

# Appendix A. Audit Protocol

## NEEA 2002-2004 Commercial Building Survey

### PROJECT INFORMATION

Inspector \_\_\_\_\_ Date \_\_\_\_\_

Building Name \_\_\_\_\_

Building Address \_\_\_\_\_

Contact At Building \_\_\_\_\_ Phone \_\_\_\_\_ Email \_\_\_\_\_

Completion Date \_\_\_\_\_ % Occupied \_\_\_\_\_

Class of Work [New] [Addition] [Other] \_\_\_\_\_

Total Floor Area \_\_\_\_\_ New/Addition Floor Area \_\_\_\_\_

Number of Buildings \_\_\_\_\_ Number of Stories \_\_\_\_\_

Stand Alone Bld Y \_\_\_ N \_\_\_

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_

### BUILDING/SURVEYED AREA

Surveyed Floor Area \_\_\_\_\_

Surveyed Area/Building Description \_\_\_\_\_

\_\_\_\_\_

### STANDARD BUILDING USE CATAGORY (choose one)

- |  |  |   |
|--|--|---|
| <input type="checkbox"/> Assembly        | <input type="checkbox"/> Institution             | <input type="checkbox"/> Restaurant/Bar                 |
| <input type="checkbox"/> Education       | <input type="checkbox"/> Laboratory              | <input type="checkbox"/> Retail                         |
| <input type="checkbox"/> Grocery         | <input type="checkbox"/> Office                  | <input type="checkbox"/> Warehouse Storage/Distribution |
| <input type="checkbox"/> Health Services | <input type="checkbox"/> Residential and Lodging | <input type="checkbox"/> Other (describe)               |

### STANDARD BUILDING USE TYPE

| Space ID <sup>1</sup> | Use Code <sup>2</sup> | Use Description | Floorspace |         |       | Inside insulated Envelop | Heat Level <sup>3</sup> | Cool Level <sup>4</sup> |
|-----------------------|-----------------------|-----------------|------------|---------|-------|--------------------------|-------------------------|-------------------------|
|                       |                       |                 | New        | Remodel | Total |                          |                         |                         |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |
|                       |                       |                 |            |         |       | Y N                      | H S U                   | F R C U                 |

<sup>1</sup> Separate spaces based on major use type, special use categories, differences in space conditioning level, and business. Separate unfinished tenant areas too. Special Uses: K-12 ed – classroom, gym/multipurpose, office, corridor; Health – Patient, surgery, diagnostics, office, service

<sup>2</sup> Enter the Standard use type code from the use type reference sheet.

<sup>3</sup> Heated, Semi-heated, Unheated    <sup>4</sup> Frozen, Refrigerated, Cooled, Uncooled

## Ownership and Operations

What best describes the building ownership: [Individual] [Corporation] [Religious] [Federal Gov't] [Local/State Gov't]  
 [Syndicated Partnership (REIT)] [Other Partnership] [Non-Gov't Institution]  
 [Private University/College] [Other]

Percent of area occupied by Owner \_\_\_\_\_

Building Management [Owner] [Tenant] [Property Management Firm] [Unknown]

Does the building operator have formalized training? [BOC] [Other] [None] [Unknown]

Is there an on-site facility *manager* [Yes] [No] [Unknown]

How many staff are assigned to O&M \_\_\_\_\_

How many facilities are this staff responsible for \_\_\_\_\_

Is there a staff person with energy management/conservation duties [Yes] [No] [Unknown]

Is energy use tracked? (explain below) [Yes] [No] [Unknown]

Is or can the energy use tracked by end use? (explain below) [Yes] [No] [Unknown]

Is the O&M manual specific to the installed systems [Yes] [No] [Unknown]

Has trending been set up through the DDC to monitor systems? [Yes] [No] [Unknown]

Is the trending data actively used? (note what data & how below) [Yes] [No] [Unknown] [NA]

Are the following systems regularly maintained in-house or contracted. Regular inspection?

| Item           | In-house or Out |   | Inspected? |   | Frequency |
|----------------|-----------------|---|------------|---|-----------|
| General O&M    | I               | O |            |   |           |
| HVAC Equipment | I               | O | Y          | N |           |
| HVAC Controls  | I               | O | Y          | N |           |
| Lighting       | I               | O |            |   |           |
| Refrigeration  | I               | O | Y          | N |           |

## Programs

Did this building participate in any utility energy efficiency programs [Yes] [No] [Unknown]

Were incentives paid by utilities for energy efficient design or equipment [Yes] [No] [Unknown]

Did this building participate in any state energy efficiency programs [Yes] [No] [Unknown]

Did this building receive state energy efficiency incentives or tax credits [Incentive] [Tax Credit] [Other] [None] [??]

What items received incentives: [insulation] [windows] [LPD] [lighting control] [HVAC] [HVAC controls] [unknown]

What building code jurisdiction is this building in \_\_\_\_\_

What Energy code was used to determine compliance (code,year) \_\_\_\_\_

What Energy code path was used? [prescriptive] [simulation] [OR-simplified tradeoff] [WA-component perf]

[unknown]

Is this building LEED certified [No] [Yes] [Basic] [Silver] [Gold] [Platinum] [Other] [Unknown]

Did this project receive LEED energy credits? [No] [Yes] If yes, attach copy of leed certificate.

Did this building receive carbon credits? [No] [Yes] [huh]

Was project benchmarked? [No] [Yes] [huh] Method Used \_\_\_\_\_

## Building Problems

Is the building finished? [Yes] [No] [Unknown]

Is the building fully occupied? [Yes] [No] [Unknown] if not explain:

Are systems/controls setup complete? [Yes] [No] [Unknown]

Has building be "delivered" from builders to owner? [Yes] [No] [Unknown]

Was system training adequate [Yes] [No] [Unknown] [NA]

Have there been any problems with comfort and HVAC control? [Yes] [No] [Unknown] if yes explain:

Have there been any problems with lighting and lighting control? [Yes] [No] [Unknown] if yes explain:

Have there been any problems with refrigeration systems? [Yes] [No] [NA] [Unknown] if yes explain:

Have there been any problems with the windows? [None] [Water Leakage] [Air Leakage] [Other]

Have there been any other problems with energy use or energy using systems? [Yes] [No] [Unknown] if yes explain:

## Commissioning

Was the building commissioned? [Yes] [No] [Unknown] [NA]  
Agent [designer] [installer] [3<sup>rd</sup> party] [building operator] [Unknown]  
Is the final commissioning report onsite [Yes] [No] [Unknown] [NA]

Systems commissioned (check all that apply)

EMS [Yes] [No] [Unknown] [NA]  
Building level mechanical systems [Yes] [No] [Unknown] [NA]  
Zone level mechanical system [Yes] [No] [Unknown] [NA]  
Lighting Control [Yes] [No] [Unknown] [NA]  
Electric Acceptance Testing [Yes] [No] [Unknown] [NA]  
Emergency Power [Yes] [No] [Unknown] [NA]  
Plumbing [Yes] [No] [Unknown] [NA]  
Fire/Life/Safety [Yes] [No] [Unknown] [NA]  
Envelope [Yes] [No] [Unknown] [NA]  
Refrigeration [Yes] [No] [Unknown] [NA]  
Elevators [Yes] [No] [Unknown] [NA]  
other \_\_\_\_\_

Did building get LEED commissioning credit: [Yes] [No] [Unknown] [NA]

Describe process used in project. Was the building manager or owner satisfied?

**Air Flow Testing & Balanced** [Yes] [No] [Unknown] [NA]

**Auditor Recommendations**

## Utilities

| Ute Name | Type (G/E) | Meter # | Account # | Street Address (leave blank if same as front page address) | Spaces Served <sup>1</sup> | Area Served by meter but not audited. |                  |
|----------|------------|---------|-----------|--|----------------------------|---------------------------------------|------------------|
|          |            |         |           |  |                            | Floor area <sup>2</sup>               | Area Description |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |
|          |            |         |           |  |                            |                                       |                  |

1 Enter the space Ids of all spaces served by this meter. Indicate percentages if only part of space on given meter. Indicate enduses if only some enduses on meter.

2 Mostly for central plants. Ask manager for area served by plant or meter, and subtract the surveyed area.

Describe any unusual meter issues. Particularly when the permitted space is an addition to an existing space, or when the meters do not cover all enduses..

Describe any major changes that will change energy use between this year and next. Contractor schedules versus operator schedules, remodels, and what not.

Describe type, use, and quantity of other fuels used on site?

# Schedules

## Hours Per Week

| Space ID | Schedule Type |        |      |        |
|----------|---------------|--------|------|--------|
|          | Doors Open    | Lights | HVAC | Season |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |
|          |               |        |      |        |

## Server Rooms

Total Floor Area:

Describe:

Number of processors:

Does space have it's own conditioning [y] [n] [?]

System Id's \_\_\_\_\_

Cooling Capacity:

UPS Electrical Capacity:

UPS current load:

# Lighting

| Space ID | Designer(name,co,#) | Designer(name,co,#) |
|----------|---------------------|---------------------|
| _____    | _____               | _____               |
| _____    | _____               | _____               |
| _____    | _____               | _____               |

Controlled by Centralized Lighting Controller [Yes] [No] [Unknown]

Manufacturer/model: \_\_\_\_\_

Is it integrated with HVAC control system [Yes] [No] [Unknown]

How often are schedules adjusted?

Make, model of primary T8 lamp specified: \_\_\_\_\_

Make, model of actual replacement T8 lamp: \_\_\_\_\_

Is egress lighting on 24/7? [Yes] [No] [Unknown]

General lighting control description plus any comments by building operator, tenants or auditor (ask building manager and tenants about lighting. Do they like it? Do the controls work?).



# Interior Lighting

| Subspace Information                |                                      |                |   |                               | Fixture Takeoff |                               |                               |             |
|-------------------------------------|--------------------------------------|----------------|---|-------------------------------|-----------------|-------------------------------|-------------------------------|-------------|
| SpaceID, Subspace Type <sup>1</sup> | Area (ft <sup>2</sup> ) <sup>2</sup> | Fixture Height | Space Control Codes <sup>3</sup> & Schedule | Desktop Foot-candles high/low | Fixture Type ID | Fixture Controls <sup>3</sup> | Special Code Cat <sup>3</sup> | Total Count |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |
|                                     |                                      |                |   |                               |                 |                               |                               |             |

### <sup>1</sup>Subspace Type Codes

- |        |                               |       |                          |                |                     |
|--------|-------------------------------|-------|--------------------------|----------------|---------------------|
| Aud    | Auditoriums                   | Exam  | Medical exam rooms       | Offop          | Open Office         |
| Class  | Classroom                     | Groc  | Grocery                  | Retail         | Retail              |
| Conf   | Conference rooms              | Gym   | Gyms                     | Ware           | Warehouses          |
| Core   | Building Core/lobby/bathrooms | Kit   | Kitchens                 | Show           | Wholesale showrooms |
| Corr   | Corridor                      | Mech  | Mech                     | Room           | Patient/hotel room  |
| Eating | Eating areas                  | Offcl | Enclosed Office (<300sf) | <i>specify</i> | Other               |

<sup>2</sup>If fixture counts are for portion of area enter XXX of YYY. XXX=area surveyed, YYY=total area

<sup>3</sup>See lighting control reference, enter all the apply. Do not leave control blank.

### Fixtures to NOT Survey

1. Emergency lighting that is automatically OFF during normal building operation.
2. Lighting that is part of machines, equipment or furniture.except refrigerated case lighting.
3. Technical production lights in theaters.





# Mechanical

Individual Package equipment [Yes] [No] [Unknown]  
 Built up system [Yes] [No] [Unknown]  
 Single Zone equipment [Yes] [No] [Unknown]  
 Multi Zone equipment [Yes] [No] [Unknown]  
 Primary Sys Heating Fuel [Gas] [Oil] [Electric] [Heat Pump] [ ] [Unknown]  
 Secondary Sys Heating Fuel [Gas] [Oil] [Electric] [Heat Pump] [ ] [Unknown]  
 Reheat Fuel [Gas] [Oil] [Electric] [ ] [Unknown] [None]

Designer (name,firm & #) \_\_\_\_\_

**All Systems** -Quickly describe the HVAC and controls. For multi-zone/build-up systems **describe with reference to boiler, chiller, and delivery system numbers and other components.**

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| Space Or Sys Id | Thermostat Type <sup>1</sup> | EMS ( y / n ) | Scheduling       |                   |                     | Fan Setting | Vent Reset <sup>2</sup> | Optimum Start (y/n/na) | Warmup OA lockout (y/n/na) | Humidity Control Var <sup>3</sup> | Humidity Devices <sup>4</sup> |
|-----------------|------------------------------|---------------|------------------|-------------------|---------------------|-------------|-------------------------|------------------------|----------------------------|-----------------------------------|-------------------------------|
|                 |                              |               | Setback (y/n/na) | Off days (y/n/na) | Occ. Override (y/n) |             |                         |                        |                            |                                   |                               |
|                 |                              |               |                  |                   |                     |             |                         |                        |                            |                                   |                               |
|                 |                              |               |                  |                   |                     |             |                         |                        |                            |                                   |                               |
|                 |                              |               |                  |                   |                     |             |                         |                        |                            |                                   |                               |
|                 |                              |               |                  |                   |                     |             |                         |                        |                            |                                   |                               |
|                 |                              |               |                  |                   |                     |             |                         |                        |                            |                                   |                               |
|                 |                              |               |                  |                   |                     |             |                         |                        |                            |                                   |                               |
|                 |                              |               |                  |                   |                     |             |                         |                        |                            |                                   |                               |

- 1 – Programmable, Manual, or Slave (sensor for EMS)
- 2 – None, CO2, **Schedule**, **Occupancy Sensor**, Unknown
- 3 – None, RH, Humidity Ratio, Enthalpy, Unknown, Other (specify)
- 4 – None, Cooling Coil, Steam Injection, Unknown, Other (specify)

**If EMS:**

Programmer(name,co,#): \_\_\_\_\_

Manufacturer: \_\_\_\_\_

**Duct Location and Insulation**

| Location (describe) | Amount of Duct Work <sup>1</sup> | Duct Insulation <sup>2</sup> |
|---------------------|----------------------------------|------------------------------|
| Interior            |                                  |                              |
| Buffer Area         |                                  |                              |
| Outside             |                                  |                              |
|                     |                                  |                              |

- 1 Amount of Duct Work - All, Some, None, NA, Unknown
- 2 Duct Insulation R-value, or yes/no

**Package Equipment – (from plans, verified where possible in field)**

| Unit Dsg <sup>1</sup> | Space ID <sup>2</sup> | Qty | Equip Type (see notes) | Fan HP (S/R) <sup>3</sup> | CFM | Min OA <sup>4</sup> | Econo (y/n) | Cooling          |                        | Fuel | Heating          |           |
|-----------------------|-----------------------|-----|------------------------|---------------------------|-----|---------------------|-------------|------------------|------------------------|------|------------------|-----------|
|                       |                       |     |                        |                           |     |                     |             | Output Cap+Units | Eff+Units <sup>5</sup> |      | Output Cap+Units | Eff+Units |
| Brand, Model:         |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| _____                 |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| Brand, Model:         |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| _____                 |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| Brand, Model:         |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| _____                 |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| Brand, Model:         |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| _____                 |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| Brand, Model:         |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| _____                 |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| Brand, Model:         |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| _____                 |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| Brand, Model:         |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| _____                 |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| Brand, Model:         |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |
| _____                 |                       |     |                        |                           |     |                     |             |                  |                        |      |                  |           |

<sup>1</sup> Enter unit designation to be referred to by multizone form if equipment is part of built up or multizone system  
<sup>2</sup> Enter SPACE ID if single zone package equipment. <sup>3</sup> Only for larger equipment or if very easily available.  
<sup>4</sup> Specify minimum outside air fraction. Add “co2” for demand control ventilation equipment. <sup>5</sup> Enter CW if cooling provided by chilled water

|   |   |  |
|---|---|--|
| <p><b>EQUIPMENT TYPE NOTES</b><br/> Codes can be found in references. ADD <b>WC</b> for water cooled, <b>EV</b> for evaporative cooled. ADD <b>IV</b> for inlet vane and <b>ASD</b> for adjustable speed drive.</p> | <p><b>CAPACITY UNITS</b><br/> KW HP (<i>horsepower</i>)<br/> KBTU TON<br/> MBTU MMBTU<br/> IF CAPACITY IS INPUT ADD “<b>IN</b>” SUFFIX TO UNITS</p> | <p><b>HEATING FUELS</b><br/> E = ELECTRICITY<br/> G = NATURAL GAS<br/> HW = HOT WATER<br/> OIL = FUEL OIL / DIESEL<br/> P = PROPANE / BUTANE<br/> OTHER (<i>SPECIFY</i>)</p> |
|---|---|--|

# MultiUse and Built Up Systems

Delivery System # \_\_\_: This system provides \_\_\_heat \_\_\_cool \_\_\_vent

From Plans? Y / N  
Field Verified? Y / N

Space ID Served: SPACE-  
Description:

System Type: \_\_\_\_\_

Configuration [package] [built-up] [unknown]

Total CFM \_\_\_\_\_ MinOA \_\_\_\_\_ Enter fraction or cfm depending upon how controlled

Economizer [Yes] [No] [NA] [Unknown]

Economizer Type [air] [water] [NA] [Unknown]

Sub-Zone Reheat [Yes] [No] [NA] [Unknown] Reheat Fuel Type: \_\_\_\_\_

Humidifier [Yes] [No] [NA] [Unknown] Type: \_\_\_\_\_

Dehumidifier [Yes] [No] [NA] [Unknown] Type: \_\_\_\_\_

Heat Source(reference to boiler, or none): \_\_\_\_\_

Cool Source (ref. to chiller/tower or none): \_\_\_\_\_

Fans Serving (reference to fan number): \_\_\_\_\_

Package Eq Number (ref. to pkg number): \_\_\_\_\_

Terminal Units (ref. to terminal number): \_\_\_\_\_

Control Strategies (*this system. Describe strategy. List duct static pressure and design deck temperature, and bounds of reset schedules if known*)

Description:

Specific items:

[ ] OA control [fixed pct] [fixed cfm] [Occ] [CO2] [Sch] [unknown][Other] \_\_\_\_\_

[ ] terminal minimum reset [Y] [N] [unknown]

[ ] Deck Temp. Reset [Y] [N] [n/a] [unknown]

[ ] Deck Pressure Reset [Y] [N] [n/a] [unknown]

[ ] Deck Reset Based on [OAT] [ZT] [BoxDamper] [unknown] ] [Other] \_\_\_\_\_

[ ] Night Time "setback" [Y] [N] [n/a] [unknown]

Setback Duration \_\_\_\_\_

[ ] Terminal fan speed [Constant] [Variable] [n/a] [unknown]

