DESIGN AND ANALYSIS OF A DISTRIBUTED WATER HEAT PUMP SYSTEM FOR NEAR- AND NET-ZERO ENERGY COMMERCIAL BUILDINGS

by

Maudud Hassan Quazi

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Maudud Hassan Quazi
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Abstract

This objective of this project is to determine the energy and environmental potential of distributed common loop water source heat pump system in a near or net-zero commercial office building, which has simultaneous heating and cooling load in winter and shoulder seasons. It is expected that the perimeter zones will have heating demand during those months, while the core zones will have consistent cooling demand throughout the year. The motive is to reclaim the rejected heat from the cooling operation and transfer it to the zones requiring heating. The building under study is a 60,000 ft^2 three storey commercial office building, which has private offices along the perimeter, and open work area in the core.

In the first part of the analysis, the base building has been modelled and simulated to the minimum requirements of ASHRAE 90.1-Energy Standard for Buildings except Low-Rise Residential Buildings using simulation software eQuest 3.65. The Heating Ventilation and Air-conditioning (HVAC) system used is four-pipe fan coil system serving individual zones. The fan coil units use a centralized natural gas boiler and a variable capacity centrifugal chiller as external source of heating and cooling respectively. The base case consumes a total of 524.54 x 1000 kWh of electricity and 1,056 million Btu of natural gas annually.

The second part is the modelling and simulation of a proposed case, which uses the same building envelope, occupancy, lighting and equipment as the base case. The HVAC system used is a distributed common loop heat pump system connected to a cooling tower for heat rejection, and a condensing boiler for heat addition. During the occupied hours, when simultaneous cooling and heating loads exist in the building, the cooling zone heat pumps rejects exhaust heat into the common loop, and the heat is subsequently used by the heat pumps operating in heating mode. Using this method, the heat pump system reduces its dependence on the cooling tower and the boiler, which only operate to maintain the loop temperature in an acceptable range.

There is 9,510 kWh (1.81%) increase in electricity consumption by proposed case comparing to the base building. Natural gas consumption has been reduced by 353.65 million Btu (33.48%). Annual utility bill has increased by $1,483.00 which is 1.88% higher than the base case. 15.7 tonnes of greenhouse gas can be reduced if the proposed case is adopted.

Acknowledgements

First of all, I would like to humble myself to my Creator, who has given me the ability to learn.

I would like to thank Dr. Alan Fung for being my advisor and for providing his valuable guidance for this project. I would also like to thank Dr. Wey Leong for serving on the examination committee.

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1. Introduction

1.1 Purpose of the Project

The purpose of this project is to examine energy saving potential of an office building located in Toronto by modelling it to ASHRAE 90.1 standard and using distributed water loop heat pump (DWLHP) system for providing simultaneous heating and cooling in different zones. Toronto has a large number of commercial buildings used for variety of different industries. Often the office buildings have cooling load in the core zones during the winter season because of heat generated from occupancy, lighting and other office equipment. Buildings also lose heat to the ambient during the winter because of the difference between the indoor design temperature and the outdoor temperature. Thus addition of heating energy is required to maintain the indoor comfort condition. A common loop water source heat pump is a system, where some heat pumps extract heat from the water loop and add thermodynamic work in order to release higher amount of heat to the space; on the other hand heat pumps in cooling mode extract heat from the space and perform thermodynamic work to reject more heat to the water loop. It is also known that normally the offices are occupied for a certain period of time during the day, and unoccupied for the remaining hours. During the unoccupied hours of winter, interior heat generation does not take place. Therefore, to eliminate the role of external heat generating equipment, the cumulative daily heat rejection to the common water loop must exceed the cumulative daily heat extracted.

1.2 Energy Use of Commercial Buildings

According to a Natural Resources Canada publication titled Energy Efficiency Trends in Canada 1990 to 2009, floor space for the entire commercial/institutional sector is equivalent to about 40 percent of the total residential floor space. In 2009, the commercial/institutional sector was responsible for 14 percent of the total energy use in Canada and produced 13 percent of the associated greenhouse gas (GHG) emissions, shown in Figure 1 and Figure 2 (NRCan, 2011).

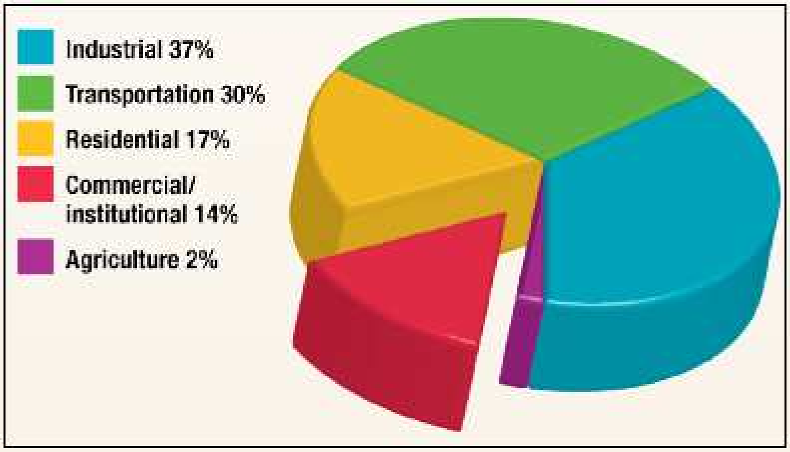


Figure 1: Secondary energy use by sector (NRCan, 2011)

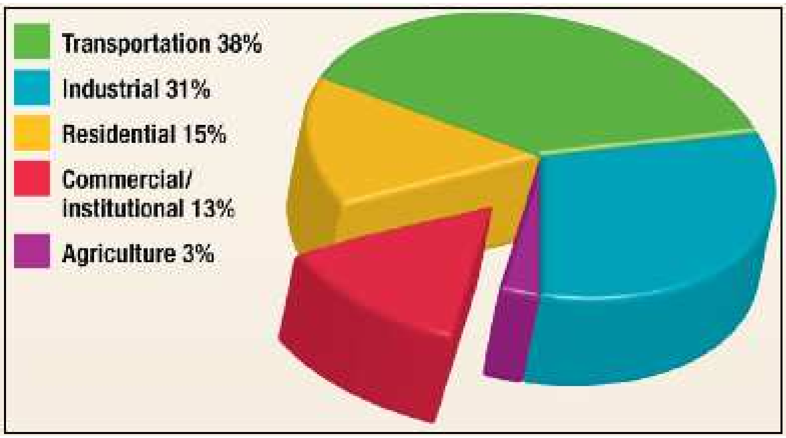


Figure 2: GHG emission by sector (NRCan, 2011)

Space heating accounts for the largest share of energy use. Figure 3 shows that in the commercial sector offices, retail trade and educational services account for 70 percent of the total Canadian commercial/institutional floor space, which in 2009 was estimated at 709.5 million m^2 (NRCan, 2011).

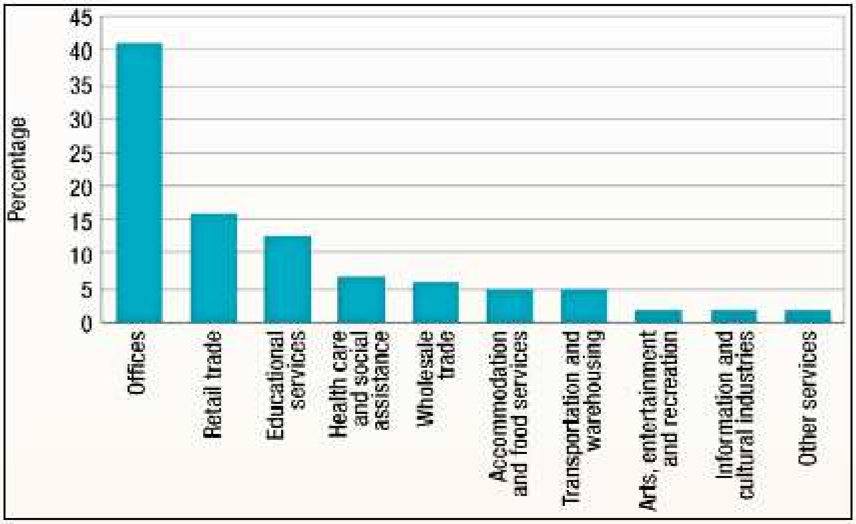


Figure 3: Commercial/institutional floor space by activity type in 2009 (NRCan, 2011)

Natural gas and electricity are the main energy source for the commercial/industrial sector, accounting for 87 percent of the energy use. According to Figure 4 and Figure 5, electricity is the primary source of energy for lighting, space cooling, auxiliary motors and equipment. Natural gas and the remaining fuels are the primary energy sources for space and water heating (NRCan, 2011).

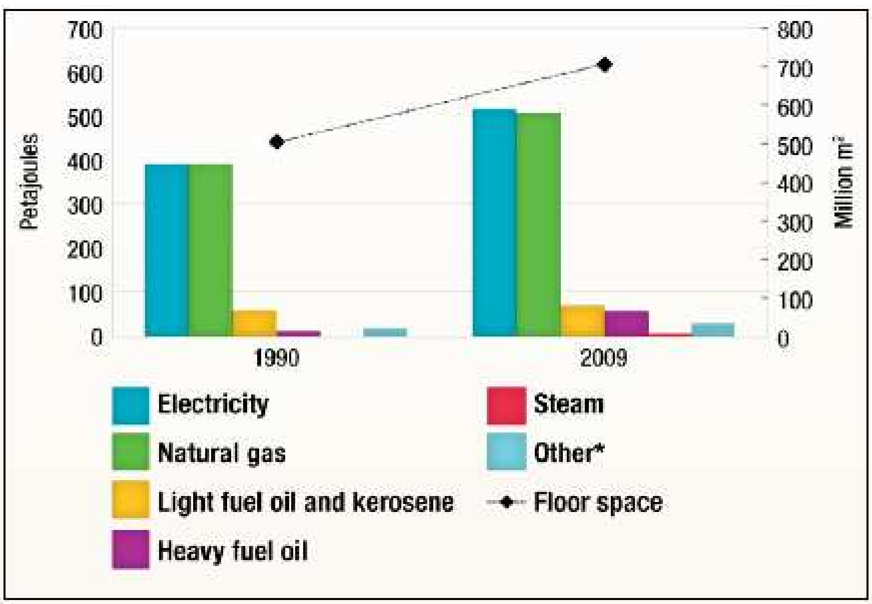


Figure 4: Energy use by fuel type (NRCan, 2011)

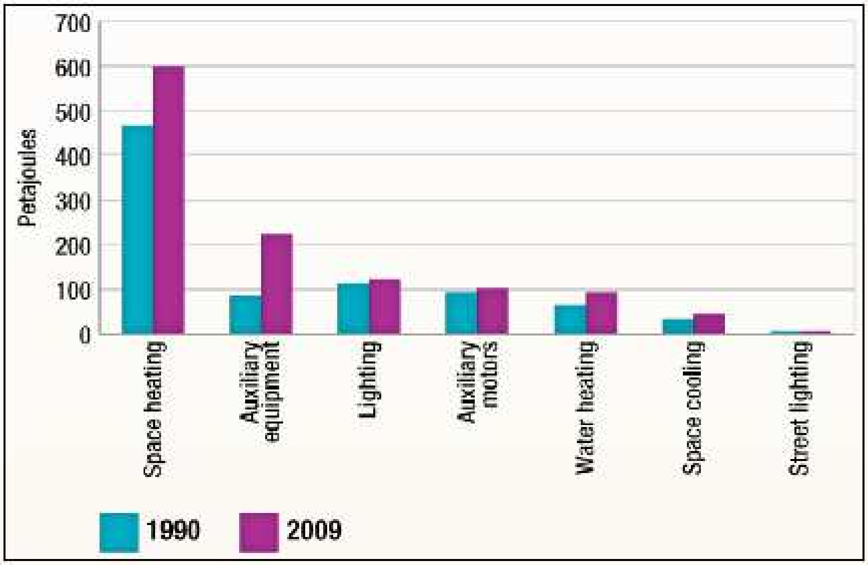


Figure 5: Energy use by end-use (NRCan, 2011)

1.3 Commercial Building heating and cooling load characteristics

Office buildings are of two types; those that are occupied by the owner for company head office or local business, and the ones that are built for leasing to tenants. In both cases a safe and comfortable working condition takes the utmost priority. A comfortable indoor working condition is vital to the performance of the workers and thus, a design must take in consideration all necessary factors. Few important environmental requirements for comfortable working conditions are temperature, humidity, air movement, noise, cleanliness. The factors that affect the environmental requirements are: climate conditions: local temperature, humidity, wind speed, day and night length, rain, snow etc.

Building Physical Characteristics include:

- Building envelope such as wall, floor, roof, windows, doors and framing.
- Orientation and aspect ratio of the building.
- Reflectance and solar heat gain through the windows and doors.
- Heat loss/heat gain and humidity transfer through infiltration dependent upon the air tightness of the building envelope.
- Internal sources such as lighting, office equipment, motors etc.

Enclosed space require fresh air supply, which is required to be heated, cooled, humidified and de-humidified based on design conditions.

Density of population adds to the heating/cooling load of the building in two ways. Human body produces heat, thus higher occupancy density adds more heat to the indoor environment, and increases requirement for cooling while decreases heating requirement. Higher occupancy also requires increased outdoor air, which need to be conditioned before introducing to the indoor environment. Activities of the occupant also contribute to the heating and cooling load. Walking or physical activities generate more heat than sedentary activities.

This project analyzes and optimizes aspects of building design, which contributes to the heating and cooling load as well as energy consumption. These factors will be discussed in details in the forthcoming sections.

While building envelope design and internal factors influence heating and cooling load in the interior space, building HVAC system provide the heating, cooling, humidification and de-humidification for maintaining indoor comfort condition. The perception of comfort, temperature and thermal acceptability is related to one's rate of metabolic heat production, its rate of transfer to the environment, and the resulting physiological adjustments and body temperatures. The heat transfer rate from the body is influenced by the environmental factors of air temperature, thermal radiation, air movement, and humidity, and by the personal factors of activity and clothing. The temperature range for comfort in summer is higher than for winter. The acceptable range of operative temperature for winter and summer is 73 - 75 °F (23 - 24 °C) (McQuiston, 1982).

In the process of producing cooling and heating for buildings, the HVAC system consumes energy in the form of electricity, natural gas, oil and other sources. The total energy consumptions of commercial and institutional buildings account for 12% of Canada's secondary energy use and 11% of our national greenhouse gas (GHG) emission (NRCan, 2011). In the United States residential and commercial buildings consume over 40% of all the primary energy supply. They also represent over 72% of all electrical power generation and 55% of natural gas consumption. Table 1 shows that according to a 2009 report by Natural Resources Canada titled

'Commercial and Institutional Energy Use-Building 2009', commercial office (non-medical) buildings make up 147.5 million m^2 of floor space, which is 19.25% of all commercial and institutional buildings (NRCan, 2012).

Table 1: Building characteristics and energy use by primary activity (NRCan, 2012)

Building characteristics and energy use by primary activity of the building

Primary activity	Buildings		Floor space		Energy use		Energy intensity	
		Q.I.	(millions of m²)	Q.I.	(PJ)	Q.I.	(GJ/m²)	Q.I.
Office building (non-medical)	83 583	A	147.5	A	176.6	A	1.20	A
Medical office building	10 525	A	9.6	A	10.5	A	1.09	A
Elementary or secondary school	18 425	A	83.6	A	64.4	A	0.77	A
Nursing or residential care facility	6 482	A	25.0	B	39.1	B	1.56	A
Warehouse	32 879	A	83.0	A	55.0	A	0.66	A
Hotel or motel	9 963	C	19.7	B	26.5	C	1.35	A
Hospital	752	A	15.1	A	36.5	A	2.42	A
Food or beverage store	40 403	A	29.3	A	82.7	A	2.82	A
Non-food retail store	56 750	A	68.9	A	65.2	A	0.95	A
Other*	222 505	A	284.3	A	285.8	A	1.01	A
Canada	482 266	A	765.9	A	842.2	A	1.10	A

Building overall energy performance can be improved by two ways:

- Improving construction of the building envelope to minimize transfer of heat and moisture through the wall, roof, windows and doors.
- Improving energy consumption of the HVAC system by optimizing design, and using fuel efficient equipment.

1.4 Building Heating Ventilation and Air-Conditioning (HVAC) System

As mentioned earlier, providing comfort condition in the building indoor environment is necessary for performance of the occupants. Building HVAC system maintains the indoor comfort condition by offsetting the heat gain/loss through building envelope, infiltration, fresh air and internal gain/loss. Building HVAC system is normally sized to meet annual peak heating and cooling demands though the peak conditions may happen for a very short time of the year. During the cooling mode the HVAC system removes heat from the indoor environment and releases the removed heat to the ambient; during the heating season, the HVAC system adds heat to the indoor environment to raise the space temperature. Common HVAC systems are three types:

- All air system
- Water to air system
- All water system

All Air System:

An all air HVAC system use only air to deliver heating and cooling to the space. It does not use any water to generate or transport energy. Normally cooling is produced by DX coils, and cooled air is blown into the indoor space by fans. Heating is produced by electric heater or gas burner. Supply fans are used for blowing air into the zones. Return fan draws room air, part of which is exhausted so that fresh outdoor air can be brought in through the supply fan. Part of the return air, which is already conditioned, is mixed with the fresh air, conditioned by the heating or the cooling system, and then re-circulated back into the indoor space by the supply air. A typical all air system is shown in Figure 6.

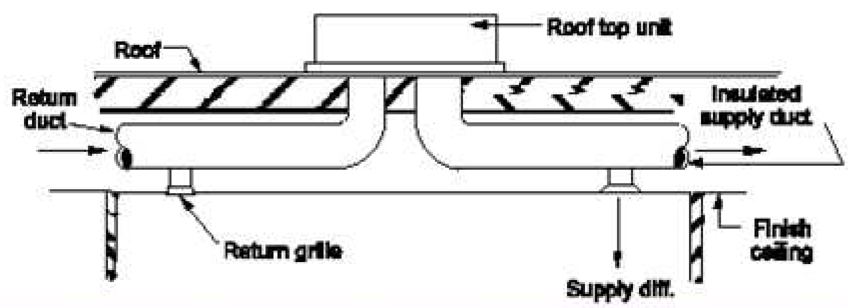


Figure 6: Example of an air system (Schneider Electric, 2006)

Water-to-air System:

Cooling is produced by a cooling unit, which can be of many types such as chiller, heat pump, cooling economizer, deep lake cooling system. Cold water is then transmitted through carrying pipe and circulated through cooling coil. During the heating season, hot water is produced by boiler, heat pump, solar heating system etc., and pumped through hot water pipes and finally circulated through hot water coils. For both heating and cooling, air is blown over the heating/cooling coil in order to bring the space supply air to design temperature. A typical water-to-air HVAC system is shown in Figure 7.

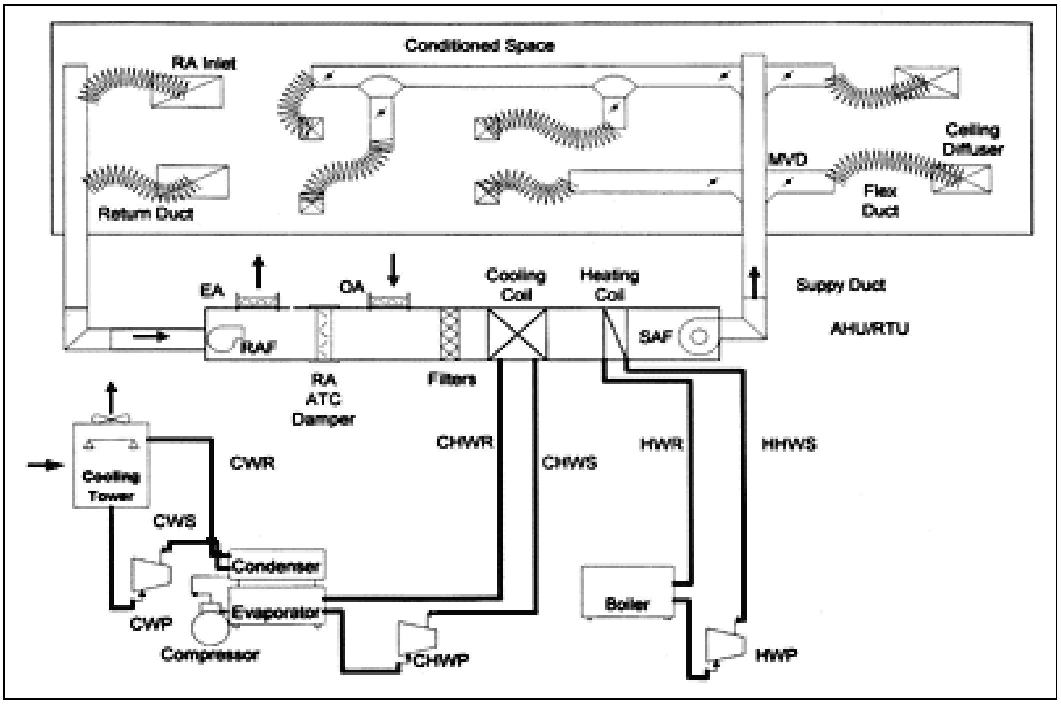


Figure 7: Example of a water-to-air HVAC system (Schneider Electric, 2006)

All Water System:

All water system does not use any fan to blow tempered air into the zone. Normally cooling and heating is produced in the central plant by cooling equipment such as chiller, heat pump etc. and heating equipment such as boiler, solar system etc. and transported through pipes to the individual zones. Depending on the cooling or heating demand, chilled or heated water is then circulated through coils or tubes, which emit heat to the space through radiation. Examples of all-water system are radiant floor heater, baseboard radiator, ceiling radiator etc.

In all of the above cases provision must be made to draw fresh outside air into the room to meet ASHRAE-62.1 minimum fresh air requirement.

Figure 8 shows screenshot of a sample air side HVAC system modelled in eQuest energy simulation software.

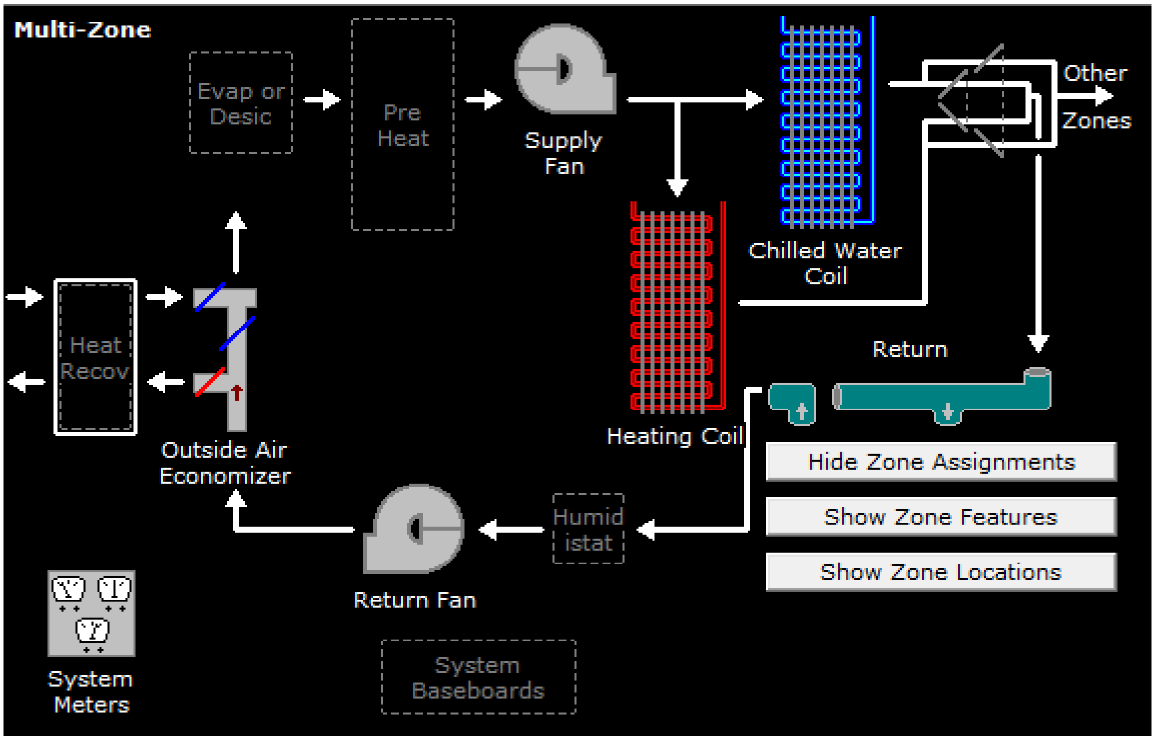


Figure 8: Building air system designed in eQuest

1.5 Heat Pump Technology

Traditionally heat pumps are designed based on vapor compression cycle. In the heating mode, heat is generally absorbed from the heat source (evaporator) and released to the zone (condenser) in requirement of heating. In the cooling mode, heat is extracted from the zone (evaporator), which requires cooling, and released into a relatively cooler heat sink (condenser). As this project involves water source heat pumps, water is the heat source in heating mode and heat sink in the cooling mode; room air is heat sink in the heating mode and heat source in the cooling mode. Different types of refrigerant gases are used in the vapor compression systems. Figure 9 illustrates a process flow of the refrigeration in a heat pump.

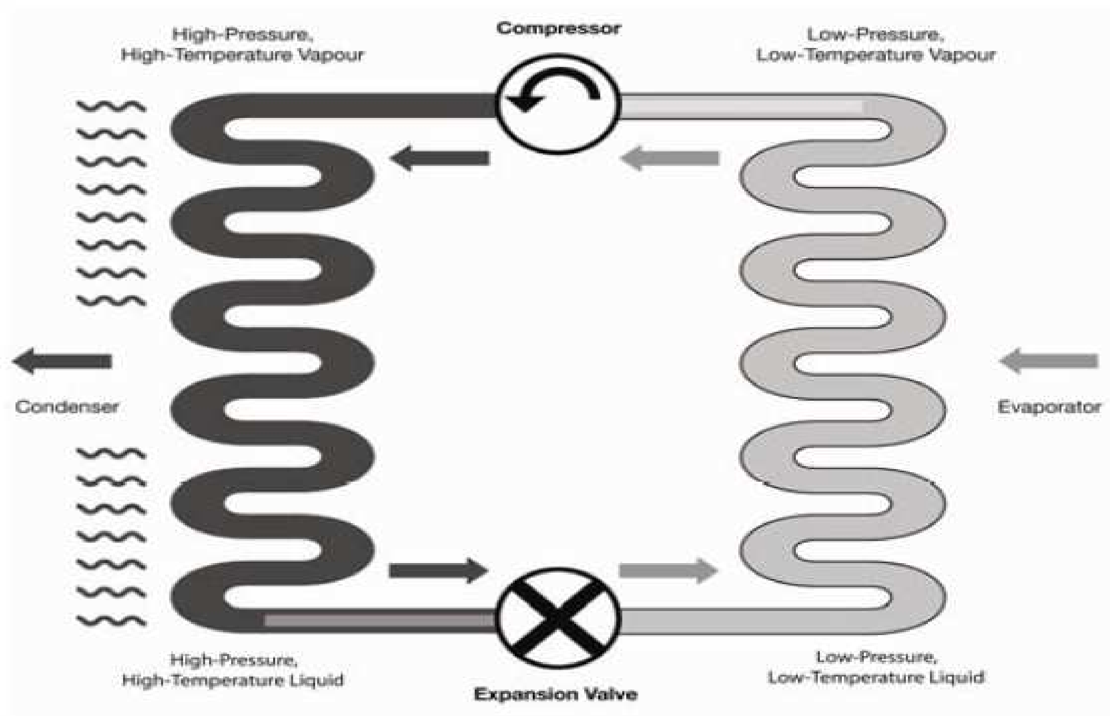


Figure 9: Heat pump cycle based on vapour compression (CEA Technologies)

Heat pump typically delivers or extracts much more heat than the work input provided to it. A heat pump can have coefficient of performance of 3.5 and higher depending of the supply water temperature (heat source), return air temperature (heat sink), water flow rate and air flow rate. This means that if the heat pump uses 1 kW of electricy, it can deliver 3.5 kW of heating or higher. Heat pump energy performance for heating can be calculated as:

COP = Heat Delivered (kW) / Electrical Energy Input (kW) (Equation 1)

Or, COP = Heating Energy Delivered (Btu/h) / (Energy input in Watts x 3.412 Btu/Watt-hour) (Equation 2)

Heat pump efficiency for cooling can be shows as:

Energy Efficiency Ratio (EER) = Cooling Capacity (Btu/h)/ Energy input (watts) (Equation 3)

Cooling COP = Cooling EER/3.412 Btu/watt-hour (Equation 4)

The higher the COP and EER are, the more efficient the heat pump is. Calculation of the COP and EER only considers the energy consumed by the compressor; energy consumed by fans or pumps are not included.

From the definition of COP it is seen that the heat extracted for cooling is higher than the heat rejected for heating, as the Heating Energy Delivered includes the energy introduced by the compressor.

For the Heating Operation:

$COP_{heat} = Q_{h(out)}/W_h$ (Equation 5)

$COP_{heat} = (Q_{h(in)} + W_h)/W_h$ (Equation 6)

$Q_{h(in)} = COP_{heat}. W_h - W_h$ (Equation 7)

COP_{heat} is the coefficient of performance of the heat pumps during the heating operation; it can also be explained as the heat pumps' efficiency of adding heat to the space

$Q_{h(out)}$ is the heat added to the space by the heat pumps; also knows as the heating load

$Q_{h(in)}$ is the heat extracted from the common water loop by the heat pumps

W_h is the work done by the heat pump compressor, defined as the heating-end-use energy (kWh) in the hourly report.

Similarly for the Cooling Operation:

$COP_{cool} = Q_{c(in)}/W_c$ (Equation 8)

$COP_{cool} = (Q_{c(out)} - W_c)/W_c$ (Equation 9)

$Q_{c(out)} = COP_{cool}. W_c + W_c$ (Equation 10)

COP_{cool} is the coefficient of performance of the heat pumps during the cooling operation. It can also be explained as the efficiency of the heat pump to remove heat from the space.

$Q_{c(out)}$ is the heat added to the common water loop by the heat pumps

$Q_{c(in)}$ is the heat extracted from space by the heat pumps; also known as the space cooling load

W_c is the work done by the heat pump compressor, defined as the cooling-end-use energy (kWh) in the hourly report.

From Equation 1 to 10, it is evident that for the het balancing and heat re-use system to work; the daily total cooling load can be less than the daily total heat load of the space. This can also be formulated as:

$$Q_{c(in)} \geq Q_{h(out)} - W_c - W_h \qquad \text{(Equation 11)}$$

Heat Pump Efficiency:

Heat pump efficiency will play a major role in determining how the zone loads should be balanced. Three major brands of heat pumps have been analyzed to examine the performance efficiency. Different sizes and associated energy performances are shown in Table 2, Table 3 and Table 4.

Table 2: Effinity Series water source heat pumps performance (Daikin McQuay, 2007)

Enfinity Horizontal ISO Performance Data – Water Loop

Water Loop Performance Data per ISO Standard 13256-1.

UNIT SIZE	AIRFLOW		WATERFLOW		VOLTAGE	COOLING				HEATING		
	CFM	L/S	GPM	L/S		BTU/HR	WATTS	EER	COP	BTU/HR	WATTS	COP
007	300	142	2.1	0.14	115-1-60 208/230-1-60	8028	682	11.8	3.5	10715	744	4.2
009	300	142	2.3	0.14	115-1-60 208/230-1-60	8813	681	12.9	3.8	11769	745	4.6
012	400	189	3.0	0.19	115-1-60 208/230-1-60 265-1-60 230-1-50	12941	1021	12.7	3.7	15804	1080	4.3
019	630	297	5.3	0.33	208/230-1-60 265-1-60	21000	6149	14.9	4.4	23600	6910	4.8
024	800	378	6.2	0.39	208/230-1-60 265-1-60 208/230-3-60 460-3-60	24700	7232	14.4	4.2	28400	8316	4.7
030	1000	472	7.6	0.48	208/230-1-60 265-1-60 208/230-3-60 460-3-60	30400	8901	15.3	4.5	36200	10600	5.0
036	1200	566	9.0	0.57	208/230-1-60 208/230-3-60 460-3-60	35800	10483	15.2	4.5	42500	12444	4.9
042	1400	661	10.7	0.68	208/230-1-60 208/230-3-60 460-3-60 575-60-3	43000	12591	15.0	4.4	50700	14845	5.0
048	1600	755	12.3	0.78	208/230-1-60 208/230-3-60 460-3-60 575-60-3	48400	14172	14.1	4.1	57100	16719	4.7
060	2000	944	15.2	0.96	208/230-1-60 208/230-3-60 460-3-60 575-60-3	59500	17422	14.6	4.3	69400	20321	4.9

Notes:
EER = Energy Efficiency Ratio   COP = Coefficient of Performance   L/s = Liters per second

Cooling capacity is based on 80.6°F db, 66.2°F wb (27/19°C) entering air temperature and 86°F (30°C) entering water temperature.
Heating capacity is based on 68°F (20°C) entering air temperature and 68°F (20°C) entering water temperature.

For the McQuay water source heat pump units, cooling COP ranges from 3.5 to 4.3, which implicates that if the compressor consumes 1 kW of electrical energy, the heat pump will extract 3.5 to 4.3 kW of heat from the zones that are in need of cooling. However, heat pumps operating in cooling mode will reject 4.5 to 5.3 kW of heat into the return water loop. Heating the COP ranges from 4.2 to 4.9, which implicates that if the compressor introduces 1 kW of energy, 4.2 to 4.9 kW of heat will be provided to the zones that require heating. During the heating process, water source heat pumps will extract 3.2 to 3.9 kW of heat energy from the supply water.

Table 3: Tranquility series water source heat pump performance (ClimateMaster, 2014)

ASHRAE/AHRI/ISO 13256-1. English (I-P) Units

Model	Water Loop Heat Pump				Ground Water Heat Pump			
	Cooling 86°F		Heating 68°F		Cooling 59°F		Heating 50°F	
	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP
TE026 Part	19,200	19.8	23,600	7.0	22,000	34.1	1[illegible],000	5.8
TE026 Full	25,000	17.4	31,400	6.0	28,500	26.4	25,800	5.3
TE038 Part	27,400	20.1	32,600	6.5	30,700	34.4	27,300	5.[illegible]
TE038 Full	37,700	17.9	45,700	5.8	42,100	26.1	37,900	5.2
TE049 Part	36,300	18.8	42,200	6.1	41,800	32.9	34,800	5.0
TE049 Full	48,600	16.8	56,700	5.1	55,000	25.3	46,800	4.6
TE064 Part	46,300	18.7	54,700	6.0	53,100	32.4	44,000	5.0
TE064 Full	61,500	16.2	77,400	5.4	71,500	24.4	63,200	4.8
TE072 Part	53,000	16.8	64,600	5.2	60,800	28.6	53,200	4.5
TE072 Full	68,300	15.1	85,300	4.8	77,700	22.5	71,400	4.4

Cooling capacities based upon 80.6°F DB, 66.2°F WB entering air temperature
Heating capacities based upon 68°F DB, 59°F WB entering air temperature

Table 3 shows performance of the ClimateMaster Tranquility-30 series water source heat pumps. This variable speed heat pump's capacity can vary between 1.5 ton to 6 ton. At full load, cooling COP can range from 4.4 to 5.1, which means for 1 kW of electrical energy consumed by compressor, the heat pump can remove 4.4 to 5.1 kW of heat from the zones required cooling, and reject the heat to the water loop. At full load, heating COP ranges from 4.8 to 6.0, which implies that for 1 kW of electrical energy consumed by the compressor, 4.8 to 6.0 kW of heat is provided to the space requiring heat; therefore 3.8 to 5.0 kW of heat is extracted from the water loop. Since the cooling load in the core zone is weather independent, the peak cooling load will persist throughout the year. The peak heating load will likely happen during the winter days in January. As this project aims to have a balanced load during the peak heating, only full load efficiencies will be used for modelling and analysis.

