APPENDIX 2D

ENERGY AND CARBON GUARANTEES

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APPENDIX 2D

ENERGY AND CARBON GUARANTEES

1. INTERPRETATION

1.1 Definitions

In this Appendix, in addition to the definitions set out in Schedule 1 [Definitions and Interpretation] to this Agreement:

"**Approved Energy Modeller**" means an individual who is a registered professional engineer with documented experience in energy modelling, and has the Building Energy Modelling Professional (BEMP) designation and is approved by BC Hydro to provide energy models for Clean BC (if applicable) and/or the Fortis Commercial New Construction Program (if applicable);

"**Building Energy Modelling Professional**" or "**BEMP**" means an energy modeller who has earned the ASHRAE BEMP designation, as listed on ASHRAE website http://certificants.ashrae.org/;

"**Carbon Emissions**" for a period means the total amount of carbon equivalent greenhouse gas emissions associated with Energy Consumption during that period, expressed in metric tonnes of equivalent carbon dioxide (*tCO_2e)* and calculated using the following formula:

$$tCO_2e = \left(Elec_C \times 0.011\ \frac{tCO_2e}{MWh}\right) + \left(NG_C \times 0.1795 \frac{tCO_2e}{MWh}\right)$$

where,

$$Elec_C = Electricity\ Consumption\ [MWh]$$

$$NG_C = Natural\ Gas\ Consumption\ [MWh]$$

"**Carbon Guarantee**" has the meaning given in Section 5.1 (Meet or Beat Carbon Target) of this Appendix;

"**Carbon Guarantee LDs**" has the meaning given in Section 5.4(a) (Failure to Achieve Carbon Target) of this Appendix;

"**Carbon Holdback**" has the meaning set out in Schedule 8 [Payments];

"**Carbon Holdback Letter of Credit**" has the meaning set out in Schedule 8 [Payments];

"**Carbon Target**" means generated from the New Tower;

"**Cooling Degree Days**" for a period means the figure obtained or calculated from the Site Weather Data setting out the extent to which the average outdoor temperature during that period at the Site was greater than a mean temperature of +18 degrees Celsius;

"**Electricity Consumption**" means the electrical energy used within, by or for the New Tower, measured in units of MWh as reflected by the readings for the metered utilities, whether or not directly from utility providers, and as calibrated by the Independent Energy Consultant;

"**Energy**" means electrical and thermal energy used within, by or for the New Tower and electrical and thermal energy used within, by or for exterior elements connected to the building electrical and thermal systems for the New Tower;

"**Energy Consumption**" for a period means the total amount of Energy consumed at and by the New Tower during that period, expressed in MWh as reflected by the readings for the metered utilities, whether or not directly from utility providers, and as calibrated by the Independent Energy Consultant;

"**Energy Costs**" means the total calculated operational energy cost associated with the New Tower Energy Consumption, expressed in $ per year;

"**Energy Dashboard**" means a password protected web-accessible tool that can display real time (with up to 2 hour lag time) Energy Consumption and Carbon Emissions for a range of time increments (including hourly, daily, monthly, and yearly) and broken down by energy type (electrical and thermal at a minimum) and major end uses, with comparisons to the Energy Target and the Carbon Target;

"**Energy Guarantee**" has the meaning given in Section 4.1 (Meet or Beat Energy Target) of this Appendix.

"**Energy Guarantee LDs**" has the meaning given in Section 4.4(a) (Failure to Achieve Energy Target) of this Appendix;

"**Energy Holdback**" has the meaning set out in Schedule 8 [Payments];

"**Energy Holdback Letter of Credit**" has the meaning set out in Schedule 8 [Payments];

"**Energy Model**" means the hourly energy simulation model produced using whole building energy modelling software, with such model identified as EnergyPlus, including any calculations and Energy Model Report of expected Energy Consumption, Energy Costs and expected Carbon Emissions;

"**Energy Model Assumptions**" means the energy model assumptions set out in Attachment 1 to this Appendix;

"**Energy Modelling Summary Report**" means the report referred to as the "Energy Modelling Summary Report" in Section attachment 15.2 of Attachment 1 to this Appendix;

"**Energy Modeller**" means an Approved Energy Modeller engaged by Project Co to prepare the Energy Model and confirm associated Energy Consumption, Energy Costs and Carbon Emissions;

"**Energy Target**" means per year consumed by the New Tower;

"**Energy Utility**" means each different type of energy that is purchased or produced for use in the New Tower (and may include electricity from BC Hydro, hot water, steam or chilled water delivered from a plant sharing multiple buildings, and natural gas from FortisBC);

"**Environmental Credit**" means any income, credit, right, benefit or advantage relating to environmental matters, including type and level of emissions (including carbon and carbon equivalent greenhouse gas emissions), means of production of Energy, input sources, and compliance with any Environmental Laws;

"**Facility Operation Variances**" means any material variances between the actual occupancy and usage of the New Tower and the assumptions for occupancy and usage set out in the Design and Construction Specifications, the Reviewed Drawings and Specifications and the Proposal Extracts regarding the occupancy and usage of the New Tower;

"**Heating Degree Days**" for a period means the figure obtained or calculated from the Site Weather Data setting out the extent to which the average outdoor temperature during that period at the Site was less than a mean temperature of +18 degrees Celsius;

"**IEC Functions**" means the functions to be carried out by the Independent Energy Consultant, as set out in Section 2.3 of this Appendix;

"**Independent Energy Consultant**" means a third party independent professional engineer retained by Project Co in accordance with this Appendix;

"**M&V**" means measurement and verification;

"**Measurement and Verification Plan**" has the meaning set out in Section 2.3(b)(i)(2) of this Appendix and in keeping with Section attachment 15.3 of Attachment 1 to this Appendix;

"**Megawatt hour**" or "**MWh**" is the unit of Energy to be used throughout this Appendix and 1 MWh is equivalent to 3.6 GJ;

"**Modelled Floor Area**" or "**MFA**" means the total enclosed floor area of the New Tower, as reported by the energy simulation software, excluding exterior areas and indoor parking areas. All other spaces, including partially-conditioned and unconditioned spaces, are included in the MFA. The MFA must be within 5% of the gross floor area from the architectural drawings, unless justification is provided demonstrating where the discrepancy arises and why the MFA should differ from the gross floor area by greater than 5%;

"**Natural Gas Consumption**" means the natural gas energy used within, by or for the New Tower, measured in units of MWh as reflected by the readings for the metered utilities, whether or not directly from utility providers, and as calibrated by the Independent Energy Consultant;

"**Portfolio Manager**" means the ENERGY STAR® Portfolio Manager™, an interactive energy management tool that allows tracking and assessment of facility energy and water consumption in a secure online environment;

"**Predicted Carbon Emissions**" means the prediction of Carbon Emissions as calculated (in accordance with the formulae in the definition of Carbon Emissions) from Project Co's current Energy Model and documented in the Energy Modelling Summary Report or as determined by the Independent Energy Consultant;

"**Predicted Energy Consumption**" means the prediction of Energy Consumption as determined from Project Co's current Energy Model and documented in the Energy Modelling Summary Report or as determined by the Independent Energy Consultant;

"**Process Load**" means Energy Consumption other than zone lighting or zone receptacle loads that in general are a function of the occupant-driven or commercial processes occurring within the New Tower rather than energy consumption associated with operation of the New Tower;

"**Test Period**" means the 12 month period commencing no later than 12 months after the New Tower Substantial Completion Date and ending within 24 months after the New Tower Substantial Completion Date, to be mutually agreed upon between Project Co and the Authority;

"**Total Energy Use Intensity**" means the sum of all Energy used by the New Tower (i.e. electricity and natural gas), minus all renewable energy generated on site, and divided by the MFA, reported as kWh/m2/year; and

"**Weather Data**" means the historic weather data obtained from Environment Canada's "National Climate Data and Information Archive" for the weather station that best reflects the Hospital, including the following hourly meteorological parameters:

(a) atmospheric pressure;

(b) drybulb temperature;

(c) humidity ratio (or dewpoint / wetbulb temperature); and

(d) solar parameters.

2. INDEPENDENT ENERGY CONSULTANT

2.1 General

Project Co will engage an Independent Energy Consultant, acceptable to the Authority.

2.2 Duty of Independent Judgment

(a) In exercising the IEC Functions, the Independent Energy Consultant will act:

(i) impartially, honestly and independently;

(ii) reasonably and professionally; and

(iii) in a timely manner as follows:

(1) in accordance with the applicable timelines prescribed in this Agreement; or

(2) where no timelines are prescribed, within five Business Days or such earlier time so as to enable Project Co and the Authority to perform their respective obligations under this Agreement.

(b) Although the Independent Energy Consultant should take account of any opinions or representations made by each of Project Co and the Authority, the Independent Energy Consultant will not be bound to comply with any opinions or representations made by either of them in connection with any matter on which the Independent Energy Consultant is required to exercise their professional judgment.

(c) Project Co and the Authority agree to co-operate with and provide reasonable assistance to the Independent Energy Consultant to familiarize the Independent Energy Consultant with all necessary aspects of the Project to enable the Independent Energy Consultant to carry out its obligations under this Agreement.

(d) Project Co will give all instructions to the Independent Energy Consultant in writing, copied to the Authority.

2.3 IEC Functions

Without limiting any other applicable provision of this Agreement, the Independent Energy Consultant will provide services as follows:

(a) Throughout the Construction Period and Test Period:

(i) Project Co will keep the Independent Energy Consultant informed and involved with the Project and will ensure that the Independent Energy Consultant reviews any major Project changes that could impact the Energy Guarantee or the Carbon Guarantee;

(ii) the Independent Energy Consultant will review any major Project changes that could impact the Energy Guarantee or the Carbon Guarantee and confirm that these guarantees will be met;

(iii) the Independent Energy Consultant will make efforts to integrate various disciplines and knowledge areas related to energy and carbon performance, metering, measurement and verification;

(iv) the Independent Energy Consultant will review the Energy Model updates and provide comment on the extent to which, in its professional opinion and within the time constraints of its involvement, the Energy Guarantee and the Carbon Guarantee are anticipated to be met; and

(v) the Independent Energy Consultant will provide a written report of the foregoing reviews to the Authority.

