

# BC Hydro Power Smart - New Construction Program

## Sample Energy Study Proposal

### Modeling Study Proposal for *ABC High School*

The purpose of this document is to provide guidance to consultants participating in the BC Hydro New Construction Program in how to prepare a modeling study proposal for the Whole Building Design option. This proposal is to be brief, but provides important information to BC Hydro that will determine our willingness to provide energy study funding for the project.

#### ***Background***

Use this section to provide an overview of the building, as well as any other pertinent information. Also indicate if building will be targeting any LEED level.

School District #1 has determined the need for the new ABC High School in Vancouver, which will be constructed to replace the existing high school. The existing high school was originally built in 1945, with the most recent addition being constructed in 1977. School District #1 will own the school, and has an active interest in energy conservation issues. The project will be targeting the LEED silver level.

#### ***Building Information***

Use this section to provide information on the baseline and proposed building. The baseline building is the building and systems that would have been designed if no energy study had been conducted. It represents a good design practice. This section is split into three major components: building envelope, mechanical systems, and electrical systems. The baseline and proposed building description format shown below is just an option. Consultants can arrange required information as per their personal preferences. However, the preferred BC Hydro format would be tabular, side by side format, showing baseline and proposed building information in one table.

The proposed building is a 124,000 ft<sup>2</sup>, 2-storey high school to be built at 123 Elm Street, Vancouver.

Table 1: Building Description

<b>Model Parameter</b>	<b>Baseline Building</b>	<b>Proposed Building</b>
<b>Net Floor Area</b>	124,000 ft <sup>2</sup>	
<b><u>Envelope Performance</u></b>		
<b>Overall Roof R-value</b>	As per ASHRAE 90.1 2007 building envelope prescriptive requirements	ECM #1: Increased roof insulation by 1" (R-7)
<b>Overall Wall R-value</b>	As per ASHRAE 90.1 2007 building envelope prescriptive requirements	ECM #3: Wall insulation net reduction of R-2.6 ECM #4: Wall insulation net increase of R-7
<b>Glazing Properties</b>	As per ASHRAE 90.1 2007 building envelope prescriptive requirements Windows percentage (window / wall ratio): North 11.2 % East 10.9 % South 9.2 % West 8.3 % Total 10 %	ECM #5: Same as baseline with reduced U value (low-e windows) by 28% Windows percentage (window / wall ratio): Same as baseline
<b>Shading</b>	No Shading	
<b><u>Internal Loads</u></b>		
<b>Lighting Power Density</b>	The requirements for design of lighting system outlined in Section 9 of ANSI/IESNA/ASHRAE Standard 90.1-2007 based on the space-by-space method	ECM #6: Reduced interior LPD by 25% ECM #7 Reduced LPD for exterior lighting system by 10% Exterior lighting connected load: Same as baseline
<b>Lighting Controls</b>	Code Minimum	ECM #8: Occupancy controls in classrooms and offices ECM #9: Occupancy controls in gym
<b>Plug Loads</b>	Overall building plug load density: 0.35 W/ft <sup>2</sup>	
<b><u>Operating Conditions</u></b>		
<b>Occupancy schedules</b>	Mon – Fri: 8:00 AM to 5:00 PM, Weekend: Unoccupied	
<b>Indoor Design Temperatures</b>	Heating setpoint / setback: 70 °F / 56°F Cooling setpoint / setback: 76 °F / 99°F	
<b>Indoor Humidity Levels</b>	No Control	
<b><u>Mechanical Systems</u></b>		
<b>Heating/Cooling/Ventilation System</b>	4-pipe fan coil system with gas-fired make-up air units	
<b>DHW System</b>	Dedicated Natural Gas Unit with 80% Efficiency	
<b><u>Central Plant</u></b>		
<b>Cooling System</b>	Air Cooled Chiller	ECM #10: High Efficiency Air Cooled Chiller
<b>Cooling efficiency</b>	As per ASHRAE 90.1 2007 Efficiency prescriptive requirements	ECM #10: COP = 4
<b>Heating System</b>	Gas Fired Boilers with Modulating Burners	ECM #11: Condensing Boilers
<b>Heating efficiency</b>	As per ASHRAE 90.1 2007 Efficiency prescriptive requirements	ECM #11: 95%
<b>Pumps</b>	Single speed	ECM # 12 – Variable Frequency Drives on the Heating Water Pumps

## Lighting System

Use this section to provide an overview of proposed lighting technology.