Table 4: Axiom series water-source heat pumps performance (Trane Inc., 2013)

Horizontal EXH ARI-ISO performance

Model	Rated water flow (GPM)	Rated air flow (SCFM)	Cooling capacity WLHP (BTUH)	EER WLHP	Heating capacity WLHP (BTUH)	COP WLHP	Cooling capacity GWHP (BTUH)	EER GWHP	Heating capacity GWHP (BTUH)	COP GWHP	Cooling capacity GLHP (BTUH)	EER GLHP	Heating capacity GLHP (BTUH)	COP GLHP
EXHF006	1.8	215	7600	15.0	8800	4.9	8800	23.4	7600	4.4	8000	17.4	5700	3.4
EXHF009	2.1	285	9000	14.9	11100	5.4	10000	21.9	9100	4.7	9400	16.9	7000	3.8
EXHF012	2.8	380	11900	15.5	14600	5.2	14000	26.6	11900	4.5	12700	[illegible]	9000	3.6
EXHF015	3.5	475	15100	15.3	18300	4.8	17500	25.0	15200	4.2	15900	17.9	11300	3.4
EXHF018	4.2	570	19300	16.7	23300	5.1	20600	25.0	19100	4.5	[illegible]	18.7	14200	3.6
EXHF024	5.6	760	23800	16.0	27700	4.8	25900	23.8	24100	4.5	24700	18.0	18800	3.6
EXHF030	7.0	950	30500	16.8	36200	5.4	33700	24.3	29600	[illegible]	31600	[illegible]	22700	3.7
EXHF036	8.4	1140	35200	17.0	44400	5.4	39700	25.8	36500	4.8	36700	19.1	28200	3.8
EXHF042	9.8	1330	42500	16.8	52400	5.3	45800	23.3	43100	4.7	43700	18.5	[illegible]	3.9
EXHF048	11.2	1520	47800	16.1	60000	5.3	52000	22.8	[illegible]	4.7	49100	17.7	38000	3.9
EXHF060	14.0	1700	58600	15.0	77800	4.9	64700	22.0	64100	4.4	61400	17.1	50400	3.8
EXHF070	15.4	2090	66600	15.5	82100	4.5	70900	[illegible]	68900	4.1	68500	16.9	52600	[illegible]

Notes: Rated in accordance with ISO Standard 13256-1: 1998 (Water Loop Heat Pumps [redacted]). Certified conditions are 86°F EWT, 80.6°F DB/66.2°F WB EAT in cooling and 68°F EWT, 68°F DB/59°F WB EAT in heating.

Table 4 shows performance of the Trane Axiom series water source heat pumps. This high efficiency heat pump's capacity can vary between 0.5 ton to 6 ton. At full load, cooling COP can range from 4.4 to 5.0, which means for 1 kW of electrical energy consumed by compressor, the heat pump can remove 4.4 to 5.0 kW of heat from the zones required cooling, and reject the heat to the water loop. At full load, heating COP ranges from 4.5 to 5.4, which implicates that for 1 kW of electrical energy consumed by the compressor, 4.5 to 5.4 kW of heat is provided to the space requiring heat; therefore 3.5 to 4.4 kW of heat is extracted from the water loop.

From Table 2 to Table 4, it can be inferred that in order to have a balanced load condition, the proposed net zero building should have a higher cooling load than the heating load in winter peak conditions. Once the peak condition is balanced, ways of offsetting imbalance during the off-peak hours will be investigated and analyzed.

1.6 Energy Efficiency Requirement for Internal Closed Loop Heat Pumps (NRCan, 2016)

Natural Resource Canada has published the minimum efficiency requirements (table 5) for heat pumps used in the distributed common loop heat pumps in an article titled "Internal water loop heat-pumps". The energy efficiency rating applies to water source heat pump not exceeding 40 kW (135,000 Btu) in heating/cooling as per the rating standard of CAN/CSA-C13256-1.

Table 5: Minimum COP requirements for heat pumps

PRODUCT CLASS	MINIMUM COP	
	Cooling COPc	Heating COPh
	November 2006	
Cooling capacity < 5 kW	≥ 3.28 with 30°C inlet water	≥ 4.2 with 20°C inlet water
Cooling capacity ≥ 5 kW and ≤ 40 kW	≥ 3.52 with 30°C inlet water	≥ 4.2 with 20°C inlet water

1.7 ASHRAE 90.1 Standards (ASHRAE, 2013)

The purpose of ASHRAE 90.1 is to establish the minimum energy efficiency requirement of buildings other than low rise residential buildings, for:

- Design, construction and a plant for operations and maintenance, and
- Utilization of on site, renewable energy sources.

It sets a minimum energy efficiency standard for:

- New buildings and their systems.
- New portion of the buildings and their systems.
- New system and equipment in existing buildings.

The original Standard 90 was first published in 1975, and revised editions were published in 1980, 1989 and 1999 using the ANSI and ASHRAE periodic maintenance procedures.

Prescriptive requirements of ASHRAE 90.1 2013 related to the building envelope, HVAC, DHW, power, lighting and auxiliary equipment will be used to design the base case commercial building.

Roof assembly maximum U-value = 0.032 Btu/h-ft^2.°F

Roof assembly minimum R-value = 30

Above grade wall maximum U-value = 0.080 Btu/hr.ft^2.°F

Above grade wall minimum R-value = 13.3

Slab-on-grade floors minimum R-value = R20 for 24 inch along the exterior cavity

Opaque door maximum U-value = 0.500 Btu/h-ft^2.°F

Vertical fenestration (0% to 40% of Wall) with non-metal framing, maximum U-value = 0.32 Btu/h-ft^2.°F

Vertical fenestration (0% to 40% of Wall) with non-metal framing, maximum solar heat gain coefficient (SHGC) = 0.40

Vertical fenestration (0% to 40% of Wall) with non-metal framing, minimum visible transmittance (VT) = 0.44

Skylight, 0% to 3% of Roof

Maximum U-value = 0.50 Btu/h-ft^2.°F

Max SHGC = 0.40

HVAC System Requirements:

Setback Control: Heating systems shall be equipped with controls configured to automatically restart and temporarily operate the system as required to maintain zone temperature above and adjustable heating setpoint at least 10F below the occupied heating setpoint. Cooling systems shall be equipped with controls configured to automatically restart and temporarily operate the mechanical cooling system as required to maintain zone temperature below an adjustable cooling setpoint at least 5 °F above the occupied cooling setpoint or to prevent high humidity level.

Hydronic (water loop) Heat Pump Systems: Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g. cooling tower) and heat addition (e.g. boiler) shall have the following:

Controls those are capable of providing a heat-pump water supply temperature dead band of at least 20 °F between initiation of heat rejection and heat addition by the central devices (e.g. tower and boiler).

Fan Efficiency: Fans shall have a fan efficiency grade of 67% or higher based on manufacturers' certified data, as defined by AMCA 205. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.

Boiler Turndown: Boiler systems with design input of at least 1,000,000 Btu/h shall comply with the turn-down ratio specified in Table 6.5.4.1
The system turndown requirement shall be met through the use of multiple single-input boilers, one or more modulating boilers, or a combination of single-input and modulating boilers.

All boilers shall meet the minimum efficiency requirements in Table 6.7.1-6

Hydronic Variable Flow System: HVAC pumping systems having a total pump system power exceeding 10 hp that include control valves designed to modulate or step open and close as a function of load shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to 50% or less of the design flow rate.

Hydronic heat pumps and water-cooled unitary air-conditioners having a total pump system power exceeding 5 hp shall have controls and/or devices (such as variable-speed control) that will result in pump motor demand or no more that 30% of design wattage at 50% of design water flow.

Water source heat pump minimum cooling efficiency required at 86°F entering water temperature:

<17,000 Btu/h ; 12.2 EER

>=17,000Btu/h and <65,000 Btu/h; 13.0 EER

>=65,000 Btu/h and <135,000 Btu/h; 13.0EER

Heating mode minimum efficiency at 68 °F enter water temperature: 4.3 COP

Gas fired heating boiler minimum annual fuel usage efficiency (AFUE) = 80%

Minimum efficiency of propeller or axial fan cooling tower rated at 95 °F entering water, 85 °F leaving water and 75 °F entering wet bulb = 40.2 gpm/hp.

Electrically operated multi-split heat recover air-to-air variable flow applied heat pup cooling mode minimum efficiency:

>=65,000 Btu/h and <135,000 Btu/h: 10.8 EER and 12.1 IEER

1.8 eQuest Building Simulation (Nall and Crawley, 2011)

Building energy simulation programs have been in existence for about 18 years. Initially, they were commissioned by gas and electricity utility associations to influence designers in the selection of gas or electric systems. Subsequent development of programs was sponsored by the federal government with North Baltimore Local School Board (NBLSD) as a research tool and the U.S. Post Office programs a compliance tool for design guidelines. These federal efforts have culminated in the BLAST and DOE-2 programs available today. This project utilizes energy simulation software eQuest V3.65, which is a DOE-2 based building energy simulation wizard. eQuest combines the DOE-2 engine with a building creation wizard and an energy efficiency measure (EEM) wizard. The building creation wizard can be used to create a complete building using steps that take input in the following design aspects, which contribute to building energy consumptions:

- Architectural design.

- HVAC design and equipment.
- Building type and size.
- Floor plan layout.
- Construction material.
- Area usage and occupancy distribution.
- Lighting and internal equipment.

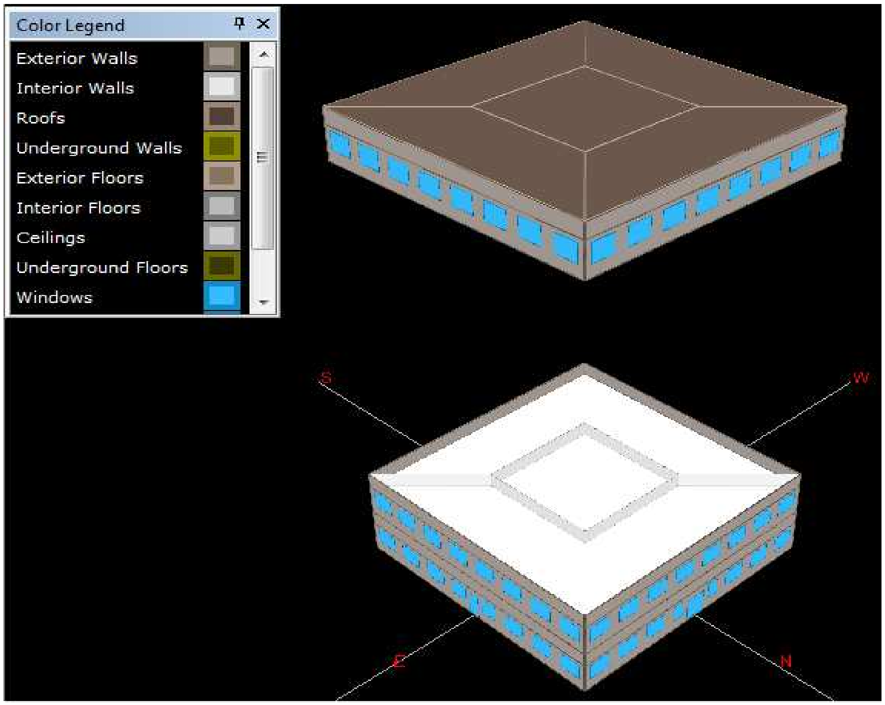


Figure 10: Sample base building model in eQuest

After compiling the complete building information, eQuest produces a detailed simulation of the building, heating and cooling load calculation and annual energy consumption of the building. eQuest performs hourly simulation of the building using local weather data for an entire year using the following information:

- Walls
- Windows
- Glass
- People
- Plug load

- Ventilation

The DOE engine simulates the performance of fans, pumps, chillers, boilers and other energy consuming equipment. Once a simulation is complete, eQuest produces graphic results of estimated monthly and yearly energy consumptions.

1.9 HVAC Zoning in eQuest (Hirsch & Associates, 2009)

The official eQuest tutorial published by Hirsch describes that HVAC zoning recognizes that the load profiles seen by different spaces in a building differ. It is suggested that areas with similar load profiles be grouped under the same thermostat control to improve comfort and save energy. The zone temperatures are effected by internal gains, solar gains, and envelope gains and losses. The following factors should be considered when creating zones in eQuest:

- Magnitude and schedule of internal loads
- Magnitude and schedule of solar gains
- Schedule of fan system operations
- Outside air temperature
- Intended efficiency measures
- One exterior zone per major orientation (12 to 18 ft deep)
- One internal zone per use schedule
- One zone each for special uses such as conference rooms, cafeterias etc.
- Separate ground and top floor zones.

1.10 Net Zero Energy Building (Duncan, 2009)

A Net Zero Energy Building (NZEB) must achieve an operating net zero energy demand, which means that the total energy consumed by building must be met by the energy produced within the site. The choice of building façade, mechanical systems and occupant behaviour has significant impact on the design of the NZEB. Envelop energy demands include sensible conduction and solar load, whereas infiltration contributes to latent and sensible gain/loss. Occupancy energy consumption involves sensible and latent heat gain due to occupants, lighting and equipment. Building system energy efficiency involves HVAC system efficiency, configuration and control strategies. The first step to design a net zero building is estimating the building's energy demand by performing energy model, which predicts building load and energy consumption. Initially the building is modelled to represent ASHRAE 90.1-2010 minimum energy efficiency requirement, which recommends energy densities and schedules for occupancy, lighting and equipment/plug load gains. The base case is then improved and simulated for better energy performance of the building. For a large office, the gains to a space are dominated by windows solar transmittance and thermal conductance, occupant, lighting and equipment load. In winter, heat is lost through the walls and windows by conduction, whereas heat is gained due to solar transmittance through the windows. Proper solar shading practice can reduce heat gain in summer and increase heat gain in winter. High performance façade significantly reduces solar gain and infiltration load. A large portion of the load comes from the plug and lighting load during the cooling season. These can be addressed by optimizing daylight penetration, internal lighting controls and use of energy efficiency appliances.

2. Literature Review

A set of publications and case studies have been reviewed, which will be used as the guiding principle for creating a methodology of the design of a net zero energy building, heated and conditioned by common loop water source heat pumps systems.

2.1 Simulation Overview (Clarke, 2001)

In the book "Energy Simulation in Building Design", Clarke has presented overview, method and validation technique of energy simulation. Clarke presented that buildings typically account for around 50% of the total energy consumption in a developed country and similar portion of the carbon dioxide emission. Building energy simulation approach is able to address all aspects of a building's life cycle and thereby help designers to strike a balance between energy use, indoor comfort and local/global impact. A brief summary of simulation overview and thermo physical factors of a building have been extracted from Clarke's book.

A building interacts in a dynamic manner to dictate comfort levels and energy demands. Components that contribute to the load and energy of a building are constructional elements, room contents, glazing systems, occupancy, use, plant system, HVAC distribution system, lighting and internal equipment. Our focus on building energy analysis here is mainly based on energy consumed by building heating, ventilating and air-conditioning (HVAC) system, which is linked to building heat transfer processes that are highly inter-related. Therefore it is necessary to apply simultaneous solution techniques if the performance is to be both accurate and preserve the spatial and temporal integrity of the modelled system. These simultaneous heat transfer processes involve a large number of complex equations combined to present heat transfer and energy consumption process of a complex building system. A simulation process can be utilized throughout the design process from the early concept stage through the detailed design. It helps owners and designer to make the right decision in terms of their energy focus and financial feasibility. There are a number of building simulation programs; however it is more efficient to use a single program throughout the design process than use a progression of tools. This will help to use theoretical discontinuities and pernicious assumptions. Simulation tools can be used at multiple stages of the design; each simulation can optimize a single aspect of the building design. It is possible to use a simulation program to determine the optimum combination of zoning and constructional scheme that will provide a climate responsive solution and minimize the need for a mechanical plant. Some simulation might focus on the choice of construction materials and their relative positioning within multi-layered construction so that good temperature and load leveling is attained. Simulation can also be used to perform optimum daylight capture and shading strategies in order to utilize sunlight to gain heat during colder season, while avoid solar heat gain during the summer/cooling months. This strategy may involve optimized sizing and material selection for gaining solar heat during the winter, while reducing conductive heat loss. In the summer months, the simulation will aim for minimizing both solar heat gain as well as conductive heat transfer between the ambient and the indoor environment; a shading strategy can be effectively used for such scenario. In both summer and winter cases, optimum daylight capture can reduce use of lighting in the perimeter zones.

Once the physical characteristics of a building are decided upon for the anticipated scenarios, different control strategies can be simulated for energy usage reduction while maintaining desired indoor environment. Basic control strategies will help to decide on the start stop control of HVAC systems, appropriate temperature setback during unoccupied hours, location of sensors and interrelation of thermal and visual comfort variables. To further stress on these scenarios, one can design and simulate HVAC system controls in terms of how the system will turn on and off on demand or whether the HVAC equipment will just modulate according to the heating/cooling demand or how should the equipment respond from the sequence of operation perspective. Similarly sensors can be integrated in the model to test benefits of occupancy sensor driven lighting control, day light control to optimize natural light and solar heat gain/heat loss and HVAC temperature setbacks.

Building energy consumption by HVAC system is directly influenced by various heat and mass transfer between the ambient and the indoor environment. A good simulation software should simultaneously process all energy transport paths, and the HVAC system, which maintains desired indoor environment by converting energy (electricity, natural gas etc.) into heating and cooling. Major factors influencing heat and cooling loads are briefly discussed here.

Conduction Loss/Gain: This can be defined as the heat transfer through the envelope of the building due the temperature difference between the indoor and the outside. Building envelop consists of the walls, windows, doors, roof and the floor which is in contact with the earth. The rate at which heat travels through the building envelope is a deciding factor in the heating and cooling load of a building. The thermo physical properties influencing heating/cooling load are conductivity, k (Btu/ft.°F), density, ρ (lb/ft^3) and specific heat capacity, C_p (Btu/lb.F). By combining these three factors, overall thermal transmittance U (Btu/ft2.F) of the wall can be found. As the goal of this project is not to analyze the calculation methods of the heat loss/heat gain, it is only important to understand how the conductive heat loss takes place and using its knowledge to optimize envelope construction of the intended office building.

Surface Convection: Convection is the process of exchanging the heat flux between a surface and the adjacent air layer. In the case of the ambient, convection is wind induced and considered as forced convection, whereas in the indoor environment, convection is natural unless mechanical forced flow is used. In energy simulation it is normal practice to make use of time varying, but surface-averaged convection coefficience h_c ($Btu/ft^2.°F$). Typically for external building surfaces, wind speed and direction data are available for some reference height. Convective heat loss and heat gain will be different with building shape, orientation and aspect ratio. Wind direction will cause higher convective heat loss/gain in certain perimeter areas than the other.

Internal Surface Long Wave Radiation: Long wave radiation is a function of the prevailing surface temperature, the surface emissivities, the extent to which the surfaces are in visual contact and the nature of the surface reflection. Generally windows with low emissive increase the reflection of longwave solar radiation and breaks inter surface heat exchange. Optimization of solar radiation will be experimented in order to balance thermal load of the building.

Shortwave Radiation: This is the solar energy gain which constitutes and significant portion of the cooling load and which can offset some of the heating load in winter. Proper treatment of the solar radiation can help reduce the heating load in the perimeter zones. When solar energy impinges on any glazing, it is partially reflected and partially transmitted into the indoor space. The transmitted beam strikes internal surfaces where it goes through absorption, reflection and transmission. The heat flux is then stored and lagged in the internal surfaces, thus giving rise to the solar heat gain. The thermo physical properties of interest include shortwave absorptive for opaque elements and absorptive, transmissivity and reflectivity for transparent elements.

Shading and Insolation: The solar energy incident on a building is influenced by shading as caused by parts of itself, surrounding buildings, façade features and natural obstructions such as trees. Shading and insolation are therefore function of solar position and target geometry. The design optimization strategy is to use design parameters such as orientation, shape and obstruction geometry to so modify the shading/insolation patterns that environmental performance is improved without recourse to mechanical intervention.

2.2 Building Envelop Design for Energy Balance (Chwieduk, 2014)

Solar Thermal Efficiency of Building Envelope:
A number of recommendations were made concerning shaping of building envelopes in high altitude countries based on simulation by Sodha. Since the principle objective of this project is to balance load during winter and shoulder seasons, recommendations are provided to optimize solar gain in those two periods.
In the winter, because of poor solar irradiation, recommendations are very strict.

- The façade should be opened for solar radiation from the south. Envelope of a building must not be shaded by elements of a building architecture or surrounding objects. If any extended curved of the south façade is used, the glazed part should have azimuth angles from -30° to +30°.
- It is recommended to use envelope elements with high tilt angle, sloped roofs with tilt in ranges from 50 to 70. Horizontal surfaces and surfaces with small tilt angle should be avoided.
- The main façade in the south should be large grazed surface.
- Innovative materials can be proposed including smart windows with transmittivity for solar radiation depending on the angle of the inclined solar radiation, and length of the radiation wave.
- Northern parts of the building envelope are the least exposed to solar radiation.

Therefore storages, depots, technical facilities should be placed in the north most rooms. The number of windows should be minimized.

- The eastern parts of the building can be used for offices and meeting rooms, which require good daylight access during the morning hours. In summer time, these rooms will be much less heated than the ones located at the south and the west side of the building.

Direct solar gain can reduce heating load in the winter season. A direct solar gain is utilized by the room as it enters directly through windows and doors. Solar radiation passes through windows glazing, which acts as a transparent cover of the solar energy receiver (the room). Depending of the solar radiation absorptance of the surfaces of the internal walls, solar radiation is absorbed and stored for a period. The stored heat is normally exchanged between medial of different temperatures, thus the temperature within the room increases. Enlarging glazing area in the sides more exposed to solar radiation can add radiance heat to the perimeter area of the building. During the winter, large glazing also causes heat loss to the ambient. In the case of the modern windows with compact glass panes, more heat is transferred through the framing than the through the glazing, thus the frame area needs to be reduced. Large glazing can cause the indoor temperature change considerably and sharply through both heat gain and heat loss. In winter, transmittance of the solar gain should be as high as possible, while the windows should have high thermal resistance to prevent heat to be lost to the ambient. Heat insulation characteristics of the windows not only depend on the material of the glazing, but also on the entire window design, including the number of glass layers, assembly method, material and thermal performance of framing and gap between panes. Heat transfer through the central part of the window panes are relatively low, but heat transfer is significant at the edges where the panes make contact with the frame. Since metal spacers act as heat transfer medium, spacers with high insulation value should be used. Once recommendation for design window is the so-called solar glass with low iron content which gives the window high transmittance for solar radiation and low transmittance for thermal radiation. Electromagnetic glazing has been recommended in the book titled Solar Energy in Buildings. There are many different types of windows with different optical properties, and therefore different coefficients of solar radiation gains. Commonly double-glazed windows and triple-glazed windows are used. In modern compact windows, gaps between panes are billed with noble gas like argon and krypton. Different materials low conductance such as wood or plastics with chambers filled with air or insulation can be used for framing.

Thermal resistance of a glazing is the sum of all the elementary resistance such as external thermal resistance, thermal resistance of the glazing and the internal thermal resistance. Thermal resistance of a double or triple pane window with air gaps depends on the intensity of the heat transfer phenomena of the glass material and the gap. In order to reduce heat exchange through thermal radiation, low-emission coating on the inner glass pane surfaces are used. Convective heat loss can be reduced by using proper gap between the glass panes and filling the gap with a noble gas or even creating vacuum gap. It is important to improve thermal insulating characteristics of windows. Apply low emissivity coating on the internal surface of the inner glass pane, increases thermal resistance of the double-glazed windows more than twofold. Filling the air gap between panes with noble gas reduces convective heat transfer because noble gases have fewer particles than air. In an old standard double-glazed window with an air-filled gap, the heat transfer coefficient during winter is 0.504 Btu/h-ft^2.°F (2.86 W/m^2.K) and during summer 0.595 Btu/h-ft^2.°F (3.38 W/m^2.K). The solar heat gain coefficient SHGC is 0.76. A double glazing with low-emissivity coating on the inner surface of the inner pane (ε=0.08) and an argon-filled gap, the heat transfer coefficient is 0.137 Btu/h-ft^2.°F (0.78 W/m^2.K) for winter and 0.157 Btu/h-ft^2.°F (0.89 W/m^2.K) for summer. The Solar Heat Gain coefficient is 0.45.

Energy Balance of a Building:

Any building is influenced by its external surroundings, especially climatic conditions including solar radiation. The thermal interaction with the surrounding is influenced by building architectural and structural designs, which should increase solar radiation in winter and reduce solar gain in summer. This also requires using transparent elements of building façade of high transmittance as well as opaque elements of high absorptance for solar gain in winter.

The energy balance of a building is influenced by heat flows through its envelope, air flow through infiltration through the building envelope, air flow through ventilation and heat gain from internal heat sources. Due to the heat loss/gain factors changing with time, the internal temperature also change; the requirement for heat generation from an external source also change. Considering the heat flow into and out of the building, and the internal heat gain, the following is the expression of a building energy balance:

$$\rho c V \frac{dT_{in}}{dt} = \sum \dot{Q}_{in}(t) - \sum \dot{Q}_{out}(t) + \sum \dot{Q}_{qv}(t)$$ (Equation 12)

where:

$\sum \dot{Q}_{in}(t) =$ the sum of energy fluxes flowing into the interior through elements of a building envelope (W);

$\sum \dot{Q}_{out}(t) =$ the sum of heat fluxes flowing out of the interior through elements of a building envelope (W);

$\sum \dot{Q}_{qv} =$ the sum of internal heat sources in a building (room) (W);

$T_{in}(t) =$ the air temperature inside a building (room) (K);

$V =$ the air volume inside a building (m^3).

Energy balance including solar radiation flux will be the following:

$$(\rho c V) \frac{dT_{in}}{dt} = \dot{Q}_{in}(t) + \dot{Q}_{h}(t) + \dot{Q}_{sol}(t) - U_t(t) A_t (T_{in}(t) - T_a(t)) - \dot{Q}_{ven}(t)$$ (Eq 13)

Here Q_{in} is internal heat gains, Q_{sol} is solar radiation gains, Q_h is heat flow supplied by the heating system in the building, Q_{ven} is the heat requirement to temper the ventilation air depending on the outdoor temperature and U_t is the heat transfer coefficient for all the envelope elements and their surfaces.

If the entire building is heated at a given time and the temperature is maintained constant, then the whole building is considered as one temperature zone. However, due to different exposure level to sun and different internal gains, different areas of the building have different heating/cooling demand; thus applying several temperature zones is adopted depending on the location and function of different rooms. Heat fluxes through different envelope elements characterized by specific thermal resistance coefficients, are exchanged between the building's interior of a certain air temperature and its exterior of ambient air, the sky temperature, and ground temperature variable in time. Internal heat sources are people (approximate heat output 50-100W/person depending on activity) appliances, devices, light sources and equipment. In some cases heat provided by the internal source may be high enough, that the interior zone may not have any heating load, and sometime cooling might be required. Figure 11 shows interaction between a building and its surroundings.

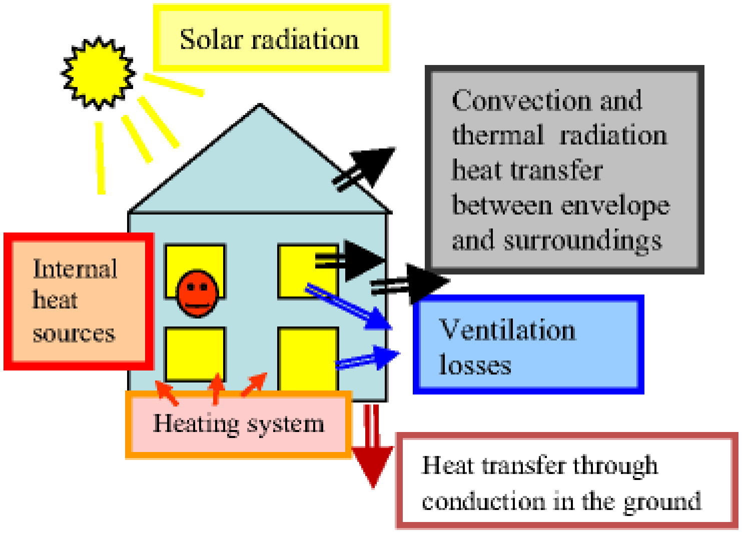


Figure 11: Energy transfer between a building and its surroundings (Chwieduk, 2014)

To minimize heat loss/gain, heat stored inside a building should stay inside as long as possible by using envelope elements of high thermal capacity, which gives an element the ability to store large amount of heat. Heat storage capacity is related to high thermal mass, volume, density and specific heat.

2.3 Net Zero Energy Building Design

Net Zero Design and Energy Basics: In the book titled Net Zero Energy Design, by Thomas Hootmat, the relationship between building architectural design and energy used has been emphasized. Hootman mentions that energy and architecture have always been intertwined. Architecture has always been formed by energy; it has been used to both mediate and harness the energy of the world. Hootman also explores work by Luis Fernandez-Galiano, who emphasizes on the importance of energy in architectural history. He refers to two fundamental interactions of energy and architecture; "regulation of free energy through construction" and "exploitation of accumulated energy through combustion". Net zero energy design offers architects an opportunity to reengage in one of the fundamentals of architectural design, which combines the rigors of building science and the expression of the purpose and meaning of energy in architecture (Hootman, 2013).

Climate condition dictates the heating and cooling loads at the building envelope. In severe climate like Canadian weather, thermal energy transfer between indoor environment of a building and the ambient can account for a large portion of the overall energy use of a building. Due to being mainly cold & dry and having heating-degree day (HDD) measured between 7200<HDD(65 °F)<9000, Toronto is designated as climate zone **6B** by ASHRAE. Table 6 and Figure 12 demonstrate climate zone designation and energy use intensity (EUI) in commercial buildings.

Table 6: Climate zone definition (Hootman, 2013)

Zone No.	Climate Zone Type	Degree-days Criteria
1A	Very Hot-Humid	9000 < CDD50°F
1B	Very Hot-Dry	9000 < CDD50°F
2A	Hot-Humid	6300 < CCD50°F ≤ 9000
2B	Hot-Dry	6300 < CCD50°F ≤ 9000
3A	Warm-Humid	4500 < CDD50°F ≤ 6300
3B	Warm-Dry	4500 < CDD50°F ≤ 6300
3C	Warm-Marine	HDD65°F ≤ 3600
4A	Mixed-Humid	CDD50°F ≤ 4500 and HDD65°F ≤ 5400
4B	Mixed-Dry	CDD50°F ≤ 4500 and HDD65°F ≤ 5400
4C	Mixed-Marine	3600 < HDD65°F ≤ 5400
5	Cool-Humid	5400 < HDD65°F ≤ 7200
5B	Cool-Dry	5400 < HDD65°F ≤ 7200
5C	Cool-Marine	5400 < HDD65°F ≤ 7200
6A	Cold-Humid	7200 < HDD65°F ≤ 9000
6B	Cold-Dry	7200 < HDD65°F ≤ 9000
7	Very Cold	9000 < HDD65°F ≤ 12600
8	Subarctic	12600 < HDD65°F

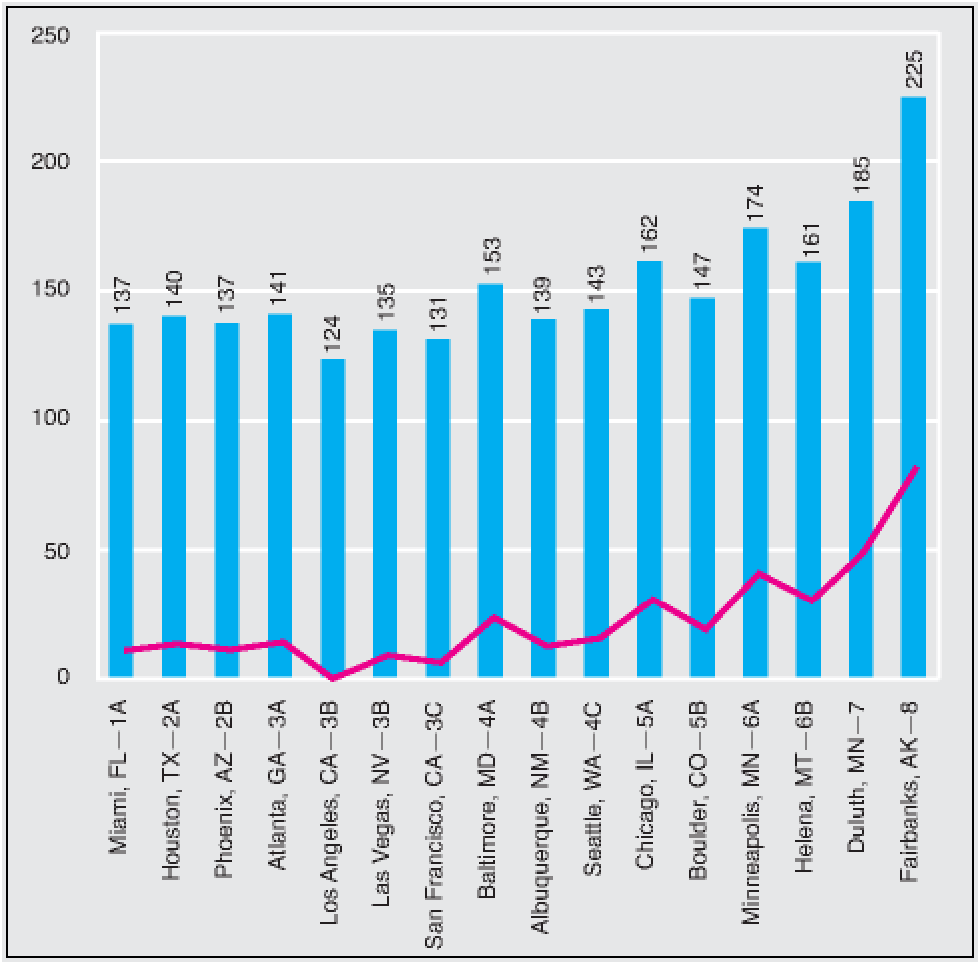


Figure 12: Annual Energy Use Intensity (kBtu/ft^2/year) of commercial buildings in different zones based on average of 16 commercial building types (Hootman, 2013)

Figure 13 shows energy use intensity of commercial and institutional buildings by activity type in Canada.

