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:

Item	Abbreviation	Refers To
Responsible Party	Arch	Architect
	Mech Engr	Mechanical Engineer
	Elec Engr	Electrical Engineer
	Ltg Des	Lighting Designer
	Ctrls Cont	Controls Contractor
Design Phase	Program	Programming Phase
	Concept Des	Conceptual or Schematic Design Phase
	Design Dev	Design Development Phase
	Const Doc	Construction Documents Phase
	Spec Dev	Specification Development (late Const. Documents Phase)

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

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)

___
___
___

1.2 Sustainable Construction and Environmental Compatibility

Design Intent *Architect* *Concept Des*

What are the objectives regarding sustainability and environmental compatibility?

____
____
____
____
____
____

Basis of Design*-General Description and Function*

Architect *Design Dev*

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

____
____
____
____
____
____

1.3 Indoor Environmental Quality

Design Intent *Mech Engr* *Concept Des*

What are the general objectives for indoor environmental quality?

____
____
____

Thermal Comfort*—General Description and Function*

Mech Engr *Design Dev*

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

Air Distribution *Mech Engr* *Const Doc*

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 CO_2 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   *Mech Engr*   *Const Doc*

Table 1

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

Space	Use / Activity	Occupant Type	Num of Occs	Operating Hours per Day	Design Cooling DB	Design Cooling WB or RH	Design Heating DB OSAT	OSA CFM / Person or CO_2	Design Noise Level (NC)	Design Light Level (FC)	Special Pressure Relation-ship (note)

2 HVAC Systems and Design Parameters

2.1 General *Mech Engr* *Design Dev*

General description of the main HVAC systems and areas served.

System Areas Served

______________________ ____
______________________ ____
______________________ ____
______________________ ____
______________________ ____

Why were the above particular systems chosen?

____
____
____
____
____
____

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

____
____
____

2.2 Specific System Descriptions *Mech Engr* *Const Doc*

System	Heating / Cooling / Both	Areas Served

What is the rationale for the way the HVAC and lighting were zoned?

____
____
____
____
____

2.3 Load Calculations *Mech Engr* *Const Doc*

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______

Internal load assumptions: Lighting: ______W/sf. Misc: ______W/sf. Other:_____________

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:

Orientation	% of Wall Area	Overall U	SC
N			
S			
E			
W			

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 *Mech Engr* *Design Dev*

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 *Mech Engr* *Const Doc*

Briefly describe the chiller system.

____
____
____
____
____
____
____
____

☐ 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?______________ Describe.___________________
____

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 *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:____________________
____

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 is 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

Chiller Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Chiller Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______

Chiller Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Chiller Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______

Chiller System Sequence of Operations and Operating Parameters

Mech Engr *Const Doc*

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 *Mech Engr* *Design Dev*

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 *Mech Engr* *Const Doc*

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 accomodating 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?____________________
____
____
____
____
____
____

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 is 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 _____________
____

Integration of Control and Monitoring Points With the BAS

Boiler Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Boiler Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______

Boiler Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Boiler Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______
	______	______		______	______

4.4 Boiler System Sequence of Operations and Operating Parameters

Mech Engr *Spec Dev*

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 — *Mech Engr* — *Design Dev*

What is this system or component used for?____
____

Systems Description — *Mech Engr* — *Const Doc*

Briefly describe the system:

- ☐ Heat pump
- ☐ Gas pack
- ☐ AC only
- ☐ Resistance coil
- ☐ Hot water
- ☐ VAV
- ☐ Steam
- ☐ Constant volume
- ☐ Dual duct
- ☐ Multizone
- ☐ Other____
- ☐ Other____

List equipment and areas served: ____
____
____
____

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

Mech Engr — *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 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

Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
Mixed air temp.	______	______	Compressor stage		NA
RA temp.	______	NA	Bldg. static pressure	______	______
SA temp	______	______	Temp. lockouts	______	______
SA reset parameters	______	______	CO_2 for OSA control	______	______
RA enthalpy	______	NA	Htg. coil position	______	NA
DA static pressure	______	______	Optimum start	NA	______
Duct static pressure	______	______	Night purge	NA	______
Supply fan statuc	______	NA	Demand limit	NA	______
Ret./Exh. fan status	______	NA	Alarms (list):	______	______
Supply fan speed	______	NA	-Dirty filter	______	______
Ret./Exh. fan speed	______	NA	-Compressor fail	______	______
Supply fan cfm	______	NA	-Fan loss of air	______	______
Ret./Exh. fan cfm	______	NA	-High DA pressure	______	______
Inlet vane position	______	NA	-Fire/smoke	______	______
Filter Diff. pressure	______	______	-Emerg. shutdown	______	NA
Occup. schedule override	______	______	OSA compensation for VAV	______	______
Night low limits	______	______	OSA economizer	______	______
________________	______	______	________________	______	______

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

____

____

____

5.3 RTU Sequence of Operations and Operating Parameters

Mech Engr *Spec Dev*

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

Systems

- supply fans
- exhaust fans
- return air and exhaust dampers
- supply air capacity control
- economizer and OSA dampers
- building static pressure control
- coil valve operation
- CO_2 sensor OSA control
- smoke dampers

Conditions or Modes

- start-up
- shut-down
- normal occupied & unoccupied periods
- warm-up
- temperature lockouts
- compressor and condenser staging
- override sequences
- winter/summer changeover
- weekend operation
- normal operation heating
- normal operation cooling
- through deadband ranges
- alarms: fire, smoke, shutdown, equip. failure, temp. and pressure limits, etc.
- all energy conserving strategies (optimum start/stop, resets, etc.)
- fire alarm