The proposed lighting systems will be: mainly using fluorescent technology for interior and HID technology for exterior, as well as appropriate automated controls.

## **Mechanical System**

Use this section to provide an overview of proposed mechanical systems.

There are several mechanical systems being considered. A ground source heat pump system will be studied, as well as a fan coil system with central heating and cooling plant. Natural gas is available on site, and will be used for heating and service water, unless it can be shown that heat pumps are more cost effective.

## ***Energy Conservation Measures to be Studied***

Use this section to indicate the energy conservation measures that will be studied. The energy study is expected to be holistic, so items beyond strictly electrical components may be considered. Note that when the completed study is submitted, an analysis of each of the listed items will be required. BC Hydro reserves the right to edit your proposed list, both to delete items which have been repeatedly shown to be not cost effective, as well as to request the addition of items which have been shown to be successful.

The following is a overview of energy conservation measures which will be studied as part of the energy study:

### **Building Envelope**

- optimum roof and wall insulation levels
- glazing characteristics

### **Lighting System**

- efficient lighting design and luminaires
- automated controls in student and staff areas
- high-bay fluorescent system and automated controls for gym

### **Mechanical System**

- type of mechanical system (GSHP or fan coil)
- if GSHP:
  - variable speed pumps
  - gas vs. hydronic heating coils in AHUs
  - heat pump SEER / COP
- if fan coil:
  - boiler efficiency

## **Study Methodology**

Use this section to outline the tools and approach to your energy analysis.

### **Mechanical**

The schematic energy modelling will be completed using the eQuest modeling software. This software calculates building energy consumption on an hourly basis.

Climate data for BC Climate Region A (Greater Vancouver) will be used for this analysis. This data describes a typical meteorological year with hourly weather parameters.

### **Baseline Building**

The first step in this analysis will be to create an energy model to represent the typical “market building” convention venue: the building and systems that would be designed if no energy optimisation study had been conducted. Baseline building modeling inputs shown in Table 1 will be used to determine building loads and energy consumption

### **Energy Conservation Measures**

After the baseline analysis, a series of Energy Conservation Measures (ECMs) will be examined to determine the impact of each measure independently. The annual energy and cost savings will be determined for each measure. The capital and maintenance cost premiums or savings will be identified and a life cycle cost analysis performed for each ECM.

Finally, a bundle of measures will be selected and analysed collectively to determine the energy performance of the proposed design, taking into account the interactions between the individual measures.

### **Lighting**

The first phase will be a preliminary assessment of lighting systems. The study will explore more lighting design alternatives for significant areas. Besides lighting quality parameters (illuminance levels, luminance ratios, uniformity, etc) an economical analysis will also be performed (load and energy consumption, LPD values, life cycle costs, etc). Point-by point calculations and graphic outputs will be provided for the lighting analysis. Daylighting is not being considered for this facility.

In the second phase of the study, a thermal simulation model will be assembled using e-Quest software incorporating the results of the lighting analysis.

### **Cost Estimate**

Costs will be provided in the preliminary study by the QS. Where possible, these costs will be augmented by including the alternatives (baseline and energy conservation measure) in the project documentation, and reporting the resulting tendered price.

## Study Cost

Use this section to outline the cost of the study. Please indicate the work item, the number of hours, and hourly rate..