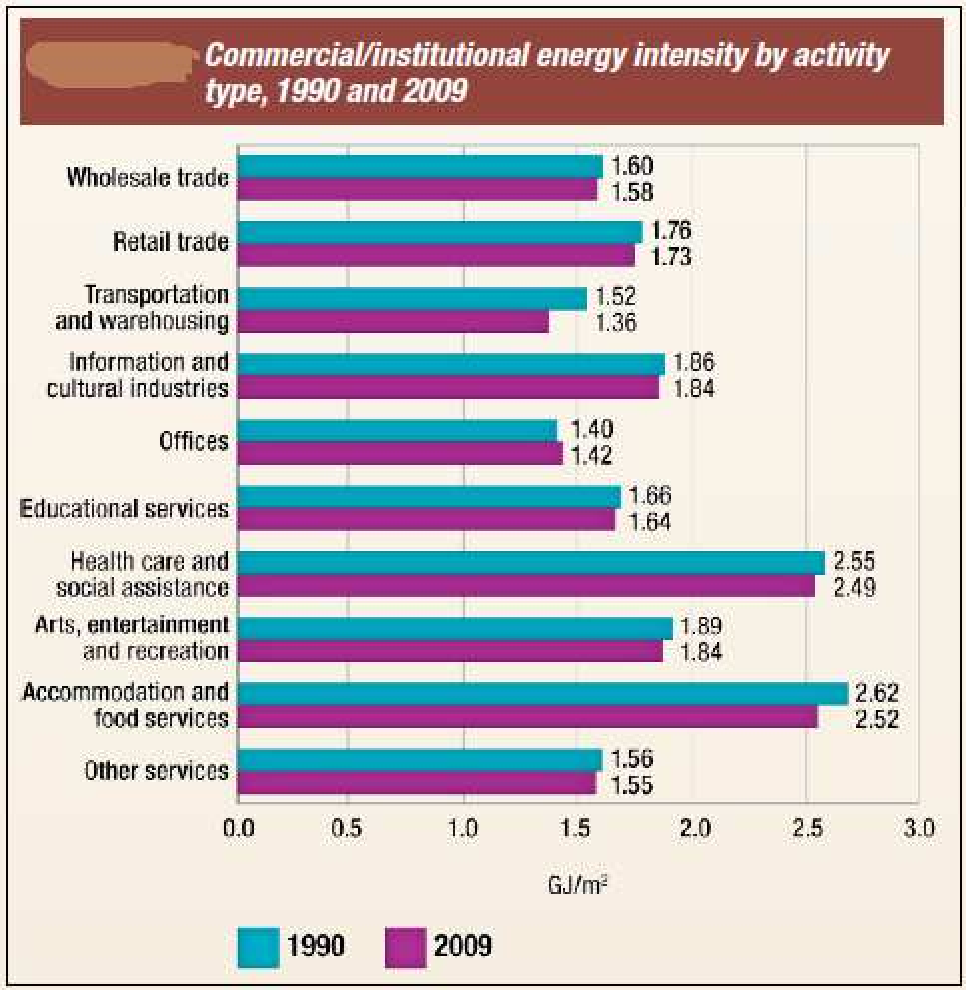


Figure 13: Commercial/institutional building energy intensity by activity type (NRCan, 2011)

The first step in establishing in energy target is setting a baseline for the design of a new building. A common energy standard is ASHRAE 90.1 "Energy Standard for Buildings except Low-rise Residential Buildings", which establishes a minimum code performance standard for the specific building under construction (Hootman, 2013). The baseline modeling simulation of a building includes building parameters such as insulation levels, mechanical systems and building orientations. Once energy use baseline is developed, the next step is to figure out what contributes to the energy use in a building. Most commercial buildings have similar set of energy end uses. Most common end uses in the commercial buildings are:

- Interior and exterior lighting
- Space heating and cooling
- Ventilation

- Water heating
- Equipment (including office equipment)
- Cooking
- Refrigeration

A substantial portion of the building energy use is dedicated to the important function of thermal comfort. Passive architectural design and efficient building systems have dramatic impact on the thermal comfort and energy use. Many design options have been outlined by Hootman for a net zero building to meet energy target; however options related to the building geometry, envelope design, zoning and HVAC system design are focused in this project.

Building orientation is one of the most fundamentally important decisions for most net zero energy buildings, because passive strategies rely on access and utilization of the climate. From the climate perspective, orientation needs to respond to both sun and wind. Wind is variable but trends can be predicted. The path of the sun is definitively known, which can be used for daylight, solar radiation control, solar access for on-site photovoltaic and solar thermal systems. In the northern hemisphere, the sun follows a range of seasonal paths from the east to west in the southern sky. The summer has the highest sun angles, and the winter has the lowest.

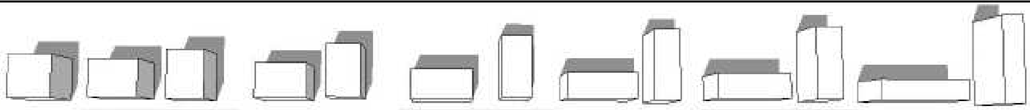
Thermal zoning within a building refers to the strategic arrangement of spaces to take advantage of the thermal synergies and qualities of spaces, and their relationship to other spaces. There are two basic approaches to planning for thermal zones. The first is to consider the thermal requirements of a space in relation to the exterior. The second is to consider the thermal requirements to a space in relation to other spaces. From the activity type, identify the desired thermal condition of each space. Also identify the thermal loads of the space, based on use. From the climate analysis, identify the seasonal temperature ranges and solar radiation. These thermal conditions can be studied to determine optimal thermal zoning, to help reduce thermal transfer, create thermal buffers, and allow beneficial thermal transfer or storage. Some spaces have high internal heat gains, such as computer server rooms, data centres, mechanical rooms, and commercial kitchens. These high heat gain rooms can be located in the north perimeter for passive cooling, or can be source of heat for other areas having heating load. The heat can also be stored in an appropriate thermal storage space designed in the room. A thermal storage space is most effective when it is a remote thermal mass zone that is unoccupied and can store heat(in winter) for an extended period for use in other areas of the building and at various times.

2.4 Effect of Building Aspect Ratio on Energy Efficiency (Mckeen, P., and Fung, A., July 2014)

Phillip McKeen under the supervision of Dr. Alan Fung at Ryerson University performed building simulation of multi-unit residential buildings with the objective of determining the effect of aspect ratio on the energy efficiency of the buildings. Aspect ratio defines the envelope surface area through which heat is transferred between the atmosphere and indoor environment. Analysis revealed that changing the aspect ratio resulted in different surface area of envelopes for an equivalent floor area. Though the minimum surface area has been achieved by 1:1 aspect ratio, the desired aspect ratio has been obtained through the balance of heat loss and gain due to the presence of solar radiation on specific areas of the building at specific length of time. McKeen simulated a number of building using eQuest to determine a relationship between the building aspect ratio and energy efficiency. The simulation was also used to establish a relationship between building's orientation and energy efficiency.

Design parameters of the building were moderately above the ASHRAE 90.1 2007 requirements, and Toronto climate condition was used for simulation. Thirteen different aspect ratios were modeled with the longest sides first facing south and north, and then rotated 90° so that the longest sides can face east and west. It can be seen in Table 7 that though the total floor area and the percentage of glazing are kept constant, the wall surface area, glazing area and south facing surface area changed with the change of aspect ratio and orientation.

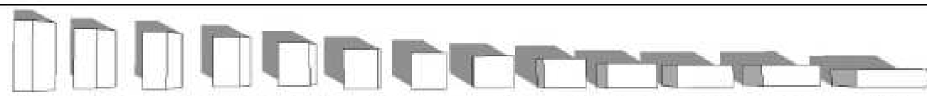
Table 7: Different aspect ratio for simulation geometry (McKeen and Fung, 2014)



Building Profile:	**A**	**B**	**B90°θ**	**C**	**C90°θ**	**D**	**D90°θ**	**E**	**E90°θ**	**F**	**F90°θ**	**G**	**G90°θ**	
Aspect Ratio (X:Y)	**1:1**	**1.3:1**	**1:1.3**	**1.5:1**	**1.5:1**	**2:1**	**1:2**	**2.7:1**	**1:2.7**	**3.2:1**	**1:3.2**	**4.2:1**	**1:4.2**	
Dimensions X	24.5	28.0	21.4	30.0	20.0	35.0	17.1	40.0	15.0	44.0	13.6	50.0	12.0	(m)
Dimension Y	24.5	21.4	28.0	20.0	30.0	17.1	35.0	15.0	40.0	13.6	44.0	12.0	50.0	(m)
Wall Surface Area	2987	3011		3048		3176		3353		3511		3780		(m^2)
Glazing Area (% of exterior surface)	36%	36%		36%		36%		36%		36%		36%		-
Glazing Area	1075	1084		1097		1143		1207		1264		1361		(m^2)
South Facing Surface Area	747	853	652	914	610	1067	521	1219	457	1341	415	1524	366	(m^2)
South Facing Surface (% of exterior surface)	25%	28%	22%	30%	20%	34%	16%	36%	14%	38%	12%	40%	10%	-

For heating and cooling, all the buildings used four-pipe fan coil units with centrifugal hermetic chiller and natural gas boiler. The annual energy consumptions due to different aspect ratio are shown in Table 8.

Table 8: Annual energy consumption for different aspect ratio (McKeen and Fung, 2014)



Aspect Ratio (x:y)	1:4.2	1:3.2	1:2.7	1:2	1.5:1	1:1.3	1:1	1.3:1	1.5:1	2:1	2.7:1	3.2:1	4.2:1	
Building Profile:	G90°θ	F90°θ	E90°θ	D90°θ	C90°θ	B90°θ	A	B	C	D	E	F	G	
Toronto														
Cooling Consumption	116.9	111.5	104.1	99.9	96.0	93.6	92.9	91.9	91.0	90.5	89.4	91.3	91.1	(MWh)
	421.0	401.2	374.8	359.8	345.8	337.1	334.6	330.7	327.5	325.9	321.7	328.5	328.1	(GJ)
Heating Consumption	1428	1303	1230	1157	1087	1063	1056	1048	1054	1100	1143	1211	1308	(GJ)
REC	35.2%	23.4%	16.5%	9.6%	3.0%	0.7%	0.0%	−0.8%	−0.2%	4.1%	8.2%	14.7%	23.9%	
Combined Energy Consumption	1849	1705	1604	1517	1433	1400	1391	1378	1381	1425	1464	1540	1636	(GJ)
REC	33.0%	22.6%	15.4%	9.1%	3.0%	0.7%	0.0%	−0.9%	−0.6%	2.5%	5.3%	10.7%	17.6%	

It is noticed from the analysis that the most energy efficient aspect ratio are 1:1, 1.3:1 and 1.5:1. Further elongation of the building in the east-west or north-south direction results in abrupt increase in both heating and cooling energy consumption.

2.5 Design of Typical Water Source Heat Pump Systems

This part of the literature review will examine design criteria of typical water source heat-pump systems used in the commercial buildings. Careful examinational of the existing designs may help to innovate ways of designing a two pipe distributive system, which will operate without any external heating or cooling equipment conventionally connected to the loop. The design guides have been developed by design professionals and leading equipment manufacturers.

2.5.1 Daikin McQuay Inc Design Guide

Water source heat pump design capitalizes on the diversity factor in heating and cooling load of any building. It is unrealistic to think that all the heat gain factors happening during the peak cooling hours in a large commercial building. Same thing can be said about the heating load. Load level in different zones can also vary. At a certain hour some zones may require higher cooling and heating than others, while the latter zones may require higher cooling and heating at a different time of the day. Central heating and cooling systems have poor part-load efficiencies, and maintaining individual zone temperature is also proven difficult (McQuay Inc., 1999). With central heating and cooling systems it is common to supply both heated and cooled air in a single zone to maintain the required zone temperature. This concept can waste a lot of energy during part load condition, which happens during the most part of the year. Water source heat pumps provide the flexibility to have individual unit at each zone, operated by individual thermostat and providing either heating or cooling. Terminal water source heat pumps connected in one closed loop also allows efficient transfer of energy from the satisfied areas of the building to the areas lacking sufficient energy.

Water-source heat pump is a decentralized system that provides heating and cooling throughout the year using a two pipe system. The system circulates non-refrigerated water from which heat-pumps either extract heat for cooling or to which the heat pumps reject heat from the zones for cooling. This system achieves energy efficiency by transferring heat from the warm zones to the cold zones when they coexist. System is designed to maintain the loop temperature between 65 °F to 95 °F (18.3 °C to 35 °C) (McQuay Inc., 1999). In a conventional system supplemental heat adding equipment such as a condensing boiler and a heat rejection equipment such as a cooling tower is added in order to add heat at the lower end of the rage and reject heat at the higher end of the range respectively. Figure 14 to Figure 17 show four possible configurations of water source heat pumps suggested by McQuay Inc. for different load conditions.

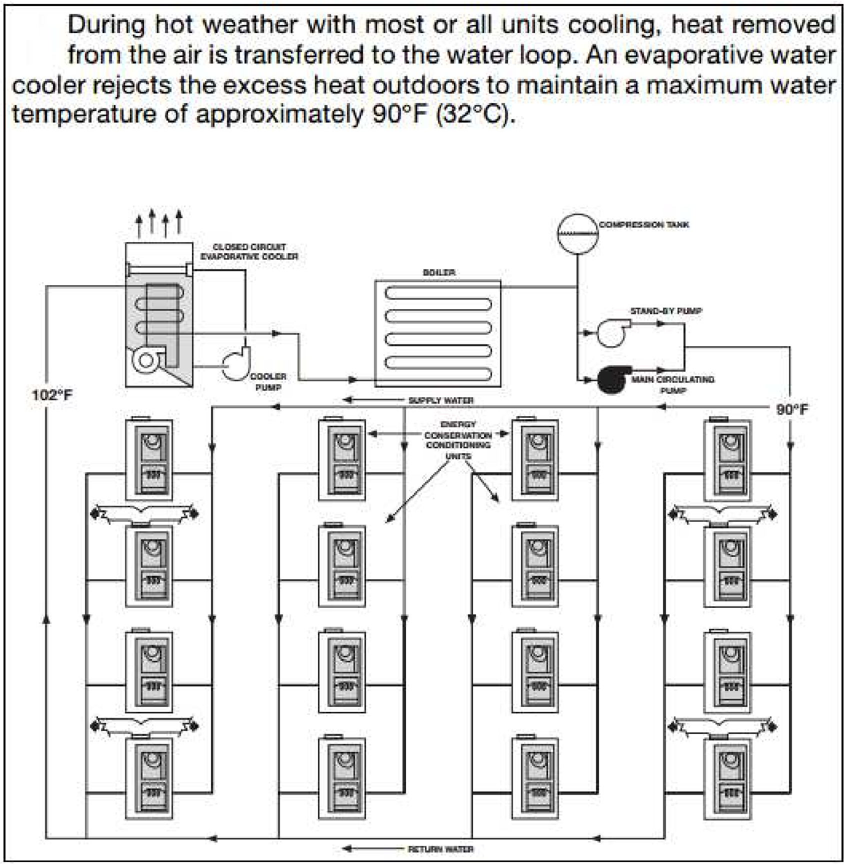


Figure 14: Configuration of conventional water-source heat pump system during cooling only operation (McQuay Inc., 1999)

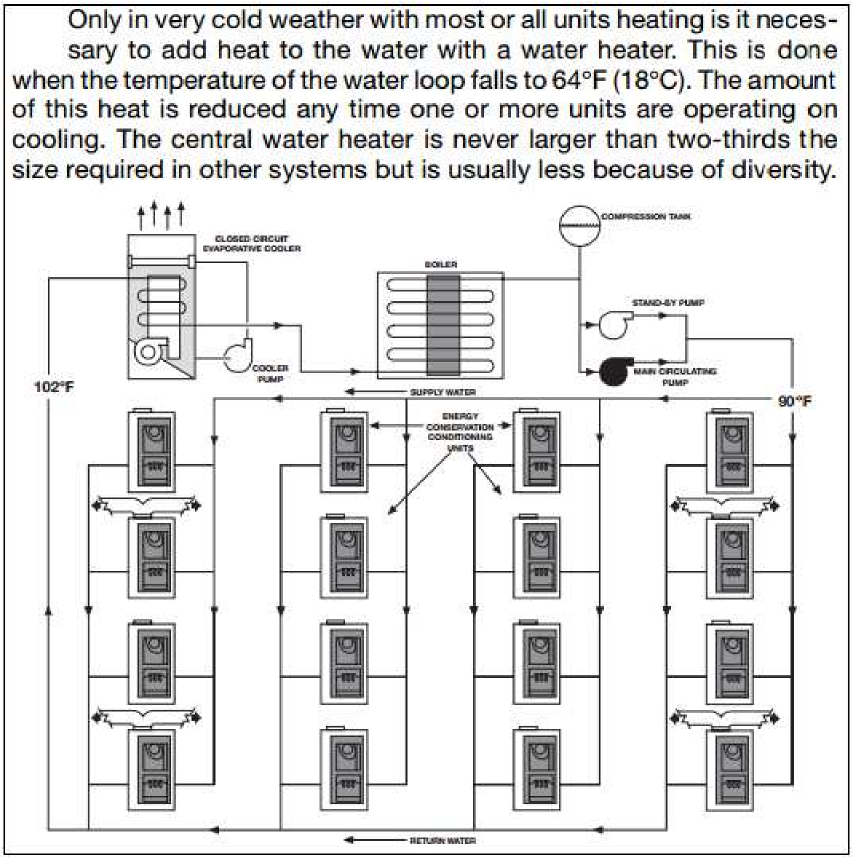


Figure 15: Configuration of conventional water-source heat pump system during mainly heating operation (McQuay Inc., 1999)

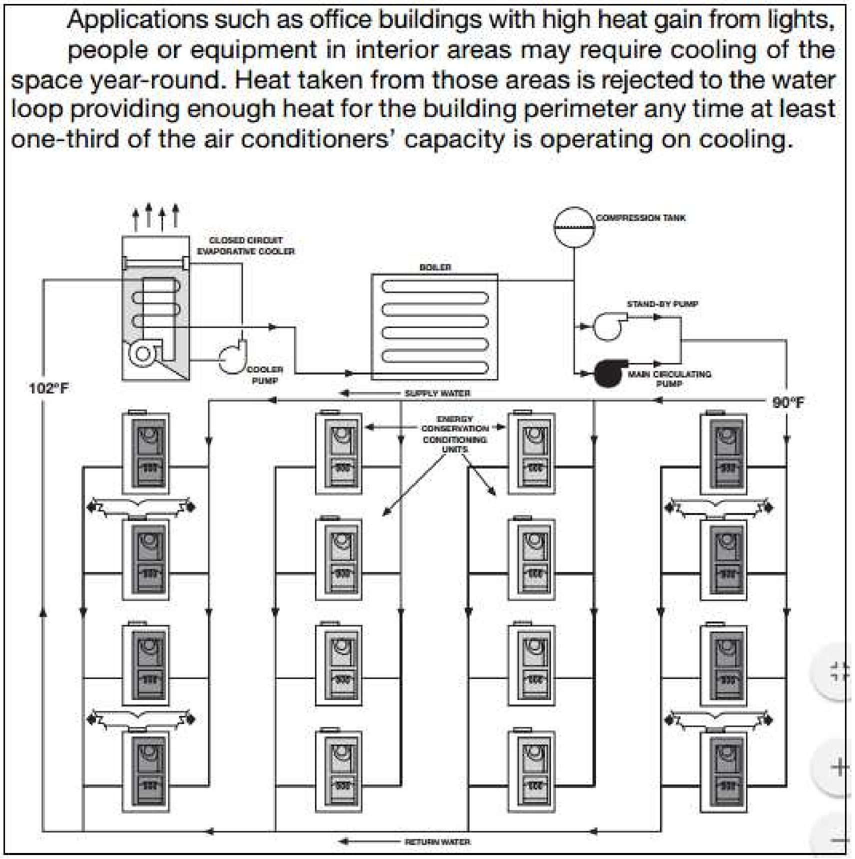


Figure 16: Configuration of conventional water-source heat pump system in buildings with high internal heat gain (McQuay Inc., 1999)

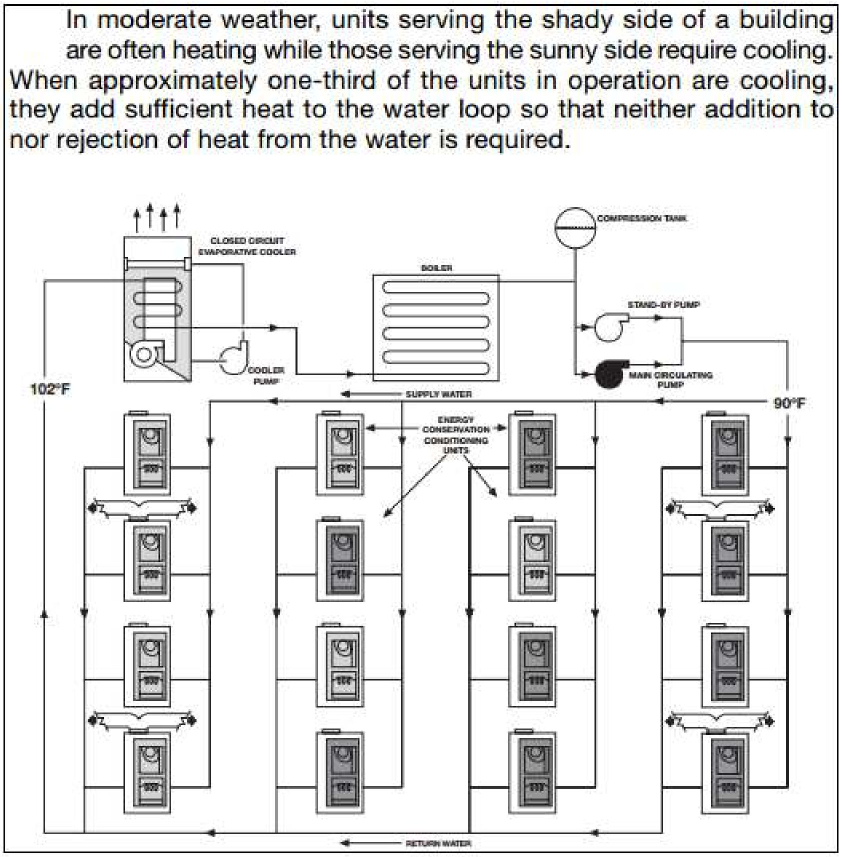


Figure 17: Configuration of conventional water-source heat pump system during simultaneous heating and cooling loads (McQuay Inc., 1999)

Energy storage tanks can be used for energy conservation. A low temperature storage tank can conserve energy by storing surplus heat produced in the building core during the day and acting as a heat source by supplying the stored heat at night to for heating. A low temperature storage tank typically uses water in a tank. It can potentially eliminate use of a cooling tower in winter and shoulder season for rejection of any surplus heat. However, a cooling tower or a dry cooling is still necessary in the summer season for rejecting heat when the stored energy in the storage tank is no longer used for heating during the night time. Once surplus heat is rejected in the storage tank, its temperature can be raised up to 140 °F (60 °C) using water to water heat pump (McQuay Inc., 1999). The tank is piped parallel to the evaporative or dry cooler. When loop temperature is above the set range, loop water is diverted to the storage tank, where excess heat is rejected. This process continues until the storage tank reaches its highest temperature. At night time, when loop temperature becomes colder than the storage tank, the storage medium rejects heat to the loop, which is then used by the heat pumps as heat source to provide energy to the areas in the need of cooling. Figure 18 is a typical schematic for a heat pump system that uses heat storage.

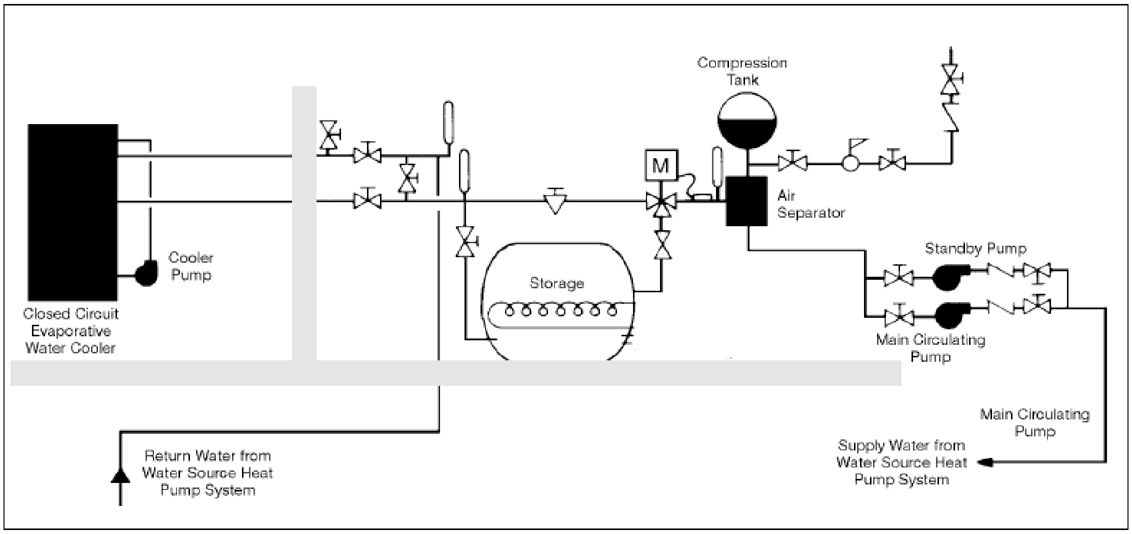


Figure 18: Heat pump system using heat storage tank (McQuay Inc., 1999)

The concept heat of heat pump system with heat storage and water-to-water heat pump is shown in Appendix A.

Water Loop Temperature Control: Water loop temperature is generally maintained between a minimum of 65 °F (18.3 °C) in winter and a maximum of 95 °F (35 °C) in the summer for optimal system operation by the building automation system (BAS) (Daikin McQuay Inc.). The control should start to reject heat in response to a temperature rise above 85 °F (29.4 °C) and achieve full capacity at 94 °F (34.4 °C). The controls should initiate addition of supplementary heat addition to the water loop when the loop temperature drops 67 °F (19.4 °C) (McQuay Inc., 1999)

Space temperature control for heat pumps includes low voltage wall thermostat. Typically one thermostat controls one heat pump; however for larger zones, two or more heat pumps can provide heating or cooling, and can be controlled by one thermostat. Night setback can substantially reduce the energy consumed by the HVAC system. Night setback can provide the following:

1) Restart all conditioners after a general shutdown, from a central point, when so

desired.

2) Stop all air conditioners from the same central point when desired.

3) Keep all electric circuits to the HVAC system energized at all times, to maintain a minimum conditioned space temperature at night time setting.

4) For systems with fans, cycle fans during night shut down period.

5) Switch ventilation systems off, and switch corridor lighting to night requirements.

6) Perimeter units can provide minimum space temperature control during the night setback.

Generally thermostats have a night temperature sensor set to control the heat pumps at 60 °F (15.6 °C) (McQuay Inc., 1999). During the morning pull-up period, most of the terminal units operate in the same mode. In winter, the perimeter units operate in the heating mode, while interior zones units are off. In summer, all units operate in the cooling mode. Through the provision of the energy storage tanks, a low temperature tank stores day surplus heat energy for overnight use.

2.5.2 Thermal Performance of Water Source Heat Pumps

Liu et al performed testing and analysis of typical water source heat pump system to establish thermal performance in the winter conditions. Testing and analysis were performed to assess energy efficiency indicator of the water source heat pump system. The following equations were used to calculate energy efficiency of the water source heat pump unit itself (EER_{HP}) and the whole system (EER_{system}):

$EER_{HP} = Q_{cap} / W_{comp}$ (Equation 14)

$EER_{system} = Q_{sh} / W_{input}$ (Equation 15)

Here Q_{cap} is heating produced by the heat pump

Q_{sh} is the space actual heating load

W_{comp} is the power input to the compressor

W_{input} is the total power input to the system

Test result shows that the heat pump system was able to maintain indoor average temperature at 73.76 °F (23.2 °C) for a 24 hour period though the outdoor temperature changed from 50 °F (10 °C) to 32 °F (0 °C) (Liu et al, 2011).

From the monitoring data of the heat pump system, it was noticed that the average temperature of water in the supply side of the source water is 13.20 °C (55.76 °F) and the return water temperature is 10.32 °C (50.58 °F) (Liu et al, 2011). Figure 19 shows supply and return temperature of the source water at different times in 24 hours period.

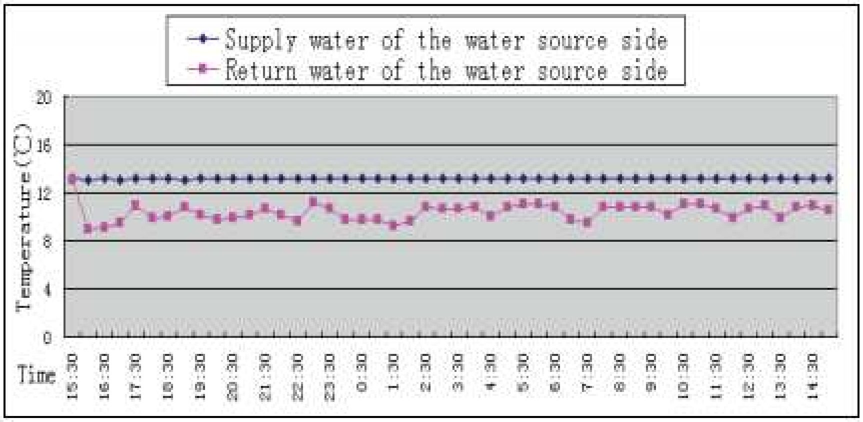


Figure 19: Source water temperature at supply and return sides of the heat pump (Liu et al, 2011)

At this design condition, the heat pump average efficiency (COP) is 3.12, whereas the rated nameplate COP is 3.51. It is suggested that the unit was operating at partial load, which caused the inefficiency. It is also suggested that the loop temperature should be increased to increase the efficiency of the heat pump (Liu et al, 2011).

2.5.3. Thermodynamic Performance Analysis of Water Source Heat Pump in Various Operating Condition

This study at the North China Electric Power University used the principal of the first law of thermodynamics to analyze performance of water source (water-to-water) heat pumps at variant operating conditions. It also suggests design and operation of water source heat pumps. Water source heat pumps usually work in off-design condition, under which the performance is different from what is rated in the equipment catalogue. The authors of this study selected a certain brand of water source heat pump with rated refrigerating capacity of 3,378 kBtu/h (990 kW), input power of 623.74 kBtu/h (182.8 kW), water flow of the condenser 396 gpm (90.1 m_3/h) and water flow of the evaporator 170.7 m_3/h (751 gpm). In the heating condition, the heating output is 3,619 kBtu/h (1058 kW), input power is 810.72 kBtu/h (237.6 kW), water flow of the condenser is 835.56 gpm (189.9 m_3/h), and water flow of evaporator is 390.28 gpm (88.7 m^3/h). Table 9 and table 10 show coefficient of performance (COP) at varying operating condition during cooling and heating operation of the water source heat pump.

Table 9: Cooling COP of water source heat pump in various operating condition

Inlet/outlet temperature Of chilled water(□)	Inlet/outlet temperature of cooling water (°C)				
	10/21	14/25	18/29	21/32	25/36
10/5	5.83698	5.302927	5.084178	4.634636	4.302235
12/7	6.248948	5.694918	5.415755	4.904835	4.578775
14/9	6.65196	6.017505	5.681233	5.165026	4.703156
16/11	6.988071	6.273696	5.988575	5.464989	4.902192
18/13		6.477668	6.189434	5.65753	5.00616
20/15		6.572518	6.335411	5.942952	5.190098

Table 10: Heating COP of water source heat pump in various operating condition

Inlet/outlet Temperature Of chilled water(□)	Inlet/outlet temperature of cooling water(°C)			
	40/45	43/48	45/50	47/52
13/5	4.317927	4.024702	3.870245	3.657708
15/7	4.452862	4.116797	3.962639	3.822368
17/9	4.629213	4.326838	4.166898	3.940586
19/11	4.849652	4.494477	4.33142	4.104377
21/13	5.020384	4.66094	4.493343	4.222542
23/15	5.238661	4.865164	4.653441	4.303186

It is evident that for cooling condition in summer, COP increases as the outlet temperature of the chilled water increases, and reduces as the inlet temperature of the cooling water increases. The outlet temperature of the chilled water can be properly increased and the inlet temperature of the cooling water can be properly decreased to reduce energy consumption (Zheng and Jing 2009).

In the winter operation, COP increases as the outlet temperature of the chilled water increases, and reduces as the inlet temperature of the cooling water increases (Zheng and Jing 2009).

For the intended common loop water source heat pump system it is expected that there will be cooling load in the core zones of the office building during the winter and shoulder season, whereas heating load is expected in the perimeter zones. Thus, a common loop temperature shall be selected to maximize the COP of both the heat pumps operating in the heating mode and the heat pumps in the cooling mode (Zheng and Jing 2009).

2.6 Energy Conservation Using Closed Loop Heat Pump in Commercial Office Building

This paper discusses the applicability of common loop water source heat pumps in buildings, where simultaneous heating and cooling loads occur. This was examined by modelling and simulation using software. The internally generated heat is used to meet heating load before use of any external source, using the closed water room as a transport system to move heat energy from where is extracted to where it is needed. The paper also discusses the option of using thermal storage to store heat for later use. The paper reports the result of a study on the effect of component arrangement and system control strategy on the energy saving potential of the water loop heat pump used for heating and cooling of a commercial office building.

The water loop heat pump system design is similar to that of a four pipe fan coil system. Each perimeter zone is served by individual heat pumps, while the cores zones are served by a central air handling unit. In a typical winter day the perimeter zones normally require heating while the core zones require cooling because of human occupancy, lighting and equipment. The closed loop water first passes through the core zones, where the heat pump rejects extracted heat into the water loop. The heated water then passed through perimeter zones, where the heat is introduced by the heat pump.

This concept was simulated for both series circuit and parallel circuit concepts. For the series circuit configuration during the experimental simulation it was observed that during the summer days the exhaust water temperature core zones reached as high as 93 °C (200 °F). When this water was passed to the perimeter zones, which also needs cooling, the heat pumps worked very inefficiently. In such case the heated water will need to go through a cooling tower capable of bringing the water temperature down to a temperature that provides minimum cooling COP of the perimeter heat pumps. In winter the heated water will travel to the perimeter heat pumps directly without going through the cooling tower.

In the parallel configuration, water will be allowed to both core zone and perimeter zones at the same time during the summer months, thus allow the perimeter and core zone to receive water at the same temperature. During the winter the water flow will go through the core zones first and then the perimeter zones.

The building that was modelled under this study is a two storey building located in St. Louis, Missouri, which has a cold winter with record coldest temperature of -23 °C (-9.4 °F). Modelling parameters of the building are shown in Table 11:

Table 11: Modelling parameters of the commercial office building (Rao and Harry, 2009)

Building roof area	22,810 sq.ft. (2119 sq.m.)
Building floor area	45, 620 sq.ft. (4238 sq.m)
Building exterior wall	9,460 sq.ft. (879 sq.m)
Fenestration glass area	7,536 sq.ft. (700 sq.m.)
Internal load density in each zone	2.9 W/sq.ft (31 W/sq.m.)
Total occupancy	408 People
Ceiling height	8.5 ft (2.59 m)
Roof U-factor	0.25 Btu/hr.sq.ft.°F (0.79 W/sq.m.°C)
Exterior wall U-factor	0.2 Btu/hr.sq.ft.°F (0.63 W/sq.m.°C)
Glass U-factor	1 Btu/hr.sq.ft.°F (3.15 W/sq.m.°C)
Shading coefficient	0.6
Interior setpoint temperature	75 °F (23.9 °C)
Relative humidity	50%
Building thermal mass	Medium
Building operation	24 hours

The building was modelled in multiple states. After simulating the building with energy storage, it was found that there is a large drop in auxiliary heating energy consumption in St. Louis and Minneapolis, which have very cold winters (Rao and Harry, 2009). The energy saving has not been quantified in the report.