[ ] Heat Recovery [Refrigeration] [Exhaust Air] [None] [unknown] [Other] \_\_\_\_\_

| SYSTEM TYPE CODES |                                 | SYSTEM TYPE CODES, CONTINUED |                       |
|-------------------|---------------------------------|------------------------------|-----------------------|
| CV                | CONSTANT VOLUME (REHEAT)        | UAFD                         | UNDERFLOOR SYSTEM     |
| VAV               | VARIABLE AIR VOLUME             | SPECIFY OTHER SYSTEMS        |                       |
| SZVAV             | SINGLE ZONE VARIABLE AIR VOLUME | <b>FUEL TYPE CODES</b>       |                       |
| HPLP              | HEAT PUMP LOOP                  | E                            | ELECTRICITY           |
| VVT               | VARIABLE VOLUME-TEMPERATURE     | NG                           | NATURAL GAS           |
| 2PFC              | TWO PIPE FAN COIL               | OIL                          | FUEL OIL / DIESEL     |
| 4PFC              | FOUR PIPE FAN COIL              | HW                           | HOT WATER FROM BOILER |
|                   |                                 | OTHER (SPECIFY)              |                       |

**Boilers**

| Unit Dsg     | Qty   | Fuel  | Load Type | Boiler Type | Burner Type | Output Cap | Cap Units | Eff.  | Eff Units | Control Type <sup>1</sup> |
|--------------|-------|-------|-----------|-------------|-------------|------------|-----------|-------|-----------|---------------------------|
| Make, Model: |       |       |           |             |             |            |           |       |           |                           |
| _____        | _____ | _____ | _____     | _____       | _____       | _____      | _____     | _____ | _____     | _____                     |
| Make, Model: |       |       |           |             |             |            |           |       |           |                           |
| _____        | _____ | _____ | _____     | _____       | _____       | _____      | _____     | _____ | _____     | _____                     |
| Make, Model: |       |       |           |             |             |            |           |       |           |                           |
| _____        | _____ | _____ | _____     | _____       | _____       | _____      | _____     | _____ | _____     | _____                     |
| Make, Model: |       |       |           |             |             |            |           |       |           |                           |
| _____        | _____ | _____ | _____     | _____       | _____       | _____      | _____     | _____ | _____     | _____                     |
| Make, Model: |       |       |           |             |             |            |           |       |           |                           |
| _____        | _____ | _____ | _____     | _____       | _____       | _____      | _____     | _____ | _____     | _____                     |
| Make, Model: |       |       |           |             |             |            |           |       |           |                           |
| _____        | _____ | _____ | _____     | _____       | _____       | _____      | _____     | _____ | _____     | _____                     |

<sup>1</sup>include all applicable control strategies

**Do steam condensate return and process hot water return [y] [n] [NA] Describe:**

|  |   |
|--|---|
| <p><b>FUEL TYPE CODES</b></p> <p>E ELECTRICITY<br/>         NG NATURAL GAS<br/>         OIL FUEL OIL / DIESEL<br/>         GO GAS/OIL (DUEL FUEL)<br/>         P PROPANE / BUTANE<br/>         WH WASTE<br/>         ST STEAM (<i>purchased from outside</i>)<br/>         OTHER (<i>SPECIFY</i>) _____</p> <p><b>LOAD TYPES</b></p> <p>S SPACE HEAT ONLY<br/>         SW SPACE HEAT AND WATER HEAT<br/>         W WATER HEAT ONLY<br/>         P PROCESS HOT WATER HEATING<br/>         OTHER (<i>SPECIFY</i>) _____</p> <p><b>BOILER TYPES</b></p> <p>HW HOT WATER<br/>         S STEAM<br/>         HWD DIRECT HOT WATER (NO HX)<br/>         SD DIRECT STEAM (NO HX)</p> | <p><b>BURNER TYPE</b></p> <p>NAT = NATURAL DRAFT<br/>         PWR = POWER DRAFT</p> <p><b>CAPACITY UNITS</b></p> <p>KBTU<br/>         MMBTU<br/>         HP(<i>horsepower</i>)<br/>         KW<br/>         OTHER (<i>SPECIFY</i>) _____</p> <p><b>CONTROL TYPE CODES</b></p> <p>B1 CYCLING<br/>         B2 TEMPERATURE RESET<br/>         B3 O2 TRIM CONTROL<br/>         B4 MODULATING<br/>         B5 STAGED</p> |
|--|---|

## Chillers

| Unit Dsg     | Qty   | Cap   | Cap Units | Compressor Type | Eff   | Eff Units | Heat Recovery (y/n) | Staged | Control Type <sup>1</sup> | Refrigerant |
|--------------|-------|-------|-----------|-----------------|-------|-----------|---------------------|--------|---------------------------|-------------|
| Make, Model: |       |       |           |                 |       |           |                     |        |                           |             |
| _____        | _____ | _____ | _____     | _____           | _____ | _____     | _____               | _____  | _____                     | _____       |
| Make, Model: |       |       |           |                 |       |           |                     |        |                           |             |
| _____        | _____ | _____ | _____     | _____           | _____ | _____     | _____               | _____  | _____                     | _____       |
| Make, Model: |       |       |           |                 |       |           |                     |        |                           |             |
| _____        | _____ | _____ | _____     | _____           | _____ | _____     | _____               | _____  | _____                     | _____       |
| Make, Model: |       |       |           |                 |       |           |                     |        |                           |             |
| _____        | _____ | _____ | _____     | _____           | _____ | _____     | _____               | _____  | _____                     | _____       |

<sup>1</sup> include all applicable control strategies

| COMPRESSOR TYPE |                            | CAPACITY UNIT CODES       |                   |
|-----------------|----------------------------|---------------------------|-------------------|
| CENT            | CENTRIFIGAL                | KBTU                      |                   |
| SCREW           | ROTARY SCREW CHILLER       | MMBTU                     |                   |
| RECIP           | RECIPROCATING              | HP(horsepower)            |                   |
| SCRO            | SCROLL                     | TON                       |                   |
| ABO             | ABSORPTION FROM OIL        | OTHER (SPECIFY) _____     |                   |
| ABG             | ABSORPTION FROM GAS        |                           |                   |
| ABW             | ABSORPTION FROM WASTE HEAT | <b>CONTROL TYPE CODES</b> |                   |
| ABS             | ABSORPTION FROM STEAM      | C1                        | TEMPERATURE RESET |
| OTHER (SPECIFY) |                            | C2                        | MODULATING        |
|                 |                            | C3                        | MODULATING -VFD   |

## Cooling Towers/Dry Cooler

| Unit ID | Qty | Equip Type | GPM | Cap | Dt <sup>1</sup> | EWT | LWT | Temp Control | Cap Control | # of Fans <sup>2</sup> | Fan HP | Fan BHP | Fan Eff |
|---------|-----|------------|-----|-----|-----------------|-----|-----|--------------|-------------|------------------------|--------|---------|---------|
|---------|-----|------------|-----|-----|-----------------|-----|-----|--------------|-------------|------------------------|--------|---------|---------|

|              |       |       |       |       |       |       |       |       |       |       |       |       |       |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Make, Model: |       |       |       |       |       |       |       |       |       |       |       |       |       |
| _____        | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| Make, Model: |       |       |       |       |       |       |       |       |       |       |       |       |       |
| _____        | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| Make, Model: |       |       |       |       |       |       |       |       |       |       |       |       |       |
| _____        | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| Make, Model: |       |       |       |       |       |       |       |       |       |       |       |       |       |
| _____        | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |

1 approach temperature  
2 enter zero for natural draft units

| EQUIPMENT TYPE CODES             |                               | CAPACITY CONTROL CODES |                 |
|----------------------------------|-------------------------------|------------------------|-----------------|
| DC                               | DRY COOLER                    | SS                     | SINGLE SPEED    |
| CT                               | COOLING TOWER - DIRECT        | TS                     | TWO SPEED       |
| CTHX                             | COOLING TOWER - INDIRECT      | VS                     | MODULATING -VFD |
| <b>TEMPERATURE CONTROL CODES</b> |                               | FB                     | FLUID BYPASS    |
| FX                               | FIXED TEMPERATURE - NO RESET  | STG                    | STAGED          |
| WB                               | TEMPERATURE RESET ON WET BULB | OTHER (SPECIFY) _____  |                 |
| DB                               | TEMPERATURE RESET ON DRY BULB |                        |                 |
| OTHER (SPECIFY)                  | _____                         |                        |                 |

**Fans** (1HP and larger, from plans field verified where possible. Do not include fans in package units)

| Unit Dsg | Qty   | HP    | BHP   | Work Type | Control <sup>1</sup> | -----Motor----- |           | Dsgn Flow | Ext. Dsgn dP | Vane Axial? |
|----------|-------|-------|-------|-----------|----------------------|-----------------|-----------|-----------|--------------|-------------|
|          |       |       |       |           |                      | Eff (plans)     | Eff (fld) |           |              |             |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |
| _____    | _____ | _____ | _____ | _____     | _____                | _____           | _____     | _____     | _____        | _____       |

<sup>1</sup>include all applicable control strategies

| WORK TYPE                              | CONTROL TYPE CODES          |
|--|-----------------------------|
| AHU = SUPPLY&RETURN FAN                | F1 = CONSTANT               |
| SF = SUPPLY FAN                        | F2 = MULTI-SPEED MOTOR      |
| RF = RETURN FAN                        | F3 = INLET VANES            |
| EF = EXHAUST FAN                       | F4 = CONE                   |
| EFGR = GARAGE EXHAUST                  | F5 = ASD-VFD                |
| CT= COOLING TOWER                      | F6 = DISCHARGE DAMPER       |
| INTR = OTHER INTERMITTENT FAN          | F7 = BYPASS DAMPER          |
| CONT= OTHER CONTINUOUS FAN (>1000 HRS) | F8 = CYCLING ON THERMOSTAT  |
| HOOD = KITCHEN/LAB EXHAUST HOOD        | F9 = CYCLING ON AIR QUALITY |
|  | F10 = VARIABLE PITCH        |

**Pumps** (1HP and larger, from plans field verified where possible.)

| Unit Dsg | Qty   | HP    | BHP   | Work Type | Control <sup>1</sup> | Eff (plans) | Eff (fld) | Dsgn Flow | Dsgn dP |
|----------|-------|-------|-------|-----------|----------------------|-------------|-----------|-----------|---------|
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |
| _____    | _____ | _____ | _____ | _____     | _____                | _____       | _____     | _____     | _____   |

<sup>1</sup>include all applicable control strategies

| WORK TYPE                                | CONTROL TYPE CODES           |
|--|------------------------------|
| PCC= PRIMARY CHILLED WATER CIRCULATION   | P1 = CONSTANT                |
| SCC= SECONDARY CHILLED WATER CIRCULATION | P2 = CYCLING ON DEMAND       |
| PHC= PRIMARY HOT WATER CIRCULATION       | P3 = DISCHARGE VALVE         |
| SHC= SECONDARY HOT WATER CIRCULATION     | P4 = ASD-VFD                 |
| CN=CONDENSOR WATER                       | P5 = STAGED WITH OTHER PUMPS |
| HP=WATER SOURCE HEAT PUMP CIRCULATION    | P6 = SPEEDS STAGED           |
| INTR = OTHER INTERMITTENT PUMP           | P7 = BYPASS VALVE            |
| CONT= OTHER CONTINUOUS PUMP (>1000 HRS)  |                              |
| DB = Domestic water booster pump         |                              |





**Domestic/Service Hot Water**

General System Type

- None
- Individual water heating tank(s)
- Central Boiler(s) (for water heating only): Indicated Boiler #: \_\_\_\_\_
- Central boiler (combined with space heating): Indicated Boiler #: \_\_\_\_\_
- Other (Please specify)
- Don't Know

Heat Exchanger to storage tank? [y] [n] [?]

Circulation Loop [y] [n] [?]

Water Uses (Mark ALL boxes that apply)

|                    |   |                              |    |
|--------------------|---|------------------------------|----|
| Kitchenette .....  | 1 | Commercial Kitchen .....     | 6  |
| Lavatory .....     | 2 | Commercial Dishwasher .....  | 7  |
| Showers .....      | 3 | Sterilization .....          | 8  |
| Laundry .....      | 4 | Other (Please Specify) ..... | 9  |
| Commercial Laundry | 5 | Don't Know                   | 10 |

Service Hot Water Heater System Info (DHW tanks and storage tanks)

| Qty   | Fuel <sup>1</sup> | Storage<br>(gallons) | Cap   | Cap<br>Units | Eff.  | Eff Units | Space ID | Manu, Model |
|-------|-------------------|----------------------|-------|--------------|-------|-----------|----------|-------------|
| _____ | _____             | _____                | _____ | _____        | _____ | _____     | _____    | _____       |
| _____ | _____             | _____                | _____ | _____        | _____ | _____     | _____    | _____       |
| _____ | _____             | _____                | _____ | _____        | _____ | _____     | _____    | _____       |
| _____ | _____             | _____                | _____ | _____        | _____ | _____     | _____    | _____       |
| _____ | _____             | _____                | _____ | _____        | _____ | _____     | _____    | _____       |
| _____ | _____             | _____                | _____ | _____        | _____ | _____     | _____    | _____       |
| _____ | _____             | _____                | _____ | _____        | _____ | _____     | _____    | _____       |
| _____ | _____             | _____                | _____ | _____        | _____ | _____     | _____    | _____       |

<sup>1</sup> Enter fuel code or boiler number

|   |  |
|---|--|
| <p><b>FUEL TYPE CODES</b></p> <p>E ELECTRICITY</p> <p>NG NATURAL GAS</p> <p>OIL FUEL OIL / DIESEL</p> <p>GO GAS/OIL (DUEL FUEL)</p> <p>P PROPANE / BUTANE</p> <p>WH WASTE</p> <p>ST STEAM (purchased from outside)</p> <p>OTHER (SPECIFY)</p> | <p><b>CAPACITY UNITS</b></p> <p>KBTU</p> <p>MMBTU</p> <p>HP(horsepower)</p> <p>KW</p> <p>OTHER (SPECIFY) _____</p> |
|---|--|

## Miscellaneous

**Heat Recovery Equipment** [Yes] [No] [NA] [Unknown]

| From | To | Capacity/units |
|------|----|----------------|
|      |    |                |
|      |    |                |
|      |    |                |

| HR FROM TYPES  | HR TO TYPES  | CAPACITY UNITS |
|--|--|----------------|
| BUILDING EXHAUST AIR<br>COMBUSTION FLUE GASES<br>LAUNDRY DRYER EXHAUST<br>WASTE WATER<br>REFRIGERATION EQUIPMENT<br>RANGE HOOD<br>DISHWASHER HOOD<br>OTHER (SPECIFY) | SERVICE HOT WATER<br>SPACE HEAT<br>OTHER (SPECIFY) | CFM<br>BTU     |

## Pools and Spas

Indicate the surface area of pools or spas. Indicate "None" if not present.

| Equipment<br>Spa/Pool/None | Surface<br>Area | Indoor /<br>Outdoor | Conditioned<br>Space | Humidity<br>Control | Cover<br>Used | Heater<br>Type | Fuel Type | Boiler<br>Reference | Months<br>Heated |
|----------------------------|-----------------|---------------------|----------------------|---------------------|---------------|----------------|-----------|---------------------|------------------|
|                            |                 | I O                 | Y N                  | Y N                 | Y N           |                |           |                     |                  |
|                            |                 | I O                 | Y N                  | Y N                 | Y N           |                |           |                     |                  |
|                            |                 | I O                 | Y N                  | Y N                 | Y N           |                |           |                     |                  |
|                            |                 | I O                 | Y N                  | Y N                 | Y N           |                |           |                     |                  |

| HEATER TYPE CODES   | FUEL TYPE CODES  |
|---|--|
| CB CENTRAL BOILER<br>SAB STAND-ALONE BOILER<br>RES ELECTRIC RESISTANCE<br>HP HEAT PUMP<br>NONE<br>OTHER (SPECIFY) | E ELECTRICITY<br>NG NATURAL GAS<br>OIL FUEL OIL / DIESEL<br>P PROPANE / BUTANE<br>WH WASTE<br>ST STEAM (purchased from outside)<br>OTHER (SPECIFY) |

**Specific Miscellania**

| Functional Use Type     | Equipment  | Space <sup>1</sup>           | Space <sup>1</sup> | Space <sup>1</sup> |               |
|-------------------------|--|------------------------------|--------------------|--------------------|---------------|
| Retail/ Grocery         | Point-of-use terminals (#)                           |                              |                    |                    |               |
|                         | Area of Mezzanines.                                  |                              |                    |                    |               |
|                         | Area of Outdoor Compressor Building                  |                              |                    |                    |               |
|                         | Food Prep - Meat Dept.                               | Y N                          | Y N                | Y N                |               |
|                         | Food Prep – Bakery                                   | Y N                          | Y N                | Y N                |               |
|                         | Food Prep – Deli                                     | Y N                          | Y N                | Y N                |               |
| Office                  | Occupants (#)  |                              |                    |                    |               |
|                         | PCs (#)  |                              |                    |                    |               |
| Warehouse               | Forklifts – gas / propane ( <i>circle fuel</i> ) (#) |                              |                    |                    |               |
|                         | Forklifts - electric (#)                             |                              |                    |                    |               |
|                         | Non-forklift electric vehicles (#)                   |                              |                    |                    |               |
| Health                  | Beds (#)   |                              |                    |                    |               |
|                         | Patient Nights (#)                                   |                              |                    |                    |               |
|                         | PCs (#)  |                              |                    |                    |               |
|                         | Labs (SF)  |                              |                    |                    |               |
|                         | Laundry Facility                                     | Y N                          | Y N                | Y N                |               |
| Lodging & Fire Stations | Rooms (#)  |                              |                    |                    |               |
|                         | Average occupancy (%)                                |                              |                    |                    |               |
|                         | Laundry Facility                                     | Y N                          | Y N                | Y N                |               |
| Residential             | Units (#)  |                              |                    |                    |               |
|                         | Bedrooms (#)   |                              |                    |                    |               |
| School                  | Students (#)   |                              |                    |                    |               |
|                         | Student Capacity (SPI) (#)                           |                              |                    |                    |               |
|                         | Classrooms (#)                                       |                              |                    |                    |               |
|                         | PCs (#)  |                              |                    |                    |               |
|                         | Area of Mechanical Mezzanine                         |                              |                    |                    |               |
| <b>ALL BUILDINGS</b>    | <b>Electric / Gas</b>                                |                              | <b>Space:</b>      | <b>Space:</b>      | <b>Space:</b> |
| Kitchens                | Is Kitchen present?                                  |                              | Y N                | Y N                | Y N           |
|                         | Kitchen type: Full Service or Warming                |                              | F W                | F W                | F W           |
|                         | Number of Meals Served/day (#)                       |                              |                    |                    |               |
|                         | Broilers (SF) E G                                    |                              |                    |                    |               |
|                         | Fryers (vats) (#) E G                                |                              |                    |                    |               |
|                         | Griddle / Grill (LF) E G                             |                              |                    |                    |               |
|                         | Oven - Baking (CF) E G                               |                              |                    |                    |               |
|                         | Oven - Convection (#) E G                            |                              |                    |                    |               |
|                         | Oven - General (CF) E G                              |                              |                    |                    |               |
|                         | Range – Top (#burners) E G                           |                              |                    |                    |               |
|                         | Steam Kettle (#) E G                                 |                              |                    |                    |               |
|                         | Food on washable plates                              |                              | Y N                | Y N                | Y N           |
|                         | Dishwater Booster Heater (#) E G                     |                              |                    |                    |               |
|                         | Laundry  | Is laundry facility present? |                    | Y N                | Y N           |
|                         | Dryer – Commercial (#) E G                           |                              |                    |                    |               |
|                         | Dryer – Residential (#) E G                          |                              |                    |                    |               |
|                         | Washer – Commercial (#) E G                          |                              |                    |                    |               |
|                         | Washer – Residential (#) E G                         |                              |                    |                    |               |
| Misc Equipment          | Air Compressors (HP) E G                             |                              |                    |                    |               |
|                         | Kilns/Industrial Furnaces (hcap) E G                 |                              |                    |                    |               |
|                         | Cogeneration (MW) E G                                |                              |                    |                    |               |
|                         | Vehicle Refueling (#) E G                            |                              |                    |                    |               |
|                         | Other ( <i>Describe</i> ) (#) E G                    |                              |                    |                    |               |
|                         | Other ( <i>Describe</i> ) (#) E G                    |                              |                    |                    |               |
|                         | Other ( <i>Describe</i> ) (#) E G                    |                              |                    |                    |               |
|                         | Other ( <i>Describe</i> ) (#) E G                    |                              |                    |                    |               |

<sup>1</sup> – Space here refers to specific ownership or metering. A school would have a single entry even though it would have several space IDs. A stripmall might have three entries.

