________

Minimum air damper position: _____% open.

When the damper is at minimum in heating and space setpoint is not being maintained, will
dampers open?________ Why?______________________________________________

Describe TU controller type: ___________________________________________________

Damper actuator type: ☐ Electric, ☐ Pneumatic.

Heating coil type: ☐ hot water, ☐ electric resistance and stages ______.

Describe heating coil valve: ☐ Two position, ☐ Modulating. _______________________

Heating valve actuator type: ☐ Electric, ☐ Pneumatic.

Do some units have 3-way valves? Why?_______________________________________

Automatic flow control valve?___ Describe: ______________________________________

What noise considerations were used when specifying the TU’s? _________________
Part II. Model Commissioning Plan—Design Phase
Appendix 1. Design Documentation Form

Integration of Control and Monitoring Points With the BAS

<table>
<thead>
<tr>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
</tr>
</thead>
<tbody>
<tr>
<td>TU air flow</td>
<td></td>
<td></td>
<td>TU air flow max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TU air flow min.</td>
<td></td>
<td></td>
<td>Valve position</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.2 TU_RH Sequence of Operations and Operating Parameters

Mech Engr Spec Dev

Provide a full and comprehensive sequence of operations (including heat lockout parameters, heating valve sequences, deadbands, alarm actions, etc.) on a separate sheet(s) and attach to this section of the form.

Number of sheets attached to this section: ______
8 Heat Recovery Unit (HRU)

8.1 Design Intent

Describe the purpose of the HRU: ________________________________________________
____________________________________________________________________________

8.2 System Description

Briefly describe the system: _____________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

On which air handlers does this system operate? _____________________________________

Integration of Control and Monitoring Points With the BAS

<table>
<thead>
<tr>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

8.3 HRU Sequence of Operations and Operating Parameters

Provide a full and comprehensive sequence of operations (including seasonal variations) on a separate sheet(s) and attach to this section of the form.

Number of sheets attached to this section: ______
9 Computer Room Conditioning Unit (ACU)

9.1 Design Intent

Mech Engr Design Dev

What is this system or component used for?
____________________________________________________________________________

9.2 Basis of Design—Component Description and Methods for Meeting the Design Intent

Mech Engr Design Dev

Areas served: ________________________________________________________________
Number of ACUs: _____ Sizes (tons) ______________________________ EER: _______
Location of ACU: _____________________________________________________________
□ Ducted system or □ discharge only? ___________________________________________
How is heat rejected? □ Cooling tower / □ DX air-cooled condenser / □ Other
Location of condenser: _________________________________________________________
Humidifier description: _______________________________________________________ 
Reheat description: __________________________________________________________
Is there a 3-way valve in the unit? _____ Will this defeat the purpose of any variable speed drives on the chilled water system? ________________________________
How is the ACU controlled?
□ Stand-alone controllers with thermostats in zones
□ Same, but enabled/disabled by central building automation system
□ “fully” controlled by BAS
Does supply air enter this space from the main HVAC system? □ Yes / □ No
If Yes, when? ______________________________________________________________

How is fresh air brought into and controlled in the space? __________________________
### Integration of Control and Monitoring Points With the BAS

<table>
<thead>
<tr>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
</tbody>
</table>

#### 9.3 ACU Sequence of Operations and Operating Parameters

*Mech Engr Spec Dev*

Provide a full and comprehensive sequence of operations (including setpoints, unoccupied, occupied, fire alarm periods, etc.) on a separate sheet(s) and attach to this section of the form.

*Number of sheets attached to this section: ______*
10 Daylighting Controls

10.1 Design Intent

Briefly describe the system: ______________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

What is the primary reason for using daylighting? 
☐ energy savings / ☐ view/aesthetics 
☐ visual light quality

What budget limitations were there? ________________________________________
_________________________________________________________________________
_________________________________________________________________________

10.2 Basis of Design

System type: ☐ continuous dimming / ☐ stepped dimming in ____ steps

Describe related architectural features such as light shelves, sloped ceilings, skylights, special interior finishes, etc. ____________________________________________
_________________________________________________________________________
_________________________________________________________________________

How low are the lights allowed to dim? _______%.