<i>Task</i>	<i>Performed by</i>	<i>Hours</i>	<i>Hourly Rate</i>	<i>Task Total</i>
Meetings and Coordination	P. Nichols	6	\$ 90	\$ 540
Create model geometry	P. Nichols	20	\$ 90	\$ 1,800
Create thermal model	N. Jones	24	\$ 95	\$ 2,280
Conduct analysis	N. Jones	18	\$ 95	\$ 1,710
Produce energy study report	N. Jones	12	\$ 95	\$ 1,140
<b>Total Modeling Cost</b>				\$ 7,470
Lighting Study Cost	J. Smith			\$ 4,250
Cost Consultant	F. McTavish			\$ 2,000
<b>Total for Energy Study</b>				<b>\$ 13,720</b>

### Attachments:

Please attach the most recent of , either schematic design, or design development reports and drawings, and other information that could be helpful to the understanding of the project and study proposal.

**The items required to be included in a NC WBD study proposal for the lighting part**

*The purpose of this document is to provide guidance to consultants participating in the BC Hydro New Construction Program in how to prepare a modeling study proposal for the Whole Building Design option. This proposal is to be brief, but provides important information to BC Hydro that will determine our willingness to provide energy study funding for the project.*

**Background**

*Use this section to provide an overview of the building, as well as any other pertinent information. Also indicate if building will be targeting any LEED level. Identify the timeframe for design and construction work for the project.*

School District #1 has determined the need for the new ABC High School in Vancouver, which will be constructed to replace the existing high school. The existing high school was originally built in 1945, with the most recent addition being constructed in 1977.

School District #1 will own the school, and has an active interest in energy conservation issues. The project will be targeting the LEED silver level. The project currently is in a Schematic Design stage; the design is to be finalized in Nov, 2010. SD#1’s plan is to start construction in early 2011. Forecasted occupancy date is in July, 2012.

**Building Information**

*Use this section to provide information on the baseline and proposed building. The baseline building is the building and systems that would have been designed if no energy study had been conducted. It represents a good design practice. This section is split into three major components: building envelope, mechanical systems, and electrical systems. The baseline and proposed building description format shown below is just an option. Consultants can arrange required information as per their personal preferences. However, the preferred BC Hydro format would be tabular, side by side format, showing baseline and proposed building information in one table. If already known at the time, indicate (in percentage of the total area) the approximate breakdown between various space types.*

The proposed building is a 124,000 ft<sup>2</sup> (60% - classrooms, auditoriums, and offices; 30% - hallways and service areas; 10% - gymnasium area), 2-storey high school to be built on 3-acre lot at 123 Elm Street, Vancouver.

Table 1: Building Description

<b>Model Parameter</b>	<b>Baseline Building</b>	<b>Proposed Building</b>
<b>Net Floor Area</b>		124,000 ft <sup>2</sup>
<b>Internal Loads</b>		
	<i>Provide the baseline description</i>	<i>Provide the short description of ECMs – please estimate how far beyond the baseline (in %) in LPD reduction the proposed design targets are</i>
<b>Lighting Power Density</b>	The requirements for design of lighting system outlined in Section 9 of ANSI/IESNA/ASHRAE Standard 90.1-2007 based on the space-by-space method	ECM #6: Reduced interior LPD by 25% ECM #7 Reduced LPD for exterior lighting system by 10%
	<i>Provide the baseline description</i>	<i>Provide the short description of ECMs – please indicate what controls features (not mandatory in the baseline case) you’re going</i>

		<i>to implement</i>
<b>Lighting Controls</b>	The requirements for design of lighting system outlined in Section 9 of ANSI/IESNA/ASHRAE Standard 90.1-2007	ECM #8: Occupancy controls in classrooms, offices, gymnasium, and service rooms ECM #9: Advanced level of lighting controls (timers and photocells) for exterior lighting system
<b>Plug Loads</b>	Overall building plug load density: 0.35 W/ft <sup>2</sup>	

## Lighting System

Use this section to provide an overview of proposed lighting and lighting controls systems. Show, **how** the proposed design will achieve the targets indicated in ECMs.