# REFRIGERATION EQUIPMENT

## Walk-Ins/Prep Areas

| Space Id | Unit Id | Description | Area | Height | Load kBtu | Doors ?<br>( yes-# / no) | Temp <sup>1</sup><br>L/M/H | Evaporator Fan Type<br>(ecm/std/?)? | Light Fixtures –<br>Type & number |
|----------|---------|-------------|------|--------|-----------|--------------------------|----------------------------|-------------------------------------|-----------------------------------|
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |
|          |         |             |      |        |           |                          |                            |                                     |                                   |

## Refrigerated Display Cases *(list each case)*

| Space Id | Unit Id | Description | Length | Load kBtu | Case Type <sup>1</sup> | Remote Comp<br>(y / n) | Temp <sup>2</sup><br>L/M/H | Doors?<br>( yes-# / no) | Anti-Sweat Controls? <sup>3</sup> | Fan Type<br>(ecm/std) | Lights <i>(fixture reference and count)</i> |
|----------|---------|-------------|--------|-----------|------------------------|------------------------|----------------------------|-------------------------|-----------------------------------|-----------------------|---|
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |
|          |         |             |        |           |                        |                        |                            |                         |                                   |                       |   |

1 – Coffin, upright ( back loading displays with walkin behind doors should have walkin and display case entry with note linking units.  
 2 – Low (freezer), Medium ( 30-40F), High (50-55F)

3 – No (watt doors), Low (watt doors), Std (standard doors), Unknown

## REFRIGERATION EQUIPMENT

### Condensers

| Unit Id | Type <sup>1</sup> | Fan HP (single fan) | Fan VSD y / n | Number of Fans | Cap (kbtu) | Design dT | Make, model |
|---------|-------------------|---------------------|---------------|----------------|------------|-----------|-------------|
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |
|         |                   |                     |               |                |            |           |             |

1 – Air-cooled, Air-cooled w/Pre-cooler, Close-approach, Evap-cooled, Water-cooled

### Compressors

| Unit Id | Type <sup>1</sup> | Temp <sup>2</sup> L/M/H | Total HP in rack | Tot kbtu Cap | Num | Unloaders or VSD Compressor | Refrigerant type | Floating Head Pressure (y/n) | Sub - Cool <sup>3</sup> | Heat Recovery <sup>4</sup> | Make, Model |
|---------|-------------------|-------------------------|------------------|--------------|-----|-----------------------------|------------------|------------------------------|-------------------------|----------------------------|-------------|
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |
|         |                   |                         |                  |              |     |                             |                  |                              |                         |                            |             |

1 – Reciprocating, Screw, Two-stage multiplex, Multiplex, Other---

2 – Low (freezer), Medium ( 30-40F), High (50-55F)

3 – Ambient, Mechanical, None

4 – None, Space heating/Reheat, Water heating, Other

---

Contact For More Detailed Information Name/Number

---

Component Area Take Offs - Gross Areas

| WALLS                 |              |          |            |                          |          |
|-----------------------|--------------|----------|------------|--------------------------|----------|
| Space ID <sup>1</sup> | Wall Type ID | Location | Gross Area | To Space ID <sup>2</sup> | Verified |
| SPACE-                | WALL-        |          |            |                          |          |
|                       |              |          |            |                          |          |
|                       |              |          |            |                          |          |
|                       |              |          |            |                          |          |
|                       |              |          |            |                          |          |

| CEILING/ROOFS |              |          |            |                          |          |
|---------------|--------------|----------|------------|--------------------------|----------|
| Space ID      | Roof Type ID | Location | Gross Area | To Space ID <sup>2</sup> | Verified |
| SPACE-        | ROOF-        |          |            |                          |          |
|               |              |          |            |                          |          |
|               |              |          |            |                          |          |
|               |              |          |            |                          |          |
|               |              |          |            |                          |          |

| FLOORS   |         |          |            |           |                          |          |
|----------|---------|----------|------------|-----------|--------------------------|----------|
| Space ID | Type ID | Location | Gross Area | Perimeter | To Space ID <sup>1</sup> | Verified |
| SPACE-   | FLR-    |          |            |           |                          |          |
|          |         |          |            |           |                          |          |
|          |         |          |            |           |                          |          |
|          |         |          |            |           |                          |          |
|          |         |          |            |           |                          |          |

<sup>1</sup> If no differences in conditioning, envelope can be for whole building. Leave space ID blank.

<sup>2</sup> For wall, roof/ceiling, floor to semi or unheated spaces only.

| WINDOWS  |                 |                |          |      |                 |                 |                  |                 |          |
|----------|-----------------|----------------|----------|------|-----------------|-----------------|------------------|-----------------|----------|
| Space ID | In Wall Type ID | Window Type ID | Location | Area | Area Dir: _____ | Area Dir: _____ | Area: Dir: _____ | Area Dir: _____ | Verified |
| SPACE-   | WALL-           | WIN-           |          |      |                 |                 |                  |                 |          |
|          |                 |                |          |      |                 |                 |                  |                 |          |
|          |                 |                |          |      |                 |                 |                  |                 |          |
|          |                 |                |          |      |                 |                 |                  |                 |          |
|          |                 |                |          |      |                 |                 |                  |                 |          |

| SKYLIGHTS – enter tilt in location ( 0=horizontal, 90=vertical) |              |                |          |      |                 |                 |                  |                 |          |
|---|--------------|----------------|----------|------|-----------------|-----------------|------------------|-----------------|----------|
| Space ID  | Roof Type ID | Window Type ID | Location | Area | Area Dir: _____ | Area Dir: _____ | Area: Dir: _____ | Area Dir: _____ | Verified |
| SPACE-  | ROOF-        | WIN-           |          |      |                 |                 |                  |                 |          |
|   |              |                |          |      |                 |                 |                  |                 |          |
|   |              |                |          |      |                 |                 |                  |                 |          |
|   |              |                |          |      |                 |                 |                  |                 |          |

| DOORS    |                 |              |          |      |                 |                 |                  |                 |          |
|----------|-----------------|--------------|----------|------|-----------------|-----------------|------------------|-----------------|----------|
| Space ID | In Wall Type ID | Door Type ID | Location | Area | Area Dir: _____ | Area Dir: _____ | Area: Dir: _____ | Area Dir: _____ | Verified |
| SPACE-   | WALL-           | DOOR-        |          |      |                 |                 |                  |                 |          |
|          |                 |              |          |      |                 |                 |                  |                 |          |
|          |                 |              |          |      |                 |                 |                  |                 |          |
|          |                 |              |          |      |                 |                 |                  |                 |          |

| Wall Types  | ID:  |  |  |  |
|---|--|--|--|--|
| <b>Plans U-Factor:</b>  |  |  |  |  |
| Wall Type: AG-Above Grade<br>BG-Below Grade, spec avg Depth (ft)<br>BUF-Buffer<br>RJ-Rim Joist<br>Specify                                       | AG<br>BG _____<br>BUF<br>RJ  | AG<br>BG _____<br>BUF<br>RJ  | AG<br>BG _____<br>BUF<br>RJ  | AG<br>BG _____<br>BUF<br>RJ  |
| <b>Structure</b>  |  |  |  |  |
| Framed – yes, no<br>Material: W-wood<br>M-Metal<br>U-Unknown<br>Specify:<br>Thickness: 4 – 4 inches<br>6 – 6 inches<br>Specify:<br>Stud spacing | <input type="checkbox"/><br>W<br>M<br>U<br>[2x4]<br>[2x6]<br>[16"] [24"]<br>[48"] [n/a]<br>[unknown] | <input type="checkbox"/><br>W<br>M<br>U<br>[2x4]<br>[2x6]<br>[16"] [24"]<br>[48"] [n/a]<br>[unknown] | <input type="checkbox"/><br>W<br>M<br>U<br>[2x4]<br>[2x6]<br>[16"] [24"]<br>[48"] [n/a]<br>[unknown] | <input type="checkbox"/><br>W<br>M<br>U<br>[2x4]<br>[2x6]<br>[16"] [24"]<br>[48"] [n/a]<br>[unknown] |
| Concrete<br>Thickness   | <input type="checkbox"/><br>[6"] [8"]  | <input type="checkbox"/><br>[6"] [8"]  | <input type="checkbox"/><br>[6"] [8"]  | <input type="checkbox"/><br>[6"] [8"]  |
| Concrete blocks<br>Thickness  | <input type="checkbox"/><br>[4"] [6"] [8"]   | <input type="checkbox"/><br>[4"] [6"] [8"]   | <input type="checkbox"/><br>[4"] [6"] [8"]   | <input type="checkbox"/><br>[4"] [6"] [8"]   |
| Brick<br>Thickness  | <input type="checkbox"/><br>[4"] [8"] [12"]  | <input type="checkbox"/><br>[4"] [8"] [12"]  | <input type="checkbox"/><br>[4"] [8"] [12"]  | <input type="checkbox"/><br>[4"] [8"] [12"]  |
| Curtain wall  | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   |
| Other (panels, foam forms, etc.) describe:  |  |  |  |  |
| <b>Insulation</b> Sum of installed R-value  | R-_____  | R-_____  | R-_____  | R-_____  |
| Batts - check if present. Specify R if known  | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   |
| Rigid - check if present. Specify R if known<br>Thickness (in.):<br>Location: I-interior, E-Exterior  | <input type="checkbox"/> R-_____<br>In-_____<br>I E  | <input type="checkbox"/> R-_____<br>In-_____<br>I E  | <input type="checkbox"/> R-_____<br>In-_____<br>I E  | <input type="checkbox"/> R-_____<br>In-_____<br>I E  |
| Spray On R  | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   |
| Thermal block between siding and purlin   | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   | <input type="checkbox"/> R-_____   |
| CMU Cores:<br>UN-Uninsulated<br>LF- Loosefill cores<br>RI- Rigid Inserts  | <input type="checkbox"/><br>UN<br>LF<br>RI   | <input type="checkbox"/><br>UN<br>LF<br>RI   | <input type="checkbox"/><br>UN<br>LF<br>RI   | <input type="checkbox"/><br>UN<br>LF<br>RI   |
| Other: specify  |  |  |  |  |
| <b>Metal Building</b>   | Y N  | Y N  | Y N  | Y N  |
| insulation compressed between siding & purlin   | Y N  | Y N  | Y N  | Y N  |
| insulation fills between purlins  | Y N  | Y N  | Y N  | Y N  |
| thermal block between siding and purlin   | Y N  | Y N  | Y N  | Y N  |
| Sheet metal siding  | Y N  | Y N  | Y N  | Y N  |
| <b>Field Review:</b>  |  |  |  |  |
| This component was checked in the field   | Y N  | Y N  | Y N  | Y N  |

| <b>Roof Types</b>                              | <b>ID:</b>                       |                                  |                                  |                                  |
|--|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| <b>Plans U-Factor:</b>                         |                                  |                                  |                                  |                                  |
| <b>Structure</b>                               |                                  |                                  |                                  |                                  |
| WD -Wood Frame                                 | WD                               | WD                               | WD                               | WD                               |
| IJ - Wood I-joists                             | IJ                               | IJ                               | IJ                               | IJ                               |
| MT -Metal Truss                                | MT                               | MT                               | MT                               | MT                               |
| MP -Metal Purlins                              | MP                               | MP                               | MP                               | MP                               |
| CON -Concrete                                  | CON                              | CON                              | CON                              | CON                              |
| UNK -Unknown                                   | UNK                              | UNK                              | UNK                              | UNK                              |
| Other Describe:                                |                                  |                                  |                                  |                                  |
| <b>Misc</b>                                    |                                  |                                  |                                  |                                  |
| What is roof pitch?                            |                                  |                                  |                                  |                                  |
| Is Attic space present                         | Y<br>N                           | Y<br>N                           | Y<br>N                           | Y<br>N                           |
| <b>Insulation - Location</b>                   |                                  |                                  |                                  |                                  |
| AT - Attic                                     | Attic                            | Attic                            | Attic                            | Attic                            |
| BR - Built up roof                             | Built up                         | Built up                         | Built up                         | Built up                         |
| CAV - Framed Cavity                            | Cavity                           | Cavity                           | Cavity                           | Cavity                           |
| UND -Underside of roof – open cavity           | Open Cav                         | Open Cav                         | Open Cav                         | Open Cav                         |
| DROP-On dropped ceiling                        | Drop                             | Drop                             | Drop                             | Drop                             |
| OP - Between purlin & exterior roof            | Over Purlin                      | Over Purlin                      | Over Purlin                      | Over Purlin                      |
| BET - Between purlins                          | Between Purlin                   | Between Purlin                   | Between Purlin                   | Between Purlin                   |
| UNK -Unknown                                   | Unk                              | Unk                              | Unk                              | Unk                              |
| Other Describe:                                |                                  |                                  |                                  |                                  |
| <b>Insulation Sum of installed R-value</b>     | R-_____                          | R-_____                          | R-_____                          | R-_____                          |
| Batts - check if present. Specify R if known   | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ |
| Loose Fill - check if present. Specify R.      | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ |
| Rigid - check if present. Specify R if known   | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ |
| Thickness (in.):                               | In-_____                         | In-_____                         | In-_____                         | In-_____                         |
| Location: I-interior, E-Exterior               | I E                              | I E                              | I E                              | I E                              |
| Spray On R                                     | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ |
| Blanket - check if present. Specify R if known | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ |



|  |                                  |                                  |                                  |
|--|----------------------------------|----------------------------------|----------------------------------|
| Thermal block between roofing and purlin | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ | <input type="checkbox"/> R-_____ |
| Other: specify                           |                                  |                                  |                                  |
| <b>Metal Building</b>                    | Y N                              | Y N                              | Y N                              |
| Sheet metal roofing                      | Y N                              | Y N                              | Y N                              |
| <b>Field Review:</b>                     |                                  |                                  |                                  |
| This component was checked in the field  | Y N                              | Y N                              | Y N                              |

# FLOORS

Floor Type ID: FLR- \_\_\_\_\_

Plans U-Factor: \_\_\_\_\_

Description: \_\_\_\_\_

Over Crawl or buffer

## Structure

Frame  
Material [lumber] [I-joists] [metal]

Concrete  
Type [slab on grade] [below grade] [not in earth contact]  
for below grade slabs depth: \_\_\_\_\_

Other (panels, etc.) describe: \_\_\_\_\_

## Crawl Space

Venting [yes] [operable] [no] [unknown]

Insulation on perimeter wall R- \_\_\_\_\_

## Frame Insulation

Batts in joists R- \_\_\_\_\_

Continuous Rigid R- \_\_\_\_\_

Continuous Spray On R- \_\_\_\_\_

other: \_\_\_\_\_

## Slab/Concrete Insulation

none

perimeter: R- \_\_\_\_\_

center/underfloor: R- \_\_\_\_\_

extends to top of slab? [y] [n] [unknown]

inside or outside footing? [inside] [outside] [unknown]

## Field Review:

This component was checked in the field [y] [n]

## DOORS

|  |                                    |                                    |                                    |
|--|------------------------------------|------------------------------------|------------------------------------|
| <b>Door Type ID:</b>   |                                    |                                    |                                    |
| Plans U-Factor:  |                                    |                                    |                                    |
| Door Type<br>WD -Wood door<br>SD -Standard steel door<br>OD -Standard overhead door<br>CD -Coil door<br>IMD -Insulated metal door<br>IOD -Insulated overhead door<br>Other specify | WD<br>SD<br>OD<br>CD<br>ISD<br>IOD | WD<br>SD<br>OD<br>CD<br>ISD<br>IOD | WD<br>SD<br>OD<br>CD<br>ISD<br>IOD |
| Glazing<br>Percent Glazed<br>Layers  | Y N<br>_____<br>1 2                | Y N<br>_____<br>1 2                | Y N<br>_____<br>1 2                |
| Automatic door controls<br>describe  | Y N                                | Y N                                | Y N                                |
| Field Review:  | Y N                                | Y N                                | Y N                                |

|  |                                    |                                    |                                    |
|--|------------------------------------|------------------------------------|------------------------------------|
| <b>Door Type ID:</b>   |                                    |                                    |                                    |
| Plans U-Factor:  |                                    |                                    |                                    |
| Door Type<br>WD -Wood door<br>SD -Standard steel door<br>OD -Standard overhead door<br>CD -Coil door<br>ISD -Insulated steel door<br>IOD -Insulated overhead door<br>Other specify | WD<br>SD<br>OD<br>CD<br>ISD<br>IOD | WD<br>SD<br>OD<br>CD<br>ISD<br>IOD | WD<br>SD<br>OD<br>CD<br>ISD<br>IOD |
| Glazing<br>Percent Glazed<br>Layers  | Y N<br>_____<br>1 2                | Y N<br>_____<br>1 2                | Y N<br>_____<br>1 2                |
| Automatic door controls<br>describe  | Y N                                | Y N                                | Y N                                |
| Field Review:  | Y N                                | Y N                                | Y N                                |