The system is controlled by: ☐ main BAS / ☐ stand alone controllers

What is the light level setpoint(s) at the work plane:

<table>
<thead>
<tr>
<th>Area</th>
<th>Design Foot Candles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

How deep into the building do the lights dim? _______ft.

Are the dimming rates the same across this distance? ☐ Yes / ☐ No

Explain: _________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What areas of the building have dimming control?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

How many zones and controllers (light sensors) are there? ____________
How do occupants override the dimming? ______________________________________________________________________

Who has access for adjusting light levels? ______________________________________________________________________

Where are these adjustments made? ______________________________________________________________________

Where are the sensors located? ______________________________________________________________________

10.3 Sequence of Operations and Operating Parameters

Elec Engr Spec Dev

Provide a full and comprehensive sequence of operations (including setpoints and occupied and unoccupied conditions, etc.) on a separate sheet(s) and attach to this section of the form.

Number of sheets attached to this section: _____
11 Lighting Sweep Control

11.1 System Description

Briefly describe the system: _____________________________________________________
____________________________________________________________________________
____________________________________________________________________________

11.2 Operating Parameters

The system is controlled by: ☐ Main BAS / ☐ Stand-alone controller
How many zones will there be? ________ Describe the zones. ______________________
____________________________________________________________________________
What is the floor area of the largest zone? _________________________________
How many sweeps will there be? ________
At what times?
Weekdays: ______________________________________________________________
Saturday: _______________________________________________________________
Sunday: _________________________________________________________________
Describe the type of switching system that occupants will use to turn the lights back on in their zone. _________________________________
____________________________________________________________________________
What is the maximum override duration? ________ hours
Who will be able to globally override the sweeps or change the schedule?
____________________________________________________________________________
How will the sweeps work with housekeeping schedules? ______________________
____________________________________________________________________________

Number of sheets attached to this section: _____
12 Building Automation System (BAS)

12.1 Design Intent

Briefly describe the system: _____________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

Why was this system chosen over others considered? _______________________________
____________________________________________________________________________

Describe any budget limitations:__________________________________________________
____________________________________________________________________________

How important was energy conservation in the decision of BAS type?____________________
____________________________________________________________________________

12.2 Basis of Design—Component Description and Methods for Meeting the Design Intent

Central system is:  □ DDC, □ pneumatic
Valve actuators: □ electric, □ pneumatic.  AHU damper actuators: □ electric, □ pneumatic
VAV terminal box damper actuators: □ electric, □ pneumatic
Fire / smoke damper actuators: □ electric, □ pneumatic
User interface:  □ graphical display of components

Limitations of the modules or features specified, compared to the highest model line system:
____________________________________________________________________________
____________________________________________________________________________

Check the systems that the BAS will control (vs local equipment, packaged controllers). Refer to
the individual system section for a complete description of the points and their control by the BAS
Virtually Full Control | Partial Control | Enable/Disable Only | Monitor Only
---|---|---|---
Rooftop packaged unit | ☐ | ☐ | ☐ | ☐
Air handler unit | ☐ | ☐ | ☐ | ☐
Terminal units | ☐ | ☐ | ☐ | ☐
Economizer functions | ☐ | ☐ | ☐ | ☐
Boiler plant | ☐ | ☐ | ☐ | ☐
Heating water pumping system | ☐ | ☐ | ☐ | ☐
Chiller plant | ☐ | ☐ | ☐ | ☐
Chilled water pumping system | ☐ | ☐ | ☐ | ☐
Cooling tower | ☐ | ☐ | ☐ | ☐
Condenser water pumping | ☐ | ☐ | ☐ | ☐
Terminal unit settings | ☐ | ☐ | ☐ | ☐
Heat recovery unit | ☐ | ☐ | ☐ | ☐
Daylighting setpoints | ☐ | ☐ | ☐ | ☐
Lighting sweep control | ☐ | ☐ | ☐ | ☐
Exterior lighting | ☐ | ☐ | ☐ | ☐
Computer room HVAC unit | ☐ | ☐ | ☐ | ☐
Fan coil unit and condenser | ☐ | ☐ | ☐ | ☐
Unit heaters | ☐ | ☐ | ☐ | ☐
Smoke and fire control | ☐ | ☐ | ☐ | ☐
Emergency power system | ☐ | ☐ | ☐ | ☐
UPS power system | ☐ | ☐ | ☐ | ☐
Service water heating pump | ☐ | ☐ | ☐ | ☐
____________________________________ | ☐ | ☐ | ☐ | ☐
____________________________________ | ☐ | ☐ | ☐ | ☐
____________________________________ | ☐ | ☐ | ☐ | ☐