2.7 Optimizing Water Loop Temperature

Selecting the optimized temperature was part of a study performed by the University of Nebraska-Lincoln on the control strategy of water loop heat pump system. It is stated that generally the conventional heat pump loop temperature is maintained between 60 °F lower limit and 90 °F upper limit; heating boiler and cooling tower are programmed to this temperature range (Lian, 2011). Generally no measure is taken in the loop temperature is floating in this range. From a parametric analysis to find out the optimal supply temperature for the water source heat pump system, it has been found that the heat pump performance is more sensitive to the loop supply water temperature in the cooling mode than in the heating mode. By gather data from a heat pump manufacturer, it was found that the cooling energy efficiency ratio (EER) increases from 11 to 20 when the loop supply temperature decreases from 85 °F to 50 °F, and the heating EER increases from 17 to 19.5 when the supply temperature increases from 50 °F to 85 °F. Based on a mathematical model, Lian concluded that the water source heat pump system is most suitable for buildings that have interior cooling load ratio of 0.3 or higher. It is also concluded that during the heating season, the supply water temperature should be maintained as high as possible to improve the heat pump efficiency. Lian suggested that the temperature of water at the inlet of the heat pumps must be 50 °F or higher to ensure safety (Lian, 2011).

2.8 Office building-Heat recovery using water source heat pumps

This case study has been taken from ASHRAE Journal, published in December, 2014. The project of Jonxion-4905 Lapiniere is an 117,918 sq.ft. (10,955 sq.m.) office building near Montreal, and uses heat recovery from distributed common loop heat pump system without any external energy sources. Its energy consumption is only 9.7 kWh/ft^2 (104 kWh/m^2) annually comparing to the Canadian office building average energy consumption of 31 kWh/ft^2 (333 kWh/m^2) annually (Lussier, 2014).

Building envelope design was very crucial to balance the cooling and heating load so that the entire building and the fresh air supply can be heated by the recovered air and energy stored in the ground. Windows that are floor to ceiling are triple paned to limit the heat loss and heat gain in the perimeter areas. Windows that are 5 ft. high or less are double paned, low-e with argon gas space. This architectural character of the building helped to minimize the perimeter heat loss so that heat rejection from the interior space can be sufficient for the perimeter heating.

The heat pump system for the building is located in the roof penthouse. Each floor has a secondary ventilation system. There is a dedicated outdoor air system (DOAS) on the roof that supplies 16,000 cfm (7551 L/s) of tempered fresh air to the secondary units, which also draws return air proportionally from the zones. The DOAS is equipped with an Energy Recovery wheel, which recovers heat and moisture from the exhaust air to pre-heat and humidify the fresh air introduced to the secondary units. There are six fan coil units to provide heating or cooling to the perimeter zones of the building. Heating and cooling to the fan coil units is provided by the central heat pump systems. Since the fan coils offset the heat loss/gain in the perimeter, the internal zones do not loose/gain heat to/from the outdoor environment; thus there is a sizable and consistent cooling load in the internal space generated from people, equipment, lighting etc.

The design incorporates two 80 ton (281 kW) centralized chillers, which act as heat pumps in the winter. Heat is removed from the interior zones by the chiller evaporators and transferred to the perimeter zones by the chiller condensers. The chiller evaporators operate 48 °F (9 °C) and condensers operate at 95 °F (35 °C), which results in a lower kW/ton. If the heat gain from the internal zones is not sufficient to heat the perimeters, the chillers extract energy from the ground using 28 geothermal closed loop vertical boreholes at 500 ft (152 m) deep. Heating coils are selected to use low temperature water allowing the chiller condenser water to provide heating without use of a boiler.

The distributed loop provides cooling to the interior space through the secondary ventilator. While the airflow from the secondary units is varied based on space load minimum fresh air supplied by the DOAS is set by ASHRAE 62.1 requirement. The fan coil units either cool or heat the perimeter zone based on the demand. All fans are equipped with variable frequency drives. Every coil is connected to the cooling and heating water loops and switches on the appropriate loop using automatic control three-way valves. All pumps are variable speed and modulate flow based on demand.

Both chilled and heated water are produced using two 80 ton (281 kW) high efficiency twin screw compressor chillers. After one year of operation, it was observed that only one chiller is needed and it operates at 60% part load (48 ton). At this operation point, the chiller's energy consumption is about 0.65 kW/ton (Lussier, 2014). During the cooling season, when both perimeter and the interior zones are in need of cooling, the chillers extract heat from the building and then reject to the ground via the closed ground loops. Figure 20 shows schematic of the air system as well as the common loop heat recovery system.

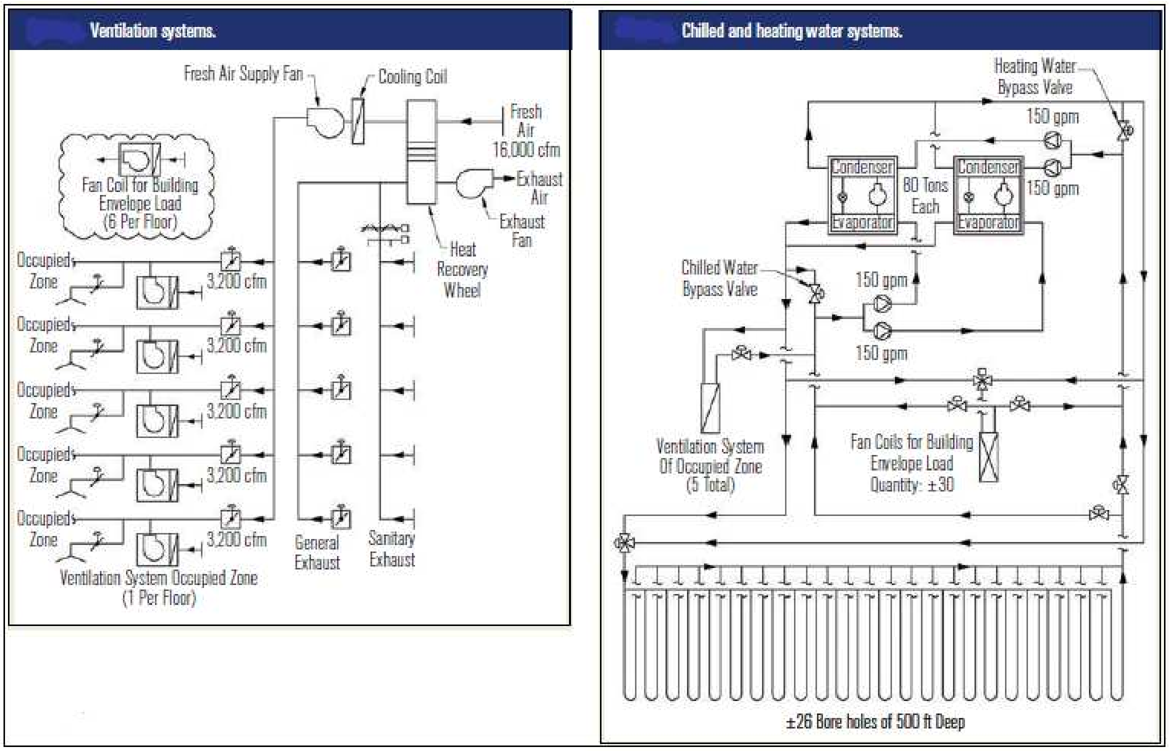


Figure 20: Schematic for ventilation, heating and cooling system (Lussier, 2014)

Energy performance of the building was modeled prior to the construction, and then actual energy consumption for one year was measured at 70% average occupancy level. Figure 21 compares model energy consumption with the actual energy consumption after one year of operation.

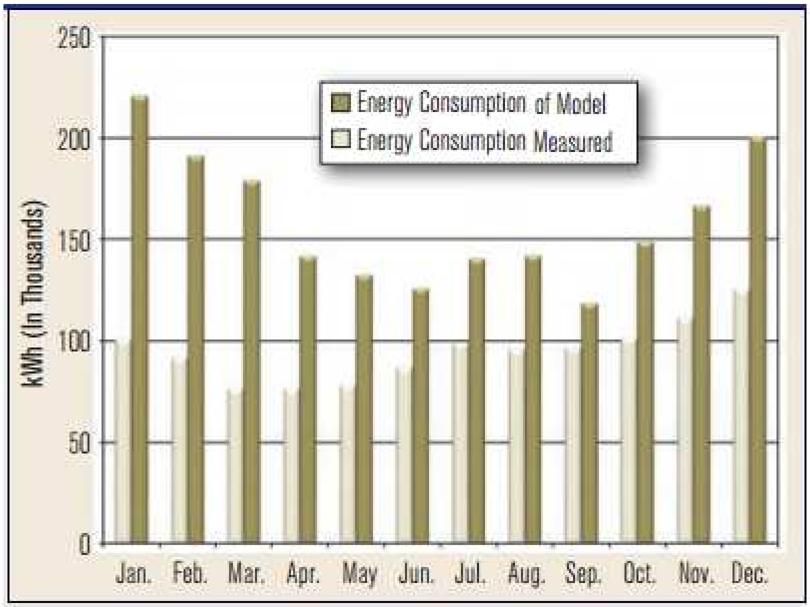


Figure 21: Modeled vs. actual energy consumption data (Lussier, 2014)

The actual total energy consumption for the year was 1,141,800 kWh, which translates to 9.7 kWh/ft^2 (104 kWh/m^2), whereas the model energy consumption of the model was 1,906,400 kWh per year, which translates to 16 kWh/ft^2 (172 kWh/m^2) per year. The actual annual energy consumption is 60% of the modeled energy consumption (Lussier, 2014).

3.0 Objective and Methodology

The simulation and analysis of this project is done in two parts. The first part will be modelling of a typical commercial office building in Toronto. Heating and cooling of this building will be provided by four pipe fan coil system served by centrifugal chiller and natural gas boiler. All parameters of the base case will be based on the minimum energy efficiency standard of ASHRAE 90.1. Simulation of the base model will produce the following:

- Building peak heating and cooling load (without HVAC)
- Space heating and cooling load summary. This will be used for sizing the zone heat pumps.
- Building peak heating and cooling load components.
- Building monthly and annual load summary.
- Building annual energy consumption for heating, cooling, lighting and internal equipment
- Building monthly energy consumption for heating, cooling, lighting and internal equipment.

The second part will be modelling and analysis of the same building using distributed common loop water source heat pump system. It is expected that there will be cooling load in the core zones during the winter and shoulder seasons, when heating load will exist in the perimeter zones. Heat pumps in the core zones will raise the temperature of the water loop, which will act as heat sink; the hotter water will then be used as heat source for the heat pumps in the perimeter to provide heating. The heat pump loop will be connected to a cooling tower and a condensing boiler to reject excess heat or add heat during the winter to maintain the loop at a predetermined temperature range. Peak heating and cooling load data, as well as the annual energy consumption from this model will be compared against the base case.

Once the proposed model energy consumption is determined using distributed loop water source heat pump system, a sensitivity analysis will be performed to investigate the energy saving potential by changing the common loop temperature.

4.0 Modelling and simulation

4.1 The Base Case

The base building is located in Toronto and designed to meet minimum design requirements of ASHRAE 90.1, which has been previously defined in section 1.6. It is a three storey building with a total area of 60,000 sq.ft. used for commercial office, which has private offices and board rooms along the perimeter, and open space in corridor with workstations and cubicles. The occupant density follows ASHRAE 62.1 standard for indoor air quality for buildings. Electricity rate has been taken from Toronto Hydro's time of use rate for commercial building, and the gas rate has been taken from Ontario Energy Board (rates have been shown in Table 13, 13A and 14). In order to utilize solar heat gain during the winter months, the building has been designed to have an aspect ratio of 1.5:1, which makes the north and south sides of the building longer than the east and west side. The south face of the building will be exposed to solar radiation for the longest time during the winter season. Wall, roof and window values are taken from the ASHRAE 90.1 standards, with windows making up 40% of the wall area. Windows are furnished with blinds to control the allowance of solar radiation during the summer months. Normally there is a dedicated make up air unit to introduce tempered outside air to the space, where ducts will carry the fresh air to the water loop heat pumps that serve individual zones. For the purpose of simplicity of the analysis, the make-up air unit has not been included in the model as it is independent of the building heating loop. Individual zones are heated and cooled by dedicated fan coil units that maintain minimum temperature starting from 1 hour before the building is occupied and ending 1 hour after the building is occupied; during the unoccupied hours the fan coils operate to maintain setback temperature. Heating and cooling of the building is provided by a natural gas boiler and a centrifugal chiller respectively, which uses a cooling tower for heat rejection. Domestic hot water demand and storage capacity is calculated by eQuest using the occupant density and hours of occupancy. Domestic water heating is provided by natural gas boiler, which is set to meet the minimum energy efficiency of ASHRAE 90.1 standard. The base building has been modelled using the Design Development Wizard in eQuest. Modelling parameters for the base building are shown in table 12 to table 28.

Table 12: Base building project and site data

Design Parameter/Requirement	Value
Building Type	Office building, mid-rise
Location	Canadian location
Region	Ontario region A
City	Toronto
Jurisdiction	ASHRAE 90.1
Electricity rate	Custom
Gas rate	Custom

Electricity Time of Use Rate (Source: Toronto Hydro):

According to the summer time of use (TOU) rates, effective May, 2016 to October 31, 2016 the time of use rates for weekdays are shown in table 13. Weekends and statutory holidays are at the lowest price (off-peak) all day. In addition, there is a monthly customer charge of $30.47/month.

Table 13: Summer time-of-use electricity rate for commercial buildings (Toronto Hydro)

Time of the Day	Unit Rate ($/kWh)	Delivery ($/kWh)	Regulatory Charge ($/kWh)	Debt Retirement ($/kWh)	Total cost per unit ($/kWh)
On-peak 11 am – 5 pm	0.18	0.044	0.050	0.007	0.281
Mid-peak 7 am – 11 am 5 pm – 7 pm	0.132	0.044	0.050	0.007	0.233
Off-peak 7 pm – 7 am	0.087	0.044	0.050	0.007	0.188

Winter time of use (TOU) electricity rates are shown in table 13A. Weekends and statutory holidays are at the lowest price (off-peak) all day.

Table 13A: Winter time-of-use electricity rate for commercial buildings (Toronto Hydro)

Time of the Day	Unit Rate ($/kWh)	Delivery ($/kWh)	Regulatory Charge ($/kWh)	Debt Retirement ($/kWh)	Total cost per unit ($/kWh)
On-peak 7 am – 11 am 5 pm – 7 pm	0.18	0.044	0.050	0.007	0.281
Mid-peak 11 am – 5 pm	0.132	0.044	0.050	0.007	0.233
Off-peak 7 pm – 7 am	0.087	0.044b	0.050	0.007	0.188

Natural gas rate has been taken from Enbridge commercial rate, and shown in Table 14. In addition, there is a monthly customer charge of $70/month.

Table 14: Block charges for natural gas supply for commercial buildings (Source: Enbridge)

Blocks (m^3)	Unit charge ($/m3)	Block (Therm)	Basic cost ($/therm)	Supply Charge ($/therm)	Transportation Charge ($/therm)	Total unit cost ($/therm)
500	0.091180	180	0.2533	0.2556	0.1482	0.6571
Next 1050	0.073162	378	0.2032	0.2556	0.1482	0.6070
Next 4500	0.060543	1620	0.1682	0.2556	0.1482	0.5720
Next 7000	0.052434	2520	0.1457	0.2556	0.1482	0.5495
Next 15250	0.048832	5490	0.1356	0.2556	0.1482	0.5394
Next 28300	0.047928	10188	0.1331	0.2556	0.1482	0.5369

Table 15: Building shell and footprint

Building shell area	60,000 ft^2
Number of floors above grade	3
Floor area at each floor	20,000 ft^2
Building dimension	173 ft x 115 ft
Daylight control	Yes
Plan north	Same as actual north
Building aspect ratio	1.5:1
Building shape	Rectangular
Perimeter depth	15 ft.
Floor to floor height	13 ft.
Percentage of area in the perimeter zones	38.8%
Floor to ceiling height	10 ft.

Table 16: Building envelope construction

Roof construction	4 in. concrete
Roof exterior finish	Built-up
Roof exterior insulation	5 in. polyurethane; RSI-5.28 (R-30)
Above grade exterior wall construction	4 in. heavy weight concrete
Exterior wall finish	Concrete with medium brown paint
Exterior wall insulation	2 in. polyisocyanurate; RSI-2.47 (R-14)
Ground floor exposure	Earth contact
Ground floor construction	6 inch concrete
Ground floor insulation	Full under slab insulation; RSI-1.76 (R-10)
Infiltration through exterior wall	0.038 cfm/ft^2
Interior wall type	Drywall (no additional insulation)

Table 17: Exterior doors and windows

Main entrance door	Revolving glass door at the south face
Other doors	1 glass door at each of the east, west and north
Revolving door dimension	Height = 7 ft.; Width = 6 ft.
All door glass property	U-factor = 0.32; SHGC = 0.40
All door framing	3 inch wide aluminum with thermal break
Exterior wall to window ratio	40%
Typical window dimension	6 ft. x 6 ft.
Window property	U-factor = 0.32; SHGC = 0.40; VT = 0.44
Window framing	Insulated fiberglass, non-operable

Table 18: Exterior shades and blinds

Blind type	Vertical blinds
Summer Season (June 21 to September 20)	
Percent of blinds closed when occupied	90% at all sides
Percent of blinds closed when unoccupied	90% at all sides
Winter Season (December 21 to March 20)	
Percent of blinds closed when occupied	20% at all sides
Percent of blinds closed when unoccupied	90% at all sides
Fall/spring season (remaining dates)	
Percent of blinds closed when occupied	20% at all sides
Percent of blinds closed when unoccupied	90% at all sides

Table 19: Roof skylight

Roof area covered by skylight	3%
Configuration	Domed with vinyl framing
Glazing type	Double acrylic white
Inside reflectance	70%

Table 20: Daylight control

Daylight control method	On/off
Percentage of lighting controlled	Ground and second floor: 100% in the perimeter zones Third floor: 100% in all zones
Photosensor per zone	1
Photosensor height	2.50 ft

Table 21: Building operation schedule

Monday to Friday	8:00 am – 5:00 pm
Saturday	Closed
Sunday	Closed
Holiday	Closed

Table 22: Activity area allocation

Activity type	Percent area (%)	Max occupancy (ft^2/person)
Office (open)	60	17
Office (executive)	20	100
Lobby	5	100
Restroom	5	100
Boardroom	4	15
Mechanical/electrical	4	333
Photocopy/Printing	2	333

Table 23: Interior lighting loads

Area type	Lighting density (W/sq.ft.)
Office (open)	1.10
Office (executive)	1.10
Lobby	1.30
Restroom	0.9
Boardroom	1.30
Mechanical/electrical	1.50
Photocopy/Printing	1.50

Table 24: Office equipment loads and profiles

Area type	Load (W/sq.ft.)	Sensible heat fraction
Office (open)	0.75	1.00
Office (executive)	0.75	1.00
Lobby	0.25	1.00
Restroom	0.10	1.00
Boardroom	0.10	1.00
Mechanical/electrical	0.10	1.00
Photocopy/Printing	0.70	1.00

Table 25: Zone HVAC system parameters

System type	4-pipe fan coil units
Location	System per zone
Cooling source	Chilled water coils
Heating source	Hot water coils
Zone thermostat set point for heating	Occupied : 70 °F; Unoccupied: 60 °F
Zone thermostat set point for cooling	Occupied : 75 °F; Unoccupied: 82 °F
Cooling supply temperature	55 °F
Heating supply temperature	95 °F
Fan operation hours	24 hours based on demand
Night time cycling	Cycles fan
Night cycle fan mode	Intermittent

Table26: Cooling primary equipment design parameters

Chiller type	Electric centrifugal hermetic
Condenser type	Water cooled
Chiller sizing	Auto
Compressor	Variable speed
Chiller COP	3.8 (ASHRAE 90.1)
Pump configuration	Single system pump
Chilled water loop flow	Variable
Heat rejection equipment	Water cooled cooling tower
Condenser configuration	Open tower
Temperature control	Temperature reset based on demand
Capacity control	Variable speed fan
Chilled water temperature set point	44 °F
Operation control	On demand
Operating hours	24 hours based on demand

Table 27: Heating primary equipment

Heating equipment	Natural gas fired hot water boiler
Sizing	Auto
Boiler efficiency	80% (ASHRAE 90.1)
Pump configuration	Single system pump-variable speed
Hot water loop temperature	Load reset between 140 °F and 180 °F
Operation control	On demand
Operating hours	24 hours on demand

Table 28: Domestic hot water modeling parameter

Heat source	Natural gas
Heating efficiency	80% (ASHRAE 90.1)
Input rating	1,748 kBtu (calculated by eQuest)
Tank capacity	1,235 gallons (calculated by eQuest)
Supply water	140 °F (60°C)
Cold water temperature (at inlet)	Same as seasonal ground temperature

Once the modelling is completed, eQuest produced 3D view of the three storey building (shown in Figure 22), and schematic view of the heating, cooling and domestic hot water (DHW) system (shown in Figure 23).

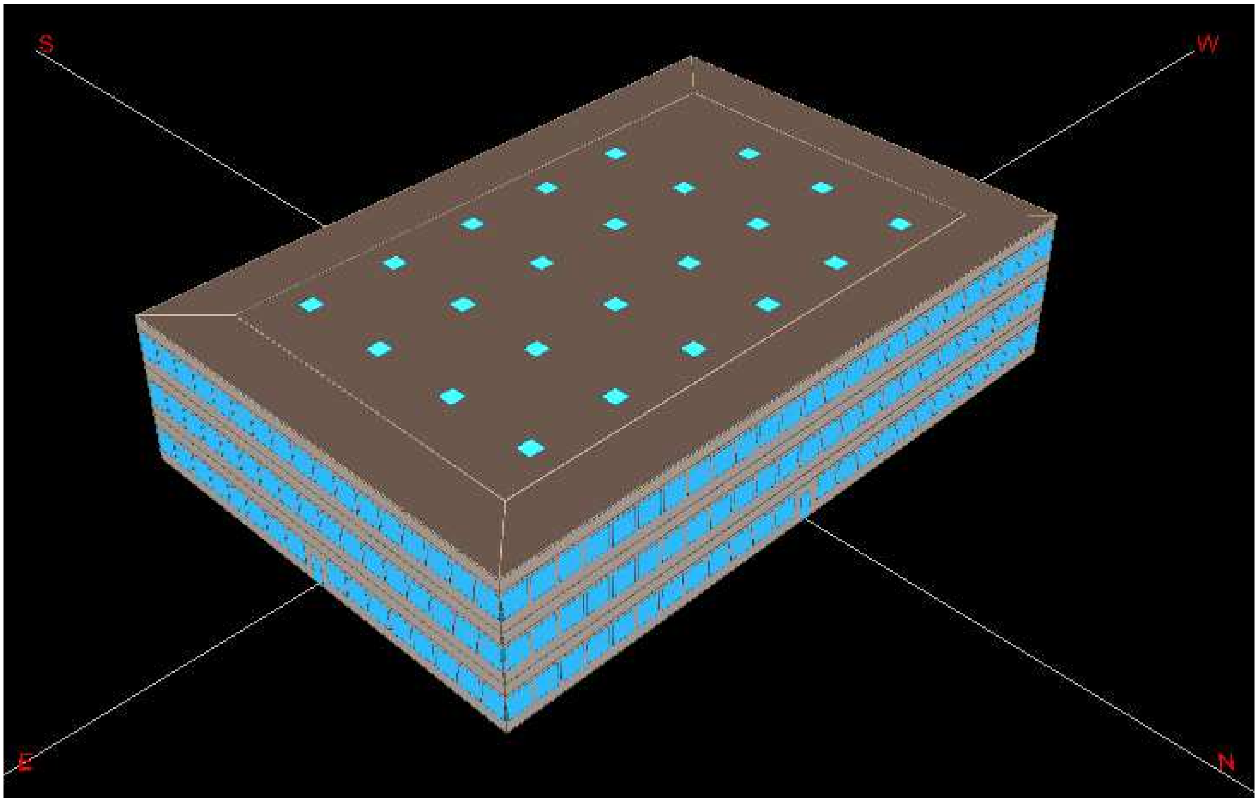


Figure 22: 3D view of the three storey office building

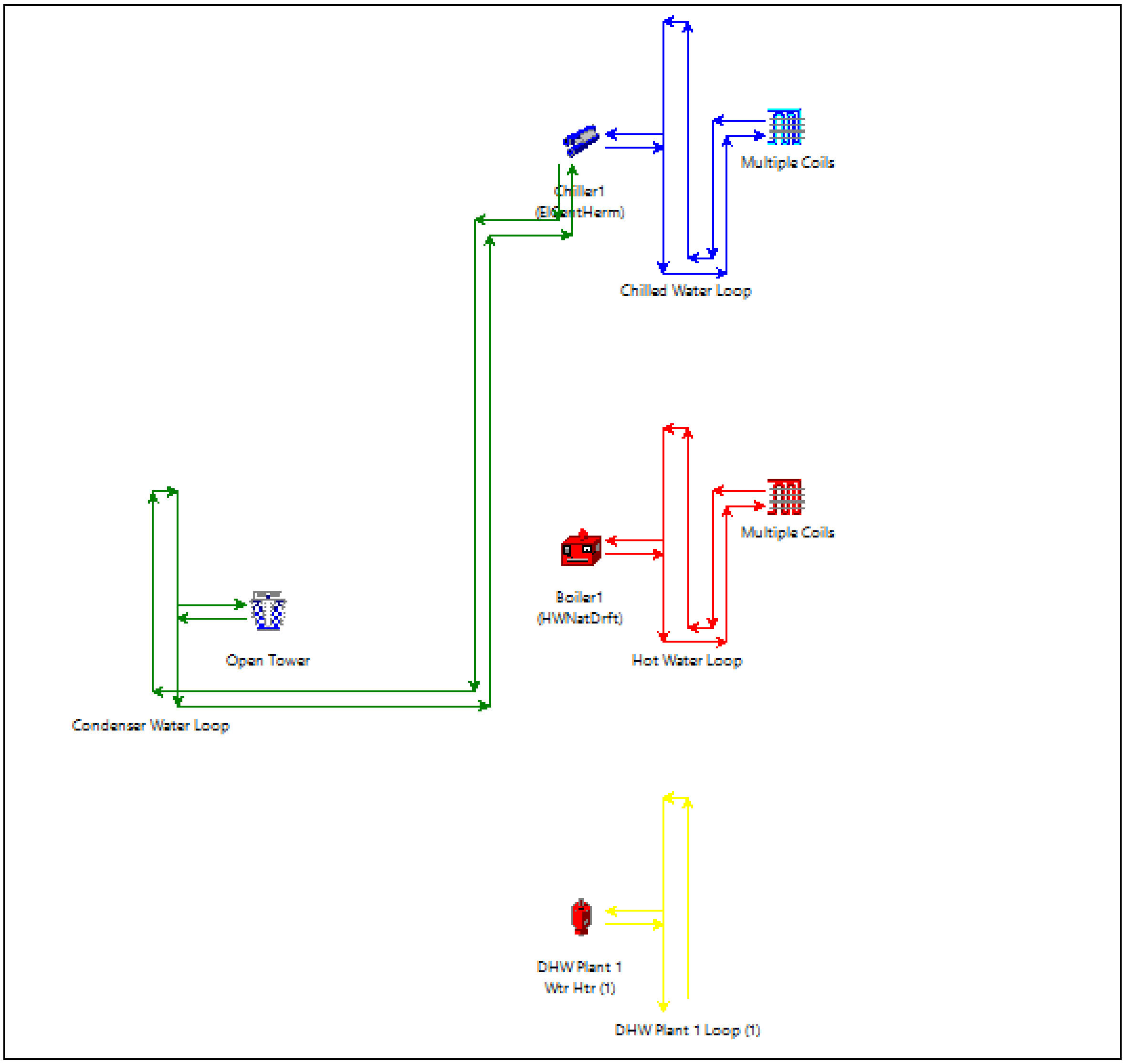


Figure 23: Heating, cooling and domestic hot water heating schematic produced by eQuest

4.1.1 Base Case Simulation Result

After simulation of the base building, eQuest has produced detailed load and energy consumption data. Peak heating and cooling loads of the building are 261.9 kBtu/h (76.7 kW) and 1458.4 kBtu/h (427.3 kW) respectively. The peak load components for the building and their effects on the heating and cooling loads are shown in Table 29.

Table 29: Building peak load and components (from eQuest simulation result)

FLOOR AREA	59988	SQFT	5573	M2
VOLUME	599878	CUFT	16989	M3

	COOLING LOAD		HEATING LOAD	
TIME	JUN 11 4PM		JAN 1 6AM	
DRY-BULB TEMP	86 F	30 C	-3 F	-19 C
WET-BULB TEMP	69 F	21 C	-3 F	-19 C
TOT HORIZONTAL SOLAR RAD	216 BTU/H.SQFT	680 W/M2	0 BTU/H.SQFT	0 W/M2
WINDSPEED AT SPACE	10.6 KTS	5.4 M/S	7.8 KTS	4.0 M/S
CLOUD AMOUNT 0(CLEAR)-10	6		7	

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALL CONDUCTION	9.663	2.831	0.000	0.000	-32.411	-9.496
ROOF CONDUCTION	0.146	0.043	0.000	0.000	-0.886	-0.260
WINDOW GLASS+FRM COND	40.602	11.896	0.000	0.000	-212.944	-62.393
WINDOW GLASS SOLAR	231.593	67.857	0.000	0.000	11.901	3.487
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	-6.851	-2.007	0.000	0.000	-10.515	-3.081
OCCUPANTS TO SPACE	492.914	144.424	441.087	129.239	0.000	0.000
LIGHT TO SPACE	115.762	33.918	0.000	0.000	2.675	0.784
EQUIPMENT TO SPACE	115.049	33.709	0.000	0.000	5.980	1.752
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	10.543	3.089	7.891	2.312	-25.667	-7.520
TOTAL	1009.421	295.760	448.979	131.551	-261.868	-76.727
TOTAL / AREA	0.017	0.053	0.007	0.024	-0.004	-0.014
TOTAL LOAD	1458.399 KBTU/H		427.311 KW		-261.868 KBTU/H	-76.727 KW
TOTAL LOAD / AREA	24.31 BTU/H.SQFT		76.675 W/M2		4.365 BTU/H.SQFT	13.768 W/M2

Zone peak heating and cooling loads generated by eQuest are shown in table 30. It is worth noting that at any floor, though the south and the north perimeter zones have same area, the heating load is higher in the north as it gains less solar heat than the south. Similarly, cooling load is lesser in the north perimeter than the south because the north gains less solar radiation than the south.

Table 30: Zone peak heating and cooling loads (eQuest simulation result)

Zone	Heating Load		Cooling Load	
	kBtu/h	kW	kBtu/h	kW
Ground floor south perimeter	24	7.1	46	13.4
Ground floor east perimeter	18	5.4	29	8.4
Ground floor north perimeter	29	8.5	23	6.6
Ground floor west perimeter	19	5.6	26	7.5
Ground floor core zone	2	0.7	186	54.5
Second floor south perimeter	26	7.7	70	20.4
Second floor east perimeter	18	5.4	45	13.1
Second floor north perimeter	28	8.3	33	9.8
Second floor west perimeter	19	5.5	40	11.7
Second floor core zone	0	0.1	217	63.7
Third floor south perimeter	31	9.0	71	20.9
Third floor east perimeter	21	6.2	46	13.4
Third floor north perimeter	33	9.6	35	10.3
Third floor west perimeter	22	6.4	41	12.0
Third floor core zone	51	14.8	270	79.0

Monthly total energy consumption is shown in Table 31 and monthly total gas consumption is shown in table 32. From the monthly electricity consumption, it is evident that space cooling is needed in even in the coldest months (December, January and February). This is due to the cooling requirement in the core zones, which gain internal heat bur looses very little or no heat to the external atmosphere. Cooling load is higher during the summer months because all zones require cooling during then. Space heating energy consumption is the highest during the coldest months and it reduces in the shoulder seasons. During the hottest months (June, July, August and September) there is no space heating related energy consumption. Energy consumption related to domestic water heating does not change drastically from month to month; this is due to the consistency in the demand of domestic hot water. It can be noticed that the energy consumption for domestic water heating is higher during the winter months because the incoming cold water temperature is lower due to the colder earth temperature, thus more energy is required to raise the water temperature to 140 °F.

Table 31: Monthly total electricity consumption in kWh x 1000 (generated by eQuest)

End Use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	9.8	10.0	12.4	12.7	13.6	20.9	24.4	22.7	16.9	12.2	10.8	11.1	177.5
Heat Reject.	0.1	0.1	0.1	0.2	0.3	0.7	1.0	1.0	0.6	0.3	0.2	0.1	4.6
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	1.1	1.0	1.2	1.3	1.4	1.9	1.9	1.9	1.6	1.2	1.0	1.1	16.6
Pumps & Aux	3.4	3.4	4.1	4.2	4.7	6.8	8.6	7.7	5.9	4.1	3.5	3.8	60.0
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	9.7	9.5	11.4	10.9	10.1	10.9	10.5	11.0	10.5	10.1	10.1	10.5	125.2
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	11.8	11.3	13.0	12.0	10.2	11.1	11.0	11.0	11.4	11.6	13.0	13.4	140.7
Total	35.9	35.4	42.1	41.2	40.3	52.3	57.4	55.3	46.8	39.4	38.5	40.0	524.5

Yearly utility bill for the base case is $132,404, of which $125,171 is for electricity and $7,233 is for natural gas.

The greenhouse gas (CO_2) emission factor in Ontario for natural gas is 1,879 gram/m^3 (Government of Canada, 2011). Based on that natural gas consumption of 1056 million Btu, which is equivalent to 29,316 m^3, produces . Therefore, 55,084,764 grams (55.1 tonnes) of green house gas will be reduced.

Greenhouse gas (CO_2) emission factor for electricity is 244 gram/kWh (City of Toronto, 2007). Based on that, greenhouse gas emission for electricity for the base case is 127 tonnes.

The total greenhouse gas released by the base case is 182.1 tonnes.

Table 32: Monthly total natural gas consumption in million Btu (table generated by eQuest)

End Use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	106.8	77.9	49.4	16.2	0.9	-	-	-	-	8.0	36.1	77.2	372.5
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	57.7	58.9	70.8	66.7	57.4	57.8	52.0	51.8	49.3	49.3	52.6	59.2	683.5
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	164.5	136.8	120.2	82.8	58.3	57.8	52.0	51.8	49.3	57.4	88.6	136.4	1056.0

Base building simulation results are shown in Appendix C.

4.2 Proposed Case 1

The proposed case is similar to the base case except that it uses distributed water loop heat pump system for space heating and cooling. Building envelope design, occupancy, lighting, office equipment and water heating parameters remain same as the base building. Therefore it is expected that the space heating and cooling loads will not change, but the energy consumption due to heating and cooling operation will change due to change of the HVAC system. Similar to the base case, in the proposed case, make up air has not been included in the model for the purpose of simplicity as it is independent of the space heating and cooling system. The water source heat pump design parameters are shown in Table 33 and Table 34.

Table 33: Zone HVAC system parameters

System type	Water source heat pumps
Location	System per zone
Cooling source	Water loop
Heating source	Hot water loop
Zone thermostat set point for heating	Occupied : 70 °F; Unoccupied: 60 °F
Zone thermostat set point for Cooling	Occupied : 75 °F; Unoccupied: 82 °F
Cooling supply air temperature	55 °F
Heating supply air temperature	95 °F
Cooling Energy Efficiency Ratio (EER)	13.0 (ASHRAE 90.1)
Heating Coefficient of Performance (COP)	4.3 (ASHRAE 90.1)
Fan operation hours	24 hours based on demand
Night time cycling	Cycles fan
Night cycle fan on via	Zone controls

Table 34: Water source heat pump plant equipment

Heat generating equipment	Condensing boiler
Fuel type	Natural gas
Efficiency	91.5% (ASHRAE 90.1)
Heat rejection equipment	Water cooled cooling tower
Condenser configuration	Open tower
Capacity control	Variable speed fan
Fan type	Centrifugal
Fan efficiency	High
Pump configuration	Single loop pump
Loop flow	Variable
Operation of the pump	On demand
Loop minimum temperature	68 °F (20 °C) (ASHRAE 90.1)
Loop maximum temperature	86 °F (30 °C) (ASHRAE 90.1)

Once the water source heat pump was modelled, it created a common loop system, where both heat pumps in heating mode and heat pumps in cooling mode operate simultaneously, thus the heat rejected from the cooling zones can be used in the zones in requirement of heating. The cooling tower and the condensing boiler operate on a need basis to maintain the loop supply temperature between 68 °F (20 °C) and 86 °F (30 °C), which are the energy efficiency rating conditions used in ASHRAE 90.1. Upon completion of the proposed case the common loop water source heat pump schematic was generated by eQuest, and it has been shown in Figure 24.

