APPENDIX D

TOTAL BUILDING PERFORMANCE REPORTING FORMAT

Note: This entire appendix is a Seattle amendment and is not underlined.

The reporting format has been developed to guide both staff and applicants through the energy analysis process. The report (three copies are to be submitted) begins with a text summary including project description, methodology description, and a discussion of the estimated energy consumption differences. These are accompanied by an appendix which has summary forms, calculations to support the inputs, and copies of the computer inputs and outputs (all with numbered pages).

The text and summary forms are among the most important parts of the submittal. This information is read prior to any review of the computer inputs and outputs to give an overall orientation to the project. The first evaluation of the project is based on a review of the text and summary forms. These indicate what the key energy efficiency strategies are and form the basis for a more detailed review of the drawings and of the computer analysis. Information for statistical summaries or other evaluations is drawn from the text and summary forms. While these may be the last items completed by the applicant prior to submittal, the importance of having them complete and accurate cannot be overemphasized.

REPORTING FORMAT OUTLINE

(See detailed description below)

I. Executive Summary
II. Project Description
III. Methodology Description
IV. Discussion of Estimated Energy Consumption Differences

Appendices (Supporting Material)

A. Energy Analysis Summary Form
    1. Energy Consumption by End-use portion
    2. Design Parameter Comparison portion

B. General Information
    1. Site Plan
    2. HVAC Zoning Diagram

C. Building Envelope
    1. Fenestration: NFRC Certification Authorization Report (CAR) or Simulation Report for *U*-factor and SHGC
    2. Opaque Elements: Cross-sections and *U*-factor Calculations
    3. Shading Diagrams

D. Lighting System
    1. Lighting for Interior
    2. Lighting for Parking and Outdoor Areas
    3. Lighting for Façade

E. Space Heating and Space Cooling
    1. Equipment Efficiency – Manufacturer's Specifications

F. Ventilation

G. Interior Exhaust Fans

H. Parking Ventilation Fans

I. Service Water Heating

J. Other End-uses
    1. Office Equipment
    2. Elevators and Escalators
    3. Refrigeration
    4. Cooking
    5. Other

K. Computer Printout of Inputs and Outputs

I. Executive Summary

The executive summary is the condensed version of the text. This is usually several paragraphs long, never more than one page, and includes:

1. A brief description of the project with name, address, number of stories, and total square footage, as well as a listing of the various uses and the square footage of each use.
2. An explanation about why the systems analysis compliance option was chosen (i.e. what elements of the Proposed Design do not comply with the prescriptive option).
3. A listing of the key energy efficiency features that are being used to compensate for the elements that do not comply.
4. The total energy consumption on a Btu-per-conditioned-square-foot-per-year basis for both the Standard Reference Design and the Proposed Design, and the percentage ratio of the Proposed Design to the Standard Reference Design (i.e. what the energy efficiency improvement has been).

II. Project Description

The project description is a detailed summary of the project. First is the name and the street address as well as adjacent cross-streets or streets on all four sides of the building if it is a full-block development. Indicate the number of stories and total square footage. A listing of the various uses and square footage of each use should be done on a floor-by-floor or a system-by-system basis. Thus, for mixed-use floors, specify how much is office and how much is retail, or how much is

office and how much is lab. Include parking garage number of floors and area in the listing. The description should also include information on the energy efficiency of the Proposed Design systems.

1. For the building envelope: indicate the glazing area, and how the fenestration *U*-factor and SHGC compare with the Standard Reference Design requirements; and point out any opaque component *U*-factors or *R*-values which are better than the Standard Reference Design requirements.
2. For each HVAC system: provide an explanation of the system including area served, key features, economizer percentage, control strategies, etc. Indicate any differences between the Standard Reference Design and the Proposed Design, such as equipment efficiency.
3. For the lighting: indicate whether any tradeoffs are included in this analysis, and, if so, what they are.
4. For other end-uses: indicate any differences between the Standard Reference Design and the Proposed Desgn. It is intended that the material in this section be descriptive, supporting calculations are to be included in the appendices.

III. Methodology Description

The methodology description is an explanation of any aspects of the modeling which are unusual or not perfectly clear. (The algorithms in approved analysis programs are generally acceptable and do not need to be explained.) For example:

1. Explain what shading by adjacent buildings has been included in the analysis and how it has been modeled (e.g., either using the program capabilities or as a north-facing wall, etc.).
2. If there are below-grade walls and floors, explain how the heat loss has been modeled for these (e.g., either as an exterior wall with a limited ground temperature variation or as a constant negative load to a zone, etc.)
3. If a program cannot model a system exactly, explain why the modeling assumptions used are the best representation of that system. It is intended that the material in this section provide a heads-up for anything unusual. Again, it is intended that the material in this section be descriptive, supporting calculations are to be included in the appendices.