(b) In each of the Project phases listed below, the Independent Energy Consultant will:

(i) Design:

(1) Review the Design of the Facilities and the Energy Model submission at each of the project milestones set out in Table A1 to ensure the Energy Model remains in alignment with the Energy Target and the Carbon Target and report on findings to Project Co and the Authority.

(2) Prepare a measurement and verification plan (the "**Measurement and Verification Plan**") in order to:

A. document the measured performance of the New Tower relative to the Energy Target;

B. provide a mechanism to optimize actual energy performance and associated operating costs;

C. facilitate operations and maintenance efficiency; and

D. review metering matrix to ensure the Energy Target and the Carbon Target can be verified through the Measurement and Verification Plan.

(ii) Construction:

(1) Implement the Measurement and Verification Plan consistent with Option D IPMVP Volume three (3)-2003 (Concepts and Options for Determining Energy Savings for new construction).

(2) Document the measured performance of the New Tower relative to the Energy Target.

(3) Provide a mechanism to optimize actual energy performance and associated operating costs.

(4) Facilitate operations and maintenance trouble shooting.

(5) Review the metering matrix to ensure that the Energy Guarantee and the Carbon Guarantee can be verified through the Measurement and Verification Plan.

(6) Report on any Construction that fails to comply with, or will cause Project Co to fail to comply with the Energy Guarantee or the Carbon Guarantee, until such Construction is modified to comply with Reviewed Drawings and Specifications that demonstrate that the Energy Guarantee and the Carbon Guarantee will be met.

(7) To bridge the gap between Design and Construction energy performance, on a quarterly basis commencing on the date that is three months following the date of submission of Project Co's 100% Design submittals in accordance with Appendix 2C [User Consultation and Review Procedure], submit a summary statement to the Authority of all noted Project changes that could impact the Energy Guarantee or the Carbon Guarantee, the preparation of which should take into account, but not be limited to, the following:

A. Review of shop drawings and Changes for impact on the Energy Target and the Carbon Target.

B. Review the controls strategies and sequence of operations.

C. Review of metering installation.

D. Ensuring the Energy Modeller is provided with all Project updates to be included in Energy Model updates and calibration.

E. Review and comment, as needed if the Independent Energy Consultant finds discrepancies between this Agreement and the work of the Energy Modeller (input, output, results).

(8) Determine, at Substantial Completion, whether and to what extent the Predicted Energy Consumption and the Predicted Carbon Emission for the New Tower exceed the Energy Target and the Carbon Target, as applicable.

A. This process shall allow for the IEC to have four consecutive days onsite to verify that the building control system and the sequences of operation are able to operate in accordance with the mechanical control sequence and in keeping with the Energy Model) and in collaboration with relevant parties (mechanical designer, controls contractor, and Authority building operator) to identify any resolve any discrepancies.

(iii) Test Period :

(1) Execute the Measurement and Verification Plan.

(2) Review the calibrated Energy Model versus operational performance data taking into account actual operational factors including actual climate conditions, occupancy, equipment schedules, and Authority-controlled effects, and flag deviations from the Energy Target and the Carbon Target.

(3) Provide monthly reports summarizing performance by each end use relative to the Energy Target and the Carbon Target, and flag any issues and identify corrective actions needed, as identified in Section attachment 12.2 (Energy Management Plan Submittals) of Attachment 1 to this Appendix.

(4) Determine, before the end of the Test Period, whether and to what extent either or both of the Energy Guarantee and the Carbon Guarantee should be adjusted based on factors which, in the Independent Energy Consultant's professional opinion, are applicable, including actual climate conditions, occupancy, equipment use and Authority-controlled effects during the Test Period, and differ from the factors taken into account in the Energy Model Assumptions. The Independent Energy Consultant will develop a more detailed methodology for such adjustment to the satisfaction of the Authority and Project Co. The Independent Energy Consultant may use the Energy Model or another analytical tool. The detailed methodology will include a simplified summary of inputs, assumptions, and changes reasonably required by the Authority and Project Co for purposes of clearly explaining the adjustments.

(5) Determine, at the end of the Test Period, whether and to what extent the Energy Consumption and the Carbon Emission for the New Tower during the Test Period exceed the Energy Target and the Carbon Target, as applicable.

2.4 Timelines

(a) During Design, the Independent Energy Consultant will review the Submittals before Project Co submits such Submittals to the Authority in accordance with Appendix 2C [User Consultation and Review Procedure] and will provide certification in writing where the applicable Submittal confirms that the Design will meet the Energy Target and the Carbon Target. Project Co will not submit any Submittal to the Authority pursuant to the Review Procedure without such certification from the Independent Energy Consultant.

(b) During Construction, on a quarterly basis commencing on the date that is three months following the date of submission of Project Co's 100% IFC submittals under Appendix 2C [User Consultation and Review Procedure], the Independent Energy Consultant will prepare and deliver to the Authority and Project Co a quarterly written report containing a description of the IEC Functions completed in the previous quarter, with respect to Sections 2.3(a) and 2.3(b)(ii) of this Appendix.

(c) During the Test Period, as the Independent Energy Consultant determines is required for purposes of the IEC Functions and, no later than the 10th day of each month, the Independent Energy Consultant will prepare and deliver to the Authority and Project Co a monthly written report containing a description of the

functions completed in the previous month, with respect to Sections 2.3(a) and 2.3(b)(iii) of this Appendix.

(d) The format of written reports is to be approved by the Authority.

2.5 Qualifications

(a) The Independent Energy Consultant will:

(i) be an independent contractor of Project Co, and not the servant, employee, partner or agent of Project Co or the Authority;

(ii) be a professional engineer with documented experience in energy modelling and measurement and verification, such as but not limited to having the Building Energy Modelling Professional (BEMP) designation;

(iii) have a high level of knowledge and experience with mechanical design;

(iv) be experienced in measurement and verification (M&V);

(v) have familiarity with electrical design and controls;

(vi) have familiarity with commissioning process; and

(vii) have familiarity with facilities maintenance and operation needs.

(b) The role of the Independent Energy Consultant will not include preparing or completing Energy Models for or on behalf of Project Co.

3. MONITORING EQUIPMENT

3.1 Equipment Installation

Project Co will install equipment, including metering, satisfactory to the Authority to measure, record, and monitor Energy Consumption and Carbon Emissions for purposes of the Energy Guarantee and the Carbon Guarantee.

Such equipment must be suitable and properly calibrated to enable a detailed measurement, recording and monitoring of Energy and to allow analysis of the data collected to enable various matters, including:

(a) comparisons to be made with the Energy Guarantee and the Carbon Guarantee;

(b) early warning of malfunctions and deviations from norms; and

(c) to provide an Energy Dashboard to the Authority.

Such equipment must secure all such properly recorded information so that it is not lost or degraded as a result of any equipment or service malfunctions and is secure from adjustment, modification or loss from any source.

3.2 Review of Equipment

Project Co will submit the proposed equipment required pursuant to Section 3.1 (Equipment Installation) of this Appendix to the Authority for review in accordance with the design development

process described in Section 5.3 (Design Process) of Schedule 2 [Design and Construction Protocols].

4. ENERGY GUARANTEE

4.1 Meet or Beat Energy Target

Project Co warrants to the Authority that the New Tower will be designed and constructed so that the Energy Consumption for the New Tower per year will not exceed the Energy Target (the "**Energy Guarantee**"). The consequences to Project Co for breach of this warranty are limited to those set out in Sections 4.2 and 4.4 of this Appendix.

4.2 Construction Period

(a) Project Co warrants to the Authority that at all times during Construction and as at New Tower Substantial Completion, the New Tower will, upon completion of Construction in compliance with the current Reviewed Drawings and Specifications, meet the Energy Guarantee.

(b) Project Co will, with each Submittal submitted to the Authority under Appendix 2C [User Consultation and Review Procedure], identify any impacts on the Energy Guarantee or the Energy Model Assumptions, for review by the Authority. Any such impacts will not be effective unless agreed in writing by the Authority. If Project Co does not identify any impacts, the Submittal will be deemed to have no impact on the Energy Guarantee or the Energy Model Assumptions.

(c) On a quarterly basis commencing no later than the date that is three months following the submission of the 100% Design Submittals under Appendix 2C [User Consultation and Review Procedure] and together with the application for the Certificate of New Tower Substantial Completion, Project Co will provide an updated Energy Model and Energy Modelling Summary Report prepared by the Energy Modeller that demonstrates that the Energy Guarantee will be met.

(d) If at any time prior to the New Tower Substantial Completion Date, Project Co fails to demonstrate that the Energy Guarantee will be met, Project Co will:

(i) revise the Design and re-submit the Reviewed Drawings and Specifications for the New Tower, together with an updated Energy Model and Energy Modelling Summary Report prepared by the Energy Modeller demonstrating that the Energy Guarantee will be met, to the Authority for review under Appendix 2C [User Consultation and Review Procedure]; and

(ii) modify the Design and the Construction for the New Tower as required to comply with the revised Reviewed Drawings and Specifications.

(e) The Authority will not be required to make any payment for any Design or Construction work that fails to comply with, or will cause Project Co to fail to comply with, the Energy Guarantee. The Independent Certifier will assess any such work and apply a holdback for the value of correction of such work, until such work is modified to comply with the revised Reviewed Drawings and Specifications that demonstrate that the Energy Guarantee will be met.

