Efficiency Vermont

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Efficiency Vermont
Multifamily Mechanical Design Protocol **January 2012**

Efficiency Vermont Multifamily Mechanical Design Protocol			
Task		**Responsibility**	**Completed**
1.	**Owner Project Requirements (OPR)**	Provided by the Owner/Developer to the design team with RFP. If this is not feasible, provided prior to design work on the project.	
2.	**Basis of Design (BoD)**	• Draft BoD available with Design Development. • Updated version submitted with 80% Design Drawing review. (Review by owner, all members of design team and energy consultants. If project includes commissioning, the Commissioning Agent should be included in review.)	
3.	**Training**	Staff training will be included at both project turn-over and end of warranty period. Design team will include this requirement in 80% Design Drawing review.	
		During construction: training plan review with installation contractors, including schedules	

Consider these additional, non-required opportunities to ensure project success: *(See Mechanical Design Protocol Appendix for detail)*			
Task		**Responsibility**	**Completed**
A.	**Design Team Procurement**	Base "Design Team Procurement" on understanding of, and experience with, high-performance building. Include OPR in RFP for design team and their work contracts.	
B.	**Sequence of Operation**	Completed by design team. Included in final documentation to building owner and operator.	

1. Owner Project Requirements (OPR):

Provided by the Owner/Developer to the design team with RFP. If this is not feasible, provided prior to design work on the project. Upon request, Efficiency Vermont technical staff can assist owner to develop OPR; the document should be complete by preliminary design team meeting.

***Example* of Owner Project Requirements**	
The OPR should include:	
General	• All information necessary to develop the Basis of Design (BoD) documentation (Section 2) • Training expectations (Section 3) for both project turnover and end of warranty • Expected occupancy information, number of units, accessibility needs, estimated occupancy schedule

Energy Performance	• Applicable energy standards for the building type.
	• Energy efficiency goals *(examples):*
	  ○ *Efficiency Vermont Multifamily New Construction and Major Rehabilitation program, including Mechanical and Air Sealing protocols*
	  ○ *ENERGY STAR, LEED, or other building certification, when applicable*
	  ○ *Use of ENERGY STAR appliances, lighting, and mechanical systems*
	  ○ *Renewable energy systems*
	  ○ *Other energy performance goals or requirements*
	• Expected lifetime of equipment and components.
	• As appropriate: Per Unit Per Month (PUM) energy cost goals
	  ○ Central systems (owner paid)
	  ○ Individual systems (occupant paid)

Indoor Environmental Conditions	• Conditioning expectations: in-units, hallways, common spaces, etc.
	• Acceptable time delay for domestic hot water
	• Expectations for unit to unit air movement (compartmentalization)
	• Light levels for common areas while occupied and unoccupied
	• Non energy items which may be included include:
	  ○ Elevator turnaround times
	  ○ VOC limitations during construction and maintenance, etc.

Building Occupant and O&M Personnel	• Will ongoing maintenance be provided by owner or contracted?
	• Acceptable frequency of maintenance
	  ○ Central systems
	  ○ In – Unit systems
	• For in-unit maintenance, address access expectations

Sample OPR language is provided in the Mechanical Systems Optimization Guide (MSOG), Appendix C (Available for reference here: http://www.vhcb.org/pdfs/optimization-sm.pdf). *This is not intended as a comprehensive example, but rather a starting place for owners to develop a project specific OPR.*

2. Basis of Design (BoD) Documentation

The design team shall provide Basis of Design documentation outlining the design assumptions, and describing how the system design will meet or exceed the OPR.

a. Deliverable Schedule:

Event	Deliverable
RFP & Contract	Recommended: Owner includes BoD requirements in RFP and Contract
Design Development	Required: BoD submitted for review (Review by owner, all members of design team, and energy consultants. If the project includes commissioning, the Commissioning Agent should be included)
80% Design Drawings	Required: Updated and final BoD

b. Content Requirements:

Basis of Design document will include three sections:

BoD Content Requirements	
1	**General Project Information:** Primary design, applicable standards and codes
2	**Narrative:** Description of mechanical systems
3	**Sizing:** Specifications of inputs and outputs