# WINDOWS

Window Type ID: \_\_\_\_\_

|                    |                  |                         |
|--------------------|------------------|-------------------------|
|                    | Source:<br>_____ | Better Source:<br>_____ |
| U-Factor:          |                  |                         |
| Shade Coefficient: |                  |                         |
| SHGC:              |                  |                         |
| VLT:               |                  |                         |
| Center of Glass    | Y N ?            | Y N ?                   |

## Opening

- Window - Manufactured
- Window – Site Built
- Store Front
- Curtain wall
- Skylight
- Other \_\_\_\_\_

Description/Notes: \_\_\_\_\_

## Frame Material

- unknown
- vinyl
- wood
- aluminum      [thermal break]                      [no thermal break]
- other: \_\_\_\_\_

## Glazing

- Number of glazing layers:    [1]    [2]    [3]    [unknown]
- Low-ε coating:                      [y]    [n]                      [unknown] based on installer/documentation/or spacer
- Tinted:                                      [y]    [n]                      [unknown]
- Reflective                                      [y]    [n]                      [unknown]
- Gas filled:                                      [y]    [n]                      [unknown]
- Spacing:                                      [ ≤3/8" ]    [ ≥1/2" ]    [unknown]

## Low-E Meter Readings

- Low-ε coating                      [y]    [n]    [unknown] based on low-e meter
- Reading from INSIDE:                      [clear]    [near]    [far]
- Reading from OUTSIDE:                      [clear]    [near]    [far]

Frame Manufacturer,model: \_\_\_\_\_

Glass Manufacturer,model (plans): \_\_\_\_\_

Sealed Unit Manufacturer,model (plans): \_\_\_\_\_

Installer: \_\_\_\_\_

General Contractor: \_\_\_\_\_

Typical Head Height – First Floor \_\_\_\_\_, Middle Floor \_\_\_\_\_, Top Floor \_\_\_\_\_

Percent Operable: \_\_\_\_\_ Type: slider casement awning sngl hung dbl hung

Glass Manu/spacer info (middle floor or so):

|            |             |
|------------|-------------|
| Glass Manu | Spacer Info |
|            |             |

## Shading

| Orientation | Architectural Shade | Landscaping | Exposures |
|-------------|---------------------|-------------|-----------|
| North       |                     |             |           |
| East        |                     |             |           |
| South       |                     |             |           |
| West        |                     |             |           |

### LANDSCAPING

NONE  
 SCRUBS (1ST FLOOR OBSTRUCTIONS)  
 TREES ( 1ST AND SECOND FLOOR)  
 FOREST ( SHADING OF 3RD AND/OR 4TH FLOOR)

### EXPOSURES

**DO** - DOWNTOWN – GENERALLY OPEN EXPOSURE. ADJACENT BUILDINGS SHORTER BY LESS THAN THAN ½ OF DISTANCE BETWEEN  
**DP** - DOWNTOWN – PARTIALLY BLOCKED EXPOSURE. ADJACENT BUILDINGS OF SAME HEIGHT  
**DB** - DOWNTOWN – BLOCKED EXPOSURE. ADJACENT BUILDINGS TALLER BY 4 STORIES OR MORE  
**SO** - SUBURBAN – GENERALLY OPEN. ADJACENT BUILDINGS/TREES NO HIGHER THAN ½ OF DISTANCE BETWEEN.  
**SP** - SUBURBAN – PARTIALLY BLOCKED.  
**SB** - SUBURBAN – BLOCKED. ADJACENT BUILDINGS/TREES 2 TIMES HIGHER THAN THE DISTANCE BETWEEN.

### ARCHITECTURAL

EVE ON TOP FLOOR  
 EVE ON ALL FLOORS  
 AWNING  
 VERTICAL FINS ADJACENT TO WINDOWS  
 VERTICAL FINS OVER WINDOWS  
 HORIZONTAL FINS OVER WINDOWS  
 EXTERIOR BARS  
 INTERIOR BARS

## Interior Shades

| Space ID | Notes | North | East | South | West | Usage - % and timing |
|----------|-------|-------|------|-------|------|----------------------|
|          |       |       |      |       |      |                      |
|          |       |       |      |       |      |                      |
|          |       |       |      |       |      |                      |
|          |       |       |      |       |      |                      |

LS - LIGHT SHELF  
 VB - VENETIAN BLINDS  
 LV - LOUVERS

DR – DRAPES  
 IS - INTERIOR SIGNS/OBJECTS  
 ES - EXTERIOR SIGNS/OBJECTS

## Footcandle Profile *(lights off, if possible)* Skycover \_\_\_\_\_

| Space Identification, shade type & position, light status | Window |     | Time | Vertical (5') |           | Horizontal – at 3 foot height |         |         |         |         |         |
|---|--------|-----|------|---------------|-----------|-------------------------------|---------|---------|---------|---------|---------|
|   | Height | Dir |      | At window     | at 2 feet | 5 Feet                        | 10 feet | 15 feet | 20 feet | 25 feet | 30 feet |
|   |        |     |      |               |           |                               |         |         |         |         |         |
|   |        |     |      |               |           |                               |         |         |         |         |         |
|   |        |     |      |               |           |                               |         |         |         |         |         |

## Site Visit Checklist

|       |   |             |
|-------|---|-------------|
| _____ | Verify main HVAC type and configuration                                     | Pages 11-15 |
| _____ | Verify secondary systems type and configuration                             | Pages 11-15 |
| _____ | Get HVAC make and model   | Pages 11-15 |
| _____ | Verify major pump motor size and control, and get efficiency                | Page 16     |
| _____ | Verify major fan motor size and control, and get efficiency                 | Page 16     |
| _____ | Ask about commissioning? HVAC? Lighting?                                    | Page 3      |
| _____ | Utility Meters and Release  | Page 4      |
| _____ | Verify main lighting fixtures (assumes light takeoffs completed from plans) | Pages 6-8   |
| _____ | Determine lighting controls and schedule. Check local switching.            | Page 8      |
| _____ | Footcandle measurements of major space, fixture height                      | Page 8      |
| _____ | Photos – Interior looking out,  |             |
| _____ | Photos - Building Face and Exposure   |             |
| _____ | Glass Specification   | Page 29     |
| _____ | Glass Area, wall area   | Page 28     |
| _____ | Server Rooms  | Page 5      |
| _____ | Domestic Hot Water system Uses/cafeteria                                    | Page 18     |
| _____ | Miscellaneous Loads/ cafeterias   | Page 20     |
|       |   |             |

## Project Contacts

| <b>Name</b> | <b>Company</b> | <b>Role</b> | <b>Phone</b> | <b>notes</b> |
|-------------|----------------|-------------|--------------|--------------|
|             |                |             |              |              |
|             |                |             |              |              |
|             |                |             |              |              |
|             |                |             |              |              |
|             |                |             |              |              |
|             |                |             |              |              |

## Appendix B. Building Designer/Engineer Interview

Project Name: \_\_\_\_\_

Project ID: \_\_\_\_\_

Interviewees:

| Design Role                 | ID        |            | MT        |            | OR        |            | WA        |            | Total      |            |
|-----------------------------|-----------|------------|-----------|------------|-----------|------------|-----------|------------|------------|------------|
|                             | N         | %          | N         | %          | N         | %          | N         | %          | N          | %          |
| Architect/Envelope Designer | 19        | 61         | 9         | 60         | 18        | 56         | 37        | 51         | 83         | 55         |
| Mechanical Engineer         | 11        | 36         | 6         | 40         | 8         | 25         | 33        | 45         | 58         | 38         |
| Mechanical Contractor       | 0         | 0          | 0         | 0          | 4         | 13         | 0         | 0          | 4          | 3          |
| Other                       | 1         | 3          | 0         | 0          | 2         | 6          | 3         | 4          | 6          | 4          |
| <b>Total</b>                | <b>31</b> | <b>100</b> | <b>15</b> | <b>100</b> | <b>32</b> | <b>100</b> | <b>73</b> | <b>100</b> | <b>151</b> | <b>100</b> |

### 1. General Questions

First, we would like to obtain some general information about your firm.

1.1 How many employees are at your company?

| Design Role  | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|              | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| 1-5          | 4         | 12.90         | 4         | 26.67         | 6         | 26.67         | 6          | 8.22          | 20         | 13.25         |
| 11-25        | 15        | 48.39         | 2         | 13.33         | 11        | 34.38         | 13         | 17.81         | 41         | 27.15         |
| 26-100       | 6         | 19.35         | 3         | 20.00         | 8         | 25.00         | 27         | 36.99         | 44         | 29.14         |
| 6-10         | 3         | 9.68          | 0         | 0.00          | 3         | 9.38          | 5          | 6.85          | 11         | 7.28          |
| Over 100     | 3         | 9.68          | 6         | 40.00         | 4         | 12.50         | 22         | 30.14         | 35         | 23.18         |
| <b>Total</b> | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

1.2 What is your company's primary business?

| Primary Business     | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|----------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                      | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Architecture         | 19        | 61.29         | 9         | 60.00         | 18        | 56.25         | 34         | 46.58         | 80         | 52.98         |
| Engineering          | 10        | 32.26         | 6         | 40.00         | 11        | 34.38         | 35         | 47.95         | 62         | 41.06         |
| Other                | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 3          | 4.11          | 3          | 1.99          |
| Other Design Built   | 1         | 3.23          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 1          | 0.66          |
| Specialty Contractor | 1         | 3.23          | 0         | 0.00          | 3         | 9.38          | 1          | 1.37          | 5          | 3.31          |
| <b>Total</b>         | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

1.3 How many projects do you estimate your firm completes annually?

| Primary Business | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                  | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| 1-5              | 1         | 3.23          | 0         | 0.00          | 0         | 0.00          | 4          | 5.56          | 5          | 5.56          |
| 11-25            | 1         | 3.23          | 1         | 6.67          | 4         | 12.50         | 9          | 12.50         | 15         | 10.00         |
| 26-100           | 14        | 45.16         | 6         | 40.00         | 15        | 46.88         | 16         | 22.22         | 51         | 34.00         |
| 6-10             | 1         | 3.23          | 0         | 0.00          | 2         | 6.25          | 5          | 6.94          | 8          | 5.33          |
| Don't know       | 0         | 0.00          | 1         | 6.67          | 0         | 0.00          | 0          | 0.00          | 1          | .67           |
| Over 100         | 14        | 45.16         | 7         | 46.67         | 11        | 34.38         | 38         | 52.78         | 70         | 46.67         |
| <b>Total</b>     | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>72</b>  | <b>100.00</b> | <b>150</b> | <b>100.00</b> |

1.3 a What (estimated) square footage does this represent?

| Square Footage      | Freq.      | Percent       | Cum.   |
|---------------------|------------|---------------|--------|
| <500,000            | 26         | 17.22         | 17.22  |
| 500,000-1,000,000   | 21         | 13.91         | 31.13  |
| 1,000,000-5,000,000 | 46         | 30.46         | 61.59  |
| >5,000,000          | 58         | 38.41         | 100.00 |
| <b>Total</b>        | <b>151</b> | <b>100.00</b> |        |

| Square Footage      | ID        | MT        | OR        | WA        | Total      |
|---------------------|-----------|-----------|-----------|-----------|------------|
| <500,000            | 3         | 3         | 10        | 10        | 26         |
| 500,000-1,000,000   | 8         | 3         | 4         | 6         | 21         |
| 1,000,000-5,000,000 | 10        | 4         | 8         | 24        | 46         |
| >5,000,000          | 10        | 5         | 10        | 33        | 58         |
| <b>Total</b>        | <b>31</b> | <b>15</b> | <b>32</b> | <b>73</b> | <b>151</b> |

1.3 b What is the estimated dollar value?

| Dollar Value              | Freq.      | Percent       | Cum.   |
|---------------------------|------------|---------------|--------|
| <\$10,000,000             | 15         | 9.93          | 9.93   |
| \$10,000,000-100,000,000  | 32         | 21.19         | 31.13  |
| \$100,000,000-500,000,000 | 41         | 27.15         | 58.28  |
| >\$500,000,000            | 63         | 41.72         | 100.00 |
| <b>Total</b>              | <b>151</b> | <b>100.00</b> |        |

| Project value          | ID        | MT        | OR        | WA        | Total      |
|------------------------|-----------|-----------|-----------|-----------|------------|
| <\$10,000,000          | 3         | 1         | 8         | 3         | 15         |
| \$10,000,000-100,000,0 | 7         | 4         | 8         | 13        | 32         |
| \$100,000,000-500,000, | 11        | 3         | 6         | 21        | 41         |
| >\$500,000,000         | 10        | 7         | 10        | 36        | 63         |
| <b>Total</b>           | <b>31</b> | <b>15</b> | <b>32</b> | <b>73</b> | <b>151</b> |

1.4 Does your firm specialize in any type of commercial buildings (i.e. retail, grocery, office)?

Yes [ ]

No [ ]

| Special Type | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|              | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No           | 18        | 58.06         | 7         | 46.67         | 19        | 61.29         | 35         | 47.95         | 79         | 52.67         |
| Yes          | 13        | 41.94         | 8         | 53.33         | 12        | 38.71         | 38         | 52.05         | 71         | 47.33         |
| <b>Total</b> | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>31</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>150</b> | <b>100.00</b> |



1.4 a If yes, what type?

| Special Type   | Idaho     |               | Montana  |               | Oregon    |               | Washington |               | Total      |               |
|----------------|-----------|---------------|----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                | N         | %             | N        | %             | N         | %             | N          | %             | N          | %             |
| Mixed Use      | 0         | 0.00          | 1        | 11.11         | 1         | 5.00          | 2          | 3.92          | 4          | 3.84          |
| Office         | 1         | 4.16          | 0        | 0.00          | 4         | 20.00         | 4          | 7.84          | 9          | 8.65          |
| Schools (K-12) | 3         | 12.50         | 1        | 11.11         | 3         | 15.00         | 7          | 13.72         | 14         | 13.46         |
| Retail         | 1         | 4.16          | 0        | 0.00          | 5         | 25.00         | 9          | 17.64         | 15         | 14.42         |
| Medical        | 5         | 20.83         | 5        | 55.55         | 1         | 5.00          | 8          | 15.68         | 19         | 18.26         |
| Government     | 6         | 25.00         | 1        | 11.11         | 2         | 10.00         | 7          | 13.72         | 16         | 15.38         |
| Education      | 8         | 33.33         | 1        | 11.11         | 2         | 10.00         | 13         | 25.49         | 24         | 23.07         |
| Warehouse      | 0         | 0.00          | 0        | 0.00          | 2         | 10.00         | 1          | 1.96          | 3          | 2.88          |
| <b>Total</b>   | <b>24</b> | <b>100.00</b> | <b>9</b> | <b>100.00</b> | <b>20</b> | <b>100.00</b> | <b>51</b>  | <b>100.00</b> | <b>104</b> | <b>100.00</b> |

1.5 Who is the primary decision-maker responsible for energy code and energy efficiency decisions for the following components?

1.5 a Building Shell:

| Decision Maker:<br>Building Shell | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-----------------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                                   | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Architect                         | 15        | 48.39         | 6         | 40.00         | 18        | 56.25         | 30         | 41.10         | 69         | 45.70         |
| Code                              | 4         | 12.90         | 0         | 0.00          | 5         | 15.63         | 9          | 12.33         | 18         | 11.92         |
| Consultant                        | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.37          | 1          | 0.66          |
| Corporate Manager                 | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.37          | 1          | 0.66          |
| Other                             | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 3          | 4.11          | 3          | 1.99          |
| Owner                             | 0         | 0.00          | 1         | 6.67          | 4         | 12.50         | 5          | 6.85          | 10         | 6.62          |
| Structural Engineer               | 0         | 0.00          | 1         | 6.67          | 0         | 0.00          | 0          | 0.00          | 1          | 0.66          |
| Team<br>(owner/arch/ME)           | 12        | 38.71         | 7         | 46.67         | 5         | 15.63         | 24         | 32.88         | 48         | 31.79         |
| <b>Total</b>                      | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

1.5 b Mechanical System

| Decision Maker:<br>Mechanical Systems | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|---------------------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                                       | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Architect                             | 0         | 0.00          | 0         | 0.00          | 1         | 3.13          | 2          | 2.74          | 3          | 1.99          |
| Code                                  | 3         | 9.68          | 0         | 0.00          | 1         | 3.13          | 5          | 6.85          | 9          | 5.96          |
| HVAC Contractor                       | 1         | 3.23          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 1          | 0.66          |
| Mechanical Engineer                   | 16        | 51.61         | 4         | 26.67         | 16        | 50.00         | 34         | 46.58         | 70         | 46.36         |
| Other                                 | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 2          | 2.74          | 2          | 1.32          |
| Owner                                 | 0         | 0.00          | 2         | 13.33         | 3         | 9.38          | 6          | 8.22          | 11         | 7.28          |
| Team (owner/arch/ME)                  | 11        | 35.48         | 9         | 60.00         | 11        | 34.38         | 24         | 32.88         | 55         | 36.42         |
| <b>Total</b>                          | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

1.5 c Lighting System

| Decision Maker:<br>Lighting Systems | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-------------------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                                     | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Architect                           | 0         | 0.00          | 1         | 6.67          | 3         | 9.68          | 9          | 12.33         | 13         | 8.78          |
| Code                                | 4         | 13.79         | 0         | 0.00          | 1         | 3.23          | 8          | 10.96         | 13         | 8.78          |
| Consultant                          | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.37          | 1          | 0.68          |
| Electrical Engineer                 | 11        | 37.93         | 6         | 40.00         | 11        | 35.48         | 30         | 41.10         | 58         | 39.19         |
| Lighting Contractor                 | 0         | 0.00          | 0         | 0.00          | 1         | 3.23          | 0          | 0.00          | 1          | 0.68          |
| Other                               | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.37          | 1          | 0.68          |
| Owner                               | 1         | 3.45          | 1         | 6.67          | 2         | 6.45          | 3          | 4.11          | 7          | 4.73          |
| Team (owner/arch/ME)                | 13        | 44.83         | 7         | 46.67         | 13        | 41.94         | 21         | 28.77         | 54         | 36.49         |
| <b>Total</b>                        | <b>29</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>31</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>148</b> | <b>100.00</b> |

Practices and Attitudes Related to the Energy Code

2.1 What energy code(s) applies to your projects?

| What Code    | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|              | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| ASHRAE 90.1  | 2         | 6.45          | 1         | 6.67          | 0         | 0.00          | 0          | 0.00          | 3          | 1.99          |
| IECC 2000    | 14        | 45.16         | 4         | 26.67         | 0         | 0.00          | 0          | 0.00          | 18         | 11.92         |
| IECC 2003    | 6         | 19.35         | 5         | 33.33         | 1         | 3.13          | 0          | 0.00          | 12         | 7.95          |
| None         | 9         | 29.03         | 5         | 33.33         | 0         | 0.00          | 0          | 0.00          | 14         | 9.27          |
| Oregon       | 0         | 0.00          | 0         | 0.00          | 31        | 96.88         | 0          | 0.00          | 31         | 20.53         |
| Seattle      | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 18         | 24.66         | 18         | 11.92         |
| Washington   | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 55         | 75.34         | 55         | 36.42         |
| <b>Total</b> | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

2.2 Were energy codes or standards mentioned as part of the building department’s review of the project (e.g. energy forms, direct notes on plans, questions at counter, etc.)?