Location of user interface: ______________________________________________________

Type of user interface:
☐ Permanent on-site computer terminal
☐ Plug-in portable computer
☐ Remote terminal of ________________________
☐ Keypad only

Describe parties who will be able to change schedules only: ____________________________
____________________________________________________________________________

Describe parties who will have full access to system: _________________________________
____________________________________________________________________________
Check the energy conserving control strategies that will be operational in this building through the BAS.

- Holiday scheduling
- Zonal scheduling
- Sequential startup of equipment
- Lighting sweep
- Night setup/setback
- Optimum start
- Optimum stop
- Hot & cold deck reset (supply air)
- Chilled water reset
- Chiller staging and optimization
- Cooling tower component staging
- Air-side economizer control
- Night ventilation purge / pre-cooling
- CO2 outside air rate control
- VAV control-pressure independent
- VAV control-pressure dependent
- Duct static pressure reset
- ______________________________
- ______________________________
- ______________________________
- ______________________________
- ______________________________

List all special monitoring points installed for diagnostic, performance verification and trouble shooting purposes, which are not needed to execute the control sequences and strategies?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

12.3 BAS Sequence of Operations and Operating Parameters

Provide a full and comprehensive sequence of operations, including setpoints, deadbands, etc. List full control sequences for all control strategies. Refer to sequences already provided in other component sections, if applicable. List on a separate sheet(s) and attach to this section of the form.

Include the position or status at which each component resides at start-up, provide all setpoints and control parameters, including all time delays. In the sequences, describe what controls what. That is, what components must be ON or at certain conditions in order for others to operate. Equipment manufacturers’ sequences and control drawings may be included, but will generally require additional narrative. Flow charts may be used if sufficiently detailed. Narrative and flow chart examples are found in Section 4 of the instructions.
Note: Complete BAS description, points list with all details, program listing, etc. are not part of the design intent, but will be required as part of the O&M documentation.

12.4 Points List

For this design intent, list all points in a table that includes at least the information shown in the following example table.

<table>
<thead>
<tr>
<th>Controlled System</th>
<th>Point Abbr.</th>
<th>Point Description</th>
<th>Display Units</th>
<th>Control or Setpoint Y/N</th>
<th>Monitoring Point Y/N</th>
<th>Intermediate Point Y/N</th>
<th>Calculated Point Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

Key:
- **Point Description**: DB temp, airflow, etc.
- **Control or Setpoint**: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)
- **Intermediate Point**: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).
- **Monitoring Point**: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
- **Calculated Point**: “Virtual” point generated from calculations of other point values.

*Number of sheets attached to this section:* ______
13 Split ___ Air Conditioning; ___Heat Pump System

13.1 Design Intent

Mech Engr    Design Dev

What is this system or component used for?

______________________________________________________________________________

Systems Description

Mech Engr    Const Doc

Briefly describe the system:

☐ DX AC only    ☐ VAV
☐ Heat Pump and AC    ☐ Constant volume
☐ Resistance coil    ☐ Dual duct
☐ Hot water coil    ☐ Multizone
☐ Gas furnace    ☐ Other

List equipment and areas served:

______________________________________________________________________________

______________________________________________________________________________

13.2 Basis of Design—Component Description and Methods for Meeting the Design Intent

Mech Eng    Const Doc

Give size, quantity, and other specific information and the areas served, and how it will meet the objectives.