IV. Discussion of Estimated Energy Consumption Differences

The discussion of estimated energy consumption differences is a summary and explanation of the energy savings.

1. First, list the total energy consumption on a Btu-per-conditioned-square-foot-per-year basis for both the Standard Reference Design and the Proposed Design, and the percentage ratio of the Proposed Design to the Standard Reference Design (i.e., what the energy efficiency improvement would be).
2. Then, review the energy savings by end-use, starting with the end-use which has the largest difference as a percent of the Standard Reference Design total. Attempt to correlate the differences by end-use with the strategies used. While some changes will have a simple, direct correlation with consumption, other end-use differences may have a more complex explanation due to interactive effects. For example:
    - Changes in exterior lighting will have a simple, direct correlation with consumption.
    - Differences in space heating and space cooling are likely due to a combination of building envelope and HVAC system strategies. (Lacking any better information, the following procedure can provide a rough-cut disaggregation. First, determine the ratio of the design heating load of the Proposed Design to the design heating load of the Standard Reference Design. Multiply the space heating energy consumption of the Standard Reference Design by this ratio and assume that the resulting figure is what the space heating energy consumption would have been for the Proposed Design if only the building envelope had changed. This difference is what could be attributed to the building envelope. Second, determine the ratio of the average equipment efficiency of the Proposed Design to the average equipment efficiency of the Standard Reference Design. Multiply the space heating energy consumption from the first step by this ratio and assume that the resulting figure is what the space heating energy consumption would have been for the Proposed Design if only the building envelope and equipment efficiency had changed. This second difference is what could be attributed to changes in equipment efficiency. Finally, assume that whatever energy consumption differences remain are due to other HVAC system strategies. Follow this same process for space cooling, starting with a comparison of loads, then equipment efficiency, then system type. Differences in economizer cycle, however, add another layer of complexity.)

This section should, at a minimum, provide confirmation that the results of the analysis are reasonable.

Appendices (Supporting Materials)

A. Energy Analysis Summary Form (required)

1. Complete the Energy Consumption by End-use portion of the form for each project. Where a project has multiple buildings which are individually analyzed, complete the form for each building as well as for the overall project.
2. Complete the Design Parameter Comparison portion of the form for each project. Where a project has multiple HVAC systems, complete the HVAC information for each system.

B. General Information

1. Site Plan (required) – provide site plan ($8^1/_2$ x 11 preferred) showing location and height, in feet or

stories, of all adjacent buildings and also any other buildings and topography which would provide significant shading of the proposed building.

2. HVAC zoning diagram used in the modeling process (required) – provide zoning diagram indicating zone lines and with zones labeled to match the modeling, plus takeoff sheets with area inputs for DPD review.)

C. Building Envelope

1. Glazing and opaque doors, including windows, skylights, sliding/swinging/rollup doors, glass block (required):
    a. *U*-factor, with basis for information (NFRC Certification Authorization Report, simulation report or approved alternate source).
    b. Solar Heat Gain Coefficient (SHGC), with basis for information (NFRC Certification Authorization Report, simulation report or approved alternate source)
2. Opaque roof, wall, floor (required):
    a. Provide cross-sections and *U*-factor calculations for each different assembly where default *U*-factors from Chapter 3 and Appendix A have not been used;
    b. If multiple elements (e.g., three wall types) are combined into one value for modeling purposes, provide calculations used to determine weighted-average value.
3. Shading diagrams (required):
    a. Provide information on how shading by adjacent buildings and topography has been modeled,
    b. Provide wall and roof sections showing overhangs and setbacks for glazing to justify the shading modeled.
4. Building air leakage:
    a. The Standard Reference Design building air leakage test rate shall equal that required by Section C402.4.1.2.3,
    b. Provide calculation showing how the building air leakage test rate at the standard rating conditions in Section C402.4.1.2.3 has been converted to an air leakage test rate appropriate for the energy modeling,
    c. For modeling, indicate:
        i. What percentage of air leakage is modeled for the hours when the building fan system is off and
        ii. What percentage of air leakage is modeled for the hours when the building fan system is on.