4.3 Energy Consumption Certificate at New Tower Substantial Completion Date

As set out in Section 2.3(b)(ii)(8) of this Appendix, following New Tower Substantial Completion, the Independent Energy Consultant will assess whether the Predicted Energy Consumption for the New Tower exceeds the Energy Target. Following this assessment, and within six months after the New Tower Substantial Completion Date, Project Co will deliver to the Authority a certificate of the Independent Energy Consultant showing:

(a) the Predicted Energy Consumption for the New Tower;

(b) if applicable, the adjusted Energy Target, or if the Energy Target is not adjusted, confirmation that the original Energy Target is appropriate; and

(c) any variable that affects or invalidates the Predicted Energy Consumption for the New Tower relative to the Energy Model Assumptions.

4.4 Failure to Achieve Energy Target at New Tower Substantial Completion

(a) If at the end of the assessment outlined in Section 4.3 (Energy Consumption Certificate at New Tower Substantial Completion) of this Appendix, the Independent Energy Consultant determines that the Predicted Energy Consumption for the New Tower exceeds the Energy Target, Project Co will be liable for liquidated damages to the Authority (the "**Energy Guarantee LDs**") in accordance with the following formula:

[Predicted Energy Consumption for the New Tower (MWh) - Energy Target (MWh)] x per MWh

(b) The parties agree that the Energy Guarantee LDs are a genuine pre-estimate of the damages and expenses likely to be suffered by the Authority as a result of Project Co failing to achieve the Energy Target and are not a penalty.

(c) The maximum amount of the total aggregate liability of Project Co to the Authority for the Energy Guarantee LDs under this Section 4.4 is .

4.5 Payment of Energy Guarantee LDs

The Authority will retain the Energy Guarantee LDs by:

(a) applying an amount from the Energy Holdback equal to the amount of such damages and paying the balance of the Energy Holdback to Project Co; and/or

(b) if an Energy Holdback Letter of Credit has been provided by Project Co, retaining such Energy Holdback Letter of Credit.

Project Co may provide a replacement Energy Holdback Letter of Credit in an amount equal to the amount of the Energy Guarantee LDs and in this case, the Authority shall return the original Energy Holdback Letter of Credit to Project Co.

4.6 Monitoring of Energy Consumption during Test Period

During the Test Period, Project Co and the Authority will monitor Energy Consumption in the New Tower in order to determine the Energy Consumption for the Test Period.

4.7 Adjustment to Energy Target during Test Period

As set out in Section 2.3(b)(iii)(4) of this Appendix, the Independent Energy Consultant will determine whether and to what extent the Energy Target should be adjusted, for example to reflect new or improved information that impacts energy loads and/or end uses that are beyond the control of Project Co or are heavily impacted by Authority controlled variables.

4.8 Energy Consumption Certificate during Test Period

As set out in Section 2.3(b)(iii)(5) of this Appendix, at the end of the Test Period, the Independent Energy Consultant will assess whether the Energy Consumption for the New Tower during the Test Period exceeds the Energy Target. Following this assessment, and within 90 days after the end of the Test Period, Project Co will deliver to the Authority a certificate of the Independent Energy Consultant showing:

(a) the Energy Consumption for the New Tower during the Test Period;

(b) if applicable, the adjusted Energy Target, or if the Energy Target is not adjusted, confirmation that the original Energy Target is appropriate;

(c) the Weather Data for the Test Period, including the number of Cooling Degree Days and Heating Degree Days; and

(d) any other variable that affects or invalidates the Energy Consumption for the New Tower relative to the Energy Model Assumptions.

4.9 Adjustment to Energy Guarantee LDs

(a) If Project Co was liable for Energy Guarantee LDs pursuant to Section 4.4 (Failure to Achieve Energy Target at New Tower Substantial Completion) of this Appendix, the parties will recalculate the Energy Guarantee LDs at the end of the assessment outlined in Section 4.8 (Energy Consumption Certificate during Test Period) of this Appendix.

(b) The recalculation of the Energy Guarantee LDs shall be made in accordance with the following formula:

[Energy Consumption for the New Tower during the Test Period (MWh) - Energy Target (MWh)] x per MWh

(c) If the Authority has retained the Energy Holdback pursuant to Section 4.5(a) of this Appendix, it shall use an amount of such Energy Holdback equal to the recalculated Energy Guarantee LDs to satisfy Project Co's liability for the recalculated Energy Guarantee LDs and the Authority will reimburse any amount remaining of the Energy Holdback to Project Co no later than 60 days after delivery to the Authority of the certificate referred to in Section 4.8 (Energy Consumption Certificate during Test Period).

(d) If Project Co has provided an Energy Holdback Letter of Credit, Project Co will pay the recalculated Energy Guarantee LDs within 30 days after delivery to the Authority of the certificate referred to in Section 4.8 (Energy Consumption Certificate during Test Period) of this Appendix. If Project Co fails to pay such amount, the Authority will be entitled to discharge such obligation by making a demand under such Energy Holdback Letter of Credit.

5. CARBON GUARANTEE

5.1 Meet or Beat Carbon Target

Project Co warrants to the Authority that the New Tower will be designed and constructed so that the Carbon Emissions for the New Tower per year will not exceed the Carbon Target (the "**Carbon Guarantee**"). The consequences to Project Co for breach of this warranty are limited to those set out in Sections 5.2 and 5.4 of this Appendix.

5.2 Construction Period

(a) Project Co warrants to the Authority that at all times during Construction and as at New Tower Substantial Completion, the New Tower will, upon completion of Construction in compliance with the current Reviewed Drawings and Specifications, meet the Carbon Guarantee.

(b) Project Co will, with each Submittal submitted to the Authority under Appendix 2C [User Consultation and Review Procedure], identify any impacts on the Carbon Guarantee or the Energy Model Assumptions, for review by the Authority. Any such impacts will not be effective unless agreed in writing by the Authority. If Project Co does not identify any impacts, the Submittal will be deemed to have no impact on the Carbon Guarantee or the Energy Model Assumptions.

(c) On a quarterly basis commencing no later than the date that is three months following the submission of the 100% Design Submittals under Appendix 2C [User Consultation and Review Procedure and together with the application for the Certificate of New Tower Substantial Completion, Project Co will provide an updated Energy Model and Energy Modelling Summary Report prepared by the Energy Modeller that demonstrates that the Carbon Guarantee will be met.

(d) If at any time prior to the New Tower Substantial Completion Date, Project Co fails to demonstrate that the Carbon Guarantee will be met, Project Co will:

(i) revise the Design and re-submit the Reviewed Drawings and Specifications for the New Tower, together with an updated Energy Model and Energy Modelling Summary Report prepared by the Energy Modeller demonstrating that the Carbon Guarantee will be met, to the Authority for review under Appendix 2C [User Consultation and Review Procedure]; and

(ii) modify the Design and the Construction for the New Tower as required to comply with the revised Reviewed Drawings and Specifications.

(e) The Authority will not be required to make any payment for any Design or Construction work that fails to comply with, or will cause Project Co to fail to comply with, the Carbon Guarantee. The Independent Certifier will assess any such work and apply a holdback for the value of correction of such work, until such work is modified to comply with the revised Reviewed Drawings and Specifications that demonstrate that the Carbon Guarantee will be met.

(f) The Authority reserves the right to require Project Co to retain an Independent Energy Consultant acceptable to the Authority, acting reasonably, to review the Energy Model updates and confirm that the Carbon Guarantee will be met.

5.3 Carbon Emissions Certificate at New Tower Substantial Completion Date

As set out in Section 2.3(b)(ii)(8) of this Appendix, following New Tower Substantial Completion, the Independent Energy Consultant will assess whether the Predicted Carbon Emissions for the New Tower exceeds the Carbon Target. Following this assessment, and within six months after the New Tower Substantial Completion Date, Project Co will deliver to the Authority a certificate of the Independent Energy Consultant showing:

(a) the Predicted Carbon Emissions for the New Tower;

(b) if applicable, the adjusted Carbon Target, or if the Carbon Target is not adjusted, a statement confirming that the original Carbon Target is appropriate; and

(c) any variable that affects the Carbon Emissions for the New Tower relative to the Energy Model Assumptions.

5.4 Failure to Achieve Carbon Target at New Tower Substantial Completion

(a) If at the end of the assessment outlined in Section 5.3 (Carbon Emissions Certificate at New Tower Substantial Completion Date) of this Appendix, the Independent Energy Consultant determines that the Predicted Carbon Emissions for the New Tower exceeds the Carbon Target, Project Co will be liable for liquidated damages to the Authority (the "**Carbon Guarantee LDs**") in accordance with the following formula:

[Predicted Carbon Emissions for the New Tower (tCO2e/year] - Carbon Target (tCO2e/year)] x per tCO2e

(b) The parties agree that the Carbon Guarantee LDs are a genuine pre-estimate of the damages and expenses likely to be suffered by the Authority as a result of Project Co failing to achieve the Carbon Target and are not a penalty.

(c) The maximum amount of the total aggregate liability of Project Co to the Authority for the Carbon Guarantee LDs under this Section 5.4 is

5.5 Payment of Carbon Guarantee LDs

The Authority will retain the Carbon Guarantee LDs by:

(a) applying an amount from the Carbon Holdback equal to the amount of such damages and paying the balance of the Carbon Holdback to Project Co; and/or

(b) if a Carbon Holdback Letter of Credit has been provided by Project Co, retaining such Carbon Holdback Letter of Credit.

Project Co may provide a replacement Carbon Holdback Letter of Credit in an amount equal to the amount of the Carbon Guarantee LDs and in this case, the Authority shall return the original Carbon Holdback Letter of Credit to Project Co.