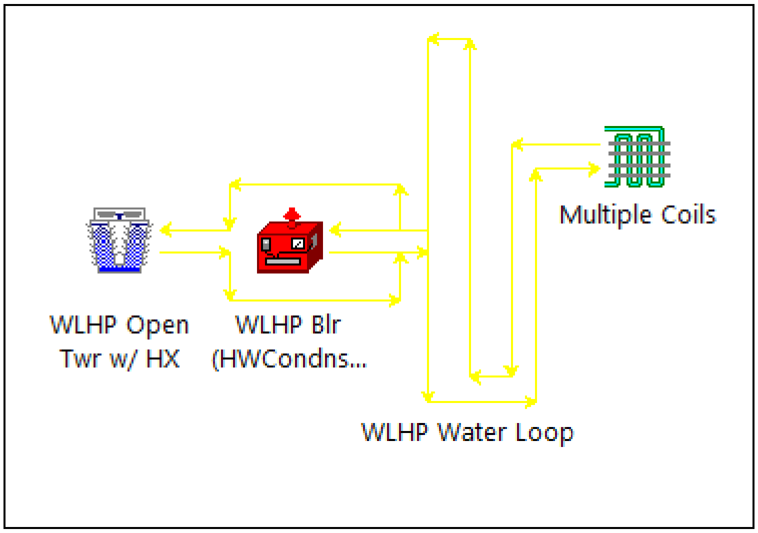


Figure 24: Common loop water source heat pump schematic generated by eQuest

The monthly and annual total electricity and natural gas consumption have been shown in Table 35 and Table 36. It is evident that cooling is required throughout the year though the cooling load doubles between winter and summer. The total annual electricity consumption is 555,370 kWh and the total natural gas consumption is 711.71 million Btu.

Table 35: Monthly electricity consumption (kWh x 1000) for proposed Case 1

End Use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	11.1	11.7	15.6	17.5	19.4	24.8	25.3	25.4	22.1	17.1	13.6	13.1	216.6
Heat Reject.	0.0	0.0	0.0	0.1	0.1	0.3	0.5	0.4	0.2	0.1	0.1	0.0	1.8
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	4.2	2.5	1.2	0.2	0.0	-	-	-	-	0.1	0.9	2.6	11.7
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	1.5	1.4	1.7	1.7	1.8	2.4	2.5	2.5	2.1	1.6	1.4	1.6	22.2
Pumps & Aux	2.6	2.5	2.8	2.8	3.0	3.8	4.4	3.9	3.3	2.7	2.4	2.8	37.1
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	9.7	9.5	11.4	10.9	10.1	10.9	10.5	11.0	10.5	10.1	10.1	10.5	125.2
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	11.8	11.3	13.0	12.0	10.2	11.1	11.0	11.0	11.4	11.6	13.0	13.4	140.7
Total	41.0	39.0	45.6	45.2	44.7	53.3	54.1	54.2	49.6	43.2	41.4	44.0	555.37

Table 36: Month natural gas consumption (million Btu) for proposed Case 1

End Use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	18.4	5.0	0.4	-	-	-	-	-	-	-	-	4.4	28.1
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	57.7	58.9	70.8	66.7	57.4	57.8	52.0	51.8	49.4	49.3	52.6	59.2	683.6
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	76.1	63.9	71.2	66.7	57.4	57.8	52.0	51.8	49.4	49.3	52.6	63.6	711.71

In order to verify that the heat rejected from the heat pumps in cooling mode is used for heating in zones requiring heat, hourly energy consumption data has been checked. On January 4th, which is one of the coldest days of the year, there are both heating and cooling loads during the occupied hours, shown in Table 37 (generated from eQuest hourly data). It can be noticed that there is natural gas consumption by the heating boiler from the 1st hour to the 10th hour, when there is no cooling operation. Once the cooling operation beings at the 10th hour, the heating natural gas consumption become zero due to simultaneous heating and cooling operation.

Table 37: Hourly energy consumption data on January 4th, 2016

Month	Day	Hour	Heating end-use energy (kWh)	Cooling end-use energy (kWh)	Heat rejection end-use energy (kWh)	Heating end-use energy (Btu)	Domestic hot water end-use	Total end-use energy (Btu)
1	4	1	18.470	0.000	0.000	147228	20908	168136
1	4	2	18.175	0.000	0.000	143293	20909	164202
1	4	3	18.337	0.000	0.000	145238	20901	166140
1	4	4	18.267	0.000	0.000	144376	20900	165275
1	4	5	18.150	0.000	0.000	142862	20898	163759
1	4	6	18.328	0.000	0.000	145107	20896	166004
1	4	7	17.424	0.000	0.000	139135	36557	175692
1	4	8	55.269	0.000	0.000	615185	159247	774432
1	4	9	31.133	0.000	0.000	320112	159212	479324
1	4	10	17.157	5.806	0.000	134423	281636	416059
1	4	11	12.472	17.146	0.000	0	281574	281574
1	4	12	11.861	10.349	0.000	0	281461	281461
1	4	13	11.267	21.297	0.000	0	281416	281416
1	4	14	9.533	44.941	0.000	0	281414	281414
1	4	15	7.345	51.478	0.000	0	281391	281391
1	4	16	6.063	54.262	0.006	0	218691	218691
1	4	17	7.906	42.737	0.000	0	158628	158628
1	4	18	10.626	15.664	0.000	0	95959	95959
1	4	19	0.000	0.000	0.000	0	67231	67231
1	4	20	0.000	0.000	0.000	0	67242	67242
1	4	21	0.000	0.000	0.000	0	67250	67250
1	4	22	0.000	0.000	0.000	0	20282	20282
1	4	23	0.266	0.000	0.000	0	20300	20300
1	4	24	2.136	0.000	0.000	0	20310	20310

4.3 Result Comparison:

Based on the energy consumption data, Table 38 and Table 39 have been created to compare annual energy consumption between the base case and the proposed Case 1.

Table 38: Electricity consumption comparison between base case and proposed case 1

End Use	Base Case	Proposed Case	Increase/decrease	% increase/decrease
Space Cool	177.47	216.6	39.1	22.04%
Heat Reject.	4.59	1.8	-2.8	-60.78%
Refrigeration	-	-		
Space Heat	-	11.7		
HP Supp.	-	-		
Hot Water	-	-		
Vent. Fans	16.56	22.2	5.7	34.24%
Pumps & Aux	60.02	37.1	-22.9	-38.14%
Ext. Usage	-	-		
Misc. Equip.	125.23	125.2	0.0	0.00%
Task Lights	-	-		
Area Lights	140.68	140.7	0.0	0.00%
Total	524.54	555.4	30.8	5.88%

Table 39: Annual natural gas consumption comparison in million Btu (negative denotes decrease by the proposed case1)

End Use	Base Case	Proposed Case	Increase/decrease	% increase/decrease
Space Cool	-	-		
Heat Reject.	-	-		
Refrigeration	-	-		
Space Heat	372.5	28.1	-344.4	-92.45%
HP Supp.	-	-		
Hot Water	683.5	683.6	0.1	0.01%
Vent. Fans	-	-		
Pumps & Aux	-	-		
Ext. Usage	-	-		
Misc. Equip.	-	-		
Task Lights	-	-		
Area Lights	-	-		
Total	1,056.00	711.7	-344.3	-32.60%

There is 30,800 kWh (5.88%) increase in electricity consumption by proposed Case 1; this is due to the work input to the compressors in the heat pumps for both heating and cooling operations. Electricity consumption by the cooling tower has decreased 60.78% comparing to the base case due to the exhaust heat from the cooling operation being used for space heating. Natural gas consumption for heating has drastically reduced by 344.4 million Btu (92.45%) due to the use of distributed common loop heat pump system, and the overall natural gas consumption has reduced by 32.60%. By converting the reduction of natural gas to equivalent kWh, it can be seen that 100,904.37 equivalent kWh hour has by saved. Thus, measuring the total equivalent kWh saving gives (-100,904.37 + 30,800) = -70,104.37 kWh of annual energy saving.

4.4 Greenhouse Gas Emission

The greenhouse gas (CO2) emission factor in Ontario for natural gas is 1,879 gram/m^3 (Government of Canada, 2011). Using the common loop water source heat pump system of proposed case 1, the natural gas consumption has been reduced by 344.4 million Btu, which is equivalent to 9,317 m^3 of natural gas. Therefore, 17,506,643 grams (17.5 ton) of greenhouse gas will be reduced.

Electricity consumption has increased by 30,800 kWh, thus green house gas emission increased by 7.52 tonnes.

Therefore, overall greenhouse gas reduction by Proposed Case1 is 10 tonnes.

5. Modelling for Sensitivity Analysis

The purpose of the sensitivity analysis is to determine the influence of the change of design parameters of the building as well as the heat pump system. The sensitivity analysis of the proposed common loop water based heat pump system will be re-modelled three times by changing design temperature of the common water loop. The result of the three models will be then compared against the proposed Case 1 to find optimum operating range of the common loop based on energy consumption.

5.1 Sensitivity analysis for finding optimum heat pump system design parameters

5.1.1 Proposed Case 2: Water loop temperature at lowest 50 °F and highest 86 °F

From the base building simulation result, it is evident that the building is cooling dominated in the winter months. Thus in order to observe the change of energy performance of the common loop heat pump system, the loop temperature of the proposed case has been lowered, which is expected to increase the cooling COP and decrease the heating COP; however, the magnitude of the cooling COP increase is higher than the that of the heating COP (Lian, 2011). For the proposed Case 2, the lowest design temperature of the loop is set at 50 °F (Lian, 2011). The highest design temperature of the water loop remains 86 °F (ASHRAE 90.1). Simulation produces annual electricity and natural gas consumption of **543,700 kWh** and **700.5 million Btu** respectively.

5.1.2 Proposed Case 3: Water loop temperature at lowest 50 °F and highest 72.14 °F

For the proposed Case 3, the lowest design temperature of the loop is set at 50 °F. The highest design temperature of the water loop is lowered to 78.12 °F, which is the design outdoor wet bulb temperature in Toronto (ASHRAE Fundamental, 2005); this temperature can be achieved by the operation of a cooling tower in summer. Upon simulation, the annual electricity consumption is **534,050 kWh**, and natural gas consumption is **702.35 million Btu**.

5.1.3 Proposed Case 4: Water loop temperature lowest 68 °F and highest 72.14 °F

The water loop minimum is set at 68 °F, which is the design temperature used for minimum energy efficiency requirement in ASHRAE 90.1. The highest temperature of the loop is set at 72.14 °F, which is the design outdoor wet bulb temperature in Toronto (ASHRAE, 2005). Annual electricity consumption for proposed case 4 is **533,340 kWh**, and the natural gas consumption is **714.53 million Btu**.

5.1.4 Annual electricity and natural gas consumption of proposed case 1, 2, 3 and 4 have been compared in table 40, which helps to determine the optimum temperature setting for the common water loop.

Table 40: Sensitivity test to determine optimum temperature of the common loop

	Base Case	Proposed Case 1	Proposed Case 2	Proposed Case 3	Proposed Case 4
Electricity (kWh)	524,500	555,370	543,700	534,050	533,340
Natural Gas (MMBtu)	1056.0	711.71	700.5	702.35	714.53
Yearly electricity bill ($)	125,171	137,979	135,173	132,794	132,609
Yearly natural gas bill ($)	7,233	5,245	5,181	5,192	5,262
Total annual utility bill ($)	132,404	143,224	140,354	137,986	137,871

Though, the electricity consumption of proposed Case 3 is slightly higher than that of proposed case 4, the natural gas consumption of Case 3 is significantly less than case 4. Therefore, proposed case 3 is the optimum solution, which suggests the common loop temperature should operate between 50 °F and highest 72.14 °F.

5.2 Comparison between the base case and proposed case 3

Table 41 compares between the base case and the optimum proposed case in terms of annual electricity consumption, annual natural gas consumption and annual utility bill.

Table 41: Energy and economic comparison between the base case and proposed case 3

	Base Case	Proposed Case 3
Electricity (kWh)	524,540	534,050
Natural gas (MMBtu)	1,056.00	702.35
Annual utility bill ($)	132,404	137,986

There is 9,510 kWh (1.81%) increase in electricity consumption by proposed case 3; this is due to the work input to the compressors in the heat pumps for both heating and cooling operations. Natural gas consumption has been reduced by 353.65 million Btu (33.48%). Annual utility bill has increased by $5,582.00 which is 4.22% higher than the base case.

The greenhouse gas (CO2) emission factor in Ontario for natural gas is 1,879 gram/m^3 (Government of Canada, 2011). Using the common loop water source heat pump system of proposed Case 3, the natural gas consumption has been reduced by 353.65 million Btu, which is equivalent to 9,567.239 m^3 of natural gas. Therefore, 17,976,842 grams (17.98 ton) of green house gas will be reduced.

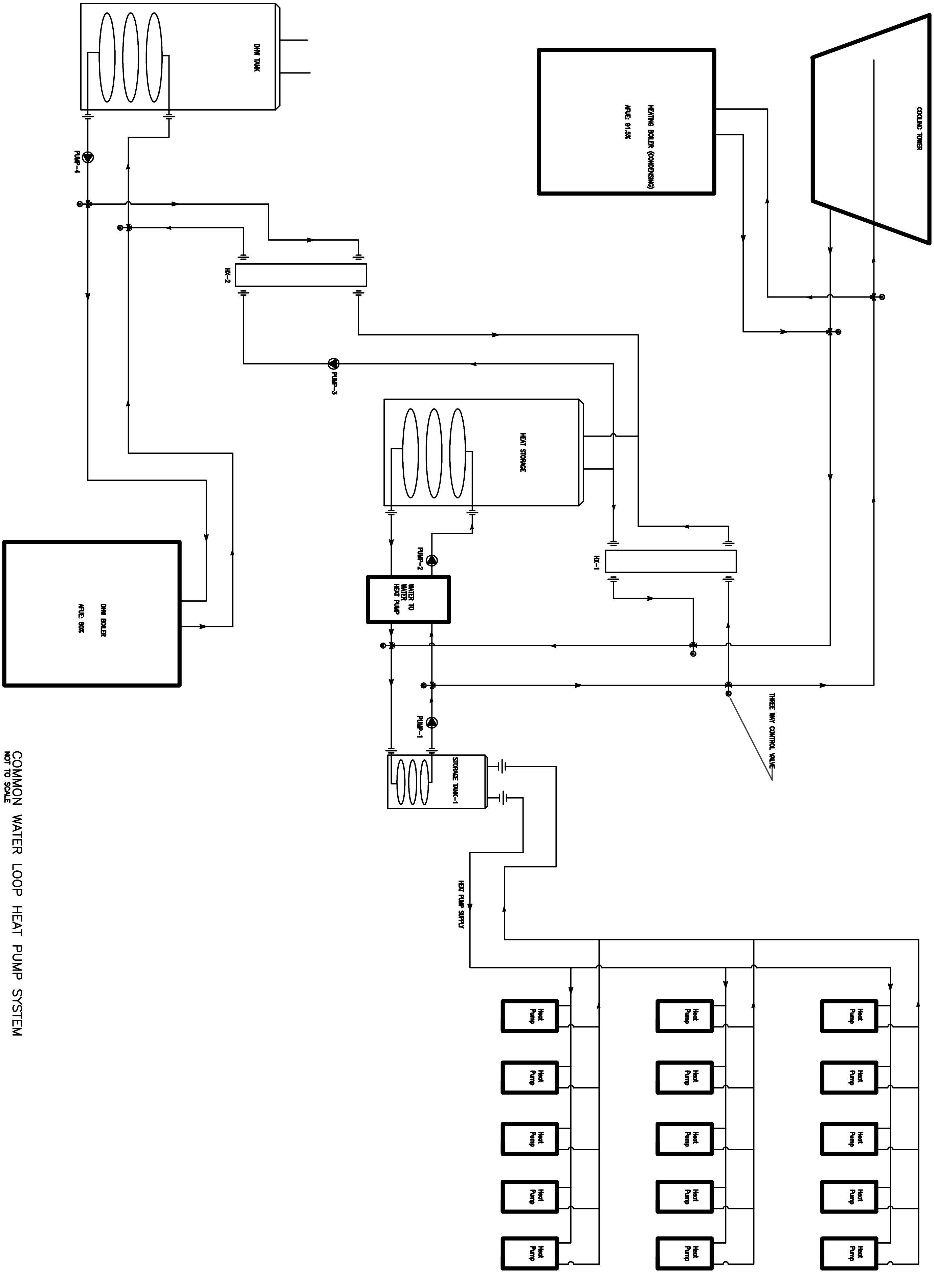
Electricity consumption has increased by 9,510 kWh, thus green house gas emission increased by 2.3 tonnes.

Therefore, overall greenhouse gas reduction by Proposed Case 3 is 15.7 tonnes.

6. Conclusion

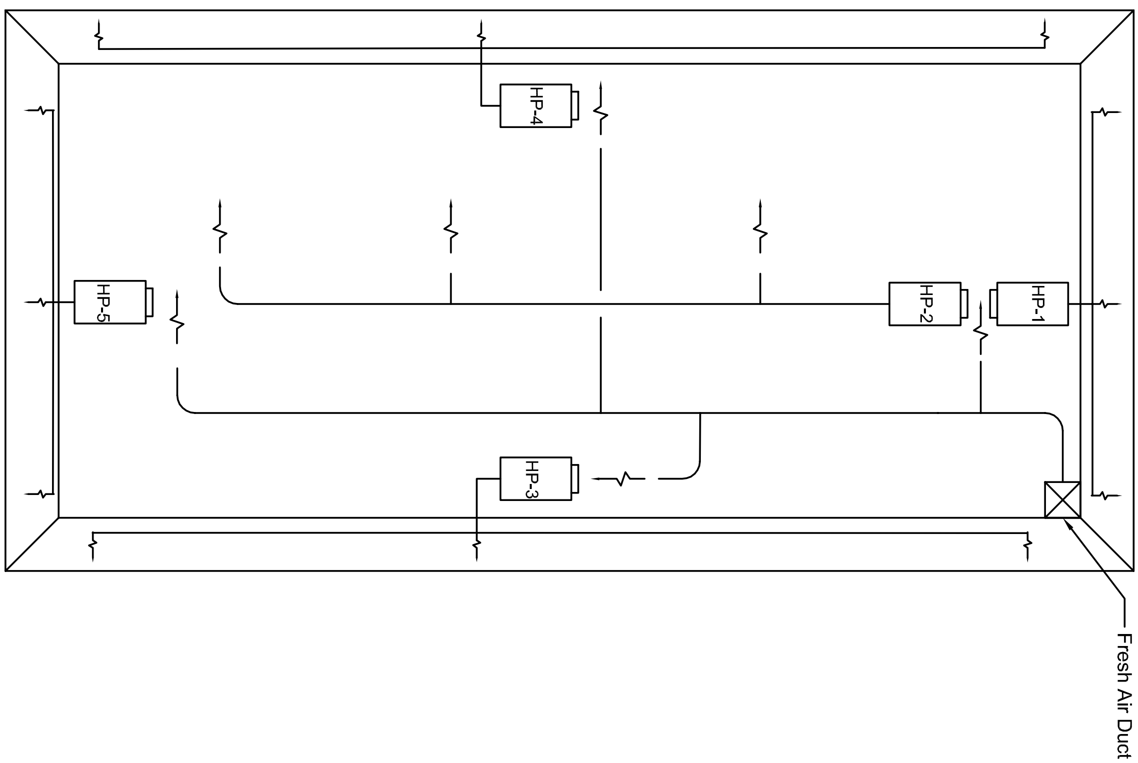
From the energy and environmental consideration, the common loop water source heat pump system is a significantly better option than the base case; however, from the economic point of view, the base case is better than the proposed case. It should be noted that further natural gas saving can be achieved if the remaining exhaust heat in the common water loop can be stored in a heat storage system, and subsequently used for space heating during the hours when there is no cooling load in the building. During the shoulder season and the summer months, the stored heat can be used for domestic water preheating using a water-to-water heat pump, which provides and excelled opportunity to reduce consumption of natural gas. This will also reduce the electricity consumption of the cooling tower, as the tower will then need to reject less heat to the atmosphere. However, some increase in the electricity consumption is expected due to the work input to the water-to-water heat pump.

Appendix 1: Conceptual design of common loop water source heat pump with heat storage



COMMON WATER LOOP HEAT PUMP SYSTEM
NOT TO SCALE

Appendix 2: Typical office floor layout with water source heat pumps



HVAC SYSTEM TYPICAL LAYOUT

Appendix 3: Building load from eQuest simulation

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-A Space Peak Loads Summary WEATHER FILE- Toronto ON CWEC

SPACE NAME	MULTIPLIER SPACE	MULTIPLIER FLOOR	COOLING LOAD (KBTU/HR)	TIME OF PEAK	DRY-BULB	WET-BULB	HEATING LOAD (KBTU/HR)	TIME OF PEAK	DRY-BULB	WET-BULB
EL1 South Perim Spc (G.S1)	1.	1.	44.461	SEP 28 3 PM	57.F	46.F	-20.583	JAN 1 6 AM	-3.F	-3.F
EL1 East Perim Spc (G.E2)	1.	1.	27.677	JUN 14 10 AM	65.F	53.F	-15.694	JAN 1 6 AM	-3.F	-3.F
EL1 North Perim Spc (G.N3)	1.	1.	21.484	JUN 11 4 PM	86.F	69.F	-25.001	JAN 1 6 AM	-3.F	-3.F
EL1 West Perim Spc (G.W4)	1.	1.	24.822	JUL 10 7 PM	80.F	63.F	-16.550	JAN 1 6 AM	-3.F	-3.F
EL1 Core Spc (G.C5)	1.	1.	185.958	SEP 3 4 PM	77.F	67.F	-1.879	JAN 1 6 AM	-3.F	-3.F
EL1 South Perim Plnm (G.S6)	1.	1.	1.423	AUG 3 6 PM	87.F	67.F	-3.725	JAN 27 8 AM	-3.F	-4.F
EL1 East Perim Plnm (G.E7)	1.	1.	1.030	JUL 8 5 PM	88.F	75.F	-2.597	JAN 27 8 AM	-3.F	-4.F
EL1 North Perim Plnm (G.N8)	1.	1.	1.070	JUL 8 6 PM	88.F	75.F	-3.944	JAN 27 8 AM	-3.F	-4.F
EL1 West Perim Plnm (G.W9)	1.	1.	0.822	JUL 8 6 PM	88.F	75.F	-2.589	JAN 27 11 AM	0.F	-1.F
EL1 Core Plnm (G.C10)	1.	1.	0.132	AUG 3 3 PM	91.F	71.F	-0.471	JAN 27 9 AM	-3.F	-4.F
EL1 South Perim Spc (M.S11)	1.	1.	68.079	SEP 28 3 PM	57.F	46.F	-22.515	JAN 1 8 AM	0.F	-1.F
EL1 East Perim Spc (M.E12)	1.	1.	43.725	MAY 7 10 AM	54.F	42.F	-15.854	JAN 1 6 AM	-3.F	-3.F
EL1 North Perim Spc (M.N13)	1.	1.	32.413	JUN 11 4 PM	86.F	69.F	-24.211	JAN 1 6 AM	-3.F	-3.F
EL1 West Perim Spc (M.W14)	1.	1.	39.007	APR 14 6 PM	63.F	47.F	-16.251	JAN 1 6 AM	-3.F	-3.F
EL1 Core Spc (M.C15)	1.	1.	217.177	JUL 8 4 PM	90.F	75.F	0.000		0.F	0.F
EL1 South Perim Plnm (M.S16)	1.	1.	1.423	AUG 3 6 PM	87.F	67.F	-3.725	JAN 27 8 AM	-3.F	-4.F
EL1 East Perim Plnm (M.E17)	1.	1.	1.030	JUL 8 5 PM	88.F	75.F	-2.597	JAN 27 8 AM	-3.F	-4.F
EL1 North Perim Plnm (M.N18)	1.	1.	1.070	JUL 8 6 PM	88.F	75.F	-3.944	JAN 27 8 AM	-3.F	-4.F
EL1 West Perim Plnm (M.W19)	1.	1.	0.822	JUL 8 6 PM	88.F	75.F	-2.589	JAN 27 11 AM	0.F	-1.F
EL1 Core Plnm (M.C20)	1.	1.	0.132	AUG 3 3 PM	91.F	71.F	-0.471	JAN 27 9 AM	-3.F	-4.F
EL1 South Perim Spc (T.S21)	1.	1.	68.079	SEP 28 3 PM	57.F	46.F	-22.515	JAN 1 8 AM	0.F	-1.F
EL1 East Perim Spc (T.E22)	1.	1.	43.725	MAY 7 10 AM	54.F	42.F	-15.854	JAN 1 6 AM	-3.F	-3.F
EL1 North Perim Spc (T.N23)	1.	1.	32.413	JUN 11 4 PM	86.F	69.F	-24.211	JAN 1 6 AM	-3.F	-3.F
EL1 West Perim Spc (T.W24)	1.	1.	39.007	APR 14 6 PM	63.F	47.F	-16.251	JAN 1 6 AM	-3.F	-3.F
EL1 Core Spc (T.C25)	1.	1.	258.234	JUL 6 4 PM	84.F	69.F	-24.984	JAN 1 5 AM	-1.F	-2.F
EL1 South Perim Plnm (T.S26)	1.	1.	3.136	AUG 3 7 PM	87.F	68.F	-8.148	JAN 27 11 AM	0.F	-1.F
EL1 East Perim Plnm (T.E27)	1.	1.	2.079	JUL 6 7 PM	80.F	70.F	-5.409	FEB 4 8 AM	2.F	1.F
EL1 North Perim Plnm (T.N28)	1.	1.	2.783	AUG 5 7 PM	86.F	73.F	-8.476	JAN 27 11 AM	0.F	-1.F
EL1 West Perim Plnm (T.W29)	1.	1.	2.051	JUL 6 9 PM	74.F	68.F	-5.467	JAN 27 11 AM	0.F	-1.F
EL1 Core Plnm (T.C30)	1.	1.	11.276	JUL 6 9 PM	74.F	68.F	-25.648	JAN 1 12 NOON	1.F	0.F
SUM			1176.540				-342.156			
BUILDING PEAK			1009.421	JUN 11 4 PM	86.F	69.F	-261.868	JAN 1 6 AM	-3.F	-3.F

REPORT- LS-B Space Peak Load Components EL1 South Perim Spc (G.S1) WEATHER FILE- Toronto ON CWEC

SPACE EL1 South Perim Spc (G.S1)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	2373 SQFT	220 M2		
VOLUME	23730 CUFT	672 M3		

	COOLING LOAD		HEATING LOAD	
TIME	SEP 28 3PM		JAN 1 6AM	
DRY-BULB TEMP	57 F	14 C	-3 F	-19 C
WET-BULB TEMP	46 F	8 C	-3 F	-19 C
TOT HORIZONTAL SOLAR RAD	216 BTU/H.SQFT	680 W/M2	0 BTU/H.SQFT	0 W/M2
WINDSPEED AT SPACE	8.7 KTS	4.5 M/S	7.4 KTS	3.8 M/S
CLOUD AMOUNT 0(CLEAR)-10	1		7	

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALL CONDUCTION	0.327	0.096	0.000	0.000	-3.035	-0.889
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	-3.980	-1.166	0.000	0.000	-18.230	-5.341
WINDOW GLASS SOLAR	42.884	12.565	0.000	0.000	4.847	1.420
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	-0.690	-0.202	0.000	0.000	-1.976	-0.579
OCCUPANTS TO SPACE	4.003	1.173	4.578	1.341	0.000	0.000
LIGHT TO SPACE	0.292	0.086	0.000	0.000	0.141	0.041
EQUIPMENT TO SPACE	2.070	0.607	0.000	0.000	0.145	0.042
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	-0.445	-0.130	0.000	0.000	-2.475	-0.725
TOTAL	44.461	13.027	4.578	1.341	-20.583	-6.031
TOTAL / AREA	0.019	0.059	0.002	0.006	-0.009	-0.027
TOTAL LOAD	49.039 KBTU/H		14.368 KW		-20.583 KBTU/H	-6.031 KW
TOTAL LOAD / AREA	20.67 BTU/H.SQFT		65.175 W/M2		8.674 BTU/H.SQFT	27.355 W/M2

NOTE
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

REPORT- LS-B Space Peak Load Components EL1 East Perim Spc (G.E2) WEATHER FILE- Toronto ON CWEC

SPACE EL1 East Perim Spc (G.E2)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	1507 SQFT	140 M2		
VOLUME	15068 CUFT	427 M3		

	COOLING LOAD		HEATING LOAD	
TIME	JUN 14 10AM		JAN 1 6AM	
DRY-BULB TEMP	65 F	18 C	-3 F	-19 C
WET-BULB TEMP	53 F	12 C	-3 F	-19 C
TOT HORIZONTAL SOLAR RAD	198 BTU/H.SQFT	624 W/M2	0 BTU/H.SQFT	0 W/M2
WINDSPEED AT SPACE	4.7 KTS	2.4 M/S	7.4 KTS	3.8 M/S
CLOUD AMOUNT 0(CLEAR)-10	1		7	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	0.222	0.065	0.000	0.000	-2.154	-0.631
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	-1.446	-0.424	0.000	0.000	-12.014	-3.520
WINDOW GLASS SOLAR	26.362	7.724	0.000	0.000	1.258	0.369
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	-0.858	-0.251	0.000	0.000	-1.317	-0.386
OCCUPANTS TO SPACE	2.230	0.653	2.907	0.852	0.000	0.000
LIGHT TO SPACE	0.038	0.011	0.000	0.000	0.091	0.027
EQUIPMENT TO SPACE	1.245	0.365	0.000	0.000	0.092	0.027
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	-0.115	-0.034	0.000	0.000	-1.650	-0.483
TOTAL	27.677	8.109	2.907	0.852	-15.694	-4.598
TOTAL / AREA	0.018	0.058	0.002	0.006	-0.010	-0.033