Yes [ ] No [ ]

| Codes Mentioned | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-----------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                 | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Don't Remember  | 0         | 0.00          | 1         | 6.67          | 0         | 0.00          | 1          | 1.37          | 2          | 1.32          |
| N/A             | 2         | 6.45          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 2          | 1.32          |
| No              | 12        | 38.71         | 5         | 33.33         | 8         | 25.00         | 11         | 15.07         | 36         | 23.84         |
| Yes             | 17        | 54.84         | 9         | 60.00         | 24        | 75.00         | 61         | 83.56         | 111        | 73.51         |
| <b>Total</b>    | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

2.2 a If yes: Did you receive any feedback on this project from plan reviewers or building officials for this project?

Yes [ ] No [ ]

| Receive Feedback | Idaho     |               | Montana  |               | Oregon    |               | Washington |               | Total      |               |
|------------------|-----------|---------------|----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                  | N         | %             | N        | %             | N         | %             | N          | %             | N          | %             |
| Don't Remember   | 0         | 0.00          | 0        | 0.00          | 0         | 0.00          | 4          | 6.56          | 4          | 3.67          |
| No               | 13        | 76.47         | 4        | 57.14         | 13        | 54.17         | 25         | 40.98         | 55         | 50.46         |
| Yes              | 4         | 23.53         | 3        | 42.86         | 11        | 45.83         | 32         | 52.46         | 50         | 45.87         |
| <b>Total</b>     | <b>17</b> | <b>100.00</b> | <b>7</b> | <b>100.00</b> | <b>24</b> | <b>100.00</b> | <b>61</b>  | <b>100.00</b> | <b>109</b> | <b>100.00</b> |

2.3 Does your firm hire a consultant to help specifically with energy code or energy efficiency issues?

Yes [ ] No [ ]

| Hire Consultant | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-----------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                 | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No              | 30        | 96.77         | 13        | 86.67         | 19        | 59.38         | 43         | 59.72         | 105        | 70.00         |
| Yes             | 1         | 3.23          | 2         | 13.33         | 13        | 40.63         | 29         | 40.28         | 45         | 30.00         |
| <b>Total</b>    | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>72</b>  | <b>100.00</b> | <b>150</b> | <b>100.00</b> |

2.3a Did such a person participate in this project?

Yes [ ] No [ ]

| Consultant on this Project | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|----------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                            | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No                         | 28        | 93.33         | 12        | 80.00         | 24        | 75.00         | 50         | 71.43         | 114        | 77.55         |
| Yes                        | 2         | 6.67          | 3         | 20.00         | 8         | 25.00         | 20         | 28.57         | 33         | 22.45         |
| <b>Total</b>               | <b>30</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>70</b>  | <b>100.00</b> | <b>147</b> | <b>100.00</b> |

2.4 Do you remember what compliance path was used for:

2.4 a Mechanical

| Mechanical Path         | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                         | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Building Modeling       | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.39          | 1          | 0.68          |
| Complex System          | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.39          | 1          | 0.68          |
| Component Performance   | 7         | 24.14         | 5         | 33.33         | 4         | 13.33         | 36         | 50.00         | 52         | 35.62         |
| Don't Remember          | 6         | 20.69         | 4         | 26.67         | 0         | 0.00          | 4          | 5.56          | 14         | 9.59          |
| N/A                     | 5         | 17.24         | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 5          | 3.42          |
| Prescriptive Path       | 11        | 37.93         | 6         | 40.00         | 26        | 86.67         | 29         | 40.28         | 72         | 49.32         |
| Whole Building Analysis | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.39          | 1          | 0.68          |
| <b>Total</b>            | <b>29</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>30</b> | <b>100.00</b> | <b>72</b>  | <b>100.00</b> | <b>146</b> | <b>100.00</b> |

2.4 b Lighting

| Lighting Systems        | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                         | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Building Modeling       | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.41          | 1          | 0.69          |
| Component Performance   | 7         | 25.00         | 5         | 33.33         | 4         | 13.33         | 34         | 47.89         | 50         | 34.72         |
| Don't Remember          | 6         | 21.43         | 4         | 26.67         | 0         | 0.00          | 4          | 5.63          | 14         | 9.72          |
| N/A No Energy Code      | 5         | 17.86         | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 5          | 3.47          |
| N/A Residential Bldg    | 1         | 3.57          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 1          | 0.69          |
| Prescriptive Path       | 9         | 32.14         | 6         | 40.00         | 26        | 86.67         | 31         | 43.66         | 72         | 50.00         |
| Whole Building Analysis | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.41          | 1          | 0.69          |
| <b>Total</b>            | <b>28</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>30</b> | <b>100.00</b> | <b>71</b>  | <b>100.00</b> | <b>144</b> | <b>100.00</b> |

2.4 c Building envelope

| Building Envelope       | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                         | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Building Modeling       | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.41          | 1          | 0.69          |
| Component Performance   | 7         | 25.00         | 5         | 33.33         | 4         | 13.33         | 38         | 53.52         | 54         | 37.50         |
| Don't Remember          | 6         | 21.43         | 4         | 26.67         | 0         | 0.00          | 4          | 5.63          | 14         | 9.72          |
| N/A No Energy Code      | 5         | 17.86         | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 5          | 3.47          |
| Prescriptive Path       | 10        | 35.71         | 6         | 40.00         | 26        | 86.67         | 27         | 38.03         | 69         | 47.92         |
| Whole Building Analysis | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.41          | 1          | 0.69          |
| <b>Total</b>            | <b>28</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>30</b> | <b>100.00</b> | <b>71</b>  | <b>100.00</b> | <b>144</b> | <b>100.00</b> |

2.5 Was energy code compliance a particularly challenging problem for any aspect of the building (envelope, mechanical, lighting) systems?  
 Yes [ ] No [ ]

| Challenge    | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|              | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| N/A          | 4         | 12.90         | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 4          | 2.68          |
| No           | 23        | 74.19         | 13        | 86.67         | 28        | 90.32         | 53         | 73.61         | 117        | 78.52         |
| Yes          | 4         | 12.90         | 2         | 13.33         | 3         | 9.68          | 19         | 26.39         | 28         | 18.79         |
| <b>Total</b> | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>31</b> | <b>100.00</b> | <b>72</b>  | <b>100.00</b> | <b>149</b> | <b>100.00</b> |

2.5 a If yes, why?

| Why Hard      | Idaho    |               | Montana  |               | Oregon   |               | Washington |               | Total     |               |
|---------------|----------|---------------|----------|---------------|----------|---------------|------------|---------------|-----------|---------------|
|               | N        | %             | N        | %             | N        | %             | N          | %             | N         | %             |
| Lighting      | 1        | 33.33         | 1        | 50.00         | 1        | 33.33         | 3          | 16.67         | 6         | 23.08         |
| Envelope      | 1        | 33.33         | 0        | 0.00          | 0        | 0.00          | 4          | 22.22         | 5         | 19.23         |
| Glazing       | 0        | 0.00          | 0        | 0.00          | 0        | 0.00          | 3          | 16.67         | 3         | 11.54         |
| Ventilation   | 0        | 0.00          | 1        | 50.00         | 0        | 0.00          | 2          | 11.11         | 3         | 11.54         |
| Code Language | 0        | 0.00          | 0        | 0.00          | 1        | 33.33         | 4          | 22.22         | 5         | 19.23         |
| Other         | 1        | 33.33         | 0        | 0.00          | 1        | 33.33         | 2          | 11.11         | 4         | 15.38         |
| <b>Total</b>  | <b>3</b> | <b>100.00</b> | <b>2</b> | <b>100.00</b> | <b>3</b> | <b>100.00</b> | <b>18</b>  | <b>100.00</b> | <b>26</b> | <b>100.00</b> |

2.6 Are there any elements of the energy code that you feel are not cost-effective or are poorly thought out?  
 Yes [ ] No [ ]

| Elements Not Cost Effective | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-----------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                             | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| N/A                         | 2         | 6.45          | 2         | 13.33         | 0         | 0.00          | 1          | 1.43          | 5          | 3.38          |
| No                          | 14        | 45.16         | 10        | 66.67         | 19        | 59.38         | 32         | 59.38         | 75         | 50.68         |
| Yes                         | 15        | 48.39         | 3         | 20.00         | 13        | 40.63         | 37         | 52.86         | 68         | 45.95         |
| <b>Total</b>                | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>70</b>  | <b>100.00</b> | <b>148</b> | <b>100.00</b> |

2.6 a If yes: What are they?

| Code Problems      | Idaho     |               | Montana  |               | Oregon    |               | Washington |               | Total     |               |
|--------------------|-----------|---------------|----------|---------------|-----------|---------------|------------|---------------|-----------|---------------|
|                    | N         | %             | N        | %             | N         | %             | N          | %             | N         | %             |
| Too Strict         | 9         | 45.00         | 2        | 50.00         | 4         | 15.38         | 28         | 58.33         | 43        | 43.87         |
| Too Lenient        | 2         | 10.00         | 0        | 0.00          | 4         | 15.38         | 1          | 2.08          | 7         | 7.14          |
| Poor Wording       | 1         | 5.00          | 1        | 25.00         | 7         | 26.92         | 7          | 14.58         | 16        | 16.32         |
| Internal Conflicts | 5         | 25.00         | 0        | 0.00          | 3         | 11.54         | 7          | 14.58         | 15        | 15.30         |
| Not Enforced       | 1         | 5.00          | 0        | 0.00          | 0         | 0.00          | 2          | 4.17          | 3         | 3.06          |
| Flexible           | 0         | 0.00          | 0        | 0.00          | 1         | 3.85          | 0          | 0.00          | 1         | 1.02          |
| Good Code          | 0         | 0.00          | 0        | 0.00          | 2         | 7.69          | 0          | 0.00          | 2         | 2.04          |
| Deficient Coverage | 2         | 10.00         | 1        | 25.00         | 5         | 19.23         | 3          | 6.25          | 11        | 11.22         |
| <b>Total</b>       | <b>20</b> | <b>100.00</b> | <b>4</b> | <b>100.00</b> | <b>26</b> | <b>100.00</b> | <b>48</b>  | <b>100.00</b> | <b>98</b> | <b>100.00</b> |

2.6 b Did you still implement them into your design?  
 Yes [ ] No [ ]

| Still Implement | Idaho    |               | Montana  |               | Oregon   |               | Washington |               | Total     |               |
|-----------------|----------|---------------|----------|---------------|----------|---------------|------------|---------------|-----------|---------------|
|                 | N        | %             | N        | %             | N        | %             | N          | %             | N         | %             |
| No              | 1        | 20.00         | 0        | 0.00          | 1        | 12.50         | 5          | 20.00         | 7         | 17.07         |
| Yes             | 4        | 80.00         | 3        | 100.00        | 7        | 87.50         | 20         | 80.00         | 34        | 82.93         |
| <b>Total</b>    | <b>5</b> | <b>100.00</b> | <b>3</b> | <b>100.00</b> | <b>8</b> | <b>100.00</b> | <b>25</b>  | <b>100.00</b> | <b>41</b> | <b>100.00</b> |

2.6 c If no: Why?

| Why  | Idaho    |               | Montana  |             | Oregon   |               | Washington |               | Total    |               |
|--|----------|---------------|----------|-------------|----------|---------------|------------|---------------|----------|---------------|
|  | N        | %             | N        | %           | N        | %             | N          | %             | N        | %             |
| Not a Big Problem with this Building   | 0        | 0.00          | 0        | 0.00        | 1        | 100.00        | 0          | 0.00          | 1        | 20.00         |
| Not Cost Effective   | 0        | 0.00          | 0        | 0.00        | 0        | 0.00          | 1          | 33.33         | 1        | 20.00         |
| Not Needed in this Building  | 0        | 0.00          | 0        | 0.00        | 0        | 0.00          | 1          | 33.33         | 1        | 20.00         |
| Received a Letter from US DOE Saying Economizer is not Cost Effective on Water Source Heat Pumps | 1        | 100.00        | 0        | 0.00        | 0        | 0.00          | 0          | 0.00          | 1        | 20.00         |
| Waste of Time Especially with Water Economizer   | 0        | 0.00          | 0        | 0.00        | 0        | 0.00          | 1          | 33.33         | 1        | 20.00         |
| <b>Total</b>   | <b>1</b> | <b>100.00</b> | <b>0</b> | <b>0.00</b> | <b>1</b> | <b>100.00</b> | <b>3</b>   | <b>100.00</b> | <b>5</b> | <b>100.00</b> |

2.7 Do you use any software package (such as ENVstd or DOE2®) to demonstrate compliance with energy codes?  
 Yes [ ] No [ ]

| Use Software | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|              | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No           | 1         | 3.23          | 5         | 33.33         | 20        | 66.67         | 43         | 58.90         | 69         | 46.31         |
| Yes          | 30        | 96.77         | 10        | 66.67         | 10        | 33.33         | 30         | 41.10         | 80         | 53.69         |
| <b>Total</b> | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>30</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>149</b> | <b>100.00</b> |

2.7 a If yes: What is your opinion on its use and outcome?

| Software Used                | Idaho     |               | Montana  |               | Oregon    |               | Washington |               | Total     |               |
|------------------------------|-----------|---------------|----------|---------------|-----------|---------------|------------|---------------|-----------|---------------|
|                              | N         | %             | N        | %             | N         | %             | N          | %             | N         | %             |
| Com Check                    | 24        | 85.71         | 6        | 66.67         | 0         | 0.00          | 4          | 14.81         | 34        | 45.95         |
| DOE2                         | 0         | 0.00          | 0        | 0.00          | 2         | 20.00         | 4          | 14.81         | 6         | 8.11          |
| Equest                       | 0         | 0.00          | 0        | 0.00          | 0         | 0.00          | 1          |               | 1         | 1.35          |
| Trace                        | 1         | 3.57          | 0        | 0.00          | 0         | 0.00          | 1          | 3.70          | 2         | 2.70          |
| Com Check<br>Equest<br>Trace | 0         | 0.00          | 1        | 11.11         | 0         | 0.00          | 0          | 0.00          | 1         | 1.35          |
| DOE2<br>Trace                | 0         | 0.00          | 0        | 0.00          | 0         | 0.00          | 3          | 11.11         | 3         | 4.05          |
| Equest<br>Trace              | 1         | 3.57          | 0        | 0.00          | 0         | 0.00          | 1          | 3.70          | 2         | 2.70          |
| Unknown                      | 2         | 7.14          | 2        | 22.22         | 8         | 80.00         | 13         | 48.15         | 25        | 33.78         |
| <b>Total</b>                 | <b>28</b> | <b>100.00</b> | <b>9</b> | <b>100.00</b> | <b>10</b> | <b>100.00</b> | <b>27</b>  | <b>100.00</b> | <b>74</b> | <b>100.00</b> |

3. Energy Efficient Design Criteria

3.1 Did you incorporate any energy efficiency measure(s) in this project beyond what is minimally required by an energy code? (If yes, please describe).

Lighting: Yes [ ] No [ ]

| Lighting       | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|----------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No             | 19        | 65.52         | 11        | 73.33         | 15        | 51.72         | 36         | 51.43         | 81         | 56.64         |
| Yes            | 6         | 20.69         | 4         | 26.67         | 13        | 44.83         | 30         | 42.86         | 53         | 37.06         |
| Don't Remember | 2         | 6.90          | 0         | 0.00          | 1         | 3.45          | 4          | 5.71          | 7          | 4.90          |
| N/A            | 2         | 6.90          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 2          | 1.40          |
| <b>Total</b>   | <b>29</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>29</b> | <b>100.00</b> | <b>70</b>  | <b>100.00</b> | <b>143</b> | <b>100.00</b> |

| What Lighting Measures                | Idaho    |               | Montana  |               | Oregon    |               | Washington |               | Total     |               |
|---------------------------------------|----------|---------------|----------|---------------|-----------|---------------|------------|---------------|-----------|---------------|
|                                       | N        | %             | N        | %             | N         | %             | N          | %             | N         | %             |
| Daylighting                           | 3        | 42.85         | 1        | 25.00         | 5         | 38.46         | 14         | 38.88         | 23        | 38.33         |
| Controls                              | 3        | 42.85         | 2        | 50.00         | 4         | 30.76         | 14         | 38.88         | 23        | 38.33         |
| Reduced Wattage<br>Efficient Ballasts | 1        | 14.28         | 1        | 25.00         | 4         | 30.76         | 8          | 22.22         | 14        | 23.33         |
| <b>Total</b>                          | <b>7</b> | <b>100.00</b> | <b>4</b> | <b>100.00</b> | <b>13</b> | <b>100.00</b> | <b>36</b>  | <b>100.00</b> | <b>60</b> | <b>100.00</b> |

HVAC: Yes [ ] No [ ]

| HVAC           | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|----------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No             | 16        | 51.61         | 8         | 53.33         | 14        | 45.16         | 33         | 45.83         | 71         | 47.65         |
| Yes            | 12        | 38.71         | 7         | 46.67         | 17        | 54.84         | 38         | 52.78         | 74         | 49.66         |
| Don't Remember | 1         | 3.23          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 1          | 0.67          |
| N/A            | 2         | 6.45          | 0         | 0.00          | 0         | 0.00          | 1          | 1.39          | 3          | 2.01          |
| <b>Total</b>   | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>31</b> | <b>100.00</b> | <b>72</b>  | <b>100.00</b> | <b>149</b> | <b>100.00</b> |

| What HVAC Measures                              | Idaho     |               | Montana  |               | Oregon    |               | Washington |               | Total     |               |
|---|-----------|---------------|----------|---------------|-----------|---------------|------------|---------------|-----------|---------------|
|   | N         | %             | N        | %             | N         | %             | N          | %             | N         | %             |
| Heat Recovery                                   | 4         | 40.00         | 0        | 0.00          | 3         | 18.75         | 8          | 20.00         | 15        | 21.42         |
| Higher Efficient Equipment                      | 6         | 60.00         | 2        | 50.00         | 9         | 56.25         | 21         | 52.50         | 38        | 54.28         |
| Controls  | 0         | 0.00          | 1        | 25.00         | 2         | 12.50         | 8          | 20.00         | 11        | 15.71         |
| Natural Technology (Solar, natural ventilation) | 0         | 0.00          | 1        | 25.00         | 2         | 12.50         | 3          | 7.50          | 6         | 8.57          |
| <b>Total</b>                                    | <b>10</b> | <b>100.00</b> | <b>4</b> | <b>100.00</b> | <b>16</b> | <b>100.00</b> | <b>40</b>  | <b>100.00</b> | <b>70</b> | <b>100.00</b> |