5.6 Monitoring of Carbon Emissions during the Test Period

During the Test Period, Project Co and the Authority will monitor Carbon Emissions in the New Tower in order to determine the Carbon Emissions for the Test Period.

5.7 Adjustment to Carbon Target during Test Period

As set out in Section 2.3(b)(iii)(4) of this Appendix, the Independent Energy Consultant will determine whether and to what extent the Carbon Target should be adjusted.

5.8 Carbon Emissions Certificate During Test Period

As set out in Section 2.3(b)(iii)(5) of this Appendix, at the end of the Test Period, the Independent Energy Consultant will assess whether the Carbon Emissions for the New Tower during the Test Period exceeds the Carbon Target. Following this assessment, and within 90 days after the end of the Test Period, Project Co will deliver to the Authority a certificate of the Independent Energy Consultant showing:

(a) the Carbon Emissions for the New Tower during the Test Period;

(b) if applicable, the adjusted Carbon Target, or if the Carbon Target is not adjusted, a statement confirming that the original Carbon Target is appropriate;

(c) the Weather Data for the Test Period, including the number of Cooling Degree Days and Heating Degree Days; and

(d) any other variable that affects the Carbon Emissions for the New Tower relative to the Energy Model Assumptions.

5.9 Adjustment to Carbon Guarantee LDs

(a) If Project Co was liable for Carbon Guarantee LDs pursuant to Section 5.4 (Failure to Achieve Carbon Target at New Tower Substantial Completion) of this Appendix, the parties will recalculate the Carbon Guarantee LDs at the end of the assessment outlined in Section 5.8 (Carbon Emissions Certificate during Test Period) of this Appendix.

(b) The recalculation of Carbon Guarantee LDs shall be made in accordance with the following formula:

[Carbon Emissions for the New Tower during the Test Period (tCO2e/year] - Carbon Target (tCO2e/year)] x per tCO2e

(c) If the Authority has retained the Carbon Holdback pursuant to Section 5.5(a) of this Appendix, it shall use an amount of such Carbon Holdback equal to the recalculated Carbon Guarantee LDs to satisfy Project Co's liability for the recalculated Carbon Guarantee LDs and the Authority will reimburse any amount remaining of the Carbon Holdback to Project Co no later than 60 days after delivery to the Authority of the certificate referred to in Section 5.8 (Carbon Emissions Certificate during Test Period).

(d) If Project Co has provided a Carbon Holdback Letter of Credit, Project Co will pay the recalculated Carbon Guarantee LDs within 30 days after delivery to the Authority of the certificate referred to in Section 5.8 (Carbon Emissions Certificate during Test Period) of this Appendix. If Project Co fails to pay such amount, the Authority will be entitled to discharge such obligation by making a demand under such Carbon Holdback Letter of Credit.

6. ENTITLEMENT TO ENVIRONMENTAL CREDITS

6.1 Environmental Credits

The Authority will be entitled to any and all Environmental Credits related to the Facilities and their operation.

6.2 Participate in Incentive Programs

Project Co will, on behalf of the Authority, apply to available Clean BC/BC Hydro and/or FortisBC New Construction Incentive Programs (and any other applicable energy incentive programs) and take all reasonable steps to obtain for the Authority the maximum benefits (funding, incentives and cost savings) offered by Clean BC, and FortisBC under such program(s). Project Co will:

(a) meet with Clean BC/BC Hydro and FortisBC, and the Authority's energy manager at an early stage of the design of the New Tower;

(b) collaborate with the Authority's energy manager, Clean BC/BC Hydro and FortisBC to identify potential improvements to the design of the Facilities that will achieve greater energy efficiency and/or carbon reduction;

(c) revise the Design of the Facilities as required to improve energy efficiency (to the extent possible without materially changing the Design and Construction Specifications or the intent of the Proposal Extracts), and use all reasonable efforts to obtain for the Authority the maximum funding or incentives offered by Clean BC/BC Hydro and FortisBC and minimize the Authority's energy costs during operation; and

(d) provide to the Authority all invoices and other documentation reasonably required by the Authority to complete incentive agreements and for the Authority to receive incentive funds within the time frame agreed to in the incentive agreements.

7. ENERGY MODELLING

(a) Project Co will comply with energy modelling submittal requirements set out in Attachment 1 to this Appendix.

(b) Project Co acknowledges that the utility cost and carbon emission assumptions in Attachment 1 to this Appendix are to be used in the energy modelling and calibration, unless other rates and emission factors are provided and agreed to by the Authority.

ATTACHMENT 1
ENERGY MODEL ASSUMPTIONS

1. OVERVIEW

The intent of this Attachment and the Tables included within and appended to this Attachment is to provide clarity regarding modelling methodologies, assumptions and reporting, especially related to Authority-controlled variables.

1.1 General

(a) Project Co shall apply the modelling assumptions and methodologies outlined in this Attachment for all energy models and supporting documentation submitted in relation to Energy Management Plan and the Energy Guarantee and Carbon Guarantee, applicable to the New Tower.

(b) The methodology for producing energy models as described in this Attachment shall take precedence over LEED, ASHRAE 90.1 ECB or Appendix G Rating Method, NECB Performance Compliance or other protocols. Where not specified herein, follow modelling procedures in accordance with protocols of LEED and ASHRAE 90.1-2016 Appendix G Performance Rating Method.

(c) A 'baseline' or 'reference' building simulation is not required for the Energy Target.

(d) Compliance with the Energy Target and Carbon Target provisions of this Appendix 2D is required regardless of simulation and calculation tools, or techniques employed by the proponent.

1.2 Terminology

(a) Simulation Templates

(i) Identifies a combination of simulation parameters that apply to specific room typologies within a department, as outlined in Table B5 [Simulation Schedules and Loads].

(b) Operating Schedules

(i) Operating schedules listed in Table B5 [Simulation Schedules and Loads] to this Attachment reflect hypothetical operation of the New Tower in which departments operate under typical clinical hours of operation. All design and construction stage energy models to be based on these operating schedules, unless the Authority provides updated data or agrees in writing that different operating schedules can be used. Final calibrated Energy Model and Measurement and Verification Plan to be updated with actual operating schedules.

(c) Climate Scenarios

(i) Three climate scenarios are requested to be analyzed for the design phase model submittals as noted in Table A1 [Energy Management Plan Submittal Schedule] of this Attachment:

(1) Climate scenario one is to be based on the provided EPW file per Section attachment 13.1(d) of this Attachment representing current climate.

(2) Climate scenario two is to be based on the provided EPW file per Section attachment 13.1(d) of this Attachment representing 2050's future predicted climate.

(3) Climate scenario three to be based on the provided EPW files per Section attachment 13.1(d) of this Attachment representing 2080's future predicted climate.

(ii) For the purpose of showing compliance with the Energy Target and the Carbon Target, only Climate Scenario one should be utilized.

1.3 Simulation Engines

(a) For determining the Energy Target, simulation engines shall at a minimum have the following abilities:

(i) Explicitly model 8760 hours per year,

(ii) Hourly variations in occupancy, lighting power, miscellaneous equipment,

(iii) HVAC system operation variations in setpoints and schedules,

(iv) Part-load performance curves for mechanical systems and equipment, and

(v) Other supporting calculations tools are at the discretion of the proponent.

(b) Compliance with the energy target provisions of this Appendix 2D is required regardless of simulation and calculation tools, or techniques employed by Project Co.

(c) For the proposal stage evaluations, simulations are to be performed in:

(i) EnergyPlus

(ii) DOE2.2/eQuest

(iii) IES Virtual Environment

(iv) Submit request to use other software.

(d) The Authority infers no preference or requirement for a specific simulation engine.

(e) It is expected that time-series output data will be utilized to simulate or perform calculations that the simulation engine is unable to do.

2. ENERGY MODEL DESIGN AND CONSTRUCTION SUBMITTALS

2.1 Energy Management Plan Submittal Schedule

(a) Energy Management Plan schedule and Submittal documents are required for each major design milestone, per Table A1 [Energy Management Plan Submittal Schedule] of this Attachment.

Table A1: Energy Management Plan Submittal Schedule

Design Milestone	Climate File Scenario	Energy Report per Section attachment 15.2(b) of this Attachment	Energy End-Use Summary per Section attachment 15.2(e) of this Attachment	Energy, Cost & Emission Summary per Section attachment 15.2(d) of this Attachment	Energy & Carbon Guarantee Statement per Section attachment 15.2(c) of this Attachment
30% Design	1, 2 and 3	yes	yes	yes	yes
50% Design	1	yes	yes	yes	yes
90% Design	1	Yes	Yes	Yes	yes
100% Design	1	yes	yes	yes	yes
Substantial Completion of the New Tower	1, 2 and 3	yes	yes	yes	yes
M&V	1 (Calibrated)	Calibrated energy model per Measurement and Verification Plan.			

2.2 Energy Management Plan Submittals

(a) Each submission shall include the following:

(i) An entire submission package in accordance with Section attachment 15 of this Attachment; or

(ii) Confirmation that there has been no material change that would impact the content or results of the report since the previous submission; or

(iii) A summary of the key changes since the previous submission including at minimum the following:

(1) A statement from the Independent Energy Consultant confirming that they have reviewed the submission and noting any concerns regarding the accuracy of the submission.

(2) Energy & Carbon Guarantee Compliance Statement, per Section attachment 15.2(c) of this Attachment.

(3) Energy, Cost & Emission Summary, per Section attachment 15.2(d) of this Attachment.

(4) Energy per End-Use Summary, per Section attachment 15.2(e) of this Attachment for all climate scenarios modelled per Table A1 [Energy Management Plan Submittal Schedule] of this Attachment.

(5) Performance Data Summary Statement per Section attachment 15.2(f) of this Attachment.

(6) Model Input Summary Table, per Section attachment 15.2(g) of this Attachment.