	COOLING		HEATING	
TOTAL LOAD	30.584 KBTU/H	8.961 KW	-15.694 KBTU/H	-4.598 KW
TOTAL LOAD / AREA	20.30 BTU/H.SQFT	64.017 W/M2	10.416 BTU/H.SQFT	32.849 W/M2

```
*****************************************************************
*                                                               *
*  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR      *
*  ----    LOADS                                                *
*        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION        *
*          IN CONSIDERATION                                     *
*        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A            *
*          CONSTANT INDOOR SPACE TEMPERATURE                    *
*                                                               *
*****************************************************************
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Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-B Space Peak Load Components EL1 North Perim Spc (G.N3) WEATHER FILE- Toronto ON CWEC

SPACE EL1 North Perim Spc (G.N3)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	2373	SQFT	220	M2
VOLUME	23730	CUFT	672	M3

	COOLING LOAD		HEATING LOAD	
TIME	JUN 11 4PM		JAN 1 6AM	
DRY-BULB TEMP	86 F	30 C	-3 F	-19 C
WET-BULB TEMP	69 F	21 C	-3 F	-19 C
TOT HORIZONTAL SOLAR RAD	216 BTU/H.SQFT	680 W/M2	0 BTU/H.SQFT	0 W/M2
WINDSPEED AT SPACE	10.0 KTS	5.2 M/S	7.4 KTS	3.8 M/S
CLOUD AMOUNT 0(CLEAR)-10	6		7	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	0.731	0.214	0.000	0.000	-3.357	-0.984
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	2.996	0.878	0.000	0.000	-18.171	-5.324
WINDOW GLASS SOLAR	11.692	3.426	0.000	0.000	0.688	0.202
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	-1.288	-0.377	0.000	0.000	-1.977	-0.579
OCCUPANTS TO SPACE	4.139	1.213	4.578	1.341	0.000	0.000
LIGHT TO SPACE	0.103	0.030	0.000	0.000	0.146	0.043
EQUIPMENT TO SPACE	2.088	0.612	0.000	0.000	0.145	0.042
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	1.024	0.300	0.767	0.225	-2.475	-0.725
TOTAL	21.484	6.295	5.345	1.566	-25.001	-7.325
TOTAL / AREA	0.009	0.029	0.002	0.007	-0.011	-0.033

	COOLING		HEATING	
TOTAL LOAD	26.829 KBTU/H	7.861 KW	-25.001 KBTU/H	-7.325 KW
TOTAL LOAD / AREA	11.31 BTU/H.SQFT	35.657 W/M2	10.536 BTU/H.SQFT	33.228 W/M2

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*****************************************************************
*                                                               *
*  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR      *
*  ----    LOADS                                                *
*        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION        *
*          IN CONSIDERATION                                     *
*        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A            *
*          CONSTANT INDOOR SPACE TEMPERATURE                    *
*                                                               *
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REPORT- LS-B Space Peak Load Components EL1 West Perim Spc (G.W4) WEATHER FILE- Toronto ON CWEC

SPACE EL1 West Perim Spc (G.W4)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER 1.0 FLOOR MULTIPLIER 1.0

FLOOR AREA 1507 SQFT 140 M2
VOLUME 15068 CUFT 427 M3

	COOLING LOAD		HEATING LOAD	
TIME	JUL 10 7PM		JAN 1 6AM	
DRY-BULB TEMP	80 F	27 C	-3 F	-19 C
WET-BULB TEMP	63 F	17 C	-3 F	-19 C
TOT HORIZONTAL SOLAR RAD	117 BTU/H.SQFT	368 W/M2	0 BTU/H.SQFT	0 W/M2
WINDSPEED AT SPACE	6.0 KTS	3.1 M/S	7.4 KTS	3.8 M/S
CLOUD AMOUNT 0(CLEAR)-10	0		7	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	0.781	0.229	0.000	0.000	-2.195	-0.643
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	1.220	0.357	0.000	0.000	-12.250	-3.589
WINDOW GLASS SOLAR	22.940	6.722	0.000	0.000	0.678	0.199
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	-0.622	-0.182	0.000	0.000	-1.317	-0.386
OCCUPANTS TO SPACE	0.116	0.034	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.041	0.012	0.000	0.000	0.091	0.027
EQUIPMENT TO SPACE	0.119	0.035	0.000	0.000	0.092	0.027
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.228	0.067	0.000	0.000	-1.650	-0.483
TOTAL	24.822	7.273	0.000	0.000	-16.550	-4.849
TOTAL / AREA	0.016	0.052	0.000	0.000	-0.011	-0.035

	COOLING		HEATING	
TOTAL LOAD	24.822 KBTU/H	7.273 KW	-16.550 KBTU/H	-4.849 KW
TOTAL LOAD / AREA	16.47 BTU/H.SQFT	51.956 W/M2	10.984 BTU/H.SQFT	34.642 W/M2

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*****************************************************************
*                                                               *
*  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
*  ----    LOADS                                                *
*        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
*          IN CONSIDERATION                                     *
*        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
*          CONSTANT INDOOR SPACE TEMPERATURE                    *
*                                                               *
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REPORT- LS-B Space Peak Load Components     EL1 Core Spc (G.C5)                      WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 Core Spc (G.C5)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                  MULTIPLIER        1.0          FLOOR MULTIPLIER        1.0

                  FLOOR  AREA     12236  SQFT      1137   M2
                  VOLUME         122364  CUFT      3465   M3

                                      COOLING  LOAD                              HEATING  LOAD
                                 ==========================                ==========================
   TIME                                SEP  3  4PM                               JAN  1  6AM

   DRY-BULB TEMP                   77 F            25 C                    -3 F            -19 C
   WET-BULB TEMP                   67 F            19 C                    -3 F            -19 C
   TOT HORIZONTAL SOLAR RAD        99 BTU/H.SQFT  312 W/M2                  0 BTU/H.SQFT     0 W/M2
   WINDSPEED AT SPACE             8.0 KTS         4.1 M/S                 7.4 KTS          3.8 M/S
   CLOUD AMOUNT 0(CLEAR)-10         4                                       7

                                SENSIBLE           LATENT                                SENSIBLE
                          (KBTU/H)     ( KW )  (KBTU/H)  ( KW )                   (KBTU/H)  ( KW )
                          --------     ------  --------  ------                   --------  --------

    WALL CONDUCTION          0.000      0.000     0.000   0.000                      0.000     0.000
    ROOF CONDUCTION          0.000      0.000     0.000   0.000                      0.000     0.000
    WINDOW GLASS+FRM COND    0.000      0.000     0.000   0.000                      0.000     0.000
    WINDOW GLASS SOLAR       0.000      0.000     0.000   0.000                      0.000     0.000
    DOOR CONDUCTION          0.000      0.000     0.000   0.000                      0.000     0.000
    INTERNAL SURFACE COND    0.000      0.000     0.000   0.000                      0.000     0.000
    UNDERGROUND SURF COND   -1.372     -0.402     0.000   0.000                     -3.929    -1.151
    OCCUPANTS TO SPACE     126.588     37.090   127.571  37.378                      0.000     0.000
    LIGHT     TO SPACE      34.704     10.168     0.000   0.000                      0.676     0.198
    EQUIPMENT TO SPACE      25.994      7.616     0.000   0.000                      1.834     0.537
    PROCESS   TO SPACE       0.000      0.000     0.000   0.000                      0.000     0.000
    INFILTRATION             0.044      0.013     0.101   0.030                     -0.460    -0.135
                          --------    -------   -------  ------                   --------  --------
    TOTAL                  185.958     54.486   127.671  37.408                     -1.879    -0.550
    TOTAL / AREA             0.015      0.048     0.010   0.033                      0.000     0.000

    TOTAL LOAD             313.629 KBTU/H        91.893  KW               -1.879 KBTU/H       -0.550  KW
    TOTAL LOAD / AREA        25.63  BTU/H.SQFT   80.835  W/M2              0.154 BTU/H.SQFT    0.484  W/M2

                                ****************************************************************
                                *                                                              *
                                *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                *  ----    LOADS                                               *
                                *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                *          IN CONSIDERATION                                    *
                                *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                *                                                              *
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Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-B Space Peak Load Components EL1 South Perim Plnm (G.S6) WEATHER FILE- Toronto ON CWEC

SPACE EL1 South Perim Plnm (G.S6)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	2373 SQFT	220 M2		
VOLUME	7119 CUFT	202 M3		

	COOLING LOAD		HEATING LOAD	
TIME	AUG 3 6PM		JAN 27 8AM	
DRY-BULB TEMP	87 F	31 C	-3 F	-19 C
WET-BULB TEMP	67 F	19 C	-4 F	-20 C
TOT HORIZONTAL SOLAR RAD	83 BTU/H.SQFT	261 W/M2	4 BTU/H.SQFT	12 W/M2
WINDSPEED AT SPACE	5.6 KTS	2.9 M/S	5.6 KTS	2.9 M/S
CLOUD AMOUNT 0(CLEAR)-10	9		1	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	0.991	0.290	0.000	0.000	-1.825	-0.535
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS SOLAR	0.000	0.000	0.000	0.000	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
EQUIPMENT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.432	0.127	0.111	0.033	-1.901	-0.557
TOTAL	1.423	0.417	0.111	0.033	-3.725	-1.091
TOTAL / AREA	0.001	0.002	0.000	0.000	-0.002	-0.005

TOTAL LOAD	1.534 KBTU/H	0.450 KW	-3.725 KBTU/H	-1.091 KW
TOTAL LOAD / AREA	0.65 BTU/H.SQFT	2.039 W/M2	1.570 BTU/H.SQFT	4.951 W/M2

NOTE
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

REPORT- LS-B Space Peak Load Components EL1 East Perim Plnm (G.E7) WEATHER FILE- Toronto ON CWEC

SPACE EL1 East Perim Plnm (G.E7)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0	
FLOOR AREA	1507	SQFT	140	M2	
VOLUME	4520	CUFT	128	M3	

	COOLING LOAD		HEATING LOAD	
TIME	JUL 8 5PM		JAN 27 8AM	
DRY-BULB TEMP	88 F	31 C	-3 F	-19 C
WET-BULB TEMP	75 F	24 C	-4 F	-20 C
TOT HORIZONTAL SOLAR RAD	172 BTU/H.SQFT	542 W/M2	4 BTU/H.SQFT	12 W/M2
WINDSPEED AT SPACE	8.5 KTS	4.4 M/S	5.6 KTS	2.9 M/S
CLOUD AMOUNT 0(CLEAR)-10	7		1	

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALL CONDUCTION	0.723	0.212	0.000	0.000	-1.330	-0.390
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS SOLAR	0.000	0.000	0.000	0.000	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
EQUIPMENT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.307	0.090	0.535	0.157	-1.267	-0.371
TOTAL	1.030	0.302	0.535	0.157	-2.597	-0.761
TOTAL / AREA	0.001	0.002	0.000	0.001	-0.002	-0.005

TOTAL LOAD	1.565 KBTU/H	0.459 KW	-2.597 KBTU/H	-0.761 KW
TOTAL LOAD / AREA	1.04 BTU/H.SQFT	3.276 W/M2	1.724 BTU/H.SQFT	5.436 W/M2

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*****************************************************************
*                                                               *
*  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR      *
*  ----    LOADS                                                *
*        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION        *
*          IN CONSIDERATION                                     *
*        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A            *
*          CONSTANT INDOOR SPACE TEMPERATURE                    *
*                                                               *
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Base Case Model-1                                                                     DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 North Perim Plnm (G.N8)                    WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 North Perim Plnm (G.N8)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER        1.0         FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      2373  SQFT       220   M2
                    VOLUME           7119  CUFT       202   M3

                                              COOLING  LOAD                                HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        JUL  8  6PM                                JAN 27  8AM

    DRY-BULB TEMP                          88 F            31 C                    -3 F            -19 C
    WET-BULB TEMP                          75 F            24 C                    -4 F            -20 C
    TOT HORIZONTAL SOLAR RAD              126 BTU/H.SQFT   397 W/M2                 4 BTU/H.SQFT    12 W/M2
    WINDSPEED AT SPACE                    7.1 KTS          3.6 M/S                5.6 KTS          2.9 M/S
    CLOUD AMOUNT 0(CLEAR)-10                1                                       1


                                       SENSIBLE          LATENT                              SENSIBLE
                                   (KBTU/H)    ( KW )  (KBTU/H)  ( KW )                  (KBTU/H)  ( KW )
                                   --------    ------  --------  ------                  --------  --------

     WALL CONDUCTION                  0.611     0.179     0.000   0.000                     -2.043    -0.599
     ROOF CONDUCTION                  0.000     0.000     0.000   0.000                      0.000     0.000
     WINDOW GLASS+FRM COND            0.000     0.000     0.000   0.000                      0.000     0.000
     WINDOW GLASS SOLAR               0.000     0.000     0.000   0.000                      0.000     0.000
     DOOR CONDUCTION                  0.000     0.000     0.000   0.000                      0.000     0.000
     INTERNAL SURFACE COND            0.000     0.000     0.000   0.000                      0.000     0.000
     UNDERGROUND SURF COND            0.000     0.000     0.000   0.000                      0.000     0.000
     OCCUPANTS TO SPACE               0.000     0.000     0.000   0.000                      0.000     0.000
     LIGHT     TO SPACE               0.000     0.000     0.000   0.000                      0.000     0.000
     EQUIPMENT TO SPACE               0.000     0.000     0.000   0.000                      0.000     0.000
     PROCESS   TO SPACE               0.000     0.000     0.000   0.000                      0.000     0.000
     INFILTRATION                     0.459     0.135     0.800   0.234                     -1.901    -0.557
                                   --------   -------   -------  ------                  --------  --------
     TOTAL                            1.070     0.313     0.800   0.234                     -3.944    -1.156
     TOTAL / AREA                     0.000     0.001     0.000   0.001                     -0.002    -0.005

     TOTAL LOAD                       1.870 KBTU/H        0.548  KW                -3.944 KBTU/H       -1.156  KW
     TOTAL LOAD / AREA                0.79  BTU/H.SQFT    2.485  W/M2               1.662 BTU/H.SQFT    5.242  W/M2

                                         ****************************************************************
                                         *                                                              *
                                         *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                         *  ----    LOADS                                               *
                                         *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                         *          IN CONSIDERATION                                    *
                                         *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                         *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                         *                                                              *
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Base Case Model-1                                                                     DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 West Perim Plnm (G.W9)                    WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 West Perim Plnm (G.W9)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                   MULTIPLIER        1.0          FLOOR MULTIPLIER        1.0

                   FLOOR  AREA      1507  SQFT       140   M2
                   VOLUME           4520  CUFT       128   M3

                                              COOLING  LOAD                               HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        JUL  8  6PM                               JAN 27 11AM

    DRY-BULB TEMP                          88 F            31 C                        0 F           -18 C
    WET-BULB TEMP                          75 F            24 C                       -1 F           -18 C
    TOT HORIZONTAL SOLAR RAD              126 BTU/H.SQFT  397 W/M2                   115 BTU/H.SQFT  362 W/M2
    WINDSPEED AT SPACE                    7.1 KTS         3.6 M/S                    2.8 KTS         1.5 M/S
    CLOUD AMOUNT 0(CLEAR)-10                1                                          1


                                     SENSIBLE           LATENT                              SENSIBLE
                                 (KBTU/H)    ( KW )  (KBTU/H)  ( KW )                  (KBTU/H)  ( KW )
                                 --------    ------  --------  ------                  --------  --------

     WALL CONDUCTION                0.516     0.151     0.000   0.000                    -1.370    -0.401
     ROOF CONDUCTION                0.000     0.000     0.000   0.000                     0.000     0.000
     WINDOW GLASS+FRM COND          0.000     0.000     0.000   0.000                     0.000     0.000
     WINDOW GLASS SOLAR             0.000     0.000     0.000   0.000                     0.000     0.000
     DOOR CONDUCTION                0.000     0.000     0.000   0.000                     0.000     0.000
     INTERNAL SURFACE COND          0.000     0.000     0.000   0.000                     0.000     0.000
     UNDERGROUND SURF COND          0.000     0.000     0.000   0.000                     0.000     0.000
     OCCUPANTS TO SPACE             0.000     0.000     0.000   0.000                     0.000     0.000
     LIGHT     TO SPACE             0.000     0.000     0.000   0.000                     0.000     0.000
     EQUIPMENT TO SPACE             0.000     0.000     0.000   0.000                     0.000     0.000
     PROCESS   TO SPACE             0.000     0.000     0.000   0.000                     0.000     0.000
     INFILTRATION                   0.306     0.090     0.533   0.156                    -1.219    -0.357
                                 --------   -------   -------  ------                  --------  --------
     TOTAL                          0.822     0.241     0.533   0.156                    -2.589    -0.759
     TOTAL / AREA                   0.001     0.002     0.000   0.001                    -0.002    -0.005

     TOTAL LOAD                     1.355 KBTU/H        0.397  KW                -2.589 KBTU/H       -0.759  KW
     TOTAL LOAD / AREA              0.90  BTU/H.SQFT    2.836  W/M2               1.718 BTU/H.SQFT    5.419  W/M2

                                  ****************************************************************
                                  *                                                              *
                                  *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                  *  ----    LOADS                                               *
                                  *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                  *          IN CONSIDERATION                                    *
                                  *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                  *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                  *                                                              *
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Base Case Model-1                                                                DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 Core Plnm (G.C10)                           WEATHER FILE- Toronto ON CWEC
---------------------------------------------------------------------------------------------------------------------------------

SPACE  EL1 Core Plnm (G.C10)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER       1.0         FLOOR MULTIPLIER        1.0

                    FLOOR  AREA     12236  SQFT      1137   M2
                    VOLUME          36709  CUFT      1040   M3

                                              COOLING  LOAD                              HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        AUG  3  3PM                               JAN 27  9AM

    DRY-BULB TEMP                          91 F             33 C                     -3 F            -19 C
    WET-BULB TEMP                          71 F             22 C                     -4 F            -20 C
    TOT HORIZONTAL SOLAR RAD              263 BTU/H.SQFT   829 W/M2                  30 BTU/H.SQFT    94 W/M2
    WINDSPEED AT SPACE                    7.1 KTS          3.6 M/S                  6.4 KTS          3.3 M/S
    CLOUD AMOUNT 0(CLEAR)-10                4                                        1


                                        SENSIBLE           LATENT                                 SENSIBLE
                                   (KBTU/H)     ( KW )  (KBTU/H)  ( KW )                     (KBTU/H)  ( KW )
                                   --------     ------  --------  ------                     --------  --------

     WALL CONDUCTION                  0.000      0.000     0.000   0.000                        0.000     0.000
     ROOF CONDUCTION                  0.000      0.000     0.000   0.000                        0.000     0.000
     WINDOW GLASS+FRM COND            0.000      0.000     0.000   0.000                        0.000     0.000
     WINDOW GLASS SOLAR               0.000      0.000     0.000   0.000                        0.000     0.000
     DOOR CONDUCTION                  0.000      0.000     0.000   0.000                        0.000     0.000
     INTERNAL SURFACE COND            0.000      0.000     0.000   0.000                        0.000     0.000
     UNDERGROUND SURF COND            0.000      0.000     0.000   0.000                        0.000     0.000
     OCCUPANTS TO SPACE               0.000      0.000     0.000   0.000                        0.000     0.000
     LIGHT     TO SPACE               0.000      0.000     0.000   0.000                        0.000     0.000
     EQUIPMENT TO SPACE               0.000      0.000     0.000   0.000                        0.000     0.000
     PROCESS   TO SPACE               0.000      0.000     0.000   0.000                        0.000     0.000
     INFILTRATION                     0.132      0.039     0.084   0.025                       -0.471    -0.138
                                   --------    -------   -------  ------                     --------  --------
     TOTAL                            0.132      0.039     0.084   0.025                       -0.471    -0.138
     TOTAL / AREA                     0.000      0.000     0.000   0.000                        0.000     0.000

     TOTAL LOAD                       0.217 KBTU/H         0.064  KW                 -0.471 KBTU/H       -0.138  KW
     TOTAL LOAD / AREA                0.02  BTU/H.SQFT     0.056  W/M2                0.039 BTU/H.SQFT    0.121  W/M2

                                        ****************************************************************
                                        *                                                              *
                                        *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                        *  ----    LOADS                                               *
                                        *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                        *          IN CONSIDERATION                                    *
                                        *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                        *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                        *                                                              *
                                        ****************************************************************
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REPORT- LS-B Space Peak Load Components EL1 South Perim Spc (M.S11) WEATHER FILE- Toronto ON CWEC

SPACE EL1 South Perim Spc (M.S11)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	2373 SQFT	220 M2		
VOLUME	23730 CUFT	672 M3		

	COOLING LOAD		HEATING LOAD	
TIME	SEP 28 3PM		JAN 1 8AM	
DRY-BULB TEMP	57 F	14 C	0 F	-18 C
WET-BULB TEMP	46 F	8 C	-1 F	-18 C
TOT HORIZONTAL SOLAR RAD	216 BTU/H.SQFT	680 W/M2	1 BTU/H.SQFT	3 W/M2
WINDSPEED AT SPACE	8.7 KTS	4.5 M/S	10.7 KTS	5.5 M/S
CLOUD AMOUNT 0(CLEAR)-10	1		4	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	0.336	0.098	0.000	0.000	-3.272	-0.959
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	-4.070	-1.193	0.000	0.000	-18.419	-5.397
WINDOW GLASS SOLAR	60.205	17.640	0.000	0.000	1.147	0.336
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	7.728	2.264	6.637	1.945	0.000	0.000
LIGHT TO SPACE	0.161	0.047	0.000	0.000	0.130	0.038
EQUIPMENT TO SPACE	4.166	1.221	0.000	0.000	0.280	0.082
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	-0.445	-0.130	0.000	0.000	-2.381	-0.698
TOTAL	68.079	19.947	6.637	1.945	-22.515	-6.597
TOTAL / AREA	0.029	0.090	0.003	0.009	-0.009	-0.030

TOTAL LOAD	74.716 KBTU/H	21.892 KW	-22.515 KBTU/H	-6.597 KW
TOTAL LOAD / AREA	31.49 BTU/H.SQFT	99.301 W/M2	9.488 BTU/H.SQFT	29.924 W/M2

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******************************************************************
*                                                                *
*  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR       *
*  ----    LOADS                                                 *
*        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION         *
*          IN CONSIDERATION                                      *
*        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A             *
*          CONSTANT INDOOR SPACE TEMPERATURE                     *
*                                                                *
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Base Case Model-1                                                     DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 East Perim Spc (M.E12)                  WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 East Perim Spc (M.E12)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER        1.0          FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      1507  SQFT       140   M2
                    VOLUME          15068  CUFT       427   M3

                                          COOLING  LOAD                               HEATING  LOAD
                                 ==========================                  ==========================
    TIME                                 MAY  7 10AM                                 JAN  1  6AM

    DRY-BULB TEMP                  54 F             12 C                    -3 F           -19 C
    WET-BULB TEMP                  42 F              6 C                    -3 F           -19 C
    TOT HORIZONTAL SOLAR RAD      194 BTU/H.SQFT   611 W/M2                  0 BTU/H.SQFT     0 W/M2
    WINDSPEED AT SPACE            4.0 KTS          2.1 M/S                 7.4 KTS          3.8 M/S
    CLOUD AMOUNT 0(CLEAR)-10        1                                        7


                              SENSIBLE          LATENT                           SENSIBLE
                          (KBTU/H)    ( KW )  (KBTU/H)  ( KW )               (KBTU/H)  ( KW )
                          --------    ------  --------  ------               --------  --------

     WALL CONDUCTION        -0.130    -0.038     0.000   0.000                 -2.145    -0.629
     ROOF CONDUCTION         0.000     0.000     0.000   0.000                  0.000     0.000
     WINDOW GLASS+FRM COND  -3.173    -0.930     0.000   0.000                -12.659    -3.709
     WINDOW GLASS SOLAR     40.279    11.802     0.000   0.000                  0.340     0.100
     DOOR CONDUCTION         0.000     0.000     0.000   0.000                  0.000     0.000
     INTERNAL SURFACE COND   0.000     0.000     0.000   0.000                  0.000     0.000
     UNDERGROUND SURF COND   0.000     0.000     0.000   0.000                  0.000     0.000
     OCCUPANTS TO SPACE      4.512     1.322     4.214   1.235                  0.000     0.000
     LIGHT     TO SPACE      0.051     0.015     0.000   0.000                  0.082     0.024
     EQUIPMENT TO SPACE      2.551     0.747     0.000   0.000                  0.178     0.052
     PROCESS   TO SPACE      0.000     0.000     0.000   0.000                  0.000     0.000
     INFILTRATION           -0.365    -0.107     0.000   0.000                 -1.650    -0.483
                          --------   -------   -------  ------               --------  --------
     TOTAL                  43.725    12.811     4.214   1.235                -15.854    -4.645
     TOTAL / AREA            0.029     0.092     0.003   0.009                 -0.011    -0.033

     TOTAL LOAD             47.939 KBTU/H      14.046  KW             -15.854 KBTU/H      -4.645  KW
     TOTAL LOAD / AREA      31.82  BTU/H.SQFT  100.342  W/M2           10.522 BTU/H.SQFT   33.185  W/M2

                                ****************************************************************
                                *                                                              *
                                *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                *  ----    LOADS                                               *
                                *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                *          IN CONSIDERATION                                    *
                                *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                *                                                              *
                                ****************************************************************
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REPORT- LS-B Space Peak Load Components EL1 North Perim Spc (M.N13) WEATHER FILE- Toronto ON CWEC

SPACE EL1 North Perim Spc (M.N13)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	2373 SQFT	220 M2		
VOLUME	23730 CUFT	672 M3		

	COOLING LOAD		HEATING LOAD	
TIME	JUN 11 4PM		JAN 1 6AM	
DRY-BULB TEMP	86 F	30 C	-3 F	-19 C
WET-BULB TEMP	69 F	21 C	-3 F	-19 C
TOT HORIZONTAL SOLAR RAD	216 BTU/H.SQFT	680 W/M2	0 BTU/H.SQFT	0 W/M2
WINDSPEED AT SPACE	10.0 KTS	5.2 M/S	7.4 KTS	3.8 M/S
CLOUD AMOUNT 0(CLEAR)-10	6		7	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	0.748	0.219	0.000	0.000	-3.360	-0.984
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	3.529	1.034	0.000	0.000	-19.000	-5.567
WINDOW GLASS SOLAR	14.948	4.380	0.000	0.000	0.213	0.063
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	7.939	2.326	6.637	1.945	0.000	0.000
LIGHT TO SPACE	0.044	0.013	0.000	0.000	0.130	0.038
EQUIPMENT TO SPACE	4.182	1.225	0.000	0.000	0.280	0.082
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	1.024	0.300	0.767	0.225	-2.475	-0.725
TOTAL	32.413	9.497	7.404	2.169	-24.211	-7.094
TOTAL / AREA	0.014	0.043	0.003	0.010	-0.010	-0.032

	COOLING		HEATING	
TOTAL LOAD	39.817 KBTU/H	11.666 KW	-24.211 KBTU/H	-7.094 KW
TOTAL LOAD / AREA	16.78 BTU/H.SQFT	52.919 W/M2	10.203 BTU/H.SQFT	32.178 W/M2

NOTE
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

REPORT- LS-B Space Peak Load Components EL1 West Perim Spc (M.W14) WEATHER FILE- Toronto ON CWEC

SPACE EL1 West Perim Spc (M.W14)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	1507 SQFT	140 M2		
VOLUME	15068 CUFT	427 M3		

	COOLING LOAD		HEATING LOAD	
TIME	APR 14 6PM		JAN 1 6AM	
DRY-BULB TEMP	63 F	17 C	-3 F	-19 C
WET-BULB TEMP	47 F	8 C	-3 F	-19 C
TOT HORIZONTAL SOLAR RAD	137 BTU/H.SQFT	431 W/M2	0 BTU/H.SQFT	0 W/M2
WINDSPEED AT SPACE	19.4 KTS	10.0 M/S	7.4 KTS	3.8 M/S
CLOUD AMOUNT 0(CLEAR)-10	2		7	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	-0.166	-0.049	0.000	0.000	-2.176	-0.638
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	-1.490	-0.437	0.000	0.000	-12.906	-3.781
WINDOW GLASS SOLAR	36.701	10.753	0.000	0.000	0.220	0.065
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	2.658	0.779	1.391	0.407	0.000	0.000
LIGHT TO SPACE	0.063	0.019	0.000	0.000	0.082	0.024
EQUIPMENT TO SPACE	1.637	0.480	0.000	0.000	0.178	0.052
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	-0.397	-0.116	0.000	0.000	-1.650	-0.483
TOTAL	39.007	11.429	1.391	0.407	-16.251	-4.762
TOTAL / AREA	0.026	0.082	0.001	0.003	-0.011	-0.034

	COOLING		HEATING	
TOTAL LOAD	40.397 KBTU/H	11.836 KW	-16.251 KBTU/H	-4.762 KW
TOTAL LOAD / AREA	26.81 BTU/H.SQFT	84.557 W/M2	10.786 BTU/H.SQFT	34.016 W/M2

NOTE
----
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

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REPORT- LS-B Space Peak Load Components     EL1 Core Spc (M.C15)                          WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 Core Spc (M.C15)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER        1.0         FLOOR MULTIPLIER        1.0

                    FLOOR  AREA     12236  SQFT      1137   M2
                    VOLUME         122364  CUFT      3465   M3

                                              COOLING  LOAD                                  HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        JUL  8  4PM

    DRY-BULB TEMP                          90 F            32 C
    WET-BULB TEMP                          75 F            24 C
    TOT HORIZONTAL SOLAR RAD              223 BTU/H.SQFT   703 W/M2
    WINDSPEED AT SPACE                    6.7 KTS          3.4 M/S
    CLOUD AMOUNT 0(CLEAR)-10                4


                                  SENSIBLE          LATENT                                     SENSIBLE
                               (KBTU/H)    ( KW )  (KBTU/H)  ( KW )                         (KBTU/H)  ( KW )
                               --------    ------  --------  ------                         --------  --------

     WALL CONDUCTION              0.000     0.000     0.000   0.000                            0.000     0.000
     ROOF CONDUCTION              0.000     0.000     0.000   0.000                            0.000     0.000
     WINDOW GLASS+FRM COND        0.000     0.000     0.000   0.000                            0.000     0.000
     WINDOW GLASS SOLAR           0.000     0.000     0.000   0.000                            0.000     0.000
     DOOR CONDUCTION              0.000     0.000     0.000   0.000                            0.000     0.000
     INTERNAL SURFACE COND        0.000     0.000     0.000   0.000                            0.000     0.000
     UNDERGROUND SURF COND        0.000     0.000     0.000   0.000                            0.000     0.000
     OCCUPANTS TO SPACE         149.447    43.788   127.571  37.378                            0.000     0.000
     LIGHT     TO SPACE          40.170    11.770     0.000   0.000                            0.000     0.000
     EQUIPMENT TO SPACE          27.433     8.038     0.000   0.000                            0.000     0.000
     PROCESS   TO SPACE           0.000     0.000     0.000   0.000                            0.000     0.000
     INFILTRATION                 0.127     0.037     0.183   0.054                            0.000     0.000
                               --------   -------   -------  ------                         --------  --------
     TOTAL                      217.177    63.633   127.754  37.432                            0.000     0.000
     TOTAL / AREA                 0.018     0.056     0.010   0.033                            0.000     0.000

     TOTAL LOAD                 344.931 KBTU/H      101.065  KW                  0.000 KBTU/H       0.000  KW
     TOTAL LOAD / AREA           28.19  BTU/H.SQFT   88.903  W/M2                0.000 BTU/H.SQFT   0.000  W/M2

                                   ****************************************************************
                                   *                                                              *
                                   *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                   *  ----    LOADS                                               *
                                   *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                   *          IN CONSIDERATION                                    *
                                   *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                   *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                   *                                                              *
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REPORT- LS-B Space Peak Load Components EL1 South Perim Plnm (M.S16) WEATHER FILE- Toronto ON CWEC

SPACE EL1 South Perim Plnm (M.S16)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER 1.0 FLOOR MULTIPLIER 1.0

FLOOR AREA 2373 SQFT 220 M2
VOLUME 7119 CUFT 202 M3

	COOLING LOAD		HEATING LOAD	
TIME	AUG 3 6PM		JAN 27 8AM	
DRY-BULB TEMP	87 F	31 C	-3 F	-19 C
WET-BULB TEMP	67 F	19 C	-4 F	-20 C
TOT HORIZONTAL SOLAR RAD	83 BTU/H.SQFT	261 W/M2	4 BTU/H.SQFT	12 W/M2
WINDSPEED AT SPACE	5.6 KTS	2.9 M/S	5.6 KTS	2.9 M/S
CLOUD AMOUNT 0(CLEAR)-10	9		1	

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	HEATING SENSIBLE (KBTU/H)	HEATING SENSIBLE (KW)
WALL CONDUCTION	0.991	0.290	0.000	0.000	-1.825	-0.535
ROOF CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS+FRM COND	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS SOLAR	0.000	0.000	0.000	0.000	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
EQUIPMENT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.432	0.127	0.111	0.033	-1.901	-0.557
TOTAL	1.423	0.417	0.111	0.033	-3.725	-1.091