Envelope: Yes [ ]

No [ ]

| Envelope       | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|----------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No             | 16        | 55.17         | 9         | 60.00         | 20        | 68.97         | 39         | 53.42         | 84         | 57.53         |
| Yes            | 9         | 31.03         | 6         | 40.00         | 9         | 31.03         | 34         | 46.58         | 58         | 39.73         |
| Don't Remember | 2         | 6.90          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 2          | 1.37          |
| N/A            | 2         | 6.90          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | 2          | 1.37          |
| <b>Total</b>   | <b>29</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>29</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>146</b> | <b>100.00</b> |

| What Envelope Measures   | Idaho     |               | Montana  |               | Oregon   |               | Washington |               | Total     |               |
|--------------------------|-----------|---------------|----------|---------------|----------|---------------|------------|---------------|-----------|---------------|
|                          | N         | %             | N        | %             | N        | %             | N          | %             | N         | %             |
| Increased Insulation     | 9         | 81.81         | 6        | 100.00        | 5        | 62.50         | 24         | 75.00         | 44        | 77.19         |
| Changed Glazing          | 1         | 9.09          | 0        | 0.00          | 2        | 25.00         | 6          | 18.75         | 9         | 15.78         |
| Passive Solar Strategies | 1         | 9.09          | 0        | 0.00          | 1        | 12.50         | 2          | 6.25          | 4         | 7.01          |
| <b>Total</b>             | <b>11</b> | <b>100.00</b> | <b>6</b> | <b>100.00</b> | <b>8</b> | <b>100.00</b> | <b>32</b>  | <b>100.00</b> | <b>57</b> | <b>100.00</b> |

3.1 a Why did you incorporate these measures?

| Why Incorporate Energy Efficiency Measures? | Idaho     |               | Montana  |               | Oregon    |               | Washington |               | Total      |               |
|---|-----------|---------------|----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|   | N         | %             | N        | %             | N         | %             | N          | %             | N          | %             |
| Owner Request                               | 3         | 25.00         | 2        | 22.22         | 5         | 22.73         | 15         | 21.74         | 25         | 22.32         |
| Architect Request                           | 0         | 0.00          | 0        | 0.00          | 2         | 9.09          | 1          | 1.45          | 3          | 2.68          |
| Cost Effective                              | 4         | 33.33         | 3        | 33.33         | 9         | 40.91         | 15         | 21.74         | 31         | 27.68         |
| Right Thing to Do                           | 0         | 0.00          | 1        | 11.11         | 4         | 18.18         | 6          | 8.70          | 11         | 9.82          |
| LEED  | 0         | 0.00          | 0        | 0.00          | 2         | 9.09          | 10         | 14.49         | 12         | 10.71         |
| Normal Work                                 | 5         | 41.67         | 3        | 33.33         | 0         | 0.00          | 17         | 24.64         | 25         | 22.32         |
| Receiving Rebates Incentives                | 0         | 0.00          | 0        | 0.00          | 0         | 0.00          | 5          | 7.25          | 5          | 4.46          |
| <b>Total</b>                                | <b>12</b> | <b>100.00</b> | <b>9</b> | <b>100.00</b> | <b>22</b> | <b>100.00</b> | <b>69</b>  | <b>100.00</b> | <b>112</b> | <b>100.00</b> |

3.1 b. How important was incorporating energy efficient features to other members of the design team?

| Importance to Team | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                    | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Don't Know         | 0         | 0.00          | 0         | 0.00          | 1         | 3.57          | 0          | 0.00          | 1          | 0.70          |
| Moderate           | 7         | 23.33         | 6         | 42.86         | 3         | 10.71         | 21         | 30.00         | 37         | 26.06         |
| Not at All         | 16        | 53.33         | 2         | 14.29         | 12        | 42.86         | 18         | 25.71         | 48         | 33.80         |
| Very               | 7         | 23.33         | 6         | 42.86         | 12        | 42.86         | 31         | 44.29         | 56         | 39.44         |
| <b>Total</b>       | <b>30</b> | <b>100.00</b> | <b>14</b> | <b>100.00</b> | <b>28</b> | <b>100.00</b> | <b>70</b>  | <b>100.00</b> | <b>142</b> | <b>100.00</b> |



3.2 Did the building owner request energy efficiency in the building design?

Yes [ ]

No [ ]

| Request Efficiency | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                    | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No                 | 20        | 64.52         | 8         | 53.33         | 17        | 53.13         | 29         | 39.73         | <b>74</b>  | <b>49.01</b>  |
| Yes                | 11        | 35.48         | 7         | 46.67         | 15        | 46.88         | 44         | 60.27         | <b>77</b>  | <b>50.99</b>  |
| <b>Total</b>       | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

3.2 a If yes, did the owner request a LEED certification as part of this project?

Yes [ ]

No [ ]

| Request LEED® | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|---------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|               | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No            | 30        | 100.00        | 15        | 100.00        | 26        | 86.67         | 6          | 84.72         | <b>132</b> | <b>89.80</b>  |
| Yes           | 0         | 0.00          | 0         | 0.00          | 4         | 13.33         | 11         | 15.28         | <b>15</b>  | <b>10.20</b>  |
| <b>Total</b>  | <b>30</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>30</b> | <b>100.00</b> | <b>72</b>  | <b>100.00</b> | <b>147</b> | <b>100.00</b> |

3.3 Was a performance analysis of the energy requirements of this building done as part of the design or code compliance process?

Yes [ ]

No [ ]

| Perform<br>ance<br>Analysis | Idaho     |               | Montana   |               | Oregon    |               | Washington |              | Total      |               |
|-----------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|--------------|------------|---------------|
|                             | N         | %             | N         | %             | N         | %             | N          | %            | N          | %             |
| No                          | 17        | 56.67         | 9         | 60.00         | 20        | 62.50         | 27         | 37.50        | <b>73</b>  | <b>48.99</b>  |
| Yes                         | 10        | 33.33         | 6         | 40.00         | 12        | 37.50         | 45         | 62.50        | <b>73</b>  | <b>48.99</b>  |
| N/A                         | 3         | 10.00         | 0         | 0.00          | 0         | 0.00          | 0          | 0.00         | <b>3</b>   | <b>2.01</b>   |
| <b>Total</b>                | <b>30</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>72</b>  | <b>10.00</b> | <b>149</b> | <b>100.00</b> |

3.4 What were the main barriers to including energy efficiency in the design of this project?

| Barriers     | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|              | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| First Costs  | 15        | 48.38         | 6         | 40.00         | 17        | 51.51         | 34         | 47.22         | <b>72</b>  | <b>48.00</b>  |
| None         | 15        | 48.38         | 8         | 53.33         | 8         | 24.24         | 29         | 40.27         | <b>60</b>  | <b>40.00</b>  |
| Other        | 1         | 3.22          | 1         | 6.66          | 6         | 18.18         | 9          | 12.50         | <b>17</b>  | <b>11.00</b>  |
| N/A          | 0         | 0.00          | 0         | 0.00          | 2         | 6.06          | 0          | 0.00          | <b>2</b>   | <b>1.00</b>   |
| <b>Total</b> | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>33</b> | <b>100.00</b> | <b>72</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

4. Support and Information Requirements

4.1 What 2 or 3 sources do you use to obtain information on energy efficiency designs and technology in new building construction?

| Information Sources              | Idaho     |            | Montana   |           | Oregon    |            | Washington |            | Total      |              |
|----------------------------------|-----------|------------|-----------|-----------|-----------|------------|------------|------------|------------|--------------|
|                                  | N         | %          | N         | %         | N         | %          | N          | %          | N          | %            |
| <b>ASHRAE</b>                    | 10        | 14.29      | 4         | 12.90     | 5         | 8.62       | 23         | 15.23      | <b>42</b>  | <b>13.55</b> |
| <b>Internet</b>                  | 13        | 18.57      | 5         | 12.90     | 6         | 10.34      | 17         | 11.26      | <b>41</b>  | <b>13.23</b> |
| <b>Professional Publications</b> | 16        | 22.86      | 6         | 19.35     | 12        | 20.69      | 22         | 14.57      | <b>56</b>  | <b>18.06</b> |
| <b>USGBC</b>                     | 7         | 10.00      | 4         | 12.90     | 8         | 13.79      | 17         | 11.26      | <b>36</b>  | <b>11.61</b> |
| <b>Manufacturers</b>             | 5         | 7.14       | 1         | 3.23      | 10        | 17.24      | 22         | 14.57      | <b>38</b>  | <b>12.26</b> |
| <b>Seminars</b>                  | 9         | 12.86      | 4         | 12.90     | 6         | 10.34      | 8          | 5.30       | <b>27</b>  | <b>8.71</b>  |
| <b>Conferences</b>               | 0         | 0.00       | 0         | 0.00      | 0         | 0.00       | 3          | 1.99       | <b>3</b>   | <b>0.97</b>  |
| <b>Consultants</b>               | 6         | 8.57       | 3         | 9.68      | 9         | 15.52      | 19         | 12.58      | <b>37</b>  | <b>11.94</b> |
| <b>In-house staff</b>            | 2         | 2.86       | 2         | 6.45      | 2         | 3.45       | 11         | 7.28       | <b>17</b>  | <b>5.48</b>  |
| <b>Energy Code</b>               | 2         | 2.86       | 2         | 6.45      | 0         | 0.00       | 9          | 5.96       | <b>13</b>  | <b>4.19</b>  |
| <b>Total</b>                     | <b>70</b> | <b>100</b> | <b>31</b> | <b>97</b> | <b>58</b> | <b>100</b> | <b>151</b> | <b>100</b> | <b>310</b> | <b>100</b>   |

4.2 Do you believe you had enough information to implement energy efficiency into this project?

Yes [ ] No [ ]

| Enough Information | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                    | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| <b>No</b>          | 4         | 12.90         | 1         | 6.67          | 3         | 9.38          | 2          | 2.74          | <b>10</b>  | <b>6.62</b>   |
| <b>Yes</b>         | 25        | 80.65         | 14        | 93.33         | 29        | 90.63         | 71         | 97.26         | <b>139</b> | <b>92.05</b>  |
| <b>N/A</b>         | 2         | 6.45          | 0         | 0.00          | 0         | 0.00          | 0          | 0.00          | <b>2</b>   | <b>1.32</b>   |
| <b>Total</b>       | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

4.2 a If no: What information would have aided in the design?

| What Information                  | Idaho    |               | Montana  |               | Oregon   |               | Washington |               | Total    |               |
|-----------------------------------|----------|---------------|----------|---------------|----------|---------------|------------|---------------|----------|---------------|
|                                   | N        | %             | N        | %             | N        | %             | N          | %             | N        | %             |
| <b>LEED®</b>                      | 0        | 0.00          | 0        | 0.00          | 1        | 33.33         | 0          | 0.00          | <b>1</b> | <b>12.50</b>  |
| <b>Cost</b>                       | 0        | 0.00          | 0        | 0.00          | 1        | 33.33         | 0          | 0.00          | <b>1</b> | <b>12.50</b>  |
| <b>Green Building</b>             | 0        | 0.00          | 0        | 0.00          | 0        | 0.00          | 1          | 100.00        | <b>1</b> | <b>12.50</b>  |
| <b>Product</b>                    | 1        | 33.33         | 0        | 0.00          | 0        | 0.00          | 0          | 0.00          | <b>1</b> | <b>12.50</b>  |
| <b>Ventilation</b>                | 1        | 33.33         | 0        | 0.00          | 0        | 0.00          | 0          | 0.00          | <b>1</b> | <b>12.50</b>  |
| <b>Lighting and Heat Recovery</b> | 0        | 0.00          | 1        | 100.00        | 0        | 0.00          | 0          | 0.00          | <b>1</b> | <b>12.50</b>  |
| <b>Owner Interest</b>             | 0        | 0.00          | 0        | 0.00          | 1        | 33.33         | 0          | 0.00          | <b>1</b> | <b>12.50</b>  |
| <b>Team Interest</b>              | 1        | 33.33         | 0        | 0.00          | 0        | 0.00          | 0          | 0.00          | <b>1</b> | <b>12.50</b>  |
| <b>Total</b>                      | <b>3</b> | <b>100.00</b> | <b>1</b> | <b>100.00</b> | <b>3</b> | <b>100.00</b> | <b>1</b>   | <b>100.00</b> | <b>8</b> | <b>100.00</b> |

4.2 b Who would you expect to provide this information?

| Who should provide info.          | Idaho    |               | Montana  |               | Oregon   |               | Washington |               | Total    |               |
|-----------------------------------|----------|---------------|----------|---------------|----------|---------------|------------|---------------|----------|---------------|
|                                   | N        | %             | N        | %             | N        | %             | N          | %             | N        | %             |
| <b>ASHARE</b>                     | 1        | 50.00         | 0        | 0.00          | 0        | 0.00          | 0          | 0.00          | 1        | 16.67         |
| <b>Architects and Consultants</b> | 0        | 0.00          | 0        | 0.00          | 1        | 50.00         | 0          | 0.00          | 1        | 16.67         |
| <b>Consultants</b>                | 0        | 0.00          | 0        | 0.00          | 1        | 50.00         | 0          | 0.00          | 1        | 16.67         |
| <b>Design Team Members</b>        | 0        | 0.00          | 0        | 0.00          | 0        | 0.00          | 1          | 100.00        | 1        | 16.67         |
| <b>Venders</b>                    | 1        | 50.00         | 0        | 0.00          | 0        | 0.00          | 0          | 0.00          | 1        | 16.67         |
| <b>Venders and Engineers</b>      | 0        | 0.00          | 1        | 100.00        | 0        | 0.00          | 0          | 0.00          | 1        | 16.67         |
| <b>Total</b>                      | <b>2</b> | <b>100.00</b> | <b>1</b> | <b>100.00</b> | <b>2</b> | <b>100.00</b> | <b>1</b>   | <b>100.00</b> | <b>6</b> | <b>100.00</b> |

4.3 Do you believe you had enough information on the energy code as it applied to this project?  
 Yes [ ] No [ ]

| Enough Information | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                    | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| <b>No</b>          | 0         | 0.00          | 1         | 6.67          | 0         | 0.00          | 2          | 2.74          | 3          | 2.03          |
| <b>Yes</b>         | 23        | 76.67         | 12        | 80.00         | 30        | 100.00        | 71         | 97.26         | 136        | 91.89         |
| <b>N/A</b>         | 7         | 23.33         | 1         | 6.67          | 0         | 0.00          | 0          | 0.00          | 8          | 5.41          |
| <b>Don't Know</b>  | 0         | 0.00          | 1         | 6.67          | 0         | 0.00          | 0          | 0.00          | 1          | 0.68          |
| <b>Total</b>       | <b>30</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>30</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>148</b> | <b>100.00</b> |

4.3 a If no: What information would have aided in the design?

| What Information                       | Idaho    |              | Montana  |               | Oregon   |             | Washington |               | Total    |               |
|--|----------|--------------|----------|---------------|----------|-------------|------------|---------------|----------|---------------|
|  | N        | %            | N        | %             | N        | %           | N          | %             | N        | %             |
| <b>Better Understanding of WA code</b> | 0        | 0.00         | 0        | 0.00          | 0        | 0.00        | 1          | 50.00         | 1        | 33.33         |
| <b>Montana Needs a State Code</b>      | 0        | 0.00         | 1        | 100.00        | 0        | 0.00        | 0          | 0.00          | 1        | 33.33         |
| <b>More Generic Code Information</b>   | 0        | 0.00         | 0        | 0.00          | 0        | 0.00        | 1          | 50.00         | 1        | 33.33         |
| <b>Total</b>                           | <b>0</b> | <b>00.00</b> | <b>1</b> | <b>100.00</b> | <b>0</b> | <b>0.00</b> | <b>2</b>   | <b>100.00</b> | <b>3</b> | <b>100.00</b> |

4.3 b Who would you expect to provide this information?

| Who                | Idaho    |              | Montana  |               | Oregon   |             | Washington |               | Total    |               |
|--------------------|----------|--------------|----------|---------------|----------|-------------|------------|---------------|----------|---------------|
|                    | N        | %            | N        | %             | N        | %           | N          | %             | N        | %             |
| <b>Don't Know</b>  | 0        | 0.00         | 0        | 0.00          | 0        | 0.00        | 1          | 50.00         | 1        | 33.33         |
| <b>State of WA</b> | 0        | 0.00         | 0        | 0.00          | 0        | 0.00        | 1          | 50.00         | 1        | 33.33         |
| <b>State of MT</b> | 0        | 0.00         | 1        | 100.00        | 0        | 0.00        | 0          | 0.00          | 1        | 33.33         |
| <b>Total</b>       | <b>0</b> | <b>00.00</b> | <b>1</b> | <b>100.00</b> | <b>0</b> | <b>0.00</b> | <b>2</b>   | <b>100.00</b> | <b>3</b> | <b>100.00</b> |

5. General Attitudes and Suggestions for Improvement

5.1 In your opinion, has client demand for an energy efficient design changed your design practices in general?

Yes

No

| Changed Practice | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                  | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| No               | 9         | 29.03         | 6         | 40.00         | 12        | 37.50         | 24         | 32.88         | 51         | 33.77         |
| Yes              | 22        | 70.97         | 9         | 60.00         | 20        | 62.50         | 49         | 67.12         | 100        | 66.23         |
| <b>Total</b>     | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>32</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>151</b> | <b>100.00</b> |

5.1 a If yes, what design elements?

| Design Elements                                   | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|---|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|   | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Lighting  | 2         | 7.69          | 0         | 0.00          | 8         | 21.62         | 6          | 7.32          | 16         | 10.06         |
| HVAC  | 2         | 7.69          | 2         | 14.29         | 9         | 24.32         | 16         | 19.51         | 29         | 18.24         |
| Envelope  | 0         | 0.00          | 2         | 14.29         | 7         | 18.92         | 7          | 8.54          | 16         | 10.06         |
| Client Requesting Energy Efficiency               | 14        | 53.85         | 5         | 35.71         | 4         | 10.81         | 29         | 35.37         | 52         | 32.70         |
| Pushing Their Clients to Energy Efficiency        | 1         | 3.85          | 3         | 21.43         | 1         | 2.70          | 10         | 12.20         | 15         | 9.43          |
| LEED®   | 2         | 7.69          | 2         | 14.29         | 3         | 8.11          | 7          | 8.54          | 14         | 8.81          |
| Holistic Team Approach                            | 1         | 3.85          | 0         | 0.00          | 4         | 10.81         | 3          | 3.66          | 8          | 5.03          |
| Clients Looking at Long Term not Just First Costs | 4         | 15.38         | 0         | 0.00          | 1         | 2.70          | 4          | 4.88          | 9          | 5.66          |
| <b>Total</b>                                      | <b>26</b> | <b>100.00</b> | <b>14</b> | <b>100.00</b> | <b>37</b> | <b>100.00</b> | <b>82</b>  | <b>100.00</b> | <b>159</b> | <b>100.00</b> |