(7) A narrative describing any deviations from or simplifications of the inputs and assumptions that are outlined in this Attachment and the rationale explaining why in Project Co's opinion it is necessary to use different assumptions, for review and approval by the Authority; the Authority reserves the right to instruct Project Co to revise these assumptions and these revisions will be included in an updated submission.

(8) Energy Model digital file(s) and any workaround calculations.

3. ENERGY MODEL ASSUMPTIONS

3.1 General Independent Assumptions

(a) To ensure comparable simulations while allowing flexibility in modelling approach, Project Co shall use the default assumptions shown in the following sections to determine operating parameters for the various spaces, unless other Authority-provided data contradicts these assumptions, or where knowledge or experience dictate that a different assumption would better reflect actual operating conditions. If deviations are made to assumptions made herein, Project Co shall provide a rationale to why different assumptions have been used and what they are.

(b) Project Co shall apply the modelling assumptions and methodologies outlined in this Appendix 2D for all energy models and supporting documentation submitted in relation to Energy Management Plan, the Energy Target and the Carbon Target.

(c) Project Co shall use the appropriate combination of individual space type categories and grouped space type categories in Table B5 [Simulation Schedules and Loads] of this Attachment to define the inputs to best represent the Design based on the particular zoning strategy and modelling approach used.

(d) Weather File

(i) Weather data for the energy models submitted per Table A1 [Energy Management Plan Submittal Schedule] of this Attachment is to be:

(1) **Climate Scenario 1:** 2020s_CAN_BC_Burnaby_Hospital-offset-from-Vancouver.Intl.AP.718920_CWEC2016.epw

(2) **Climate Scenario 2:** 2050s_CAN_BC_Burnaby_Hospital-offset-from-Vancouver.Intl.AP.718920_CWEC2016.epw

(3) **Climate Scenario 3**: 2080s_CAN_BC_Burnaby_Hospital-offset-from-Vancouver.Intl.AP.718920_CWEC2016.epw

(e) Utility Rates

(i) Energy rate structures for calculation of annual energy cost are summarized in Table A2 [Electricity Rates for Energy Model] and Table A3 [Natural Gas Rates for Energy Model] inclusive, of this Attachment, of all charges and taxes to be

accounted for on the rates, but excluding carbon offset costs, which are accounted for separately.

Table A2: Electricity Rates for Energy Model

Electricity Charge	Rate	Unit
Basic Charge	$0.27	Per day
Energy Charge	0.0606	$/kWh
Demand Charge	12.34	$/kW
BC Hydro Rate Rider	5%	Applies to energy and demand charges before tax
GST	5%	Tax on all charges

Table A3: Natural Gas Rates for Energy Model

Natural Gas (as applicable)	Rate	Unit
Forecasted Rate BUH 2021	6.80	$/GJ, including carbon tax, and net GST (excluding carbon offset costs)
	24.5	$/MWh

(f) Carbon Offset Cost

(i) When calculating operational costs for energy, the carbon offset cost assumed is $25/t$CO_2$e.This cost is not included in above Table A2 [Electricity Rates for Energy Model] through Table A3 [Natural Gas Rates for Energy Model] inclusive, of this Attachment, and should be added to the total operational cost.

(g) Emission Factors

(i) Emission factors for calculation of annual greenhouse gas emissions are summarized in Table A4 [Emission Factors Per Fuel for Energy Model] of this Attachment.

Table A4: Emission Factors Per Fuel for Energy Model

Source	Rate	Unit
Electricity	0.011	tCO_2e /MWh
Natural Gas	0.1796	tCO_2e /MWh (0.0499 tCO_2e/GJ)

(h) Schedules and Hours of Operation

(i) All schedules applicable to the simulation are to be referenced in appended Table B5 [Simulation Schedules and Loads] of this Attachment, unless Authority provided information indicates otherwise.

(i) Room Set-Points

(i) All space temperature and humidity setpoints as indicated in Table B5 [Simulation Schedules and Loads] of this Attachment, unless Authority-provided information indicates otherwise. For supplementary details on space or zone categories not listed in Table B5 [Simulation Schedules and Loads] of this Attachment, refer to Table 1 of CSA Z317.2 as outlined in the Design and Construction Specifications.

3.2 Envelope Modelling Methodology

(a) General

(i) Take-offs and building constructions as per design.

(ii) Glazing areas to represent the total area of the rough opening, including glass and frame.

(iii) Any windows, curtainwall and spandrel walls must include the thermal bridging impact of framing.

(iv) Building opaque thermal performance must account for: variations in construction types and assemblies, above and below ground.

(b) Envelope Thermal Performance Calculations

(i) Overall opaque assembly U-values must be determined using the Enhanced Thermal Performance Spreadsheet (available from BC Hydro Power Smart www.BCHydro.com/thermalguide), performance data for clear fields and interface details from the Building Envelope Thermal Bridging Guide (BETBG), and the calculation methodology as outlined in section 3.4 of the BETBG.

(ii) For thermal bridges to be included and excluded, follow methodology outlined in City of Vancouver Energy Modelling Guideline v.2.0, Section 3.1.3 and 3.1.4.

(c) Infiltration

(i) Assume a nominal air infiltration rate of 2 (L/s)/m^2 of exterior above grade envelope surface area (at 75 Pa), which should be modelled as 0.22 (L/s)/m^2 of building envelope area.

Per PNNL Report 18898, Infiltration Modeling Guidelines for Commercial Building Energy Analysis, building air leakage rates shall be converted for modelling in annual energy analysis programs by being multiplied by 0.112 (e.g. a tested air leakage of 2 (L/s)/m^2 of building envelope area at 75 Pa would be modelled at 0.224 (L/s)/m^2 of building envelope area)

(ii) Air leakage by infiltration shall be modelled at 100% when the building fan system is off, and at 25% when the building fan system is on;

(iii) Air leakage testing after construction will be used to update the assumption for nominal air infiltration rate, and the energy model input (and associated Energy Target) will be updated accordingly. The input for modelled air leakage will be adjusted based on air leakage testing after construction within the range of 0.055 to 0.45 (L/s)/m^2 of building envelope area, which is equivalent to a tested infiltration rate ranging between 0.5 and 4.0 (L/s)/m^2 (@ 75 Pa) of exterior above grade envelope surface area.

3.3 Lighting, Miscellaneous and Process Loads

(a) Exterior Lighting

(i) Lighting load and controls as per design. Total kW with schedule based on photocells control modelling methodology per ASHRAE 90.1-2016.

(b) Interior Lighting

(i) Lighting load as per design per ASHRAE or NECB space-by-space method, including modelling of occupancy and daylight sensors per design.

(ii) Task lighting included in the total W/m2 applied with schedule.

(iii) Daylight controls should be modelled explicitly in the software.

(iv) Occupancy sensors energy credit applied as per ASHRAE 90.1-2016 Appendix G, Table G3.7.

(v) Lighting Schedules as per Table B5 [Simulation Schedules and Loads] of this Attachment. With exception of spaces having 24 hour lighting requirement.

(c) Elevators

(i) Use Clean BC Commercial New Construction Incentive Energy Modelling Guideline, (version October 2019) for elevator energy assumptions kW/elevator and schedule per Table B5 [Simulation Schedules and Loads]. Indicate total number of elevators based on design, included in the energy model. For Substantial Completion energy model, base load on manufacturer's information for equipment.

(d) Electrical Plug and Process Loads

(i) Assume total annual electrical consumption of 655 MWh for all other electrical plug and process equipment (including plug-loads, IT equipment, audio visual equipment, medical equipment, appliances, morgue etc). Distribute the intensity and schedule these loads based on understanding of space use, or default to schedules noted in Table B5 [Simulation Schedules and Loads] of this Attachment. Document the assumptions and schedules used for reference in the energy report.

(ii) Use a modelling approach that takes into account the appropriate portion of loads that directly contribute to the gains in the conditioned space.

(iii) Refer to loads and schedules in Table B5 [Simulation Schedules and Loads] of this Attachment.

(iv) It is assumed that there are no electric vehicle charging stations within the New Tower.

(e) Service Water Heating

(i) Service water heating load need not be modelled at the zone level.

(ii) Assume a service hot water load of 141 MWh of thermal energy (excluding efficiency of generation or any amount of pre-heat) based on code-compliant fixtures and adjust this load as appropriate where more efficient fixtures and/or

other strategies are used to reduce service hot water requirements. Document the reduction methodology in the Energy Report.

(iii) Model the service water load as 141 MWh based on 49 kW peak load and Schedule L of Table B5 [Simulation Schedules and Loads].

3.4 Mechanical System Independent Assumptions

(a) Ventilation Rates

(i) To be modelled per design. Apply CSA Z317.2 minimum air change rates and only setback air flow rates as indicated to be allowed during unoccupied periods and where design includes controls to enable ventilation setbacks and/or demand control ventilation.

(1) Air handling systems serving Type I areas may be operated at minimum levels, and

(2) Air-handling systems serving Type II and III areas may be reduced or shut down provided that relative space pressurization and humidity in adjacent zones is not affected.

(b) Temperature

(i) Setback of zone temperatures outside of Table B5 [Simulation Schedules and Loads] of this Attachment and the mechanical requirements per Section 7.5 of Schedule 3 [Design and Construction Specifications] is not permitted.

(c) Thermal Zones

(i) Thermal zones in the simulation are to reflect the zones in the design except in cases where doing so would cause simulation issues or inaccuracies, such as:

(1) Zones served by single-zone equipment such as cooling fan coils and ventilation air provided by a central VAV system.

(2) Large, open spaces served by multiple air terminals or supplemental HVAC units.

(3) Internal loads of thermal zones are to be based on the sum of internal loads applied to the spaces with the thermal zones.

(4) Schedules and temperature settings may be applied to thermal zones based on those of the dominant space.