TOTAL / AREA	0.001	0.002	0.000	0.000	-0.002	-0.005

	COOLING		HEATING	
TOTAL LOAD	1.534 KBTU/H	0.450 KW	-3.725 KBTU/H	-1.091 KW
TOTAL LOAD / AREA	0.65 BTU/H.SQFT	2.039 W/M2	1.570 BTU/H.SQFT	4.951 W/M2

NOTE
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

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Base Case Model-1                                                                DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 East Perim Plnm (M.E17)                  WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 East Perim Plnm (M.E17)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER        1.0          FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      1507  SQFT       140   M2
                    VOLUME           4520  CUFT       128   M3

                                              COOLING  LOAD                              HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        JUL  8  5PM                               JAN 27  8AM

    DRY-BULB TEMP                          88 F             31 C                    -3 F            -19 C
    WET-BULB TEMP                          75 F             24 C                    -4 F            -20 C
    TOT HORIZONTAL SOLAR RAD              172 BTU/H.SQFT   542 W/M2                  4 BTU/H.SQFT    12 W/M2
    WINDSPEED AT SPACE                    8.5 KTS          4.4 M/S                 5.6 KTS          2.9 M/S
    CLOUD AMOUNT 0(CLEAR)-10                7                                        1


                                      SENSIBLE           LATENT                              SENSIBLE
                                  (KBTU/H)     ( KW )  (KBTU/H)   ( KW )                 (KBTU/H)   ( KW )
                                  --------     ------  --------   ------                 --------   --------

     WALL CONDUCTION                 0.723      0.212     0.000    0.000                   -1.330     -0.390
     ROOF CONDUCTION                 0.000      0.000     0.000    0.000                    0.000      0.000
     WINDOW GLASS+FRM COND           0.000      0.000     0.000    0.000                    0.000      0.000
     WINDOW GLASS SOLAR              0.000      0.000     0.000    0.000                    0.000      0.000
     DOOR CONDUCTION                 0.000      0.000     0.000    0.000                    0.000      0.000
     INTERNAL SURFACE COND           0.000      0.000     0.000    0.000                    0.000      0.000
     UNDERGROUND SURF COND           0.000      0.000     0.000    0.000                    0.000      0.000
     OCCUPANTS TO SPACE              0.000      0.000     0.000    0.000                    0.000      0.000
     LIGHT     TO SPACE              0.000      0.000     0.000    0.000                    0.000      0.000
     EQUIPMENT TO SPACE              0.000      0.000     0.000    0.000                    0.000      0.000
     PROCESS   TO SPACE              0.000      0.000     0.000    0.000                    0.000      0.000
     INFILTRATION                    0.307      0.090     0.535    0.157                   -1.267     -0.371
                                  --------    -------   -------   ------                 --------   --------
     TOTAL                           1.030      0.302     0.535    0.157                   -2.597     -0.761
     TOTAL / AREA                    0.001      0.002     0.000    0.001                   -0.002     -0.005

     TOTAL LOAD                      1.565 KBTU/H         0.459  KW                  -2.597 KBTU/H       -0.761  KW
     TOTAL LOAD / AREA               1.04  BTU/H.SQFT     3.276  W/M2                 1.724 BTU/H.SQFT    5.436  W/M2

                                  ****************************************************************
                                  *                                                              *
                                  *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                  *  ----    LOADS                                               *
                                  *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                  *          IN CONSIDERATION                                    *
                                  *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                  *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                  *                                                              *
                                  ****************************************************************
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REPORT- LS-B Space Peak Load Components     EL1 North Perim Plnm (M.N18)                WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 North Perim Plnm (M.N18)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER        1.0          FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      2373  SQFT       220   M2
                    VOLUME           7119  CUFT       202   M3

                                              COOLING  LOAD                                HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        JUL  8  6PM                               JAN 27  8AM

    DRY-BULB TEMP                          88 F            31 C                      -3 F            -19 C
    WET-BULB TEMP                          75 F            24 C                      -4 F            -20 C
    TOT HORIZONTAL SOLAR RAD              126 BTU/H.SQFT   397 W/M2                   4 BTU/H.SQFT    12 W/M2
    WINDSPEED AT SPACE                    7.1 KTS          3.6 M/S                  5.6 KTS          2.9 M/S
    CLOUD AMOUNT 0(CLEAR)-10                1                                         1


                                      SENSIBLE          LATENT                             SENSIBLE
                                (KBTU/H)     ( KW )  (KBTU/H)  ( KW )                (KBTU/H)  ( KW )
                                --------     ------  --------  ------                --------  --------

     WALL CONDUCTION              0.611      0.179     0.000   0.000                  -2.043    -0.599
     ROOF CONDUCTION              0.000      0.000     0.000   0.000                   0.000     0.000
     WINDOW GLASS+FRM COND        0.000      0.000     0.000   0.000                   0.000     0.000
     WINDOW GLASS SOLAR           0.000      0.000     0.000   0.000                   0.000     0.000
     DOOR CONDUCTION              0.000      0.000     0.000   0.000                   0.000     0.000
     INTERNAL SURFACE COND        0.000      0.000     0.000   0.000                   0.000     0.000
     UNDERGROUND SURF COND        0.000      0.000     0.000   0.000                   0.000     0.000
     OCCUPANTS TO SPACE           0.000      0.000     0.000   0.000                   0.000     0.000
     LIGHT     TO SPACE           0.000      0.000     0.000   0.000                   0.000     0.000
     EQUIPMENT TO SPACE           0.000      0.000     0.000   0.000                   0.000     0.000
     PROCESS   TO SPACE           0.000      0.000     0.000   0.000                   0.000     0.000
     INFILTRATION                 0.459      0.135     0.800   0.234                  -1.901    -0.557
                                --------   -------   -------  ------                --------  --------
     TOTAL                        1.070      0.313     0.800   0.234                  -3.944    -1.156
     TOTAL / AREA                 0.000      0.001     0.000   0.001                  -0.002    -0.005

     TOTAL LOAD                   1.870 KBTU/H       0.548  KW                 -3.944 KBTU/H       -1.156  KW
     TOTAL LOAD / AREA            0.79  BTU/H.SQFT   2.485  W/M2                1.662 BTU/H.SQFT    5.242  W/M2

                                   ****************************************************************
                                   *                                                              *
                                   *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                   *  ----    LOADS                                               *
                                   *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                   *          IN CONSIDERATION                                    *
                                   *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                   *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                   *                                                              *
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Base Case Model-1                                                                         DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 West Perim Plnm (M.W19)                   WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 West Perim Plnm (M.W19)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER        1.0         FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      1507  SQFT       140   M2
                    VOLUME           4520  CUFT       128   M3

                                              COOLING  LOAD                                HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        JUL  8  6PM                                JAN 27 11AM

    DRY-BULB TEMP                          88 F            31 C                      0 F           -18 C
    WET-BULB TEMP                          75 F            24 C                     -1 F           -18 C
    TOT HORIZONTAL SOLAR RAD              126 BTU/H.SQFT  397 W/M2                 115 BTU/H.SQFT  362 W/M2
    WINDSPEED AT SPACE                    7.1 KTS         3.6 M/S                  2.8 KTS         1.5 M/S
    CLOUD AMOUNT 0(CLEAR)-10                1                                        1


                                  SENSIBLE           LATENT                                   SENSIBLE
                              (KBTU/H)    ( KW )  (KBTU/H)  ( KW )                        (KBTU/H)  ( KW )
                              --------    ------  --------  ------                        --------  --------

     WALL CONDUCTION             0.516     0.151     0.000   0.000                          -1.370    -0.401
     ROOF CONDUCTION             0.000     0.000     0.000   0.000                           0.000     0.000
     WINDOW GLASS+FRM COND       0.000     0.000     0.000   0.000                           0.000     0.000
     WINDOW GLASS SOLAR          0.000     0.000     0.000   0.000                           0.000     0.000
     DOOR CONDUCTION             0.000     0.000     0.000   0.000                           0.000     0.000
     INTERNAL SURFACE COND       0.000     0.000     0.000   0.000                           0.000     0.000
     UNDERGROUND SURF COND       0.000     0.000     0.000   0.000                           0.000     0.000
     OCCUPANTS TO SPACE          0.000     0.000     0.000   0.000                           0.000     0.000
     LIGHT     TO SPACE          0.000     0.000     0.000   0.000                           0.000     0.000
     EQUIPMENT TO SPACE          0.000     0.000     0.000   0.000                           0.000     0.000
     PROCESS   TO SPACE          0.000     0.000     0.000   0.000                           0.000     0.000
     INFILTRATION                0.306     0.090     0.533   0.156                          -1.219    -0.357
                              --------   -------   -------  ------                        --------  --------
     TOTAL                       0.822     0.241     0.533   0.156                          -2.589    -0.759
     TOTAL / AREA                0.001     0.002     0.000   0.001                          -0.002    -0.005

     TOTAL LOAD                  1.355 KBTU/H        0.397  KW                    -2.589 KBTU/H       -0.759  KW
     TOTAL LOAD / AREA           0.90  BTU/H.SQFT    2.836  W/M2                   1.718 BTU/H.SQFT    5.419  W/M2

                                 ****************************************************************
                                 *                                                              *
                                 *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                 *  ----    LOADS                                               *
                                 *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                 *          IN CONSIDERATION                                    *
                                 *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                 *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                 *                                                              *
                                 ****************************************************************
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REPORT- LS-B Space Peak Load Components     EL1 Core Plnm (M.C20)                          WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 Core Plnm (M.C20)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                   MULTIPLIER        1.0         FLOOR MULTIPLIER        1.0

                   FLOOR  AREA     12236  SQFT      1137   M2
                   VOLUME          36709  CUFT      1040   M3

                                                COOLING  LOAD                                     HEATING  LOAD
                                           ==========================                        ==========================
    TIME                                          AUG  3  3PM                                        JAN 27  9AM

    DRY-BULB TEMP                            91 F             33 C                         -3 F             -19 C
    WET-BULB TEMP                            71 F             22 C                         -4 F             -20 C
    TOT HORIZONTAL SOLAR RAD                263 BTU/H.SQFT   829 W/M2                      30 BTU/H.SQFT     94 W/M2
    WINDSPEED AT SPACE                      7.1 KTS          3.6 M/S                      6.4 KTS           3.3 M/S
    CLOUD AMOUNT 0(CLEAR)-10                  4                                             1


                                    SENSIBLE           LATENT                                       SENSIBLE
                                (KBTU/H)     ( KW )  (KBTU/H)   ( KW )                         (KBTU/H)   ( KW )
                                --------     ------  --------   ------                         --------   --------

     WALL CONDUCTION               0.000      0.000      0.000   0.000                            0.000      0.000
     ROOF CONDUCTION               0.000      0.000      0.000   0.000                            0.000      0.000
     WINDOW GLASS+FRM COND         0.000      0.000      0.000   0.000                            0.000      0.000
     WINDOW GLASS SOLAR            0.000      0.000      0.000   0.000                            0.000      0.000
     DOOR CONDUCTION               0.000      0.000      0.000   0.000                            0.000      0.000
     INTERNAL SURFACE COND         0.000      0.000      0.000   0.000                            0.000      0.000
     UNDERGROUND SURF COND         0.000      0.000      0.000   0.000                            0.000      0.000
     OCCUPANTS TO SPACE            0.000      0.000      0.000   0.000                            0.000      0.000
     LIGHT     TO SPACE            0.000      0.000      0.000   0.000                            0.000      0.000
     EQUIPMENT TO SPACE            0.000      0.000      0.000   0.000                            0.000      0.000
     PROCESS   TO SPACE            0.000      0.000      0.000   0.000                            0.000      0.000
     INFILTRATION                  0.132      0.039      0.084   0.025                           -0.471     -0.138
                                --------    -------    -------  ------                         --------   --------
     TOTAL                         0.132      0.039      0.084   0.025                           -0.471     -0.138
     TOTAL / AREA                  0.000      0.000      0.000   0.000                            0.000      0.000

     TOTAL LOAD                    0.217 KBTU/H          0.064  KW                     -0.471 KBTU/H       -0.138  KW
     TOTAL LOAD / AREA             0.02  BTU/H.SQFT      0.056  W/M2                    0.039 BTU/H.SQFT    0.121  W/M2

                                       ****************************************************************
                                       *                                                              *
                                       *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                       *  ----    LOADS                                               *
                                       *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                       *          IN CONSIDERATION                                    *
                                       *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                       *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                       *                                                              *
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Base Case Model-1                                                                         DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 South Perim Spc (T.S21)                  WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 South Perim Spc (T.S21)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER       1.0         FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      2373  SQFT       220   M2
                    VOLUME          23730  CUFT       672   M3

                                              COOLING  LOAD                                HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        SEP 28  3PM                               JAN  1  8AM

    DRY-BULB TEMP                          57 F            14 C                        0 F            -18 C
    WET-BULB TEMP                          46 F             8 C                       -1 F            -18 C
    TOT HORIZONTAL SOLAR RAD              216 BTU/H.SQFT  680 W/M2                     1 BTU/H.SQFT     3 W/M2
    WINDSPEED AT SPACE                    8.7 KTS         4.5 M/S                   10.7 KTS          5.5 M/S
    CLOUD AMOUNT 0(CLEAR)-10                1                                          4


                                    SENSIBLE          LATENT                                   SENSIBLE
                                (KBTU/H)    ( KW )  (KBTU/H)  ( KW )                        (KBTU/H)  ( KW )
                                --------    ------  --------  ------                        --------  --------

     WALL CONDUCTION               0.336     0.098     0.000  0.000                          -3.272    -0.959
     ROOF CONDUCTION               0.000     0.000     0.000  0.000                           0.000     0.000
     WINDOW GLASS+FRM COND        -4.070    -1.193     0.000  0.000                         -18.419    -5.397
     WINDOW GLASS SOLAR           60.205    17.640     0.000  0.000                           1.147     0.336
     DOOR CONDUCTION               0.000     0.000     0.000  0.000                           0.000     0.000
     INTERNAL SURFACE COND         0.000     0.000     0.000  0.000                           0.000     0.000
     UNDERGROUND SURF COND         0.000     0.000     0.000  0.000                           0.000     0.000
     OCCUPANTS TO SPACE            7.728     2.264     6.637  1.945                           0.000     0.000
     LIGHT     TO SPACE            0.161     0.047     0.000  0.000                           0.130     0.038
     EQUIPMENT TO SPACE            4.166     1.221     0.000  0.000                           0.280     0.082
     PROCESS   TO SPACE            0.000     0.000     0.000  0.000                           0.000     0.000
     INFILTRATION                 -0.445    -0.130     0.000  0.000                          -2.381    -0.698
                                --------   -------   -------  ------                        --------  --------
     TOTAL                        68.079    19.947     6.637  1.945                         -22.515    -6.597
     TOTAL / AREA                  0.029     0.090     0.003  0.009                          -0.009    -0.030

     TOTAL LOAD                   74.716 KBTU/H      21.892  KW                    -22.515 KBTU/H       -6.597  KW
     TOTAL LOAD / AREA            31.49  BTU/H.SQFT  99.301  W/M2                    9.488 BTU/H.SQFT   29.924  W/M2

                                ****************************************************************
                                *                                                              *
                                *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                *  ----    LOADS                                               *
                                *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                *          IN CONSIDERATION                                    *
                                *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                *                                                              *
                                ****************************************************************
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REPORT- LS-B Space Peak Load Components     EL1 East Perim Spc (T.E22)                   WEATHER FILE- Toronto ON CWEC
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SPACE  EL1 East Perim Spc (T.E22)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C


                    MULTIPLIER        1.0          FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      1507  SQFT       140   M2
                    VOLUME          15068  CUFT       427   M3

                                              COOLING  LOAD                                  HEATING  LOAD
                                         ==========================                ==========================
    TIME                                        MAY  7 10AM                                  JAN  1  6AM

    DRY-BULB TEMP                          54 F            12 C                      -3 F            -19 C
    WET-BULB TEMP                          42 F             6 C                      -3 F            -19 C
    TOT HORIZONTAL SOLAR RAD              194 BTU/H.SQFT   611 W/M2                    0 BTU/H.SQFT     0 W/M2
    WINDSPEED AT SPACE                    4.0 KTS          2.1 M/S                   7.4 KTS          3.8 M/S
    CLOUD AMOUNT 0(CLEAR)-10                1                                          7


                                   SENSIBLE            LATENT                                SENSIBLE
                               (KBTU/H)     ( KW )  (KBTU/H)   ( KW )                    (KBTU/H)   ( KW )
                               --------     ------  --------   ------                    --------   --------

     WALL CONDUCTION             -0.130     -0.038     0.000    0.000                      -2.145     -0.629
     ROOF CONDUCTION              0.000      0.000     0.000    0.000                       0.000      0.000
     WINDOW GLASS+FRM COND       -3.173     -0.930     0.000    0.000                     -12.659     -3.709
     WINDOW GLASS SOLAR          40.279     11.802     0.000    0.000                       0.340      0.100
     DOOR CONDUCTION              0.000      0.000     0.000    0.000                       0.000      0.000
     INTERNAL SURFACE COND        0.000      0.000     0.000    0.000                       0.000      0.000
     UNDERGROUND SURF COND        0.000      0.000     0.000    0.000                       0.000      0.000
     OCCUPANTS TO SPACE           4.512      1.322     4.214    1.235                       0.000      0.000
     LIGHT     TO SPACE           0.051      0.015     0.000    0.000                       0.082      0.024
     EQUIPMENT TO SPACE           2.551      0.747     0.000    0.000                       0.178      0.052
     PROCESS   TO SPACE           0.000      0.000     0.000    0.000                       0.000      0.000
     INFILTRATION                -0.365     -0.107     0.000    0.000                      -1.650     -0.483
                               --------    -------   -------   ------                    --------   --------
     TOTAL                       43.725     12.811     4.214    1.235                     -15.854     -4.645
     TOTAL / AREA                 0.029      0.092     0.003    0.009                      -0.011     -0.033

     TOTAL LOAD                  47.939 KBTU/H      14.046  KW               -15.854 KBTU/H        -4.645  KW
     TOTAL LOAD / AREA           31.82  BTU/H.SQFT  100.342  W/M2              10.522 BTU/H.SQFT    33.185  W/M2

                                  ****************************************************************
                                  *                                                              *
                                  *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                  *  ----    LOADS                                               *
                                  *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                  *          IN CONSIDERATION                                    *
                                  *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                  *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                  *                                                              *
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Base Case Model-1                                                                   DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 North Perim Spc (T.N23)                  WEATHER FILE- Toronto ON CWEC
---------------------------------------------------------------------------------------------------------------------------------

SPACE  EL1 North Perim Spc (T.N23)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C

                    MULTIPLIER        1.0          FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      2373  SQFT       220   M2
                    VOLUME          23730  CUFT       672   M3

                                              COOLING  LOAD                                HEATING  LOAD
                                          ==========================                ==========================
    TIME                                         JUN 11  4PM                              JAN  1  6AM

    DRY-BULB TEMP                           86 F            30 C                    -3 F            -19 C
    WET-BULB TEMP                           69 F            21 C                    -3 F            -19 C
    TOT HORIZONTAL SOLAR RAD               216 BTU/H.SQFT  680 W/M2                  0 BTU/H.SQFT     0 W/M2
    WINDSPEED AT SPACE                    10.0 KTS         5.2 M/S                 7.4 KTS          3.8 M/S
    CLOUD AMOUNT 0(CLEAR)-10                 6                                       7


                                      SENSIBLE            LATENT                                   SENSIBLE
                                  (KBTU/H)     ( KW )  (KBTU/H)  ( KW )                        (KBTU/H)  ( KW )
                                  --------     ------  --------  ------                        --------  --------

     WALL CONDUCTION                0.748      0.219     0.000   0.000                           -3.360    -0.984
     ROOF CONDUCTION                0.000      0.000     0.000   0.000                            0.000     0.000
     WINDOW GLASS+FRM COND          3.529      1.034     0.000   0.000                          -19.000    -5.567
     WINDOW GLASS SOLAR            14.948      4.380     0.000   0.000                            0.213     0.063
     DOOR CONDUCTION                0.000      0.000     0.000   0.000                            0.000     0.000
     INTERNAL SURFACE COND          0.000      0.000     0.000   0.000                            0.000     0.000
     UNDERGROUND SURF COND          0.000      0.000     0.000   0.000                            0.000     0.000
     OCCUPANTS TO SPACE             7.939      2.326     6.637   1.945                            0.000     0.000
     LIGHT     TO SPACE             0.044      0.013     0.000   0.000                            0.130     0.038
     EQUIPMENT TO SPACE             4.182      1.225     0.000   0.000                            0.280     0.082
     PROCESS   TO SPACE             0.000      0.000     0.000   0.000                            0.000     0.000
     INFILTRATION                   1.024      0.300     0.767   0.225                           -2.475    -0.725
                                  --------   -------   -------  ------                         --------  --------
     TOTAL                         32.413      9.497     7.404   2.169                          -24.211    -7.094
     TOTAL / AREA                   0.014      0.043     0.003   0.010                           -0.010    -0.032

     TOTAL LOAD                    39.817 KBTU/H      11.666  KW                   -24.211 KBTU/H       -7.094  KW
     TOTAL LOAD / AREA             16.78  BTU/H.SQFT  52.919  W/M2                  10.203 BTU/H.SQFT   32.178  W/M2

                                  ****************************************************************
                                  *                                                              *
                                  *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                  *  ----    LOADS                                               *
                                  *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                  *          IN CONSIDERATION                                    *
                                  *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                  *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                  *                                                              *
                                  ****************************************************************
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Base Case Model-1                                                                             DOE-2.2-48r    5/01/2016    20:26:47  BDL RUN  3

REPORT- LS-B Space Peak Load Components     EL1 West Perim Spc (T.W24)                     WEATHER FILE- Toronto ON CWEC
-------------------------------------------------------------------------------------------------------------------------------------

SPACE  EL1 West Perim Spc (T.W24)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   70 F /  21 C


                    MULTIPLIER        1.0         FLOOR MULTIPLIER        1.0

                    FLOOR  AREA      1507  SQFT       140   M2
                    VOLUME          15068  CUFT       427   M3

                                          COOLING  LOAD                                HEATING  LOAD
                                 ==========================                ==========================
    TIME                                APR 14  6PM                                JAN  1  6AM

    DRY-BULB TEMP                  63 F              17 C                   -3 F             -19 C
    WET-BULB TEMP                  47 F               8 C                   -3 F             -19 C
    TOT HORIZONTAL SOLAR RAD      137 BTU/H.SQFT   431 W/M2                  0 BTU/H.SQFT      0 W/M2
    WINDSPEED AT SPACE           19.4 KTS         10.0 M/S                 7.4 KTS           3.8 M/S
    CLOUD AMOUNT 0(CLEAR)-10        2                                        7


                                   SENSIBLE          LATENT                              SENSIBLE
                              (KBTU/H)     ( KW )  (KBTU/H)  ( KW )                 (KBTU/H)  ( KW )
                              --------     ------  --------  ------                 --------  --------

     WALL CONDUCTION            -0.166    -0.049     0.000   0.000                    -2.176    -0.638
     ROOF CONDUCTION             0.000     0.000     0.000   0.000                     0.000     0.000
     WINDOW GLASS+FRM COND      -1.490    -0.437     0.000   0.000                   -12.906    -3.781
     WINDOW GLASS SOLAR         36.701    10.753     0.000   0.000                     0.220     0.065
     DOOR CONDUCTION             0.000     0.000     0.000   0.000                     0.000     0.000
     INTERNAL SURFACE COND       0.000     0.000     0.000   0.000                     0.000     0.000
     UNDERGROUND SURF COND       0.000     0.000     0.000   0.000                     0.000     0.000
     OCCUPANTS TO SPACE          2.658     0.779     1.391   0.407                     0.000     0.000
     LIGHT     TO SPACE          0.063     0.019     0.000   0.000                     0.082     0.024
     EQUIPMENT TO SPACE          1.637     0.480     0.000   0.000                     0.178     0.052
     PROCESS   TO SPACE          0.000     0.000     0.000   0.000                     0.000     0.000
     INFILTRATION               -0.397    -0.116     0.000   0.000                    -1.650    -0.483
                              --------   -------   -------  ------                  --------  --------
     TOTAL                      39.007    11.429     1.391   0.407                   -16.251    -4.762
     TOTAL / AREA                0.026     0.082     0.001   0.003                    -0.011    -0.034

     TOTAL LOAD                 40.397 KBTU/H      11.836  KW               -16.251 KBTU/H       -4.762  KW
     TOTAL LOAD / AREA          26.81  BTU/H.SQFT  84.557  W/M2              10.786 BTU/H.SQFT   34.016  W/M2

                                    ****************************************************************
                                    *                                                              *
                                    *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                    *  ----    LOADS                                               *
                                    *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                    *          IN CONSIDERATION                                    *
                                    *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                    *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                    *                                                              *
                                    ****************************************************************
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REPORT- LS-B Space Peak Load Components EL1 Core Spc (T.C25) WEATHER FILE- Toronto ON CWEC

SPACE EL1 Core Spc (T.C25)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	12236 SQFT	1137 M2		
VOLUME	122364 CUFT	3465 M3		

	COOLING LOAD		HEATING LOAD	
TIME	JUL 6 4PM		JAN 1 5AM	
DRY-BULB TEMP	84 F	29 C	-1 F	-18 C
WET-BULB TEMP	69 F	21 C	-2 F	-19 C
TOT HORIZONTAL SOLAR RAD	245 BTU/H.SQFT	772 W/M2	0 BTU/H.SQFT	0 W/M2
WINDSPEED AT SPACE	2.0 KTS	1.0 M/S	11.4 KTS	5.9 M/S
CLOUD AMOUNT 0(CLEAR)-10	3		6	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
ROOF CONDUCTION	0.039	0.012	0.000	0.000	-0.857	-0.251
WINDOW GLASS+FRM COND	7.125	2.088	0.000	0.000	-26.366	-7.725
WINDOW GLASS SOLAR	31.907	9.349	0.000	0.000	0.166	0.048
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	151.370	44.352	127.571	37.378	0.000	0.000
LIGHT TO SPACE	40.261	11.797	0.000	0.000	0.682	0.200
EQUIPMENT TO SPACE	27.443	8.041	0.000	0.000	1.841	0.539
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.089	0.026	0.092	0.027	-0.449	-0.132
TOTAL	258.234	75.663	127.662	37.405	-24.984	-7.320
TOTAL / AREA	0.021	0.067	0.010	0.033	-0.002	-0.006

TOTAL LOAD	385.896 KBTU/H	113.068 KW	-24.984 KBTU/H	-7.320 KW
TOTAL LOAD / AREA	31.54 BTU/H.SQFT	99.461 W/M2	2.042 BTU/H.SQFT	6.439 W/M2

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*****************************************************************
*                                                               *
*  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR      *
*  ----    LOADS                                                *
*        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION        *
*          IN CONSIDERATION                                     *
*        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A            *
*          CONSTANT INDOOR SPACE TEMPERATURE                    *
*                                                               *
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REPORT- LS-B Space Peak Load Components EL1 South Perim Plnm (T.S26) WEATHER FILE- Toronto ON CWEC

SPACE EL1 South Perim Plnm (T.S26)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	2373 SQFT	220 M2		
VOLUME	7119 CUFT	202 M3		

	COOLING LOAD		HEATING LOAD	
TIME	AUG 3 7PM		JAN 27 11AM	
DRY-BULB TEMP	87 F	31 C	0 F	-18 C
WET-BULB TEMP	68 F	20 C	-1 F	-18 C
TOT HORIZONTAL SOLAR RAD	37 BTU/H.SQFT	116 W/M2	115 BTU/H.SQFT	362 W/M2
WINDSPEED AT SPACE	4.2 KTS	2.2 M/S	2.8 KTS	1.5 M/S
CLOUD AMOUNT 0(CLEAR)-10	9		1	

	COOLING SENSIBLE (KBTU/H)	COOLING SENSIBLE (KW)	COOLING LATENT (KBTU/H)	COOLING LATENT (KW)	HEATING SENSIBLE (KBTU/H)	HEATING SENSIBLE (KW)
WALL CONDUCTION	0.996	0.292	0.000	0.000	-1.758	-0.515
ROOF CONDUCTION	1.815	0.532	0.000	0.000	-4.561	-1.336
WINDOW GLASS+FRM COND	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS SOLAR	0.000	0.000	0.000	0.000	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
EQUIPMENT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.325	0.095	0.151	0.044	-1.829	-0.536
TOTAL	3.136	0.919	0.151	0.044	-8.148	-2.387
TOTAL / AREA	0.001	0.004	0.000	0.000	-0.003	-0.011

	COOLING		HEATING	
TOTAL LOAD	3.287 KBTU/H	0.963 KW	-8.148 KBTU/H	-2.387 KW
TOTAL LOAD / AREA	1.39 BTU/H.SQFT	4.369 W/M2	3.434 BTU/H.SQFT	10.829 W/M2

NOTE
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

REPORT- LS-B Space Peak Load Components EL1 East Perim Plnm (T.E27) WEATHER FILE- Toronto ON CWEC

SPACE EL1 East Perim Plnm (T.E27)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER 1.0 FLOOR MULTIPLIER 1.0