D. Lighting

1. Interior lighting (as applicable):
    a. Explain any special assumptions about interior lighting,
    b. Discuss lighting inputs to account for any exempt lighting (e.g., retail, kitchen).
2. Parking/outdoor areas lighting (as applicable):
    a. Provide calculation of areas for parking garages, then multiply by allowed watts/square foot; provide calculation of areas for surface parking, and other lighted outdoor areas, then multiply by allowed watts/square foot to obtain Standard Reference Design;
    b. Provide supporting information for Proposed only if different from Standard Reference Design;
    c. If program does not list parking/outdoor area lighting energy consumption separately, then provide calculation of annual energy consumption for this end-use.
3. Façade lighting (required):
    a. Provide calculation of building façade, then multiply by allowed watts/square foot to obtain Standard Reference Design;
    b. Provide supporting information for Proposed only if different from Standard Reference Design;
    c. If program does not list facade lighting energy consumption separately, then provide calculation of annual energy consumption for this end-use.

E. Space heating and space cooling equipment and plant

1. Provide manufacturer's specifications for equipment efficiency,
2. Provide calculations per AHRI standards for COP, EER, IPLV,
3. Provide list of equipment and size and calculations to justify if Proposed Design includes multiple pieces of equipment and a weighted average equipment efficiency is used in the energy analysis,
4. Provide calculations to justify the equipment size for the Standard Reference Design
    a. Provide calculations of ratio of Proposed Design equipment size to Proposed Design design heating load and design cooling load,
    b. Provide calculations of ratio of Standard Reference Design equipment size to Standard Reference Design design heating load and design cooling load.

F. Ventilation - interior (required):

1. Provide W/CFM calculations for the ventilation system for the Proposed Design and for the Standard Reference Design to justify inputs for the Standard Reference Design,
2. If program does not list energy consumption for interior ventilation separately in the output, then provide calculation of annual energy consumption for this end-use.

G. Interior exhaust fans (as applicable):

1. Where multiple toilet exhaust and relief fans are to be installed, provide listing of capacity for each and total for the interior exhaust fans,
2. If program does not list energy consumption for interior exhaust fans separately in the output, then provide calculation of annual energy consumption for this end-use.

H. Parking garage fans (as applicable):

1. Where multiple parking garage fans are to be installed, provide listing of capacity for each and total for the parking garage fans,
2. If program does not list energy consumption for parking garage fans separately in the output, then provide calculation of annual energy consumption for this end-use.

I. Service water heating (required):

1. Provide calculations used to size equipment (see Appendix B, Table B102, for default assumptions for service hot water quantities in Btuh per person),
2. If program does not list energy consumption for service water heating separately in the output, then provide calculation of annual energy consumption for this end-use.

J. Other end-uses

1. Office/miscellaneous equipment (as applicable):
    a. If program requires an input of total equipment capacity rather than capacity on a square foot basis, then provide calculations used to size equipment (see Appendix B, Table B102, for default assumptions for service hot water quantities in watts/square foot),
    b. If program does not list energy consumption for office/miscellaneous equipment separately in the output, then provide calculation of annual energy consumption for this end-use.
2. Elevators and escalators (as applicable):
    a. Where multiple elevators and escalators are to be installed, provide listing of capacity for each and total for the system,
    b. If program does not list energy consumption for elevators and escalators separately in the output, then provide calculation of annual energy consumption for this end-use.
3. Refrigeration - food, etc. (as applicable):
    a. Where multiple units are to be installed for refrigeration other than for comfort cooling, provide listing of capacity for each and total for the system,
    b. If program does not list energy consumption for refrigeration other than for comfort cooling separately in the output, then provide calculation of annual energy consumption for this end-use.
4. Cooking (as applicable):
    a. Where multiple units are to be installed for cooking, provide listing of capacity for each and total for the system,
    b. If program does not list energy consumption for cooking separately in the output, then provide calculation of annual energy consumption for this end-use.
5. Other (as applicable):
    a. Provide supporting data for other end-uses (e.g., commercial washers and dryers, etc.),
    b. If program does not list energy consumption for other end-uses separately in the output, then provide calculation of annual energy consumption for these end-uses.

K. Computer printout of inputs and outputs:

Provide inputs and outputs with pages numbered so cross-references can be made to the Energy Analysis Summary Form.