(ii) Combination of like interior zones are to follow the following criteria:

(1) Same internal load density (lighting, plug and process loads, and occupant).

(2) Same minimum outdoor air and supply air exchange rates.

(3) Served by the same air system and no zone supplemental equipment.

(4) Same operating schedules.

(iii) Combination of like perimeter zones are to follow the following criteria:

(1) Criteria (a) through (d) per interior zones.

(2) Same net floor area +/- 20%

(3) Within a tolerance of 10%, zones have the same ratio of net floor area to: design cooling airflow; design heating airflow; and perimeter heating capacities.

(4) Same exterior surface and window constructions, and shading elements.

(iv) Same ratio of net floor area to exterior wall and window areas within a tolerance of 10%, and facing directions within 10° or all exterior surfaces facing +/- 40° from true north.

(v) All zones are completely shaded, or all zones are completely unshaded by topographical features, other buildings, or by surfaces of the building itself.

(d) Energy Centre

(i) Since the Energy Centre mechanical equipment will be serving building areas outside of the New Tower, the Energy Modeller shall use and clearly document a methodology whereby the ratio of Energy Consumption in the Energy Centre pertaining to the New Tower design can be appropriately allocated and accounted for within the Energy Model and reported per respective energy end-use as outlined in Table B2 [Energy End-Use Monthly Summary] of this Attachment.

(1) The methodology will be documented in detail within the Energy Modeling Summary Report as noted in Section attachment 15.2(b)(vii) of this Attachment.

(2) This methodology shall account for both downstream and upstream equipment, and can be based on existing industry practice for district energy modelling, such as LEEDv4 Minimum Energy Performance, Option 1- Path 2 "Full DES Performance Accounting", or other documented approach, as long as this documented approach takes all operational effects into account such as stand-by, equipment cycling, and part-load performances. The use of LEEDv4 Option1 - Path 1, Path 2 “default values”, or Path 3 are not allowed. Appropriate adjustments for allocation of the loads and energy consumption pertaining to the New Tower is expected.

(3) For recovered thermal heat, such as heat recovered from heat recovery chiller operation or any other site recovered heat, the methodology shall allow for appropriate allocation of the amount of recovered heat available for the New Tower, such as prorating kWh/MWh of heating thermal load, or similar approach.

(4) Any pump and auxiliary energy required for delivery of, or rejection of, thermal heat from the Energy Center pertaining to the New Tower should be accounted for.

(ii) Apply the provided utility rates and carbon emission rates for calculation of energy costs and carbon emissions.

(iii) Simulate separate tertiary loops per the building design.

(iv) Simulate pump flows and minimum flows, heads and power consumption, with minimum pump flow rates as required to the loops extended from the heat exchangers and central plant to the building.

4. ENERGY EFFICIENT DESIGN

4.1 Recommendations of the Energy Manager

The Authority recommends that, in order to cost-effectively meet the thresholds placed upon the Energy Target, Project Co will need to pay particular attention the following energy conservation and carbon reduction strategies, in addition to those more commonly implemented:

(a) Use of heat recovery chillers and/or other methods to ensure waste heat from cooling operations are captured for reuse and/or preheat while also minimizing carbon emissions associated with heating with fossil fuels;

(b) Low exergy design, including the use of a Thermal Gradient Header to enable waste heat to be reclaimed and re-direct to where it is needed;

(c) Additional information can be made available to make transparent the basis of the thresholds placed upon the Energy Target;

5. THE ENERGY MANAGEMENT PLAN

5.1 General

The content and format of the Energy Management Plan is described in this Attachment and includes two main components:

(a) Energy Modelling Summary Report per Section attachment 15.2 of this Attachment; and

(b) Measurement and Verification Plan per Section attachment 15.3 of this Attachment.

5.2 Content and Format of the Energy Modelling Summary Report

Project Co will produce an Energy Modelling Summary Report that will:

(a) For each submission include the following:

(i) A statement by the Independent Energy Consultant confirming that they have reviewed the submission and noting any concerns regarding the accuracy of the submission.

(ii) Energy Report, per Section attachment 15.2(b) of this Attachment.

(iii) Energy & Carbon Guarantee Compliance Statement, per Section attachment 15.2(c) of this Attachment.

(iv) Energy, Cost & Emission Summary, per Section attachment 15.2(d) of this Attachment.

(v) Energy per End-Use Summary, per Section attachment 15.2(e) of this Attachment for all climate scenarios modelled per Table A1 [Energy Management Plan Submittal Schedule] of this Attachment.

(vi) Performance Data Summary Statement per Section attachment 15.2(f) of this Attachment.

(vii) Model Input Summary, per Section attachment 15.2(g) of this Attachment.

(viii) Energy Model digital file(s) and any workaround calculations if applicable.

(b) Energy Report to include, at a minimum:

(i) Executive Summary.

(ii) Statement of software used and version.

(iii) Statement of climate scenario(s) modeled.

(iv) Using ASHRAE 90.1 definition of conditioned, semi-conditioned and unconditioned spaces, provide summary of all gross floor areas in the project, including Modeled Floor Area (MFA) and other areas broken down into:

(1) Total MFA (m^2):

A. Conditioned Area (m^2).

B. Semi-Conditioned Area (m2).

C. Unconditioned Area (m^2).

(2) Areas excluded from MFA: Parking Areas (m^2).

(v) Written narrative describing the modeled building systems and how they are designed the minimize energy consumption and carbon emissions; including

(1) thermal characteristics of the building envelope including major wall elements, windows, and roof;

(2) architectural features impacting energy including orientation, shading, location of large window areas;

(3) mechanical building systems;

(4) electrical building systems;

(5) heat recovery features;

(6) controls system approach and system sequence of operation;

(7) process loads and any strategies to minimize them;

(8) description of how the design responds to Section attachment 14.1 of this Attachment (Recommendations of the Energy Manager), including an explanation of the extent to which heat recovery and low exergy design approaches have been explored and incorporated into the design and where not incorporated, provide a rationale; and

(9) any other significant building feature or strategy that impacts energy and/or carbon emissions.

(vi) Describe how the New Tower will comply with municipal approval requirements related to applicable energy code(s).

(vii) Provide description of modeling methodologies including description of Energy Centre modeling, any workarounds or post-processing of results made outside of software.

(viii) A narrative describing any deviations from or simplifications of the inputs and assumptions that are outlined in this Attachment and the rationale explaining why in Project Co's opinion it is necessary to use different assumptions, for review and approval by the Authority; the Authority reserves the right to instruct Project Co to revise these assumptions and these revisions will be included in an updated submission.

(ix) Provide simplified results output summary reports from the energy simulation software, and more detailed outputs upon request.

(x) At the discretion of the Authority, hourly output variables of the simulation may be requested for submittal by Project Co in electronic format.

(c) Energy and Carbon Guarantee Compliance Declaration

(i) Provide written confirmation that the project achieves the Energy Target and the Carbon Target, stating in the declaration: the total achieved energy consumption (MWh) and carbon emission (tonnes CO_2e) achieved along with the statement date.

(d) Energy, Cost & Emission Summary

(i) Provide a summary for each climate scenario modeled, per Table B1 [Energy, Emission and Cost Summary] of this Attachment

(e) Energy per End-Use Summary.

(i) Provide a summary for each climate scenario modeled, per Table B2 [Energy End-Use Monthly Summary] of this Attachment.

(f) Performance Statement Data Summary

(i) A completed Performance Data Summary Statement, per Table B3 [Performance Statement Data Summary] of this Attachment.

(g) Model Input Summary Table

(i) A completed Model Input Summary Table per Table B4 [Model Input Summary Template] of this Attachment, or greater level of detail, to document key energy modeling inputs and assumptions.

5.3 Content and Format of the Measurement and Verification Plan

Project Co will produce a Measurement and Verification Plan consistent with Option D (Whole Building Calibrated Simulation) Method 2 of International Performance Measurement & Verification Protocol (IPMVP) Volume III (three)-2003 (Concepts and Options for Determining Energy Savings for new construction).

The Measurement and Verification Plan should progress with the Design, and can be finalized when the Design has developed to a point where all M&V issues can be addressed and signed off. The parties will agree upon the exact form of the Measurement and Verification Plan, which will include all the items noted within IPMVP Volume III unless otherwise agreed.

5.4 Requirements for Updating the Energy Management Plan

The Energy Management Plan will be updated at each phase of Submittals as described in Section 5.3 of Schedule 2 [Design and Construction Protocols] to align with the Design and Construction of the Project. At application for Substantial Completion of the New Tower, an updated Energy Management Plan with updated energy models and reports, per Section attachment 12.2 of this Attachment, will be submitted indicating that in Project Co's opinion, the Energy Target and the Carbon Target will be achieved by the actual building performance.

6. MEASUREMENT AND VERIFICATION

6.1 Monthly Measurement and Verification Reports

For at least 12 months during the Test Period, Project Co will deliver to the Authority a monthly Measurement and Verification Report to present findings of the Measurement and Verification Plan. The parties will agree upon the exact form of the Measurement and Verification Report from time to time but as a minimum the Measurement and Verification Report will include the following:

(a) for each calendar month (within 10 Business Days of the end of the month):

(b) the Energy Consumption in MWh for each Energy Utility and each major end use in that month (including lighting, heating, cooling, pumps, and fans, or a more detailed end use breakdown);

(c) the Weather Data for that month, including the number of Cooling Degree Days and Heating Degree Days;

(i) Facility Operation Variances provided by the Authority including:

(1) full-time equivalent workers; and

(2) number of staffed beds;

(ii) a complete set of data as required for monthly uploads to Portfolio Manager;

(iii) a record of the latest period Portfolio Manager energy performance score (out of 100);

(iv) comparison of actual Energy Consumption compared to the Energy Target on an end use basis, or more detailed as needed;

(v) differentiation between weather impacts and Authority-control variables versus variables controlled or influenced by Project Co through design and construction, such that the extent to which the Energy Target is met can be assessed;

(vi) highlight opportunities to improve energy efficiency;

(vii) suggested remedies for end uses that exceed the Energy Target for that end use; and

(viii) any other variable that affects the Energy Consumption relative to the energy model assumptions.