5.2 Is LEED® requested ?

Yes  No

| LEED® Requested | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|-----------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                 | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| N/A             | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 1          | 1.37          | 1          | 0.67          |
| No              | 7         | 22.58         | 2         | 13.33         | 4         | 12.90         | 14         | 19.18         | 27         | 18.00         |
| Yes             | 24        | 77.42         | 13        | 86.67         | 27        | 87.10         | 58         | 79.45         | 122        | 81.33         |
| <b>Total</b>    | <b>31</b> | <b>100.00</b> | <b>15</b> | <b>100.00</b> | <b>31</b> | <b>100.00</b> | <b>73</b>  | <b>100.00</b> | <b>150</b> | <b>100.00</b> |

5.2 a If yes, by what percentage of your clients?

| Percent of Clients | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                    | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| Fewer than 20%     | 18        | 72.00         | 10        | 76.92         | 15        | 53.57         | 17         | 28.81         | 60         | 48.00         |
| 20-50%             | 5         | 20.00         | 2         | 15.38         | 5         | 17.86         | 22         | 37.29         | 34         | 27.20         |
| 50-75%             | 1         | 4.00          | 1         | 7.69          | 4         | 14.29         | 18         | 30.51         | 24         | 19.20         |
| More than 75%      | 0         | 0.00          | 0         | 0.00          | 3         | 10.71         | 1          | 1.69          | 4          | 3.20          |
| None               | 1         | 4.00          | 0         | 0.00          | 1         | 3.57          | 1          | 1.69          | 3          | 2.40          |
| <b>Total</b>       | <b>25</b> | <b>100.00</b> | <b>13</b> | <b>100.00</b> | <b>28</b> | <b>100.00</b> | <b>59</b>  | <b>100.00</b> | <b>125</b> | <b>100.00</b> |

5.3 What do you feel is the best way to promote energy efficiency or respond to the demands for energy efficient design?

| Best Way                       | Idaho     |               | Montana   |               | Oregon    |               | Washington |               | Total      |               |
|--------------------------------|-----------|---------------|-----------|---------------|-----------|---------------|------------|---------------|------------|---------------|
|                                | N         | %             | N         | %             | N         | %             | N          | %             | N          | %             |
| <b>Education</b>               | 24        | 77.42         | 8         | 57.14         | 23        | 57.50         | 51         | 60.71         | <b>106</b> | <b>62.72</b>  |
| <b>Money</b>                   | 3         | 9.68          | 1         | 7.14          | 10        | 25.00         | 11         | 13.10         | <b>25</b>  | <b>14.79</b>  |
| <b>LEED</b>                    | 1         | 3.23          | 0         | 0.00          | 2         | 5.00          | 1          | 1.19          | <b>4</b>   | <b>2.37</b>   |
| <b>Keep-up / Peer Pressure</b> | 0         | 0.00          | 1         | 7.14          | 3         | 7.50          | 1          | 1.19          | <b>5</b>   | <b>2.96</b>   |
| <b>Stronger Code</b>           | 1         | 3.23          | 2         | 14.29         | 1         | 2.50          | 8          | 9.52          | <b>12</b>  | <b>7.10</b>   |
| <b>Enforce Code</b>            | 0         | 0.00          | 0         | 0.00          | 0         | 0.00          | 2          | 2.38          | <b>2</b>   | <b>1.18</b>   |
| <b>Costs</b>                   | 1         | 3.23          | 2         | 14.29         | 0         | 0.00          | 5          | 5.95          | <b>8</b>   | <b>4.73</b>   |
| <b>Technology</b>              | 1         | 3.23          | 0         | 0.00          | 1         | 2.50          | 5          | 5.95          | <b>7</b>   | <b>4.14</b>   |
| <b>Total</b>                   | <b>31</b> | <b>100.00</b> | <b>14</b> | <b>100.00</b> | <b>40</b> | <b>100.00</b> | <b>84</b>  | <b>100.00</b> | <b>169</b> | <b>100.00</b> |

## Appendix C. Case Weights and Stratification

The tables in this appendix summarize the various samples and weights used in this study. The first table in each set (Table C#A) illustrates the sample size as drawn from the Dodge<sup>®</sup> database. The actual sample differs from these samples by one or two cases depending on the uncertainty of the recruiting and participation. As can be seen, the strata are sampled with a roughly equal sample size so that the case weights are much larger for the smaller buildings and much smaller for the larger buildings (since those populations are sampled with very high frequency).

The second table in each set (Table C#B) shows the strata boundary developed from the original stratification but modified by the observed building area from the audit. The areas that are shown here identify the largest building area in each strata. In some cases the building audited was significantly different from the Dodge<sup>®</sup> data. In those cases, the case weight was assigned from the strata originally assigned since that remains the sampling probability for that point.

Each sample shown here overlaps the remaining samples. Some portion of each sample differs but depending on the summary the weights in the third table (Table C#C) allow the summary to focus on the particular subset. The weights are generally the inverse of the sampling probability in each strata and sample. For each sample (utility, building type, state) the weights are independent of any other weight the building might have. In some cases the building may have a weight that is derived from each of the samples as well as an overall population weight.

The individual samples shown here are:

**C.1:** The samples drawn to represent each state.

**C.2:** The samples drawn to represent each utility area:

- Energy Trust of Oregon (which is the only an enhanced sample of the whole state of Oregon);
- Idaho Power (which is an enhanced sample for the Idaho power service territory);
- Puget Sound not Seattle (which is a single sample encompassing three utilities PSE, TPU, and SnoPUD);
- Seattle City Light (which is designed to give the same level of statistical rigor as the state samples)

**C.3:** The samples that represents a regional assessment of four building types (Grocery, Hospital, Retail, Schools K-12).

**C.4:** Finally, combination of all samples weighted across all building types and states

## C.1 State Samples

**Table C1A: Stratification, State Sample.**

| State        | Strata    |           |           | Total      |
|--------------|-----------|-----------|-----------|------------|
|              | 1         | 2         | 3         |            |
| <b>ID</b>    | 15        | 18        | 15        | <b>48</b>  |
| <b>MT</b>    | 8         | 10        | 10        | <b>28</b>  |
| <b>OR</b>    | 17        | 21        | 21        | <b>59</b>  |
| <b>WA</b>    | 21        | 26        | 30        | <b>77</b>  |
| <b>Total</b> | <b>61</b> | <b>75</b> | <b>76</b> | <b>212</b> |

**Table C1B: Strata Boundaries, Square Feet.**

| State     | Strata |        |        |
|-----------|--------|--------|--------|
|           | 1      | 2      | 3      |
| <b>ID</b> | 67967  | 184507 | 369137 |
| <b>MT</b> | 11791  | 80068  | 132267 |
| <b>OR</b> | 21720  | 140000 | 607160 |
| <b>WA</b> | 25750  | 148008 | 680593 |

**Table C1C: Mean Cell Weight, State Sample.**

| State     | Strata |       |      |
|-----------|--------|-------|------|
|           | 1      | 2     | 3    |
| <b>ID</b> | 47.87  | 11.72 | 3.67 |
| <b>MT</b> | 16.00  | 4.70  | 1.50 |
| <b>OR</b> | 36.45  | 9.29  | 1.98 |
| <b>WA</b> | 84.57  | 17.41 | 2.37 |

## C.2 Utility Samples

**Table C2A: Utility Samples by Strata.**

| Utility Groups | Strata    |           |           | Total      |
|----------------|-----------|-----------|-----------|------------|
|                | 1         | 2         | 3         |            |
| ETO            | 29        | 34        | 35        | <b>98</b>  |
| IPCO           | 16        | 17        | 12        | <b>45</b>  |
| PSNS           | 15        | 21        | 29        | <b>65</b>  |
| SCL            | 5         | 10        | 11        | <b>26</b>  |
| <b>Total</b>   | <b>65</b> | <b>82</b> | <b>87</b> | <b>234</b> |

**Table C2B: Strata Boundaries, Square Feet.**

| Utility Groups | Strata |        |         |
|----------------|--------|--------|---------|
|                | 1      | 2      | 3       |
| ETO            | 21720  | 140000 | 607160  |
| IPCO           | 67967  | 56369  | 369137  |
| PSNS           | 25750  | 136138 | 1121129 |
| SCL            | 21300  | 148008 | 333800  |

**Table C2C: Case Weights, Utility Samples.**

| Utility Groups | Strata |       |      |
|----------------|--------|-------|------|
|                | 1      | 2     | 3    |
| ETO            | 36.41  | 9.26  | 2.00 |
| IPCO           | 35.50  | 8.24  | 3.08 |
| PSNS           | 48.53  | 10.38 | 1.38 |
| SCL            | 30.60  | 5.18  | 1.45 |



### C.3. Building Type Samples

**Table C3A: Building Type Sample Sizes.**

| Building Type Groups | Strata    |           |           | Total      |
|----------------------|-----------|-----------|-----------|------------|
|                      | 1         | 2         | 3         |            |
| Grocery              | 6         | 5         | 7         | 18         |
| Hospital             | 11        | 13        | 6         | 30         |
| Retail               | 14        | 17        | 32        | 63         |
| Schools              | 22        | 23        | 23        | 68         |
| <b>Total</b>         | <b>53</b> | <b>58</b> | <b>68</b> | <b>179</b> |

**Table C3B: Building Type Strata Boundaries.**

| Building Type Groups | Strata |        |        |
|----------------------|--------|--------|--------|
|                      | 1      | 2      | 3      |
| Grocery              | 24394  | 62931  | 169205 |
| Hospital             | 47058  | 125111 | 449537 |
| Retail               | 16490  | 148008 | 450000 |
| Schools              | 43422  | 98926  | 274289 |

**Table C3C: Case Weights, Building Type Samples.**

| Building Type Groups | Strata |      |      |
|----------------------|--------|------|------|
|                      | 1      | 2    | 3    |
| Grocery              | 10.17  | 7.00 | 1.63 |
| Hospital             | 7.91   | 1.62 | 1.17 |
| Retail               | 40.43  | 6.81 | 2.03 |
| Schools              | 15.36  | 7.09 | 2.26 |

#### C.4. Combined Weights, All Samples

**Table C4A: All Samples by State, State Strata Design.**

| State        | Strata     |            |            | Total      |
|--------------|------------|------------|------------|------------|
|              | 1          | 2          | 3          |            |
| <b>ID</b>    | 24         | 24         | 16         | <b>64</b>  |
| <b>MT</b>    | 9          | 10         | 10         | <b>29</b>  |
| <b>OR</b>    | 32         | 38         | 37         | <b>107</b> |
| <b>WA</b>    | 36         | 61         | 48         | <b>145</b> |
| <b>Total</b> | <b>101</b> | <b>133</b> | <b>111</b> | <b>345</b> |

**Table C4B: Strata Boundaries by Overall Strata.**

| State     | Strata |        |         |
|-----------|--------|--------|---------|
|           | 1      | 2      | 3       |
| <b>ID</b> | 67967  | 184507 | 369137  |
| <b>MT</b> | 11791  | 80068  | 132267  |
| <b>OR</b> | 21720  | 140000 | 607160  |
| <b>WA</b> | 40957  | 187040 | 1121129 |

**Table C4C: Cases Weights, All Samples.**

| State     | Strata |      |      |
|-----------|--------|------|------|
|           | 1      | 2    | 3    |
| <b>ID</b> | 29.92  | 8.67 | 3.44 |
| <b>MT</b> | 11.89  | 3.90 | 1.50 |
| <b>OR</b> | 33.03  | 8.18 | 1.95 |
| <b>WA</b> | 49.31  | 7.15 | 1.46 |

## Appendix D. Supplemental Component Tables

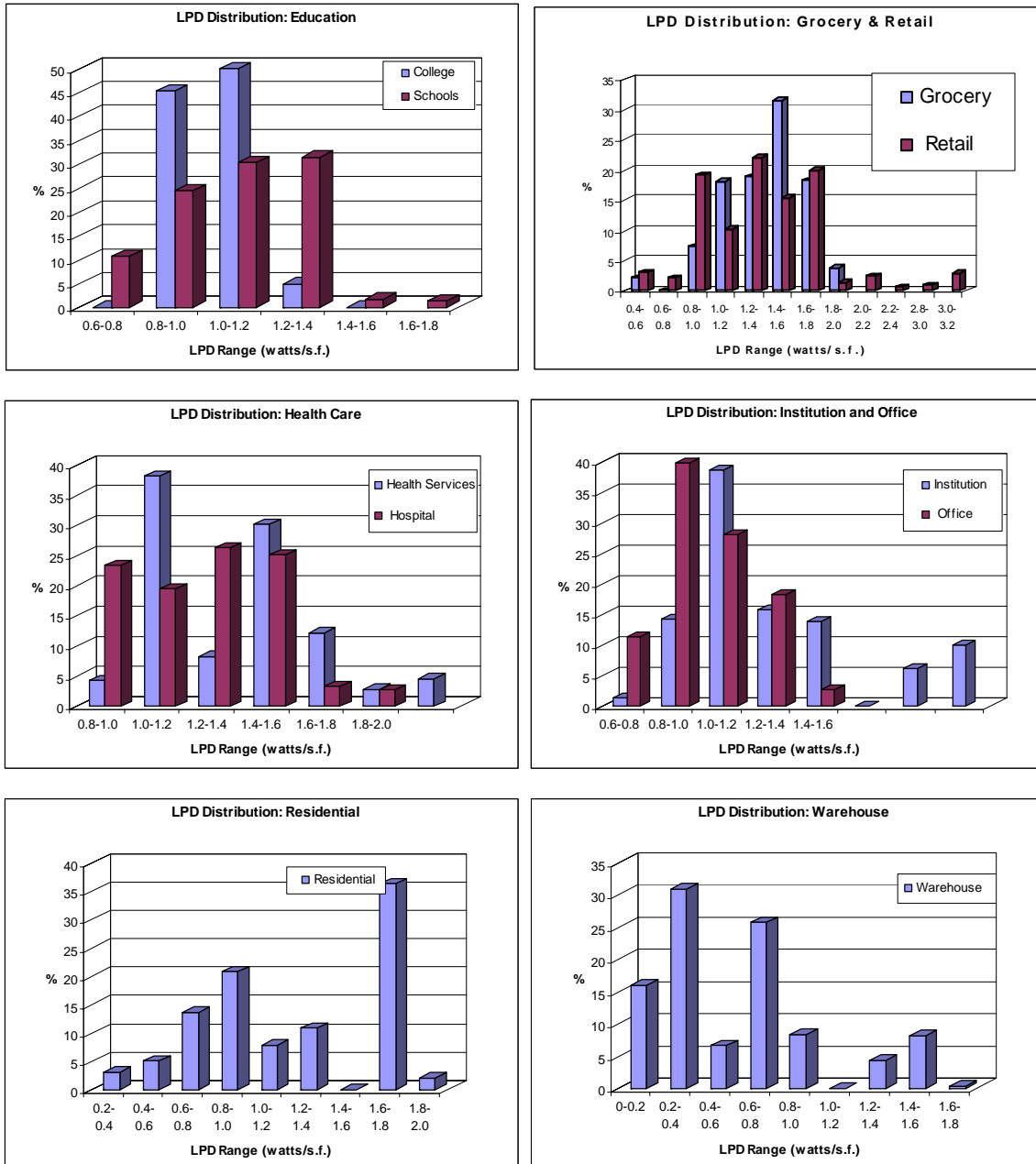
### Appendix D.1. Lighting

Table D1 presents the distribution of floor area by whole building LPD. Fully 50% of the office building floor area had LPD's less than 1 watt/s.f.. In retail, 92% of the floor area had LPDs (general plus display) less than 1.8 watt/s.f., and 84% were less than 1.6 watt/s.f.. This table is summarized in extended histograms that describe the distribution of LPDs within the individual building types. These bins include all subareas that are within the 0.2 watts/s.f..

**Table D1: LPD bin distribution by building type**

| LPD Category   | Assembly     | College      | Education    | Grocery      | Health Se    | Hospital     | Institution  | Office       | Other        | Residential  | Restaurants  | Retail       | Warehouse    | Total        |
|----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>0-0.2</b>   | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 15.9         | <b>3.2</b>   |
| <b>0.2-0.4</b> | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 3.2          | 0.0          | 0.0          | 30.9         | <b>6.4</b>   |
| <b>0.4-0.6</b> | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 1.4          | 0.0          | 17.5         | 5.1          | 0.0          | 3.1          | 6.6          | <b>2.6</b>   |
| <b>0.6-0.8</b> | 0.0          | 0.0          | 10.6         | 2.2          | 0.0          | 0.0          | 14.3         | 11.3         | 34.0         | 13.7         | 0.0          | 2.2          | 25.7         | <b>11.1</b>  |
| <b>0.8-1.0</b> | 39.1         | 45.3         | 24.4         | 0.0          | 4.2          | 23.3         | 38.6         | 39.9         | 22.0         | 20.8         | 28.4         | 19.1         | 8.3          | <b>21.7</b>  |
| <b>1.0-1.2</b> | 48.4         | 49.9         | 30.2         | 7.3          | 38.1         | 19.4         | 15.7         | 28.0         | 21.2         | 7.9          | 0.0          | 10.2         | 0.0          | <b>16.9</b>  |
| <b>1.2-1.4</b> | 12.5         | 4.9          | 31.4         | 18.1         | 8.2          | 26.2         | 13.8         | 18.2         | 3.0          | 10.9         | 13.2         | 22.1         | 4.3          | <b>16.4</b>  |
| <b>1.4-1.6</b> | 0.0          | 0.0          | 1.7          | 18.9         | 30.1         | 25.1         | 0.0          | 2.7          | 2.3          | 0.0          | 21.6         | 15.3         | 8.1          | <b>8.1</b>   |
| <b>1.6-1.8</b> | 0.0          | 0.0          | 1.4          | 31.4         | 12.1         | 3.3          | 6.2          | 0.0          | 0.0          | 36.3         | 11.8         | 19.9         | 0.3          | <b>9.3</b>   |
| <b>1.8-2.0</b> | 0.0          | 0.0          | 0.0          | 18.3         | 2.8          | 2.7          | 10.0         | 0.0          | 0.0          | 2.1          | 25.0         | 1.4          | 0.0          | <b>2.5</b>   |
| <b>2.0-2.2</b> | 0.0          | 0.0          | 0.3          | 3.9          | 4.5          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 2.4          | 0.0          | <b>0.9</b>   |
| <b>2.2-2.4</b> | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.7          | 0.0          | <b>0.1</b>   |
| <b>2.8-3.0</b> | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.9          | 0.0          | <b>0.2</b>   |
| <b>3.0-3.2</b> | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 2.9          | 0.0          | <b>0.6</b>   |
| <b>Total</b>   | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> |

**Figure D.1: LPD Distribution of Building Types.**



## Appendix D.2 HVAC

A large variety of HVAC equipment was reviewed in the audit process. These tables summarize the measures that were not reviewed directly in the main report. These tables show the distribution of efficiency in the categories of the Code tables with the ASHRAE code values as reference (highlighted cells). It is important to remember that different standards were used by different states and jurisdictions so these code values are for reference only.