ENERGY ANALYSIS SUMMARY FORM PROJECT INFORMATION

DPD Project Address:							DPD Project Number:			
Project Name:							Date of this submittal:			
	Conditioned Space						Unconditioned Space			
Bldg Use	Office	Retail	Group R			Subtotal	Parking		Subtotal	
Area (SF)										

ENERGY CONSUMPTION BY END-USE

		STANDARD REFERENCE DESIGN			PROPOSED DESIGN			DIFFERENCES		
END-USE	**FUEL SOURCE**	**Total Energy Use Estimate**	**BTU/ Cond. Sq.Ft.-Year**	**% of Standard Design Total**	**Total Energy Use Estimate**	**BTU/ Cond. Sq.Ft.-Year**	**% of Standard Design Total**	**Total Energy Use Estimate**	**BTU/ Cond. Sq.Ft.-Year**	**% of Standard Design Total**
Lighting - interior				_____%			_____%			_____%
Lighting - parking				_____%			_____%			_____%
Lighting - façade				_____%			_____%			_____%
Space Heating (1)				_____%			_____%			_____%
Space Heating (2)				_____%			_____%			_____%
Space Cooling				_____%			_____%			_____%
Fans – interior ventilation				_____%			_____%			_____%
Fans – interior exhaust				_____%			_____%			_____%
Fans – parking garage				_____%			_____%			_____%
Service water heating				_____%			_____%			_____%
Office equipment				_____%			_____%			_____%
Elevators & escalators				_____%			_____%			_____%
Refrigeration (food, etc.)				_____%			_____%			_____%
Cooking (commercial)				_____%			_____%			_____%
_____				_____%			_____%			_____%
_____				_____%			_____%			_____%
Total				100%			100%			100%
Percent of Standard Reference Design: 100% =				_____%		+	_____%		=	_____%

INSTRUCTIONS:

Electronic Version:

A spreadsheet version is available on the Seattle Energy Code website @ www.seattle.gov/dpd

Project Information:

- Enter DPD address, project number, and date of this Energy End-use Summary Form.
- Enter the space uses in the building and the gross square footage of each.
- (Add/revise headings as necessary.) Spreadsheet automatically calculates subtotals and total.

Energy Consumption by End-use:

- Enter fuel source for each end-use (e.g., electric, gas, oil, steam, etc.).
- Enter total energy consumption in **BTU** for each end-use for both the Standard Reference Design and Proposed Design.
- (Spreadsheet calculates the BTU/conditioned-square-foot-year, percentages, and differences.)

DESIGN PARAMETER COMPARISON

ELEMENT	STANDARD DESIGN VALUE	(PAGE)	PROPOSED DESIGN VALUE	(PAGE)
Building Envelope				
Space heat type (electric resistance vs. other):				
Glazing: total vertical + overhead area (sq. feet):				
Glazing area as a percentage of gross wall (%):				
Overhead: total area (square feet):				
Overhead *U*-factor (weighted-average):				
Overhead SHGC (weighted-average):				
Vertical: total area (square feet):				
Vertical *U*-factor (weighted-average):				
Vertical SHGC (weighted-average):				
Roof: total area (square feet):				
Opaque roof: net area (square feet):				
Opaque roof *U*-factor (weighted-average):				
Wall: total above-grade area (square feet):				
Opaque above-grade wall: net area (square feet):				
Above-grade wall *U*-factor (weighted-average):				
Below-grade wall: net area (square feet):				
Below-grade wall *U*-factor (weighted-average):				
Opaque door: area (sq. feet):				
Opaque door *U*-factor (weighted-average):				
Floor over unconditioned space: area (sq. feet):				
Floor *U*-factor (weighted-average):				
Slab-on-grade floor: perimeter (lineal feet):				
Slab-on-grade *F*-factor (weighted-average):				
Below-grade slab floor: net area (square feet):				
Below-grade floor *U*-factor (weighted-average):				
Infiltration rate:				
Design heating load:				
Design cooling load:				

Lighting				
Interior				
Watts/sq.ft.: Office				
Watts/sq.ft.: Retail				
Watts/sq.ft.:				
Watts/sq.ft.:				
Parking/outdoor: total area (square feet)				
Watts/square foot				
Façade: total area (square feet)				
Watts/square foot				
Space Heating and Space Cooling System				
Space Heating: system type:				
Peak equipment efficiency:				
Output capacity:				
Percent of design heating load:				
Other features:				
Space Cooling: system type:				
Peak equipment efficiency:				
Output capacity:				
Percent of design cooling load:				
Other features:				
Ventilation				
Interior ventilation fans:				
Economizer type (air or water):				
Economizer percentage:				
Supply fan: total CFM:				
Fan KW:				
Return fan: total CFM:				
Fan KW:				
Exhaust fan: total CFM:				
Fan KW:				
System Watts/CFM:				
Other features:				
Other features:				
Service Water Heating				
Capacity:				
Other End-uses				
Fans – toilet and other exhaust: capacity (KW)				
Fans – parking garage: capacity (KW)				
Elevator and escalator: capacity				
Refrigeration: capacity				
Cooking: capacity				
_____: capacity				
_____: capacity				
_____: capacity				