- General Project Information
  - Standards and Codes – Reference specific applicable codes (version), regulation, guidelines and other references that will be used for the project. The BoD should include as a minimum:
    - Specific applicable code, including referenced version for design (including Energy, Building, Fire and Life Safety, Plumbing, etc.)
    - Standards (including Ventilation)
    - Guidelines

- **Narrative**
  - Provide a narrative description of performance criteria that specifically indicate how these systems and the design approaches satisfy the Owner Project Requirements that includes:
    - Lighting: For exterior and common areas, provide design foot-candles, lighting power density, and lighting controls
    - HVAC: design loads, diversity factors, zoning, controls, venting requirements
    - Boilers: redundancy, operating efficiency, quantity, etc.
    - Pumping: arrangement (primary / secondary), variable flow, diversity factors, full load and part efficiency, fluid design temperature difference
    - Ventilation: loads, coils, delivery temperatures, economizers, exhaust systems, energy recovery systems, fan power, fan efficiency (including performance metrics)
    - Domestic Hot Water: system type (direct/indirect), full load capacity, full and part load efficiency, design entering/storage/delivery temperatures, DHW recirculation sizing, insulation standards
  - Narrative should include control and operational concepts for each system; operations and maintenance requirements.

- **Sizing**
  - Design and operating assumptions demonstrating the interactive assumptions responsible for the building performance (Modeling / Sizing Inputs and Outputs).

PART A: Sizing Inputs *Example*

Parameter	Value or Range
General Parameters	[Example information provided]
Building Location	Burlington, VT
Building Type Classification	Multifamily, Mixed Use Commercial, etc.
Weather Data Source / Type	NOAA TMY3, BTV
Winter and Summer Design Temperatures	-5°F, 90°F
Building Dimensions	
Building square feet	*XX,XXX*
Perimeter	*200 ft*
Surface Area	*4000 sq-ft*
Envelope	
Infiltration rate	*0.1 ACH*
Exterior Wall Assembly R-Value, Insulation Type	*R-2 (x" continuous polyiso + x" Batt)*
Attic Floor Assembly R-Value, Insulation Type	*R-55 (x" continuous polyiso + x" Batt)*
First Conditioned Floor is Above (Slab, Garage, Other)	*Garage, open to ambient conditions.*
Slab Insulation (Below, above, slab edge, etc.)	*X" continuous R-14 below + 3" polyiso slab edge*
Below Grade Wall Insulation	*R-15, (continuous polyeurethane, x")*
Window & Door Tabulation	*Types, assembly U-values, SHGC, quantities, etc.*
Other Envelope Features	*(inc. fixed exterior shading, trees, etc.)*
Building Occupants	
Occupancy Schedule	*Weekdays 5pm to 7am 100%, Weekdays 7am - 3 PM 55%, Weekdays 3PM - 5PM 75%, Weekends & holidays 85%*
Occupied Temperature Set Point (winter, summer)	*70/75F*
Unoccupied Temperature Set Point (winter, summer)	*70/75F (no setback)*
Total # of Units in Building	*12*
Average # of Occupants per Unit	*3*
Total Bedrooms in Building	*20*
Occupant types for DHW calculations	*Senior, Family, etc.*
Central Heating Plant Equipment	
Equipment Type	*Condensing Boiler*
Fuel Source	*Oil*
Equipment Efficiency	*91% Efficient*
Cooling Equipment	
Equipment Type	
Chilled Delivery Mode	
Equipment Efficiency (EER/COP)	
Number of Units	
DHW HP heating system	
ERV heating/cooling system	
Terminal Equipment	
Terminal Equipment Type	*Baseboard*
Capacity Rating	*800 BTU/hr/ft*

Ventilation	
Ventilation rate dwelling	
Ventilation rate common areas	
Building Loads & Schedules	
Lighting Power Density - exterior parking areas	
Common area lighting schedule	
Dwelling unit lighting schedule	
Laundry loads & frequency	
Cooking assumptions	
Miscellaneous plug loads	