### Heating efficiency

**Table D2a: Distribution of Combustion Furnace and Unit Heater Efficiency (% of COP).**

| Heating efficiency (%) | N          | Furnace      |              |              | Unit heater  | Total        |
|------------------------|------------|--------------|--------------|--------------|--------------|--------------|
|                        |            | <225 Kbtu    | >225 Kbtu    | Duct         |              |              |
| 77                     | 1          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          |
| 78                     | 20         | 1.3          | 0.0          | 15.6         | 0.0          | 1.6          |
| 79                     | 11         | 0.8          | 0.0          | 0.0          | 0.0          | 0.5          |
| 80                     | 433        | 59.9         | 52.3         | 71.2         | 59.7         | 59.0         |
| 81                     | 175        | 20.1         | 15.6         | 1.7          | 2.1          | 15.9         |
| 82                     | 41         | 4.0          | 6.2          | 0.0          | 17.5         | 6.1          |
| 83                     | 23         | 0.5          | 20.7         | 0.0          | 19.9         | 6.9          |
| 84                     | 3          | 0.2          | 0.0          | 0.3          | 0.0          | 0.1          |
| 86                     | 1          | 0.0          | 0.0          | 0.4          | 0.0          | 0.0          |
| 90                     | 33         | 4.4          | 0.0          | 0.0          | 0.8          | 2.8          |
| 91                     | 1          | 0.0          | 4.3          | 0.0          | 0.0          | 0.8          |
| 92                     | 19         | 2.7          | 0.1          | 10.8         | 0.0          | 2.3          |
| 93                     | 25         | 3.7          | 0.7          | 0.0          | 0.0          | 2.4          |
| 94                     | 8          | 2.3          | 0.0          | 0.0          | 0.0          | 1.4          |
| 98                     | 1          | 0.2          | 0.0          | 0.0          | 0.0          | 0.1          |
| <b>Total</b>           | <b>795</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> |

**Table D2b: Distribution of Heat Pump Heating Efficiency (% of Cap.).**

| COP (heating efficiency) | Heat Pump    |              | Total        |
|--------------------------|--------------|--------------|--------------|
|                          | 5-11 tons    | 11-20 tons   |              |
| 2.5                      | 65.3         | 58.5         | 63.0         |
| 3.0                      | 0.5          | 0.0          | 0.4          |
| 3.5                      | 34.1         | 41.5         | 36.6         |
| <b>Total</b>             | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> |

**Table D2c: Distribution of Water Source Heat Pump Efficiency (% of Capacity).**

| COP          | Ground Source |              | Water Source |              |              |                        | Total        |
|--------------|---------------|--------------|--------------|--------------|--------------|------------------------|--------------|
|              | Ground        | Water        | <1.5 tons    | 1.5-5 tons   | 5-11 tons    | >11 tons <sup>2)</sup> |              |
| 3.0          | 1.2           | 0.0          | 0.0          | 0.0          | 0.0          | 0.0                    | 0.3          |
| 3.5          | 81.2          | 37.5         | 0.0          | 0.5          | 0.0          | 0.0                    | 23.9         |
| 4.0          | 17.6          | 62.5         | 0.0          | 14.1         | 2.2          | 0.0                    | 10.7         |
| 4.5          | 0.0           | 0.0          | 88.8         | 14.4         | 69.8         | 100.0                  | 38.4         |
| 5.0          | 0.0           | 0.0          | 11.3         | 70.0         | 20.1         | 0.0                    | 26.1         |
| 5.5          | 0.0           | 0.0          | 0.0          | 1.0          | 7.9          | 0.0                    | 0.6          |
| <b>Total</b> | <b>100.0</b>  | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b>           | <b>100.0</b> |
| <b>Code</b>  | <b>3.4</b>    | <b>3.4</b>   | <b>3.8</b>   | <b>3.8</b>   | <b>3.8</b>   | <b>4.2</b>             |              |

**Cooling Efficiency**

**Table D2d: Distribution of Air Cooled Air Conditioner Efficiency.**

| SEER/EER     | Air Cooled AC |                 |              |              |              |              | Total         |
|--------------|---------------|-----------------|--------------|--------------|--------------|--------------|---------------|
|              | <5 tons split | <5 tons package | 5-11 tons    | 11-20 tons   | 20-60 tons   | >60 tons     |               |
| 8            | 0.1           | 0.0             | 0.4          | 0.0          | 0.0          | 0.0          | 0.1           |
| 9            | 1.3           | 0.5             | 14.8         | 22.5         | 11.1         | 56.1         | 10.4          |
| 10           | 58.1          | 31.4            | 10.3         | 14.8         | 25.4         | 32.9         | 34.2          |
| 11           | 14.4          | 52.2            | 45.3         | 25.4         | 56.7         | 1.0          | 33.3          |
| 12           | 8.3           | 1.7             | 9.9          | 34.9         | 6.7          | 0.0          | 10.0          |
| 13           | 17.8          | 14.1            | 19.3         | 1.4          | 0.1          | 0.0          | 11.5          |
| 14           | 0.0           | 0.0             | 0.0          | 1.0          | 0.0          | 10.0         | 0.5           |
| <b>Total</b> | <b>100.0</b>  | <b>100.0</b>    | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.00</b> |
| <b>Code</b>  | <b>10.0</b>   | <b>9.7</b>      | <b>8.9</b>   | <b>8.5</b>   | <b>8.5</b>   | <b>8.2</b>   |               |

**Table D2e: Distribution of Air Cooled Heat Pump Cooling Efficiency.**

| SEER/EER     | Air Source Heat Pumps |              |              |              | Total        |
|--------------|-----------------------|--------------|--------------|--------------|--------------|
|              | <5 tons, split        | 5-11 tons    | 11-20 tons   | >20 tons     |              |
| 9            | 1.4                   | 0.0          | 0.0          | 100.0        | 1.4          |
| 10           | 58.9                  | 46.5         | 66.7         | 0.0          | 53.2         |
| 11           | 9.2                   | 51.4         | 33.3         | 0.0          | 31.6         |
| 12           | 1.5                   | 2.1          | 0.0          | 0.0          | 1.6          |
| 13           | 29.1                  | 0.0          | 0.0          | 0.0          | 12.2         |
| <b>Total</b> | <b>100.0</b>          | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> |
| <b>Code</b>  | <b>10.0</b>           | <b>8.9</b>   | <b>8.5</b>   | <b>8.7</b>   |              |

**Table D2f: Distribution of Package Terminal Cooling Efficiency.**

| SEER         | Total        |
|--------------|--------------|
| 10           | 28.6         |
| 11           | 39.0         |
| 12           | 32.4         |
| <b>Total</b> | <b>100.0</b> |

**Table D2g: Distribution of Water Source Heat Pump Efficiency (% of capacity).**

| SEER/EER     | Ground Source |              | Water Source |              |              |              | Total        |
|--------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|
|              | Ground        | Water        | <1.5 tons    | 1.5-5 tons   | 5-11 tons    | >11 tons''   |              |
| 11           | 0.0           | 0.0          | 0.0          | 0.7          | 0.0          | 0.0          | 0.3          |
| 12           | 8.4           | 0.0          | 1.3          | 18.1         | 0.0          | 15.4         | 9.4          |
| 13           | 17.6          | 0.0          | 94.3         | 13.0         | 35.6         | 0.0          | 39.0         |
| 14           | 1.2           | 0.0          | 0.0          | 3.0          | 28.4         | 0.0          | 2.8          |
| 15           | 72.9          | 0.0          | 1.1          | 15.0         | 1.4          | 84.6         | 25.8         |
| 16           | 0.0           | 0.0          | 0.3          | 5.0          | 34.7         | 0.0          | 3.6          |
| 17           | 0.0           | 100.0        | 0.2          | 2.4          | 0.0          | 0.0          | 2.8          |
| 18           | 0.0           | 0.0          | 0.0          | 30.0         | 0.0          | 0.0          | 10.9         |
| 19           | 0.0           | 0.0          | 2.9          | 12.1         | 0.0          | 0.0          | 5.3          |
| 20           | 0.0           | 0.0          | 0.0          | 0.9          | 0.0          | 0.0          | 0.3          |
| <b>Total</b> | <b>100.0</b>  | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> |
| <b>Code</b>  | <b>11.0</b>   | <b>11.0</b>  | <b>9.3</b>   | <b>9.3</b>   | <b>10.5</b>  | <b>9.6</b>   |              |

## **Appendix E. Building Type Specifics**

There were several building types where the nature of the building or the goals of NEEA and the utilities were more focused. Four such building types were specifically sampled beyond the level that would happen by default in the main sampling. In these cases specific observations are both possible and more representative of the general conditions in these types. This section discusses the specifics of our findings on these building types. In general most of these features were mentioned elsewhere in the report but the effort here is to gather the observations for these building types in one section.

### **E.1. Hospitals**

The hospital sector was very interesting. No single sector had more enticing conservation opportunities. Healthcare systems are typically nearly constant volume with hot water re-heat and typically were on 24 hours a day even in outpatient clinics.

#### **Scheduling and zoning**

There were lots of critical zone issues and mixing of 24 hour with non-24 hour spaces. The basic use mix in hospitals is often oriented on patient group lines rather than cooling or schedule issues. A woman's health department, for example, will have patient education, offices, a gift shop, outpatient exam rooms, and possibly overnight patient care. These are often on the same system even though the zones operate on very different schedules.

Other examples include a UPS room amongst office space requiring the HVAC to run 24/7 and requiring 55°F cold deck temperatures or a continuously operating x-ray department or overnight patient care area on same system as outpatient clinics with no isolation dampers. In these cases, even when operators realize the importance of turning off lights and HVAC systems in these areas they are unlikely to have the means to do so. In at least one building the isolation dampers had been value engineered out of the project even though the simple payback was determined to be 2 years.

There were also several cases where designers included zone dampers that would allow different schedules in some zones, but no one was in a position to carefully review the zone status and schedules to determine which areas could be shut down and which zone dampers could be used to accomplish the change. This could be very complex given the pressure and zoning requirements in the hospital.

#### **Design**

It is very clear that hospitals get special treatment in the enforcement of energy codes. The need to meet health department regulations and other design standards, often trump any energy code restriction. Much more care is required to separate these patient critical functions from conventional office and educational activities that occupy large fractions of these buildings. Both designers and code officials could help improve the overall efficiency of this sector by introducing these distinctions into their designs.



One solution here is to design air flows in two operational modes. One for full operation and one for night or off hour operation. If that were done the Test and Balance would be asked to provide assurance that the dampers and fan speeds required to meet these alternative flows would be part of system operation.

In hospital and other health care settings, all zones should have low leak shut off dampers, and the project engineers should be strongly encouraged to determine separate lower unoccupied flow rates where possible. Due to the likelihood of cold deck temperatures driven by some other area, OS control of zones should be implemented where possible.

## **E.2. Grocery**

Energy use in the grocery sector is dominated by the refrigeration system. Heat transfer from the refrigerated cases drives most of the space conditioning demands and circumscribes most of the comfort conditions in the stores. Beyond this important feature the store is designed like any retail store. Big box retail stores often have 20 to 30 percent of their floor area devoted to grocery. In this sense the size of the grocery area in these stores is similar to stand alone groceries. Most of the measures and comments are applicable to some of these chains.

### **Heat recovery**

It is very surprising that these stores do not use heat recovery from the refrigeration systems to offset their space heating needs. Only one of the chains and one independent store included heat recovery coils for space heat in their installation. At least one other store included it in their plans but it was valued engineered out at the time of installation. This is clearly an area where many stores are contemplating a change in their systems. All stores use a heat recovery system in their hot water tanks but there is much more heat available in these systems than is currently recovered from this system.

### **Lighting**

The grocery sector should be considered as a typical retail operation. Thus the development of efficient lighting systems especially display lighting would be effective. This sector had the largest lighting LPD of any of our building types but in general it did not have a very unusual back ground lighting system.

### **Controls**

Grocery stores have fairly sophisticated controls for their refrigeration systems. These controls have remote sensing and often tied to remote sites where conditions in the cases and compressor racks can be closely monitored. In about a third of the stores reviewed this level of control or scheduling was not available for space heating or lighting. Lighting systems were manually switched and temperature control was accomplished with thermostats. Essentially none of the national chains settled for this level of control but in the independent stores or the small local chains the control systems were very simple.

## **HVAC**

The Mechanical systems used in this sector were very similar to any retail store. These systems had the capability to provide cooling to the store under all circumstances but for the most part the cooling equipment was redundant with the refrigeration system and the refrigerated case losses.

The use of non compensating exhaust is common in the grocery sector. We saw almost no cases where that was a standard. The result is that outside air dampers are set to make up a large quantity of air for these hoods. As a result there is effective no incremental control offered by CO<sub>2</sub> sensors. The primary measures here would have to both include substantial compensation in the deli, baking, and other food prep hoods coupled with ventilation control. This combination would reduce outside air and the demands on the heating and cooling capacity.

### **E.3. Schools**

The most striking aspect of this sample is the degree to which designers and school officials were willing to experiment with “high performance” design standards. There was some evidence, however, that these experiments had uneven success.

A general observation here is that in the school setting more so than almost any other building type the need to adapt zone controls and temperature, ventilation, and lighting settings to individual classroom zones cannot be overestimated. Teachers and their classrooms need become the dominant conditions that a building operator must accommodate and if they are unsuccessful even the most sophisticated control will be overridden or replaced. Moreover, it very unlikely that there will ever be a successful school design standard where the classroom and teachers area can be offered less conditioning and control than the administrative offices in the same building. We had three schools where mechanical cooling was installed in the office area and not in the classroom. In two of these cases the cooling was retrofit by the time we conducted the audit less than two years after the school was occupied.

## **Lighting**

Schools were the most likely to use advanced side daylighting controls. This presented a complication at the individual zones for both set-up and operation. Most of the Daylighting controls that we noted as disabled or overridden were in the schools in the study. This suggests a willingness to use these techniques but a failure in operator training or design specification in this application. Clearly more intervention here would be helpful but the need to have this occur not in the design phase but in the early operation and training of building operators could start the process of integrating these advanced controls into the successful operation of the school.

Occupancy sensors control of classroom lighting was very common but common area lighting was typically manually switched by custodial staff. Areas such as gyms, multi-purpose rooms, cafeterias all have much more intermittent occupancy and could benefit from

occupancy sensors to control lights. Some schools had implemented common area OS control and found it worked well.

Security lighting in schools has become a large separate usage. Many buildings reported the emergency circuit was always on. Especially in this application where a fairly large fraction of the lighting is on the emergency circuit, the effect is of negating the savings from the 10 or 15 percent reduction seen in lighting power. Our observation is that security lighting should be controlled with occupancy sensors.

### **HVAC**

OS control of vent air is common and should be the minimum implemented everywhere especially in spaces like gyms and multi-purpose rooms. Such a system would allow more scheduling control in the spaces that are not classrooms and are often operated with the rest of the school even though they have different use patterns.

There are several schools that were designed without mechanical cooling. This was the norm as recently as 10 years ago. Various criteria have intervened however to make the use of cooling almost mandatory in the design of school HVAC systems. These include the real or imagined goal of year round school operation. While this has been mentioned in almost every survey conducted in the last twenty years none of the schools in this survey were more than lightly used during the summer and most were not used at all. It would appear that this building type would be most easily adapted to a moderated cooling design or to economizer or evaporative cooled system that avoided mechanical cooling. In this context the use of integrated design techniques that include sun control and careful glazing design as well as ventilation control and operable windows could be successful in developing a school design that would be successful without significant mechanical cooling. It is clear, however, that an ad hoc approach to this problem will not result in any significant performance improvement.

### **E.4. Retail**

In this sample there was a striking dominance of big box chains. Many of these chains seem to have an unusual construction program that corresponded to our sampling window. In this study a much higher fraction of the large chains participated. The most significant thing about this participation is the degree to which these operations have integrated the design decisions into a central design approach which is meant to inform virtually all store designs. Thus once the store design includes an efficiency measure (high performance T-8s, for example) it is likely to be integrated to all the store designs. Moreover, while these measures may receive incentives from local utility programs the use of these program will probably be an after the fact incentive to include measures that were already part of their designs. There may be some specific control improvements that could be affected by utility efforts but rarely would the design process for a particular store be open to some sort of local adaptation based on utility incentives.

Another important part of this sector (that to some extent pervades all the decision-making in the entire sample) is the background of ever rising energy costs and the perception that these costs will continue to rise. This has focused the attention of the large chains in a way that was not typical in any previous review. In principle this should make the larger chains much

more receptive to energy efficiency but it also brings up the problem of influencing national decisions from the relative isolation of the Pacific Northwest.

### **Lighting**

The use of High Performance T-8 fixture should be a very easy adoption for the retail sector. They would provide a 10 to 15 percent reduction in lighting power

There is a clear move to embrace “top daylighting” into the design of their store. Several chains have successfully implemented this strategy. With the development of designs that use skylights to provide better ambience in the large stores the use of daylighting controls is an easy measure. There is evidence that some technical assistance might be welcomed in these designs especially in smaller chains without the design resources.

### **HVAC**

The big box HVAC designs are based on single zone package equipment to the exclusion of almost any other design. This is very cost effective since it allows a single spec to be negotiated with a manufacture with the benefit of using the large buying power of the chain to secure the lowest price.

The fact that these stores use a constant fan operation to ventilate the store regardless of conditioning requirements suggests that the need for a lower fan setting or a more diversified control to insure that enough air is introduced without over ventilation and significant penalties for fan energy. A VFD fan drive would allow a lower ventilation only setting. Alternatively some fraction of the package units could be designated as ventilation units and the remaining units could be set to minimum make up air settings to provide any additional conditioning that was required by the thermostat.

### **Envelope**

Envelope designs and detailing for these buildings types is significantly different from most commercial buildings. The walls are typically constructed with CMU or a tilt-up concrete detail. Insulation is provided by furring in the walls or by inserts in the CMU voids. There is a tendency in virtually all jurisdictions (especially under the IECC code) to remove as much of this insulation as would be allowed by the building inspector. A constant minimum standard would help solve some of the gaming typical in this building type. This problem extends to the slab edge which is often detailed with thermal breaks and perimeter insulation but is difficult to verify in the absence of on-site inspection.

Probably a code requirement would be much more effective in this area than incentives or “design assistance.” The individual designs are always adapted to local codes and most often the vagaries of local enforcement are not of great concern to the national chains.