6.2 Payment for M&V Services

The Authority will retain the M&V Holdback from the Substantial Completion Payment in accordance with Schedule 8 [Payments].

At the end of the Test Period, provided Project Co has fully performed all of its obligations in this Appendix that are to be performed after the New Tower Substantial Completion Date, the Authority will release:

(a) the M&V Holdback; and/or

(b) any M&V Letter of Credit that has been provided by Project Co.

To the extent Project Co has not performed any of its obligations in this Appendix that are to be performed after the New Tower Substantial Completion Date, the Authority may:

(c) retain from the M&V Holdback; and/or

(d) if an M&V Holdback Letter of Credit has been provided by Project Co, make a demand under the M&V Holdback Letter of Credit,

up to an amount in aggregate sufficient to reimburse the Authority for its additional costs incurred as a result of Project Co's failure to perform.

TABLE B1: Energy, Emission and Cost Summary

Energy End-Use	Fuel Source	Energy (MWh)	EUI (kWh/m^2/year)	GHG (tCO2e/year)	GHGI (kg/m^2/year)	Energy Cost ($/year)	Energy Cost ($/m^2)
Interior Lighting							
Exterior Lighting							
Heating							
Cooling							
Heat Rejection							
Humidification							
Fans							
Pumps							
Service Water Heating							
Receptacle Loads + Elec Process Loads							
Elevators & Escalators							
Thermal Process Loads							
Renewable Energy Generation (If applicable)							
Total Energy (all fuels)							
Electricity							
Natural Gas							

Note: Fuel Source Adjustments done as necessary

TABLE B2: Energy End-Use Monthly Summary

Energy End-Use	Fuel Source	January MWh	February MWh	March MWh	April MWh	May MWh	June MWh	July MWh	August MWh	September MWh	October MWh	November MWh	December MWh	Total MWh
Interior Lighting														
Exterior Lighting														
Heating														
Cooling														
Heat Rejection														
Humidification														
Fans														
Pumps														
Service Water Heating														
Receptacle Loads + Elec Process Loads														
Elevators & Escalators														
Thermal Process Loads														
Renewable Energy Generation (If applicable)														
Total Energy (MWh)														
	Electricity													
	Natural Gas													
Total GHG Emissions (tCO2e)														
	Electricity													
	Natural Gas													
Total Energy Cost ($)														
	Electricity													
	Natural Gas													

Note: Fuel Source Adjustments done as necessary

TABLE B3: Performance Statement Data Summary

Performance Metric	Unit	30% Design	50% Design	90% Design	100% Design	Substantial Completion	M&V
Total Energy	**MWh**						
Electricity	MWh						
Natural Gas	MWh						
Total GHG	**Tonnes CO_2e**						
Electricity	Tonnes CO_2e						
Natural Gas	Tonnes CO_2e						
Total Energy Cost	**$/year**						
Electricity	$/year						
Natural Gas	$/year						

Note: Fuel Source Adjustments done as necessary

TABLE B4: Modelling Input Summary Template

Inputs	Energy Model Assumptions Reporting
Software used and version	
Climate Zone & Weather File	
Gross Building Floor Area and MFA (including list of unconditioned, semi-conditioned and conditioned areas)	
Hours of operation (list reference schedules)	
Utility Rates & Emission Factors	
Electricity	
Gas	
Other Fuel Sources	
Envelope Performance	
Roof R-value (effective) ($^oK \cdot ft^2/btuh$)	For each type
Wall Above Grade R-value (effective) ($^oK \cdot ft^2/btuh$)	For each type
Psi-values (linear thermal bridges)	For each type
Wall Below Grade R-value (effective) ($^oK \cdot ft^2/btuh$)	For each type
Slab on grade ($^oK \cdot ft^2/btuh$)	
WWR Glazing (%)	
Glass U-value including frame ($btu/h.ft^2.F$), and Solar Heat Gain Coefficient (SHGC)	For each type
Shading Devices	
Infiltration Rate	
Internal Loads	
Occupant Density & Schedule	For each type
Lighting Power Density & Schedule	For each type

Inputs	Energy Model Assumptions Reporting
Interior Lighting Controls	
Exterior Lighting	
General Plug Loads & Schedule	
Process Loads & Schedule	
Elevators & Schedule	
Domestic Hot Water & Schedule	
Operating Conditions	
Room Set-points	Temperature, Humidity
Air Handling Units	Per AHU and MAU– list all that applies: Area it serves Min OA Flow and % of total Total Supply Air Flow Heating Coil Capacity Cooling Coil Capacity Reheat Coil Capacity Fan Power Supply Fan Power Return Fan Power Exhaust Supply Air Temperature Humidification Controls / Variable / Constant Volume / DCV
Heat Recovery Ventilators	Per HRV or ERV - list all that applies: Min OA flow Sensible efficiency % Latent efficiency %
Zone Terminal Systems	List all that applies for heating and cooling
Zone Exhausts	Per System: Air Flow Fan Power
Central Plant	
Heating Equipment Type	Type, Capacity, Efficiency, Temperature
Hot Water Loop	Per Hot Water Loop – list all that applies: Supply Water Temperature Return Water Temperature Description of Reset / Controls Heat Rejection/Heat Recovery
Cooling Equipment Type	Type, Capacity, Efficiency, Temperature
Chilled Water Loop	Per Chilled Water Loop – list all that applies: Supply Water Temperature Return Water Temperature Heat Rejection/ Heat Recovery
Heat Rejection	Type, Capacity, Efficiency, Temperature

Inputs	Energy Model Assumptions Reporting
Condenser Water Loop	Per Condenser Water Loop –list all that applies: Supply Water Temperature Return Water Temperature Heat Rejection/ Heat Recovery
Steam System	Type, Capacity, Efficiency, Temperature
Domestic Hot Water Preheat	Type, Capacity, Temperature
Domestic Hot Water	Type, Capacity, Efficiency, Temperature, Storage Capacity
Pumps	For all pumps: Flow, Power, Control type
Other	
Renewable Energy	List all that applies: Type, Capacity

TABLE B5: Simulation Templates and Loads

Building Level	Individual Space Type Category	Schedules (Occupancy, Lighting, Plug-loads, HVAC)	Design Occupancy (m^2/person)*	Receptacle Power (Plug Load) As per NECB 2015, Table A-8.4.3.2.(2) B or as indicated here	Process Loads	Set-Point Temp*	Setpoint RH (%)	HVAC on (see Section 3.4 (a) for setback credits)
Level M	Z5. Mechanical plant rooms	I	200	1 W/m^2	-	15-25C	n/a	Turn on as required and per design.
	K1.1 FMO Administration (offices/meeting)	B	20	7.5 W/m^2	-	20-24C		24/7 or setback per Section 3.4 (a)
	K.1.2 FMO Staff Support		20	7.5 W/m^2	-	20-24C		24/7 or setback per Section 3.4 (a)
	K1.3 FMO Workshop Zone		20	10 W/m^2	-	20-24C		24/7 or setback per Section 3.4 (a)
	Corridors	A	100	-	-	20-24C	40-60	24/7
Level 0 – Morgue/FMO/ Biomed/Lecture	F2.1 Morgue /Autopsy	M	50	2.5 W/m^2	20W/m^2	18-20C	40-60	24/7
	J1.2 Hospital Lecture/Admin	D	20	7.5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	J2.1 UBC Lecture/Admin		20	7.5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	K1.1 FMO Administration (offices/meeting)	B	20	7.5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	K.1.2 FMO Staff Support		20	7.5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	K1.3 FMO Workshop Zones / Maintenance Rooms / Paint / Repair		20	10 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	K1.4 FMO Storage Rooms		100	-	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	K3.1 BIOMED Workshop (Biomed Workrooms)	G	20	20 W/m2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	K3.2 BIOMED Administration (Biomed)		20	7.5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	L3.3 HOSPITAL ADMIN Workplace Health	D	20	7.5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	Z1. Electrical Room	I	200	Per design kW or 200 W/m^2	-	20-25C	N/A	24/7
	Corridors	A	100	-	-	20-24C	40-60	24/7
Level 1 – Food/Retail	Z6. Entrance / Lobby	A	10	1 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	I2.1 Back of House / Prep Kitchen /Storage Cold / Dry/ Dish-Washing	K	10	**Electric: 81 W/m^2 **Natural Gas: 304 W/m^2		20-24C	40-60	Per Schedule K
	I2.2 Food Production Service	K	10			20-24C	40-60	Per Schedule K
	I2. 4 Dining Seating Area	K	5	1 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	I3.1 Retail / Gift Shop	H	10	2.5 W/m^2	-			24/7 or setback per Section 3.4 (a)
	I4.1 Security	A	20	10 W/m^2	-			24/7
	I5.1 Volunteer Services	H	20	5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
Level 2 – Clinic/Admin/FDTN	Corridors	A	100	-	-	20-24C	40-60	24/7
	A1. Clinic Areas (Exam rooms, reception, gym, lounge)	D	20	10 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	L1. Hospital Administration (offices, workstations)	D	20	7.5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
	I1. FDTN Foundation Zone (Office, lounge, meeting, clean)	D	20	7.5 W/m^2	-	20-24C	40-60	24/7 or setback per Section 3.4 (a)
Level 3 – In Patient Units	C1. IPU's	F	10	5 W/m^2	-	22-24C	40-60	24/7
	C1. Nurse Stations/Alcoves	E	2.5	15 W/m^2	-	22-24C	40-60	24/7
	C1. Clean Utility, Supply Soiled Holding		20	1 W/m^2	-	18-20C	40-60	24/7
	C1. Staff Room, Staff Lockers		10	2.5 W/m^2	-	20-24C	40-60	24/7
	C1. Offices		20	7.5 W/m^2	-	20-24C	40-60	24/7
	Corridors	A	100	-	-	20-24C	40-60	24/7
Level 4 -LDR	B1.1 Reception	C	20	7.5 W/m^2	-	22-24C	40-60	24/7 or setback per Section 3.4 (a)24/7
	B1.2 Treatment	C	20	7.5 W/m^2	-	22-24C	40-60	24/7 or setback per Section 3.4 (a)