The proposed interior lighting systems will be mainly using linear fluorescent luminaires with high-efficient (HEF) electronic ballasts and reduced wattage fluorescent lamps. In addition, downlights with CFLs and low-wattage halogen lamps will be used to enhance the architectural appearance of some areas. Occupancy sensors will be used in certain areas (offices, classrooms, gymnasium, and service rooms) to reduce hours of operation and energy consumption.

Low-wattage metal halide pole-mounted luminaires for site lighting and downlights and building-mounted luminaires with CFLs will be used to form the exterior lighting system. All those are for dusk-to-dawn operation and will be controlled by astronomical time clock and photosensor.

## Energy Conservation Measures to be studied

Use this section to indicate the energy conservation measures that will be studied. The energy study is expected to be holistic, so items beyond strictly electrical components may be considered. Note that when the completed study is submitted, an analysis of each of the listed items will be required. BC Hydro reserves the right to edit our proposed list, both to delete items which have been repeatedly shown to be not cost effective, as well as to request the addition of items which have been shown to be successful.

The following is an overview of energy conservation measures to be studied:

### Lighting ECMs

- LPD reduction using energy-efficient lighting equipment and advanced lighting design for interior lighting system
- LPD reduction using energy-efficient lighting equipment and advanced lighting design for exterior lighting system
- Advanced level of automated lighting controls for appropriate interior areas
- Advanced level of automated lighting controls for the exterior lighting system

## Study Methodology

Use this section to outline the tools and approach to your energy analysis.

### Lighting

Describe the major actions your study work will include. Indicate what software you're planning to use for lighting analysis. Please, make sure you clearly identify the steps for **analysis of energy efficiency of the lighting systems in consideration**. Note: submission of completed BC Hydro New Construction

*Lighting Calculator (NC LC) along with a soft copy of the lighting drawings at the final study report stage is a **mandatory requirement**.*

The first step will be a preliminary assessment of performance of various lighting systems appropriate for this educational facility. The study will explore the energy efficiency of lighting design alternatives for significant areas in depth. Besides the lighting parameters (illuminance levels, luminance ratios, uniformity, load and energy consumption, LPD values) an economical analysis will also be performed (life cycle costs, simple payback for each ECM). To make sure the proposed energy-efficient lighting system meets the industry standards, IES recommended practice, and customer requirements in terms of lighting quality, point-by-point illuminance calculations and visual graphic simulations for significant areas will be performed for the lighting analysis using AGi32 simulation software. The lighting control system will be designed based on best current industry practice, codes requirements, and IESNA recommendations. The energy savings should have resulted from the implementation of ECMs will be estimated using the current version of BC Hydro New Construction Lighting Calculator and provided to the modellers for incorporation into Building Integration Model. Daylighting ECM will not be considered for this facility.

At the time when lighting design is finalized, the NC Lighting calculator will be verified and submitted along with lighting drawings and specification sheets as an appendix to the final study report.

### **Cost of Study**

*Use this section to outline the cost of the study. Please indicate the work item, performer, number of hours, and hourly rate.*

<b>Task</b>	<b>Performed by</b>	<b>Hours</b>	<b>Hourly Rate</b>	<b>Task Total</b>
<b>Lighting study</b>	<b>ABC Lighting</b>			
Project start-up meetings and coordination, BC Hydro site inspection	P. Nichols	8	\$95	\$760
Lighting analysis	P. Nichols	20	\$95	\$1,900
NC LC completion, supporting documentation	N. Pichols	12	\$85	\$1,020
Coordination with mechanical, modelling, architectural	P. Nichols	2	\$95	\$190
Report preparation	P. Nichols	4	\$95	\$380
<b>Total for Lighting</b>				<b>\$4,250</b>

### **Attachments:**

*Please attach a brief description of the performers' experience outlining their education, credentials, previous involvement in energy-efficient lighting design and in Power Smart projects particularly. Please attach the most recent of either schematic design or design development reports and drawings, and other information that will be helpful to the understanding of the project and study proposal.*