PART B: Sizing Outputs *Example*

Energy Use	Value	Units
Total Annual Space Heating Input Energy		MMBTU
Total Annual Space Cooling Input Energy [3]		Ton-Hrs
Total Annual Building Electrical Energy		kWh/yr
Total Annual DHW Input Energy		MMBtu
DHW Thermal Storage		Gallons
Peak Space Heating Load		MBTU/hr
Peak Heating Load from Ventilation		MBTU/hr
Space Heating Thermal Storage		
Boiler size and quantity		
Boiler and Thermal Storage peak hour capacity		MBTU/hr
Peak Space Cooling Load [3]		MBTU/hr
Energy Intensity		MBTU/sq-ft/yr
Estimated Energy Budget		$/year or PUM
Owner (or mechanical designer, when requested) estimated PUM costs: [1]:		
PUM Electrical Cost (current $ value) [1]		$/unit/month
PUM Fuel Costs (current $ Value) [1]		$/unit/month
PUM Electrical Costs (Yr. 15 @ 5% Esc) [2]		$/unit/month
PUM Fuel Costs (Yr. 15 @ 5% Esc)		$/unit/month
[1] Per housing unit monthly expenses. Includes common areas.		
[2] To calculate year 15 rough costs for 5% multiply current dollar fuel costs by 2.08, this is a rough approximation and does not include inflation.		
[3] For buildings with cooling, model and report loads for ERV and for HRV to allow for comparison.		

Sample BoD narrative language is provided in the Mechanical Systems Optimization Guide (MSOG*),* Appendix G Sample Modeling / Sizing Table is from the Mechanical Systems Optimization Guide (MSOG), Appendix B. (Available for reference here: http://www.vhcb.org/pdfs/optimization-sm.pdf)

3. Training Requirements Documentation

Training typically occurs at the end of project construction. Operators often do not assume full responsibility for the system until the system warranty period expires one year later. End-of warranty training shall also be included as part of the project to ensure Operation and Maintenance staff has the opportunity to apply what they've learned directly after training is completed.

Training Documentation Schedule	
Event	**Deliverable**
OPR, RFP & Contract	Recommended: Include training requirements at both project completion and end of warranty period, specify in-house or third party O&M.
Design Review	Required: 80% Design Development include training requirements at both project turn over and end of warranty period for all controls and mechanical equipment
Construction	Required: Training plan review with installation contractors, including schedules

a. Example Training Schedule

Appendix I: Training Requirements

Spec Section	Equipment / System	Total Hours	Type of Training	Timing [1]	Verified in Spec	Trainer	Trainer Organization	Verified Training Provided
			Miscellaneous Equipment					
142424	Hydraulic Elevators	4	System shut down, elevator recall, emergency proceedures, demonstrate elevator operation upon loss of power and any required reset upon restoration of power	TO				
213250	Fire Suppression	2	Overview of system, maintenance requirements and testing, location of tamper and flow switches and system valves	TO				
			Plumbing					
224100	Plumbing Piping	1	Review routing, access, placement of cleanouts, venting, roof drain locations - Building walk through with plans, review insulation levels	TO, 10 month post oc				
224400	Plumbing Fixtures	1	Review parts inventory, review equipment list	TO, 10				
	Well water system	1	location of well, pumps, valves, shut down proceedure	TO, 10				
	Septic system	1	tank location(s), maintenance requirements, mowing requirements	TO, 10 month post oc				
	Domestic Hot Water Heater	1	Equipment startup, trouble shooting and shut down proceedures, review preventive maintenance requirements as documented on the PM matrix, review spare parts	TO, 10 month post oc				
	Domestic Hot Water Pumps	1	Equipment startup, trouble shooting and shut down proceedures, controls, expected operation, potential problems with operation, review preventive maintenance requirements as documented on the PM matrix, review spare parts	TO, 10 month post oc				

Sample Training Requirements table is from the Mechanical Systems Optimization Guide (MSOG), Appendix I. (Available for reference here: http://www.vhcb.org/pdfs/optimization-sm.pdf)