Building Level	Individual Space Type Category	Schedules (Occupancy, Lighting, Plug-loads, HVAC)	Design Occupancy (m^2/person)*	Receptacle Power (Plug Load) As per NECB 2015, Table A-8.4.3.2.(2) B or as indicated here	Process Loads	Set-Point Temp*	Setpoint RH (%)	HVAC on (see Section 3.4 (a) for setback credits)
	B1.3 NICU (neonatal intensive care unit)	E	10	15 W/m^2	-	24-27C	40-60	24/7
	B1.4 Support	C	20	7.5 W/m^2	-	22-24C	40-60	24/7 or setback per Section 3.4 (a)
	B1.5 Staff Support		20	7.5 W/m^2	-	22-24C	40-60	24/7 or setback per Section 3.4 (a)
	Corridors	A	100	-	-	20-24C	40-60	24/7
Level 5 - MHIP	D1. IPU's	F	10	5 W/m^2	-	22-24C	40-60	24/7
	D1. Nurse Stations	E	2.5	15 W/m^2	-	22-24C	40-60	24/7
	D1. Clean Utility, Laundry		20	1 W/m^2	-	18-20C	40-60	24/7
	D1. Dining Area / Servery		10	2.5 W/m^2	-	22-24C	40-60	24/7
	D1. Offices / Consult/ Large Group / Meeting rooms		20	7.5 W/m^2	-	20-24C	40-60	24/7
	Corridors	A	100	-	-	20-24C	40-60	24/7
Level 6	Z2. Mechanical Room	I	200	1 W/m^2	-	15-25C	n/a	Turn on as required and per design.
Other Spaces General	Stairs	I	100	-	-	16C	N/A	Turn on as required and per design.
	Shafts	-	-	-	-	N/A	N/A	Unconditioned Space
	Elevators	J		Per Section 3.3.(c) and Schedule J		N/A	N/A	Per Design
	Washrooms	I	30	1 W/m^2	-	22-24C	N/A	Per Design
SHW	Service Hot Water	L		49.1 kW** with Schedule L				Per Schedule L

*Base design occupancy per Schedule 3 where sufficient information is provided.

**Derived from NREL/TP-5500-46861 DOE Report (Feb 2011) Internal Loads – to be updated with actual equipment loads per design for Substantial Completion and M&V.

TABLE B5 - Simulation Schedules

BUH Schedule Set A (24/7 uses)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Weekend	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Occupant																								
Weekday	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Weekend	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lighting																								
Weekday	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Weekend	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Receptacle																								
Weekday	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Weekend	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

BUH Schedule Set B (7am-3pm Mond-Sund, HVAC on unless design allows and include controls to shut off at night)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Weekend	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Occupant																								
Weekday	0.15	0.15	0.15	0.15	0.15	0.15	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Weekend	0.15	0.15	0.15	0.15	0.15	0.15	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Lighting																								
Weekday	0.15	0.15	0.15	0.15	0.15	0.15	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.7	0.6	0.4	0.15	0.15	0.15	0.15	0.15
Weekend	0.15	0.15	0.15	0.15	0.15	0.15	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.7	0.6	0.4	0.15	0.15	0.15	0.15	0.15
Receptacle																								
Weekday	0.15	0.15	0.15	0.15	0.15	0.15	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Weekend	0.15	0.15	0.15	0.15	0.15	0.15	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

BUH Schedule Set C (8am-4pm Mond-Sun, HVAC on unless design allows and include controls to shut off at night)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Weekend	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Occupant																								
Weekday	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weekend	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lighting																								
Weekday	0.4	0.4	0.4	0.4	0.4	0.4	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.4	0.4	0.4	0.4	0.4	0.4
Weekend	0.4	0.4	0.4	0.4	0.4	0.4	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.4	0.4	0.4	0.4	0.4	0.4
Receptacle																								
Weekday	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Weekend	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3

BUH Schedule Set D (8am - 4pm Mon - Fri, HVAC on unless design allows and include controls to shut off at night)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								

Weekday	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Weekend	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Occupant																								
Weekday	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.2	0.0	0.0	0.0	0.0	0.0
Weekend	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lighting																								
Weekday	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.2	0.1	0.1	0.1	0.1	0.1
Weekend	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Receptacle																								
Weekday	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.4	0.1	0.1	0.1	0.1	0.1
Weekend	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

BUH Schedule Set E (Nurse / Staff at IPU)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Weekend	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Occupant																								
Weekday	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.8
Weekend	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.8
Lighting																								
Weekday	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9
Weekend	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9
Receptacle																								
Weekday	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9
Weekend	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9

BUH Schedule Set F (Patient Rooms IPU)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Weekend	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Occupant																								
Weekday	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Weekend	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lighting																								
Weekday	0.0	0.0	0.0	0.0	0.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.0	0.0
Weekend	0.0	0.0	0.0	0.0	0.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.0	0.0
Receptacle																								
Weekday	0.1	0.1	0.1	0.1	0.1	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.1	0.1
Weekend	0.1	0.1	0.1	0.1	0.1	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.1	0.1

BUH Schedule Set G (7am-23pm Mon-Fri, WEH on call)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Weekend	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Occupant																								
Weekday	0.15	0.15	0.15	0.15	0.15	0.15	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5
Weekend	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Lighting																								
Weekday	0.2	0.2	0.2	0.2	0.2	0.2	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.7
Weekend	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Receptacle																								

Weekday	0.2	0.2	0.2	0.2	0.2	0.2	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.7
Weekend	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

BUH Schedule Set H (8am-6pm, Mond-Sund)																							
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
Weekend	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
Occupant																								
Weekday	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.3	0.0	0.0	0.0	0.0	0.0
Weekend	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.3	0.0	0.0	0.0	0.0	0.0
Lighting																								
Weekday	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.3	0.1	0.1	0.1	0.1
Weekend	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.3	0.1	0.1	0.1	0.1
Receptacle																								
Weekday	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.3	0.2	0.2	0.2	0.2
Weekend	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.3	0.2	0.2	0.2	0.2

BUH Schedule Set I (Unoccupied Conditioned)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Weekend	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Occupant																								
Weekday	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Weekend	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lighting																								
Weekday	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Weekend	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Receptacle																								
Weekday	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.75	0.75	0.75
Weekend	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.75	0.75	0.75

BUH Schedule Set J (Elevator Schedule)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Elevators																								
Weekday	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.50	0.75	1.00	1.00	1.00	0.75	1.00	1.00	1.00	1.00	1.00	0.52	0.52	0.52	0.28	0.20	0.20
Weekend	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.46	0.70	0.70	0.70	0.51	0.51	0.51	0.51	0.51	0.25	0.20	0.20	0.20	0.20	0.20	0.20

BUH Schedule Set K (Kitchen & Food Production Services) (530-8pm Mond-Sund, HVAC on unless design allows and include controls to shut off at night)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
HVAC																								
Weekday	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF
Weekend	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF
Occupant																								
Weekday	0.00	0.00	0.00	0.00	0.40	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.40	0.00	0.00	0.00
Weekend	0.00	0.00	0.00	0.00	0.40	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.40	0.00	0.00	0.00
Lighting																								

Weekday	0.10	0.10	0.10	0.10	0.40	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.40	0.10	0.10	0.10
Weekend	0.10	0.10	0.10	0.10	0.40	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.40	0.10	0.10	0.10
PlugLoads/Process Electricity																									
Weekday	0.10	0.10	0.10	0.10	0.10	0.25	0.35	0.35	0.35	0.25	0.25	0.35	0.35	0.35	0.25	0.25	0.25	0.35	0.35	0.35	0.25	0.10	0.10	0.10	0.10
Weekend	0.10	0.10	0.10	0.10	0.10	0.25	0.35	0.35	0.35	0.25	0.25	0.35	0.35	0.35	0.25	0.25	0.25	0.35	0.35	0.35	0.25	0.10	0.10	0.10	0.10
Process Natural Gas																									
Weekday	0.02	0.02	0.02	0.02	0.02	0.05	0.10	0.20	0.20	0.15	0.15	0.25	0.25	0.25	0.20	0.15	0.20	0.30	0.30	0.15	0.10	0.05	0.02	0.02	
Weekend	0.02	0.02	0.02	0.02	0.02	0.05	0.10	0.20	0.20	0.15	0.15	0.25	0.25	0.25	0.20	0.15	0.20	0.30	0.30	0.15	0.10	0.05	0.02	0.02	

BUH Schedule Set L (NREL - Building SHW)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
SHW percentage of maximum load																								
Weekday	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.17	0.58	0.66	0.78	0.82	0.71	0.82	0.78	0.74	0.63	0.41	0.18	0.18	0.18	0.18	0.01	0.01
Weekend	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.17	0.58	0.66	0.78	0.82	0.71	0.82	0.78	0.74	0.63	0.41	0.18	0.18	0.18	0.18	0.01	0.01

BUH Schedule Set M (Morgue Refrigeration)																								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Process Load																								
Weekday	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.75	0.75	0.75
Weekend	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.75	0.75	0.75