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 *Mech Engr* *Design Dev*

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

Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
TU air flow	______	______	TU air flow max.	______	______
TU air flow min.	______	______	_________________	______	______
_________________	______	______	_________________	______	______

6.2 TU_AC Sequence of Operations and Operating Parameters

Mech Engr *Spec Dev*

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 *Mech Engr* *Design Dev*

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 resistence 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? _______________________
____

Integration of Control and Monitoring Points With the BAS

Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
TU air flow	______	______	TU air flow max.	______	______
TU air flow min.	______	______	Valve position	______	______
_________________	______	______	_________________	______	______

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 — *Mech Engr* — *Design Dev*

Describe the purpose of the HRU: ____
____

8.2 System Description — *Mech Engr* — *Design Dev*

Briefly describe the system: ____
____
____
____

On which air handlers does this system operate? ______________________________

Integration of Control and Monitoring Points With the BAS

Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
____________	____	____	____________	____	____
____________	____	____	____________	____	____

8.3 HRU Sequence of Operations and Operating Parameters

Mech Engr — *Spec Dev*

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?

____

General Description *Mech Engr* *Design Dev*

Briefly describe the system or component.

____

____

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

Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
_______________	______	______	_______________	______	______
_______________	______	______	_______________	______	______

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 *Elec Engr* *Design Dev*

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 *Elec Engr* *Design Dev*

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:

Area	**Design Foot Candles**
____	__________
____	__________
____	__________
____	__________

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 *Elec Engr, Ctrls Cont, Design Dev*

Briefly describe the system: ____
____
____

11.2 Operating Parameters *Elec Engr, Ctrls Cont, Spec Dev*

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 *Mech Engr, Ctrls Cont Design Dev*

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* *Mech Engr, Ctrls Cont, Const Doc*

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
- ☐ ______________________________
- ☐ ______________________________
- ☐ ______________________________
- ☐ Occupancy-based outside air control
- ☐ DX compressor optimization
- ☐ Mixed air temperature control
- ☐ Boiler staging and optimization
- ☐ Heat element (coil) staging
- ☐ Hot water reset
- ☐ Heat recovery option control
- ☐ Water-side economizer control
- ☐ Variable speed pump control
- ☐ Occupancy based HVAC control
- ☐ Terminal regulated air volume (TRAV)
- ☐ Thermal storage control
- ☐ Demand limiting or load shedding
- ☐ Duty cycling of equipment
- ☐ DHW recirculation pump control
- ☐ DHW temperature control
- ☐ Full trending capabilities
- ☐ ______________________________
- ☐ ______________________________
- ☐ ______________________________

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

Mech Engr *Spec Dev*

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 *Mech Engr, Ctrls Cont* *Spec Dev*

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

Controlled System	Point Abbr.	Point Description	Display Units	Control or Setpoint Y/N	Monitoring Point Y/N	Intermediate Point Y/N	Calculated Point Y/N

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
- ☐ Heat Pump and AC
- ☐ Resistance coil
- ☐ Hot water coil
- ☐ Gas furnace
- ☐ VAV
- ☐ Constant volume
- ☐ Dual duct
- ☐ Multizone
- ☐ Other____
- ☐ 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

Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts	Point or Feature	BAS Monitors (Y/N)	BAS Can Change SetPts
RA temp.	______	NA	Compressor stage	______	NA
SA temp	______	______	Temp. lockouts	______	______
SA reset parameters	______	______	CO_2 for OSA control	______	______
RA enthalpy	______	NA	Htg. valve position	______	NA
DA static pressure	______	______	Optimum start	NA	______
Duct static pressure	______	______	Night purge	NA	______
Supply fan statuc	______	NA		NA	______
Ret./Exh. fan status	______	NA	Alarms (list):	______	______
Occup. schedule override	______	______	Night low limits	______	______
OSA economizer	______	______	_________________	______	______
_________________	______	______	_________________	______	______

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

Mech Engr *Spec Dev*

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

Systems

- supply fans
- supply air capacity control
- economizer and OSA dampers
- building static pressure control
- coil valve operation
- CO_2 sensor OSA control
- smoke dampers

Conditions or Modes

- start-up
- shut-down
- normal occupied & unoccupied periods
- warm-up
- temperature lockouts
- compressor and condenser staging
- override sequences
- winter/summer changeover
- weekend operation
- normal operation heating
- normal operation cooling
- through deadband ranges
- alarms: fire, smoke, shutdown, equip. failure, temp. and pressure limits, etc.
- all energy conserving strategies (optimum start/stop, resets, etc.)
- fire alarm

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: ______

14 Emergency Power System

14.1 Design Intent *Elec Engr* *Design Dev*

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

Elec Engr *Spec Dev*

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 exerciser? ____

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 *Elec Engr* *Spec Dev*

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 *Elec Engr* *Spec Dev*

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.

Equipment / Loads	**On Emerg. Power** (Y/N)	**UPS**		
		On UPS (give UPS ID)	**Stand Alone UPS** (SA) **or Integral** (I)	**Full Load Discharge Time** (min.)

Number of sheets attached to this section: ______

15 OTHER SYSTEMS NEEDING SAMPLE FORMATS

Fire Alarm and Protection Systems	
Service Water Heating	
Air Handler Units	Capacity control Supply fan Return/exhaust fan and dampers Heating and cooling coil valves Economizer and OSA and return air dampers Mixed air control
Exhaust Fans	