Plant

Number of units of this type: _______    EER (cooling): _______    Tons cooling each: _______
Accumulated capacity for all units of this type:    Total tons cooling: _______
MBtu heating: ____________    Heat Pump COP: _______    Gas efficiency: _______
Areas served: ________________________________________________________________

Compressor(s) and Condenser(s)

Number of compressors per condenser unit: _______.    Low ambient compressor package? ____
Number of condenser fans condenser unit: ___________
Compressor capacity control; general description: ____________________________________
**Evaporator / Cooling Coil**

Provide general description and any special features (high efficiency, face velocity, low pressure drop, etc.). Was a low pressure drop coil analyzed? What were the results?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

**Supply Fans and Capacity Control**

Total CFM for inside fan coil or air handler of this type: __________

☐ Constant volume  ☐ Inlet vanes  ☐ VFD  ☐ Vane axial  ☐ Outlet damper  ☐ Other: ___

☐ Evaporator fan cycles ON and OFF with compressor. Motor efficiency: ____Std. effic., ____Premium effic.

**Dampers**

Describe any dampers and their function.

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

**Smoke and Fire Dampers**

Describe the smoke and fire damper system (location and operation).

____________________________________________________________________________
____________________________________________________________________________

**Setpoint Temperatures**

Supply air (SA): _____  SA reset (see strategy sequence): _____

**Filters**

Provide general description and any special features (low pressure drop, etc.). Were low pressure drop filters analyzed? What were the results?

____________________________________________________________________________
____________________________________________________________________________

**Heating System**

Describe type, fuel, perimeter reheat, areas served, etc.
Economizer and OSA Dampers

☐ No OSA via this unit  ☐ Enthalpy  ☐ Dry Bulb  ☐ Integrated  ☐ Economizer is first stage of cooling

Number of damper positions: ☐ _____ or ☐ infinite.
Dampers closed during warm-up? ☐ Yes / ☐ No
If dry-bulb type: OSA changeover temperature: ___________
Other special features of the split system:

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
How will the fresh air rate be maintained at low supply air volumes of the VAV system? Are perimeter zones treated differently than interior zones (reheat box damper settings, etc.)?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
How is the split system controlled?
☐ Stand-alone controllers with thermostats in zones. Number of zones: _______
☐ Above, but enabled/disabled by central building automation system (BAS)
☐ Integrated into BAS as below:

Integration of Control and Monitoring Points With the BAS

<table>
<thead>
<tr>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
<th>Point or Feature</th>
<th>BAS Monitors (Y/N)</th>
<th>BAS Can Change SetPts</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA temp.</td>
<td>_____</td>
<td>NA</td>
<td>Compressor stage</td>
<td>_____</td>
<td>NA</td>
</tr>
<tr>
<td>SA temp</td>
<td>_____</td>
<td>_____</td>
<td>Temp. lockouts</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>SA reset parameters</td>
<td>_____</td>
<td>_____</td>
<td>CO₂ for OSA control</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>RA enthalpy</td>
<td>_____</td>
<td>NA</td>
<td>Htg. valve position</td>
<td>_____</td>
<td>NA</td>
</tr>
<tr>
<td>DA static pressure</td>
<td>_____</td>
<td>_____</td>
<td>Optimum start</td>
<td>NA</td>
<td>_____</td>
</tr>
<tr>
<td>Duct static pressure</td>
<td>_____</td>
<td>_____</td>
<td>Night purge</td>
<td>NA</td>
<td>_____</td>
</tr>
<tr>
<td>Supply fan status</td>
<td>_____</td>
<td>NA</td>
<td>Alarms (list):</td>
<td></td>
<td>_____</td>
</tr>
<tr>
<td>Ret./Exh. fan status</td>
<td>_____</td>
<td>NA</td>
<td>Night low limits</td>
<td></td>
<td>_____</td>
</tr>
<tr>
<td>Occup. schedule override</td>
<td>_____</td>
<td>_____</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSA economizer</td>
<td>_____</td>
<td>_____</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model Commissioning Plan and Guide Specifications

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Describe other equipment tied to the ON/OFF status of the split system unit (exhaust fans, etc.)

### 13.3 Split System Sequence of Operations and Operating Parameters

<table>
<thead>
<tr>
<th>Systems</th>
<th>Conditions or Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• supply fans</td>
<td>• start-up</td>
</tr>
<tr>
<td>• supply air capacity control</td>
<td>• shut-down</td>
</tr>
<tr>
<td>• economizer and OSA dampers</td>
<td>• normal occupied &amp; unoccupied periods</td>
</tr>
<tr>
<td>• building static pressure control</td>
<td>• warm-up</td>
</tr>
<tr>
<td>• coil valve operation</td>
<td>• temperature lockouts</td>
</tr>
<tr>
<td>• CO₂ sensor OSA control</td>
<td>• compressor and condenser staging</td>
</tr>
<tr>
<td>• smoke dampers</td>
<td>• override sequences</td>
</tr>
<tr>
<td></td>
<td>• winter/summer changeover</td>
</tr>
<tr>
<td></td>
<td>• weekend operation</td>
</tr>
<tr>
<td></td>
<td>• normal operation heating</td>
</tr>
<tr>
<td></td>
<td>• normal operation cooling</td>
</tr>
<tr>
<td></td>
<td>• through deadband ranges</td>
</tr>
<tr>
<td></td>
<td>• alarms: fire, smoke, shutdown, equip.</td>
</tr>
<tr>
<td></td>
<td>failure, temp. and pressure limits, etc.</td>
</tr>
<tr>
<td></td>
<td>• all energy conserving strategies (optimum</td>
</tr>
<tr>
<td></td>
<td>start/stop, resets, etc.)</td>
</tr>
<tr>
<td></td>
<td>• fire alarm</td>
</tr>
</tbody>
</table>

Include the position or status at which each component resides at start-up, what occurs at fire alarm, provide all setpoints and control parameters, including all time delays. In the sequences, describe what controls what. That is, what components must be ON or at certain conditions in order for others to operate. Equipment manufacturers’ sequences and control drawings may be included, but will generally require additional narrative. Flow charts may be used if sufficiently detailed. Narrative and flow chart examples are found in Sections 4 of the instructions.

For this system, these sequences are expected to be about ______ single spaced, typewritten pages.

\[ Number\ of\ sheets\ attached\ to\ this\ section: \underline{______} \]
14 Emergency Power System

14.1 Design Intent

Briefly describe the system: _______________________________________________________
____________________________________________________________________________
____________________________________________________________________________

What is the purpose of the emergency power and any UPS for each load other than the fire, life, safety loads?
____________________________________________________________________________
____________________________________________________________________________

14.2 Basis of Design - Component Description and Methods for Meeting the Design Intent

Generator

Is the generator sized to be able to handle additional loads? ______ How many? ______
____________________________________________________________________________

What is the maximum time it should take the generator to be providing power from the time street power is lost (seconds)? _________________

Is there an automatic generator exercizer? ____________________

For how long should the generator be able to provide power without refueling? ____________

Describe any special frequency and voltage regulation output requirements for the generator. _
____________________________________________________________________________

Power Quality

Describe any special power quality concerns or considerations (sensitive equipment, etc.). ___
____________________________________________________________________________

UPS

How many UPS systems are there? List all, including integral batteries in equipment. _____
____________________________________________________________________________

What kind of UPS bypass will be used on the stand-alone UPS? _________________________
____________________________________________________________________________

Emergency Power and UPS Schedule

In the following table, list each load on emergency power and/or on a UPS. List the UPS discharge time. List all the loads first that are only on emergency power.
<table>
<thead>
<tr>
<th>Equipment / Loads</th>
<th>On Emerg. Power (Y/N)</th>
<th>UPS</th>
<th>On UPS (give UPS ID)</th>
<th>Stand Alone UPS (SA) or Integral (I)</th>
<th>Full Load Discharge Time (min.)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Number of sheets attached to this section: ______
### 15 OTHER SYSTEMS NEEDING SAMPLE FORMATS

<table>
<thead>
<tr>
<th>System</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Alarm and Protection</td>
<td>Systems</td>
</tr>
<tr>
<td>Service Water Heating</td>
<td>Air Handler Units</td>
</tr>
<tr>
<td></td>
<td>Capacity control</td>
</tr>
<tr>
<td></td>
<td>Supply fan</td>
</tr>
<tr>
<td></td>
<td>Return/exhaust fan and dampers</td>
</tr>
<tr>
<td></td>
<td>Heating and cooling coil valves</td>
</tr>
<tr>
<td></td>
<td>Economizer and OSA and return air dampers</td>
</tr>
<tr>
<td></td>
<td>Mixed air control</td>
</tr>
<tr>
<td>Exhaust Fans</td>
<td></td>
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</tbody>
</table>