FLOOR AREA	1507	SQFT	140	M2
VOLUME	4520	CUFT	128	M3

	COOLING LOAD		HEATING LOAD	
TIME	JUL 6 7PM		FEB 4 8AM	
DRY-BULB TEMP	80 F	27 C	2 F	-17 C
WET-BULB TEMP	70 F	21 C	1 F	-17 C
TOT HORIZONTAL SOLAR RAD	80 BTU/H.SQFT	252 W/M2	5 BTU/H.SQFT	15 W/M2
WINDSPEED AT SPACE	4.2 KTS	2.2 M/S	8.5 KTS	4.4 M/S
CLOUD AMOUNT 0(CLEAR)-10	6		2	

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALL CONDUCTION	0.634	0.186	0.000	0.000	-1.348	-0.395
ROOF CONDUCTION	1.317	0.386	0.000	0.000	-2.897	-0.849
WINDOW GLASS+FRM COND	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS SOLAR	0.000	0.000	0.000	0.000	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
EQUIPMENT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.128	0.038	0.289	0.085	-1.164	-0.341
TOTAL	2.079	0.609	0.289	0.085	-5.409	-1.585
TOTAL / AREA	0.001	0.004	0.000	0.001	-0.004	-0.011

TOTAL LOAD	2.369 KBTU/H	0.694 KW	-5.409 KBTU/H	-1.585 KW
TOTAL LOAD / AREA	1.57 BTU/H.SQFT	4.958 W/M2	3.590 BTU/H.SQFT	11.322 W/M2

NOTE
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

REPORT- LS-B Space Peak Load Components EL1 North Perim Plnm (T.N28) WEATHER FILE- Toronto ON CWEC

SPACE EL1 North Perim Plnm (T.N28)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0	
FLOOR AREA	2373	SQFT	220	M2	
VOLUME	7119	CUFT	202	M3	

	COOLING LOAD		HEATING LOAD	
TIME	AUG 5 7PM		JAN 27 11AM	
DRY-BULB TEMP	86 F	30 C	0 F	-18 C
WET-BULB TEMP	73 F	23 C	-1 F	-18 C
TOT HORIZONTAL SOLAR RAD	71 BTU/H.SQFT	223 W/M2	115 BTU/H.SQFT	362 W/M2
WINDSPEED AT SPACE	3.5 KTS	1.8 M/S	2.8 KTS	1.5 M/S
CLOUD AMOUNT 0(CLEAR)-10	2		1	

	COOLING SENSIBLE (KBTU/H)	COOLING SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	HEATING SENSIBLE (KBTU/H)	HEATING SENSIBLE (KW)
WALL CONDUCTION	0.641	0.188	0.000	0.000	-2.086	-0.611
ROOF CONDUCTION	1.837	0.538	0.000	0.000	-4.561	-1.336
WINDOW GLASS+FRM COND	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS SOLAR	0.000	0.000	0.000	0.000	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
EQUIPMENT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.305	0.089	0.512	0.150	-1.829	-0.536
TOTAL	2.783	0.815	0.512	0.150	-8.476	-2.483
TOTAL / AREA	0.001	0.004	0.000	0.001	-0.004	-0.011

	COOLING		HEATING	
TOTAL LOAD	3.295 KBTU/H	0.965 KW	-8.476 KBTU/H	-2.483 KW
TOTAL LOAD / AREA	1.39 BTU/H.SQFT	4.379 W/M2	3.572 BTU/H.SQFT	11.265 W/M2

NOTE
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

REPORT- LS-B Space Peak Load Components EL1 West Perim Plnm (T.W29) WEATHER FILE- Toronto ON CWEC

SPACE EL1 West Perim Plnm (T.W29)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER	1.0		FLOOR MULTIPLIER	1.0
FLOOR AREA	1507 SQFT	140 M2		
VOLUME	4520 CUFT	128 M3		

	COOLING LOAD		HEATING LOAD	
TIME	JUL 6 9PM		JAN 27 11AM	
DRY-BULB TEMP	74 F	23 C	0 F	-18 C
WET-BULB TEMP	68 F	20 C	-1 F	-18 C
TOT HORIZONTAL SOLAR RAD	13 BTU/H.SQFT	40 W/M2	115 BTU/H.SQFT	362 W/M2
WINDSPEED AT SPACE	4.2 KTS	2.2 M/S	2.8 KTS	1.5 M/S
CLOUD AMOUNT 0(CLEAR)-10	5		1	

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALL CONDUCTION	0.649	0.190	0.000	0.000	-1.352	-0.396
ROOF CONDUCTION	1.375	0.403	0.000	0.000	-2.897	-0.849
WINDOW GLASS+FRM COND	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS SOLAR	0.000	0.000	0.000	0.000	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
EQUIPMENT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.027	0.008	0.153	0.045	-1.219	-0.357
TOTAL	2.051	0.601	0.153	0.045	-5.467	-1.602
TOTAL / AREA	0.001	0.004	0.000	0.000	-0.004	-0.011

	COOLING		HEATING	
TOTAL LOAD	2.205 KBTU/H	0.646 KW	-5.467 KBTU/H	-1.602 KW
TOTAL LOAD / AREA	1.46 BTU/H.SQFT	4.615 W/M2	3.629 BTU/H.SQFT	11.444 W/M2

NOTE
1) THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2) TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION
3) THE ABOVE LOADS ARE CALCULATED ASSUMING A CONSTANT INDOOR SPACE TEMPERATURE

REPORT- LS-B Space Peak Load Components EL1 Core Plnm (T.C30) WEATHER FILE- Toronto ON CWEC

SPACE EL1 Core Plnm (T.C30)
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS 70 F / 21 C

MULTIPLIER 1.0 FLOOR MULTIPLIER 1.0

FLOOR AREA 12236 SQFT 1137 M2
VOLUME 36709 CUFT 1040 M3

	COOLING LOAD		HEATING LOAD	
TIME	JUL 6 9PM		JAN 1 12NOON	
DRY-BULB TEMP	74 F	23 C	1 F	-17 C
WET-BULB TEMP	68 F	20 C	0 F	-18 C
TOT HORIZONTAL SOLAR RAD	13 BTU/H.SQFT	40 W/M2	109 BTU/H.SQFT	343 W/M2
WINDSPEED AT SPACE	4.2 KTS	2.2 M/S	14.8 KTS	7.6 M/S
CLOUD AMOUNT 0(CLEAR)-10	5		5	

	SENSIBLE		LATENT		SENSIBLE	
	(KBTU/H)	(KW)	(KBTU/H)	(KW)	(KBTU/H)	(KW)
WALL CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
ROOF CONDUCTION	11.251	3.296	0.000	0.000	-25.214	-7.388
WINDOW GLASS+FRM COND	0.000	0.000	0.000	0.000	0.000	0.000
WINDOW GLASS SOLAR	0.000	0.000	0.000	0.000	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
LIGHT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
EQUIPMENT TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.025	0.007	0.143	0.042	-0.433	-0.127
TOTAL	11.276	3.304	0.143	0.042	-25.648	-7.515
TOTAL / AREA	0.001	0.003	0.000	0.000	-0.002	-0.007

TOTAL LOAD	11.419 KBTU/H	3.346 KW	-25.648 KBTU/H	-7.515 KW
TOTAL LOAD / AREA	0.93 BTU/H.SQFT	2.943 W/M2	2.096 BTU/H.SQFT	6.610 W/M2

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*                                                               *
*  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR      *
*  ----    LOADS                                                *
*        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION        *
*          IN CONSIDERATION                                     *
*        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A            *
*          CONSTANT INDOOR SPACE TEMPERATURE                    *
*                                                               *
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REPORT- LS-C BuiLding Peak Load Components                                                    WEATHER FILE- Toronto ON CWEC
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*** BUILDING ***



                    FLOOR  AREA     59988  SQFT      5573   M2
                    VOLUME         599878  CUFT     16989   M3

                                               COOLING  LOAD                                 HEATING  LOAD
                                          ==========================                ==========================
    TIME                                         JUN 11  4PM                               JAN  1  6AM

    DRY-BULB TEMP                           86 F            30 C                     -3 F           -19 C
    WET-BULB TEMP                           69 F            21 C                     -3 F           -19 C
    TOT HORIZONTAL SOLAR RAD               216 BTU/H.SQFT  680 W/M2                   0 BTU/H.SQFT    0 W/M2
    WINDSPEED AT SPACE                    10.6 KTS         5.4 M/S                  7.8 KTS         4.0 M/S
    CLOUD AMOUNT 0(CLEAR)-10                 6                                        7


                                  SENSIBLE             LATENT                                   SENSIBLE
                             (KBTU/H)    ( KW )  (KBTU/H)  ( KW )                          (KBTU/H)  ( KW )
                             --------    ------  --------  ------                          --------  --------

     WALL CONDUCTION            9.663     2.831     0.000   0.000                           -32.411    -9.496
     ROOF CONDUCTION            0.146     0.043     0.000   0.000                            -0.886    -0.260
     WINDOW GLASS+FRM COND     40.602    11.896     0.000   0.000                          -212.944   -62.393
     WINDOW GLASS SOLAR       231.593    67.857     0.000   0.000                            11.901     3.487
     DOOR CONDUCTION            0.000     0.000     0.000   0.000                             0.000     0.000
     INTERNAL SURFACE COND      0.000     0.000     0.000   0.000                             0.000     0.000
     UNDERGROUND SURF COND     -6.851    -2.007     0.000   0.000                           -10.515    -3.081
     OCCUPANTS TO SPACE       492.914   144.424   441.087 129.239                             0.000     0.000
     LIGHT     TO SPACE       115.762    33.918     0.000   0.000                             2.675     0.784
     EQUIPMENT TO SPACE       115.049    33.709     0.000   0.000                             5.980     1.752
     PROCESS   TO SPACE         0.000     0.000     0.000   0.000                             0.000     0.000
     INFILTRATION              10.543     3.089     7.891   2.312                           -25.667    -7.520
                             --------   -------   -------  ------                          --------  --------
     TOTAL                   1009.421   295.760   448.979 131.551                          -261.868   -76.727
     TOTAL / AREA               0.017     0.053     0.007   0.024                            -0.004    -0.014

     TOTAL LOAD              1458.399 KBTU/H      427.311  KW                    -261.868 KBTU/H      -76.727  KW
     TOTAL LOAD / AREA         24.31  BTU/H.SQFT   76.675  W/M2                     4.365 BTU/H.SQFT   13.768  W/M2


                                 ****************************************************************
                                 *                                                              *
                                 *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
                                 *  ----    LOADS                                               *
                                 *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION       *
                                 *          IN CONSIDERATION                                    *
                                 *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A           *
                                 *          CONSTANT INDOOR SPACE TEMPERATURE                   *
                                 *                                                              *
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Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-D Building Monthly Loads Summary WEATHER FILE- Toronto ON CWEC

MONTH	COOLING ENERGY (MBTU)	COOLING TIME OF MAX DY	COOLING TIME OF MAX HR	COOLING DRY-BULB TEMP	COOLING WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	HEATING TIME OF MAX DY	HEATING TIME OF MAX HR	HEATING DRY-BULB TEMP	HEATING WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	141.23062	22	16	39.F	34.F	846.599	-80.802	1	6	-3.F	-3.F	-261.868	21452.	95.947
FEB	142.70102	10	16	51.F	47.F	839.949	-64.850	3	6	1.F	0.F	-226.130	20872.	95.947
MAR	182.72125	24	15	55.F	47.F	902.533	-48.221	11	6	4.F	4.F	-206.212	24355.	95.947
APR	194.04678	14	15	65.F	47.F	969.939	-25.595	4	6	14.F	12.F	-186.782	22909.	95.947
MAY	205.18846	27	15	69.F	56.F	950.009	-11.951	1	5	30.F	27.F	-119.789	20351.	95.947
JUN	244.13289	11	15	86.F	69.F	1009.421	-3.660	20	5	42.F	41.F	-80.354	21981.	95.947
JUL	248.76863	8	15	90.F	75.F	989.209	-0.966	22	5	47.F	46.F	-43.460	21479.	95.947
AUG	247.86031	3	15	90.F	71.F	999.860	-1.752	8	5	45.F	44.F	-67.379	22004.	95.947
SEP	219.59392	24	15	69.F	58.F	992.255	-6.479	26	6	33.F	32.F	-96.458	21837.	95.947
OCT	182.05438	5	15	60.F	52.F	946.203	-22.491	23	7	18.F	17.F	-162.732	21696.	95.947
NOV	156.09367	9	15	58.F	51.F	852.514	-41.894	13	5	19.F	18.F	-155.841	23050.	95.947
DEC	154.39960	8	15	30.F	28.F	818.880	-68.493	24	8	12.F	11.F	-209.991	23924.	95.947
TOTAL	2318.792						-377.154						265911.	
MAX						1009.421						-261.868		95.947

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 South Perim Spc (G.S1) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.201	0.000	0.000	-1.184	-1.264	-7.477	3.726	0.441	0.714	0.340	0.000	-5.903
JAN	SEN CL	-0.226	0.000	0.000	-0.287	-0.466	-1.731	3.496	0.460	0.284	0.268	0.000	1.798
	LAT CL					0.000			0.501		0.000	0.000	0.501
	HEATNG	-1.007	0.000	0.000	-1.128	-1.137	-6.419	3.252	0.471	0.751	0.347	0.000	-4.870
FEB	SEN CL	-0.252	0.000	0.000	-0.344	-0.458	-1.882	3.834	0.430	0.216	0.251	0.000	1.794
	LAT CL					0.000			0.472		0.000	0.000	0.472
	HEATNG	-0.767	0.000	0.000	-1.107	-0.923	-5.303	3.043	0.416	0.645	0.319	0.000	-3.677
MAR	SEN CL	-0.279	0.000	0.000	-0.537	-0.537	-2.257	4.792	0.667	0.386	0.392	0.000	2.627
	LAT CL					0.000			0.715		0.000	0.000	0.715
	HEATNG	-0.397	0.000	0.000	-0.782	-0.520	-3.128	2.110	0.246	0.331	0.206	0.000	-1.932
APR	SEN CL	-0.242	0.000	0.000	-0.735	-0.457	-2.148	5.111	0.797	0.518	0.477	0.000	3.320
	LAT CL					0.007			0.838		0.000	0.000	0.845
	HEATNG	-0.171	0.000	0.000	-0.464	-0.286	-1.776	1.316	0.121	0.164	0.122	0.000	-0.974
MAY	SEN CL	-0.089	0.000	0.000	-0.799	-0.281	-1.667	5.419	0.836	0.351	0.514	0.000	4.284
	LAT CL					0.027			0.829		0.000	0.000	0.856
	HEATNG	-0.035	0.000	0.000	-0.151	-0.096	-0.619	0.520	0.028	0.049	0.040	0.000	-0.264
JUN	SEN CL	0.155	0.000	0.000	-0.778	-0.065	-0.861	5.548	1.007	0.472	0.641	0.000	6.120
	LAT CL					0.269			0.959		0.000	0.000	1.228
	HEATNG	-0.007	0.000	0.000	-0.035	-0.026	-0.161	0.134	0.018	0.029	0.018	0.000	-0.031
JUL	SEN CL	0.361	0.000	0.000	-0.661	0.037	-0.347	5.722	0.985	0.582	0.645	0.000	7.325
	LAT CL					0.467			0.918		0.000	0.000	1.384
	HEATNG	-0.006	0.000	0.000	-0.018	-0.020	-0.128	0.106	0.004	0.010	0.009	0.000	-0.043
AUG	SEN CL	0.403	0.000	0.000	-0.510	-0.028	-0.719	6.651	1.033	0.541	0.677	0.000	8.049
	LAT CL					0.407			0.962		0.000	0.000	1.369
	HEATNG	-0.044	0.000	0.000	-0.058	-0.078	-0.473	0.396	0.025	0.050	0.030	0.000	-0.152
SEP	SEN CL	0.155	0.000	0.000	-0.439	-0.296	-1.766	7.718	0.971	0.710	0.627	0.000	7.681
	LAT CL					0.147			0.916		0.000	0.000	1.063
	HEATNG	-0.237	0.000	0.000	-0.219	-0.314	-2.021	1.405	0.110	0.189	0.105	0.000	-0.982
OCT	SEN CL	-0.192	0.000	0.000	-0.429	-0.492	-2.448	6.623	0.848	0.712	0.531	0.000	5.154
	LAT CL					0.043			0.849		0.000	0.000	0.892
	HEATNG	-0.649	0.000	0.000	-0.566	-0.679	-4.084	1.723	0.291	0.620	0.241	0.000	-3.102
NOV	SEN CL	-0.225	0.000	0.000	-0.309	-0.418	-1.799	3.117	0.649	0.794	0.387	0.000	2.196
	LAT CL					0.007			0.710		0.000	0.000	0.717
	HEATNG	-1.110	0.000	0.000	-0.973	-1.165	-6.597	2.368	0.548	0.929	0.399	0.000	-5.601
DEC	SEN CL	-0.238	0.000	0.000	-0.225	-0.392	-1.539	2.693	0.455	0.417	0.264	0.000	1.436
	LAT CL					0.000			0.501		0.000	0.000	0.501
	HEATNG	-5.631	0.000	0.000	-6.684	-6.509	-38.186	20.099	2.719	4.481	2.177	0.000	-27.533
TOT	SEN CL	-0.669	0.000	0.000	-6.054	-3.853	-19.165	60.724	9.139	5.985	5.675	0.000	51.782
	LAT CL					1.375			9.168		0.000	0.000	10.543

REPORT- LS-E Space Monthly Load Components EL1 East Perim Spc (G.E2) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.109	0.000	0.000	-0.951	-1.116	-5.936	1.506	0.519	0.692	0.357	0.000	-6.039
JAN	SEN CL	-0.029	0.000	0.000	-0.029	-0.037	-0.156	0.165	0.052	0.043	0.029	0.000	0.039
	LAT CL					0.000			0.059		0.000	0.000	0.059
	HEATNG	-0.924	0.000	0.000	-0.922	-0.992	-5.170	1.687	0.494	0.651	0.336	0.000	-4.840
FEB	SEN CL	-0.058	0.000	0.000	-0.058	-0.072	-0.321	0.421	0.078	0.042	0.043	0.000	0.076
	LAT CL					0.000			0.090		0.000	0.000	0.090
	HEATNG	-0.632	0.000	0.000	-0.845	-0.716	-3.941	1.845	0.347	0.487	0.255	0.000	-3.199
MAR	SEN CL	-0.152	0.000	0.000	-0.250	-0.257	-1.054	1.902	0.340	0.161	0.197	0.000	0.886
	LAT CL					0.000			0.383		0.000	0.000	0.383
	HEATNG	-0.298	0.000	0.000	-0.555	-0.365	-2.179	1.385	0.160	0.236	0.136	0.000	-1.479
APR	SEN CL	-0.138	0.000	0.000	-0.456	-0.287	-1.299	3.032	0.502	0.290	0.298	0.000	1.941
	LAT CL					0.004			0.539		0.000	0.000	0.543
	HEATNG	-0.081	0.000	0.000	-0.214	-0.131	-0.856	0.723	0.043	0.069	0.049	0.000	-0.400
MAY	SEN CL	0.002	0.000	0.000	-0.628	-0.246	-1.396	5.368	0.565	0.236	0.355	0.000	4.257
	LAT CL					0.020			0.551		0.000	0.000	0.570
	HEATNG	-0.013	0.000	0.000	-0.063	-0.039	-0.267	0.271	0.009	0.015	0.016	0.000	-0.071
JUN	SEN CL	0.194	0.000	0.000	-0.556	-0.068	-0.693	5.374	0.648	0.289	0.417	0.000	5.605
	LAT CL					0.180			0.611		0.000	0.000	0.791
	HEATNG	-0.004	0.000	0.000	-0.012	-0.008	-0.058	0.047	0.006	0.010	0.007	0.000	-0.012
JUL	SEN CL	0.341	0.000	0.000	-0.451	0.016	-0.265	5.392	0.630	0.354	0.413	0.000	6.431
	LAT CL					0.312			0.584		0.000	0.000	0.896
	HEATNG	-0.003	0.000	0.000	-0.009	-0.010	-0.064	0.058	0.002	0.005	0.004	0.000	-0.018
AUG	SEN CL	0.301	0.000	0.000	-0.343	-0.022	-0.491	4.824	0.656	0.278	0.431	0.000	5.634
	LAT CL					0.271			0.611		0.000	0.000	0.882
	HEATNG	-0.050	0.000	0.000	-0.065	-0.082	-0.504	0.382	0.030	0.056	0.034	0.000	-0.198
SEP	SEN CL	0.058	0.000	0.000	-0.266	-0.168	-0.985	3.903	0.601	0.426	0.383	0.000	3.953
	LAT CL					0.096			0.581		0.000	0.000	0.677
	HEATNG	-0.288	0.000	0.000	-0.232	-0.320	-1.943	0.902	0.142	0.245	0.123	0.000	-1.373
OCT	SEN CL	-0.134	0.000	0.000	-0.200	-0.217	-1.024	1.969	0.466	0.399	0.281	0.000	1.540
	LAT CL					0.025			0.491		0.000	0.000	0.516
	HEATNG	-0.590	0.000	0.000	-0.471	-0.578	-3.271	0.795	0.300	0.579	0.229	0.000	-3.008
NOV	SEN CL	-0.105	0.000	0.000	-0.112	-0.153	-0.621	0.521	0.296	0.359	0.171	0.000	0.356
	LAT CL					0.004			0.337		0.000	0.000	0.340
	HEATNG	-0.983	0.000	0.000	-0.767	-0.999	-5.191	1.011	0.563	0.856	0.381	0.000	-5.128
DEC	SEN CL	-0.036	0.000	0.000	-0.032	-0.039	-0.186	0.138	0.074	0.085	0.039	0.000	0.043
	LAT CL					0.000			0.084		0.000	0.000	0.084
	HEATNG	-4.976	0.000	0.000	-5.105	-5.358	-29.380	10.611	2.617	3.899	1.927	0.000	-25.766
TOT	SEN CL	0.244	0.000	0.000	-3.382	-1.548	-8.490	33.009	4.908	2.963	3.057	0.000	30.762
	LAT CL					0.912			4.921		0.000	0.000	5.833

REPORT- LS-E Space Monthly Load Components EL1 North Perim Spc (G.N3) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.807	0.000	0.000	-1.449	-1.710	-9.051	1.157	0.857	1.467	0.585	0.000	-9.950
JAN	SEN CL	-0.022	0.000	0.000	-0.022	-0.020	-0.099	0.035	0.044	0.077	0.023	0.000	0.017
	LAT CL					0.000			0.049		0.000	0.000	0.049
	HEATNG	-1.589	0.000	0.000	-1.446	-1.574	-8.170	1.487	0.857	1.103	0.573	0.000	-8.758
FEB	SEN CL	-0.021	0.000	0.000	-0.026	-0.022	-0.095	0.034	0.044	0.071	0.025	0.000	0.009
	LAT CL					0.000			0.050		0.000	0.000	0.050
	HEATNG	-1.367	0.000	0.000	-1.569	-1.403	-7.285	2.132	0.960	0.885	0.644	0.000	-7.003
MAR	SEN CL	-0.048	0.000	0.000	-0.075	-0.057	-0.238	0.134	0.123	0.161	0.068	0.000	0.067
	LAT CL					0.000			0.137		0.000	0.000	0.137
	HEATNG	-0.744	0.000	0.000	-1.136	-0.763	-4.299	1.826	0.487	0.485	0.362	0.000	-3.783
APR	SEN CL	-0.183	0.000	0.000	-0.381	-0.214	-0.940	1.087	0.557	0.375	0.322	0.000	0.622
	LAT CL					0.006			0.610		0.000	0.000	0.616
	HEATNG	-0.276	0.000	0.000	-0.647	-0.344	-2.184	1.331	0.170	0.214	0.163	0.000	-1.573
MAY	SEN CL	-0.181	0.000	0.000	-0.618	-0.223	-1.219	2.702	0.788	0.277	0.474	0.000	2.000
	LAT CL					0.020			0.827		0.000	0.000	0.847
	HEATNG	-0.048	0.000	0.000	-0.182	-0.103	-0.679	0.507	0.037	0.049	0.050	0.000	-0.368
JUN	SEN CL	0.050	0.000	0.000	-0.748	-0.058	-0.770	4.034	0.998	0.430	0.631	0.000	4.568
	LAT CL					0.267			0.961		0.000	0.000	1.229
	HEATNG	-0.011	0.000	0.000	-0.061	-0.037	-0.245	0.173	0.029	0.040	0.028	0.000	-0.083
JUL	SEN CL	0.224	0.000	0.000	-0.636	0.049	-0.257	3.879	0.975	0.518	0.634	0.000	5.386
	LAT CL					0.463			0.918		0.000	0.000	1.381
	HEATNG	-0.021	0.000	0.000	-0.087	-0.072	-0.464	0.304	0.043	0.056	0.049	0.000	-0.193
AUG	SEN CL	0.151	0.000	0.000	-0.441	0.024	-0.403	3.091	0.994	0.377	0.636	0.000	4.429
	LAT CL					0.394			0.959		0.000	0.000	1.354
	HEATNG	-0.170	0.000	0.000	-0.196	-0.211	-1.327	0.591	0.126	0.185	0.122	0.000	-0.880
SEP	SEN CL	-0.114	0.000	0.000	-0.301	-0.163	-0.923	1.934	0.870	0.578	0.535	0.000	2.417
	LAT CL					0.132			0.890		0.000	0.000	1.022
	HEATNG	-0.608	0.000	0.000	-0.452	-0.580	-3.477	1.065	0.327	0.493	0.264	0.000	-2.968
OCT	SEN CL	-0.194	0.000	0.000	-0.197	-0.226	-0.967	0.955	0.631	0.577	0.372	0.000	0.951
	LAT CL					0.025			0.695		0.000	0.000	0.720
	HEATNG	-0.975	0.000	0.000	-0.736	-0.917	-5.079	0.847	0.541	0.982	0.402	0.000	-4.936
NOV	SEN CL	-0.151	0.000	0.000	-0.140	-0.180	-0.755	0.314	0.400	0.603	0.227	0.000	0.318
	LAT CL					0.005			0.459		0.000	0.000	0.464
	HEATNG	-1.564	0.000	0.000	-1.162	-1.520	-7.903	0.862	0.916	1.574	0.615	0.000	-8.181
DEC	SEN CL	-0.041	0.000	0.000	-0.037	-0.037	-0.188	0.044	0.088	0.162	0.047	0.000	0.038
	LAT CL					0.000			0.100		0.000	0.000	0.100
	HEATNG	-9.180	0.000	0.000	-9.122	-9.234	-50.163	12.281	5.351	7.533	3.858	0.000	-48.676
TOT	SEN CL	-0.530	0.000	0.000	-3.621	-1.127	-6.855	18.244	6.512	4.205	3.995	0.000	20.823
	LAT CL					1.311			6.657		0.000	0.000	7.968

REPORT- LS-E Space Monthly Load Components EL1 West Perim Spc (G.W4) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.092	0.000	0.000	-0.930	-1.089	-5.879	1.411	0.484	0.697	0.339	0.000	-6.059
JAN	SEN CL	-0.050	0.000	0.000	-0.050	-0.064	-0.277	0.375	0.088	0.056	0.047	0.000	0.124
	LAT CL					0.000			0.097		0.000	0.000	0.097
	HEATNG	-0.922	0.000	0.000	-0.897	-0.967	-5.141	1.722	0.463	0.618	0.319	0.000	-4.804
FEB	SEN CL	-0.073	0.000	0.000	-0.083	-0.097	-0.418	0.639	0.109	0.070	0.061	0.000	0.207
	LAT CL					0.000			0.117		0.000	0.000	0.117
	HEATNG	-0.734	0.000	0.000	-0.921	-0.817	-4.357	1.975	0.470	0.541	0.329	0.000	-3.514
MAR	SEN CL	-0.117	0.000	0.000	-0.174	-0.156	-0.700	1.167	0.217	0.157	0.122	0.000	0.517
	LAT CL					0.000			0.227		0.000	0.000	0.227
	HEATNG	-0.337	0.000	0.000	-0.574	-0.400	-2.306	1.473	0.205	0.252	0.164	0.000	-1.523
APR	SEN CL	-0.174	0.000	0.000	-0.437	-0.252	-1.208	2.653	0.457	0.317	0.270	0.000	1.626
	LAT CL					0.004			0.478		0.000	0.000	0.482
	HEATNG	-0.117	0.000	0.000	-0.293	-0.180	-1.125	0.847	0.066	0.106	0.070	0.000	-0.625
MAY	SEN CL	-0.092	0.000	0.000	-0.549	-0.198	-1.152	3.771	0.541	0.255	0.334	0.000	2.909
	LAT CL					0.018			0.536		0.000	0.000	0.555
	HEATNG	-0.017	0.000	0.000	-0.061	-0.040	-0.260	0.250	0.010	0.018	0.016	0.000	-0.084
JUN	SEN CL	0.117	0.000	0.000	-0.558	-0.067	-0.700	4.963	0.647	0.341	0.417	0.000	5.161
	LAT CL					0.180			0.610		0.000	0.000	0.790
	HEATNG	-0.002	0.000	0.000	-0.007	-0.006	-0.033	0.026	0.004	0.007	0.004	0.000	-0.007
JUL	SEN CL	0.257	0.000	0.000	-0.457	0.014	-0.287	4.964	0.633	0.458	0.416	0.000	5.998
	LAT CL					0.312			0.583		0.000	0.000	0.895
	HEATNG	-0.003	0.000	0.000	-0.010	-0.011	-0.070	0.064	0.002	0.005	0.005	0.000	-0.017
AUG	SEN CL	0.243	0.000	0.000	-0.342	-0.021	-0.490	4.509	0.656	0.370	0.431	0.000	5.356
	LAT CL					0.270			0.611		0.000	0.000	0.881
	HEATNG	-0.055	0.000	0.000	-0.070	-0.087	-0.548	0.396	0.033	0.059	0.037	0.000	-0.237
SEP	SEN CL	-0.008	0.000	0.000	-0.261	-0.162	-0.949	3.350	0.599	0.493	0.380	0.000	3.442
	LAT CL					0.097			0.581		0.000	0.000	0.677
	HEATNG	-0.291	0.000	0.000	-0.239	-0.321	-1.972	1.012	0.145	0.221	0.127	0.000	-1.319
OCT	SEN CL	-0.155	0.000	0.000	-0.193	-0.216	-1.009	1.878	0.463	0.423	0.277	0.000	1.467
	LAT CL					0.023			0.486		0.000	0.000	0.509
	HEATNG	-0.599	0.000	0.000	-0.475	-0.593	-3.335	0.871	0.322	0.606	0.243	0.000	-2.960
NOV	SEN CL	-0.105	0.000	0.000	-0.108	-0.138	-0.590	0.541	0.274	0.366	0.156	0.000	0.396
	LAT CL					0.003			0.311		0.000	0.000	0.315
	HEATNG	-0.990	0.000	0.000	-0.764	-0.997	-5.244	0.965	0.556	0.866	0.378	0.000	-5.229
DEC	SEN CL	-0.039	0.000	0.000	-0.034	-0.041	-0.204	0.179	0.080	0.081	0.042	0.000	0.063
	LAT CL					0.000			0.091		0.000	0.000	0.091
	HEATNG	-5.158	0.000	0.000	-5.241	-5.507	-30.270	11.012	2.758	3.998	2.030	0.000	-26.378
TOT	SEN CL	-0.197	0.000	0.000	-3.246	-1.399	-7.985	28.987	4.766	3.385	2.954	0.000	27.266
	LAT CL					0.908			4.729		0.000	0.000	5.637

REPORT- LS-E Space Monthly Load Components EL1 Core Spc (G.C5) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	0.000	0.000	0.000	-0.346	-0.030	0.000	0.000	0.013	0.063	0.163	0.000	-0.137
JAN	SEN CL	0.000	0.000	0.000	-2.577	-0.199	0.000	0.000	28.430	9.360	7.504	0.000	42.519
	LAT CL					0.000			23.172		0.000	0.000	23.172
	HEATNG	0.000	0.000	0.000	-0.092	-0.005	0.000	0.000	0.019	0.020	0.040	0.000	-0.017
FEB	SEN CL	0.000	0.000	0.000	-2.834	-0.200	0.000	0.000	28.458	9.365	7.498	0.000	42.287
	LAT CL					0.000			23.172		0.000	0.000	23.172
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MAR	SEN CL	0.000	0.000	0.000	-3.267	-0.185	0.000	0.000	34.107	11.205	8.967	0.000	50.827
	LAT CL					0.000			28.050		0.000	0.000	28.050
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
APR	SEN CL	0.000	0.000	0.000	-3.017	-0.127	0.000	0.000	32.966	10.824	8.618	0.000	49.265
	LAT CL					0.001			26.831		0.000	0.000	26.831
	HEATNG	0.000	0.000	0.000	-0.013	0.000	0.000	0.000	0.002	0.003	0.008	0.000	0.000
MAY	SEN CL	0.000	0.000	0.000	-2.500	-0.078	0.000	0.000	30.372	10.021	8.036	0.000	45.850
	LAT CL					0.004			24.391		0.000	0.000	24.396
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JUN	SEN CL	0.000	0.000	0.000	-1.848	-0.028	0.000	0.000	32.584	10.710	8.585	0.000	50.002
	LAT CL					0.030			26.831		0.000	0.000	26.861
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JUL	SEN CL	0.000	0.000	0.000	-1.385	-0.003	0.000	0.000	31.759	10.459	8.357	0.000	49.188
	LAT CL					0.059			25.611		0.000	0.000	25.670
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUG	SEN CL	0.000	0.000	0.000	-1.052	-0.011	0.000	0.000	32.711	10.765	8.644	0.000	51.058
	LAT CL					0.053			26.831		0.000	0.000	26.884
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SEP	SEN CL	0.000	0.000	0.000	-0.988	-0.050	0.000	0.000	31.447	10.349	8.287	0.000	49.046
	LAT CL					0.020			25.611		0.000	0.000	25.631
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCT	SEN CL	0.000	0.000	0.000	-1.288	-0.108	0.000	0.000	30.349	10.016	8.037	0.000	47.006
	LAT CL					0.006			24.391		0.000	0.000	24.398
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NOV	SEN CL	0.000	0.000	0.000	-1.739	-0.144	0.000	0.000	29.611	9.776	7.920	0.000	45.424
	LAT CL					0.001			24.391		0.000	0.000	24.392
	HEATNG	0.000	0.000	0.000	-0.016	-0.001	0.000	0.000	0.003	0.004	0.009	0.000	-0.001
DEC	SEN CL	0.000	0.000	0.000	-2.366	-0.199	0.000	0.000	31.749	10.453	8.351	0.000	47.989
	LAT CL					0.000			25.611		0.000	0.000	25.611
	HEATNG	0.000	0.000	0.000	-0.467	-0.037	0.000	0.000	0.037	0.091	0.220	0.000	-0.155
TOT	SEN CL	0.000	0.000	0.000	-24.861	-1.331	0.000	0.000	374.545	123.306	98.804	0.000	570.465
	LAT CL					0.175			304.895		0.000	0.000	305.070

REPORT- LS-E Space Monthly Load Components EL1 South Perim Plnm (G.S6) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.952	0.000	0.000	0.000	-0.519	0.000	0.000	0.000	0.000	0.000	0.000	-1.471
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.842	0.000	0.000	0.000	-0.479	0.000	0.000	0.000	0.000	0.000	0.000	-1.321
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.699	0.000	0.000	0.000	-0.438	0.000	0.000	0.000	0.000	0.000	0.000	-1.137
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.433	0.000	0.000	0.000	-0.292	0.000	0.000	0.000	0.000	0.000	0.000	-0.725
APR	SEN CL	0.003	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.201	0.000	0.000	0.000	-0.164	0.000	0.000	0.000	0.000	0.000	0.000	-0.365
MAY	SEN CL	0.023	0.000	0.000	0.000	-0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.017
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.049	0.000	0.000	0.000	-0.059	0.000	0.000	0.000	0.000	0.000	0.000	-0.108
JUN	SEN CL	0.125	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.136
	LAT CL					0.064			0.000		0.000	0.000	0.064
	HEATNG	-0.011	0.000	0.000	0.000	-0.021	0.000	0.000	0.000	0.000	0.000	0.000	-0.032
JUL	SEN CL	0.242	0.000	0.000	0.000	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.267
	LAT CL					0.126			0.000		0.000	0.000	0.126
	HEATNG	-0.005	0.000	0.000	0.000	-0.025	0.000	0.000	0.000	0.000	0.000	0.000	-0.031
AUG	SEN CL	0.265	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.276
	LAT CL					0.113			0.000		0.000	0.000	0.113
	HEATNG	-0.063	0.000	0.000	0.000	-0.093	0.000	0.000	0.000	0.000	0.000	0.000	-0.155
SEP	SEN CL	0.131	0.000	0.000	0.000	-0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.112
	LAT CL					0.028			0.000		0.000	0.000	0.028
	HEATNG	-0.304	0.000	0.000	0.000	-0.237	0.000	0.000	0.000	0.000	0.000	0.000	-0.541
OCT	SEN CL	0.014	0.000	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.009
	LAT CL					0.002			0.000		0.000	0.000	0.002
	HEATNG	-0.584	0.000	0.000	0.000	-0.328	0.000	0.000	0.000	0.000	0.000	0.000	-0.912
NOV	SEN CL	0.001	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.899	0.000	0.000	0.000	-0.467	0.000	0.000	0.000	0.000	0.000	0.000	-1.366
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-5.042	0.000	0.000	0.000	-3.123	0.000	0.000	0.000	0.000	0.000	0.000	-8.164
TOT	SEN CL	0.805	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.819
	LAT CL					0.335			0.000		0.000	0.000	0.335

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 East Perim Plnm (G.E7) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.748	0.000	0.000	0.000	-0.346	0.000	0.000	0.000	0.000	0.000	0.000	-1.094
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.647	0.000	0.000	0.000	-0.319	0.000	0.000	0.000	0.000	0.000	0.000	-0.966
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.518	0.000	0.000	0.000	-0.292	0.000	0.000	0.000	0.000	0.000	0.000	-0.810
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.292	0.000	0.000	0.000	-0.195	0.000	0.000	0.000	0.000	0.000	0.000	-0.487
APR	SEN CL	0.003	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.093	0.000	0.000	0.000	-0.104	0.000	0.000	0.000	0.000	0.000	0.000	-0.198
MAY	SEN CL	0.038	0.000	0.000	0.000	-0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.029
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.016	0.000	0.000	0.000	-0.035	0.000	0.000	0.000	0.000	0.000	0.000	-0.050
JUN	SEN CL	0.131	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.134
	LAT CL					0.044			0.000		0.000	0.000	0.044
	HEATNG	-0.005	0.000	0.000	0.000	-0.013	0.000	0.000	0.000	0.000	0.000	0.000	-0.018
JUL	SEN CL	0.224	0.000	0.000	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.239
	LAT CL					0.085			0.000		0.000	0.000	0.085
	HEATNG	-0.002	0.000	0.000	0.000	-0.017	0.000	0.000	0.000	0.000	0.000	0.000	-0.019
AUG	SEN CL	0.195	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.203
	LAT CL					0.077			0.000		0.000	0.000	0.077
	HEATNG	-0.057	0.000	0.000	0.000	-0.069	0.000	0.000	0.000	0.000	0.000	0.000	-0.127
SEP	SEN CL	0.060	0.000	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.055
	LAT CL					0.015			0.000		0.000	0.000	0.015
	HEATNG	-0.280	0.000	0.000	0.000	-0.161	0.000	0.000	0.000	0.000	0.000	0.000	-0.441
OCT	SEN CL	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.457	0.000	0.000	0.000	-0.219	0.000	0.000	0.000	0.000	0.000	0.000	-0.677
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.669	0.000	0.000	0.000	-0.311	0.000	0.000	0.000	0.000	0.000	0.000	-0.981
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-3.785	0.000	0.000	0.000	-2.083	0.000	0.000	0.000	0.000	0.000	0.000	-5.867
TOT	SEN CL	0.653	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.663
	LAT CL					0.223			0.000		0.000	0.000	0.223

REPORT- LS-E Space Monthly Load Components EL1 North Perim Plnm (G.N8) WEATHER FILE- Toronto ON CWEC

	(UNITS=MBTU)	WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.185	0.000	0.000	0.000	-0.519	0.000	0.000	0.000	0.000	0.000	0.000	-1.705
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-1.045	0.000	0.000	0.000	-0.479	0.000	0.000	0.000	0.000	0.000	0.000	-1.523
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.919	0.000	0.000	0.000	-0.438	0.000	0.000	0.000	0.000	0.000	0.000	-1.357
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.603	0.000	0.000	0.000	-0.293	0.000	0.000	0.000	0.000	0.000	0.000	-0.896
APR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.302	0.000	0.000	0.000	-0.170	0.000	0.000	0.000	0.000	0.000	0.000	-0.472
MAY	SEN CL	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.073	0.000	0.000	0.000	-0.066	0.000	0.000	0.000	0.000	0.000	0.000	-0.138
JUN	SEN CL	0.070	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.087
	LAT CL					0.061			0.000		0.000	0.000	0.061
	HEATNG	-0.018	0.000	0.000	0.000	-0.025	0.000	0.000	0.000	0.000	0.000	0.000	-0.043
JUL	SEN CL	0.152	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.181
	LAT CL					0.124			0.000		0.000	0.000	0.124
	HEATNG	-0.029	0.000	0.000	0.000	-0.036	0.000	0.000	0.000	0.000	0.000	0.000	-0.065
AUG	SEN CL	0.110	0.000	0.000	0.000	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.132
	LAT CL					0.103			0.000		0.000	0.000	0.103
	HEATNG	-0.202	0.000	0.000	0.000	-0.116	0.000	0.000	0.000	0.000	0.000	0.000	-0.318
SEP	SEN CL	0.017	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.020
	LAT CL					0.015			0.000		0.000	0.000	0.015
	HEATNG	-0.521	0.000	0.000	0.000	-0.242	0.000	0.000	0.000	0.000	0.000	0.000	-0.763
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.730	0.000	0.000	0.000	-0.329	0.000	0.000	0.000	0.000	0.000	0.000	-1.059
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-1.040	0.000	0.000	0.000	-0.467	0.000	0.000	0.000	0.000	0.000	0.000	-1.507
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-6.666	0.000	0.000	0.000	-3.181	0.000	0.000	0.000	0.000	0.000	0.000	-9.847
TOT	SEN CL	0.350	0.000	0.000	0.000	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.423
	LAT CL					0.304			0.000		0.000	0.000	0.304

REPORT- LS-E Space Monthly Load Components EL1 West Perim Plnm (G.W9) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.752	0.000	0.000	0.000	-0.346	0.000	0.000	0.000	0.000	0.000	0.000	-1.098
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.655	0.000	0.000	0.000	-0.319	0.000	0.000	0.000	0.000	0.000	0.000	-0.975
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.561	0.000	0.000	0.000	-0.292	0.000	0.000	0.000	0.000	0.000	0.000	-0.853
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.340	0.000	0.000	0.000	-0.195	0.000	0.000	0.000	0.000	0.000	0.000	-0.535
APR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.153	0.000	0.000	0.000	-0.110	0.000	0.000	0.000	0.000	0.000	0.000	-0.263
MAY	SEN CL	0.011	0.000	0.000	0.000	-0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.008
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.030	0.000	0.000	0.000	-0.036	0.000	0.000	0.000	0.000	0.000	0.000	-0.066
JUN	SEN CL	0.091	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.095
	LAT CL					0.044			0.000		0.000	0.000	0.044
	HEATNG	-0.006	0.000	0.000	0.000	-0.011	0.000	0.000	0.000	0.000	0.000	0.000	-0.017
JUL	SEN CL	0.169	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.182
	LAT CL					0.087			0.000		0.000	0.000	0.087
	HEATNG	-0.002	0.000	0.000	0.000	-0.015	0.000	0.000	0.000	0.000	0.000	0.000	-0.018
AUG	SEN CL	0.157	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.163
	LAT CL					0.075			0.000		0.000	0.000	0.075
	HEATNG	-0.085	0.000	0.000	0.000	-0.072	0.000	0.000	0.000	0.000	0.000	0.000	-0.157
SEP	SEN CL	0.040	0.000	0.000	0.000	-0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.037
	LAT CL					0.015			0.000		0.000	0.000	0.015
	HEATNG	-0.295	0.000	0.000	0.000	-0.161	0.000	0.000	0.000	0.000	0.000	0.000	-0.457
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.463	0.000	0.000	0.000	-0.219	0.000	0.000	0.000	0.000	0.000	0.000	-0.682
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.677	0.000	0.000	0.000	-0.311	0.000	0.000	0.000	0.000	0.000	0.000	-0.988
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-4.019	0.000	0.000	0.000	-2.089	0.000	0.000	0.000	0.000	0.000	0.000	-6.108
TOT	SEN CL	0.468	0.000	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.485
	LAT CL					0.220			0.000		0.000	0.000	0.220

REPORT- LS-E Space Monthly Load Components EL1 Core Plnm (G.C10) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	0.000	0.000	0.000	0.000	-0.229	0.000	0.000	0.000	0.000	0.000	0.000	-0.229
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.205	0.000	0.000	0.000	0.000	0.000	0.000	-0.205
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.185	0.000	0.000	0.000	0.000	0.000	0.000	-0.185
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.127	0.000	0.000	0.000	0.000	0.000	0.000	-0.127
APR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.079	0.000	0.000	0.000	0.000	0.000	0.000	-0.079
MAY	SEN CL	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.036	0.000	0.000	0.000	0.000	0.000	0.000	-0.036
JUN	SEN CL	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.008
	LAT CL					0.016			0.000		0.000	0.000	0.016
	HEATNG	0.000	0.000	0.000	0.000	-0.017	0.000	0.000	0.000	0.000	0.000	0.000	-0.017
JUL	SEN CL	0.000	0.000	0.000	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.015
	LAT CL					0.034			0.000		0.000	0.000	0.034
	HEATNG	0.000	0.000	0.000	0.000	-0.022	0.000	0.000	0.000	0.000	0.000	0.000	-0.022
AUG	SEN CL	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
	LAT CL					0.032			0.000		0.000	0.000	0.032
	HEATNG	0.000	0.000	0.000	0.000	-0.054	0.000	0.000	0.000	0.000	0.000	0.000	-0.054
SEP	SEN CL	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003
	LAT CL					0.005			0.000		0.000	0.000	0.005
	HEATNG	0.000	0.000	0.000	0.000	-0.108	0.000	0.000	0.000	0.000	0.000	0.000	-0.108
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	0.000	0.000	0.000	0.000	-0.144	0.000	0.000	0.000	0.000	0.000	0.000	-0.144
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.200	0.000	0.000	0.000	0.000	0.000	0.000	-0.200
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-1.406	0.000	0.000	0.000	0.000	0.000	0.000	-1.406
TOT	SEN CL	0.000	0.000	0.000	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.039
	LAT CL					0.087			0.000		0.000	0.000	0.087

REPORT- LS-E Space Monthly Load Components EL1 South Perim Spc (M.S11) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.093	0.000	0.000	0.000	-1.046	-6.616	1.618	0.362	0.434	0.436	0.000	-5.905
JAN	SEN CL	-0.369	0.000	0.000	0.000	-0.684	-2.696	5.676	1.213	0.438	0.746	0.000	4.323
	LAT CL					0.000			0.997		0.000	0.000	0.997
	HEATNG	-0.905	0.000	0.000	0.000	-0.925	-5.622	1.521	0.418	0.434	0.447	0.000	-4.633
FEB	SEN CL	-0.388	0.000	0.000	0.000	-0.670	-2.802	5.978	1.156	0.409	0.714	0.000	4.398
	LAT CL					0.000			0.949		0.000	0.000	0.949
	HEATNG	-0.709	0.000	0.000	0.000	-0.785	-4.768	1.404	0.384	0.406	0.448	0.000	-3.621
MAR	SEN CL	-0.368	0.000	0.000	0.000	-0.676	-2.899	6.634	1.520	0.470	0.939	0.000	5.620
	LAT CL					0.000			1.244		0.000	0.000	1.244
	HEATNG	-0.369	0.000	0.000	0.000	-0.451	-2.856	0.893	0.202	0.228	0.300	0.000	-2.054
APR	SEN CL	-0.285	0.000	0.000	0.000	-0.526	-2.475	6.415	1.622	0.501	1.029	0.000	6.280
	LAT CL					0.006			1.311		0.000	0.000	1.317
	HEATNG	-0.173	0.000	0.000	0.000	-0.277	-1.830	0.674	0.104	0.137	0.213	0.000	-1.151
MAY	SEN CL	-0.092	0.000	0.000	0.000	-0.290	-1.649	6.272	1.557	0.304	1.022	0.000	7.124
	LAT CL					0.022			1.234		0.000	0.000	1.256
	HEATNG	-0.041	0.000	0.000	0.000	-0.108	-0.760	0.308	0.026	0.051	0.090	0.000	-0.433
JUN	SEN CL	0.165	0.000	0.000	0.000	-0.053	-0.736	5.894	1.795	0.411	1.238	0.000	8.714
	LAT CL					0.266			1.391		0.000	0.000	1.657
	HEATNG	-0.004	0.000	0.000	0.000	-0.045	-0.321	0.130	0.025	0.036	0.057	0.000	-0.122
JUL	SEN CL	0.369	0.000	0.000	0.000	0.056	-0.197	5.883	1.719	0.499	1.228	0.000	9.558
	LAT CL					0.459			1.330		0.000	0.000	1.789
	HEATNG	-0.003	0.000	0.000	0.000	-0.057	-0.408	0.182	0.018	0.035	0.062	0.000	-0.170
AUG	SEN CL	0.410	0.000	0.000	0.000	0.009	-0.451	6.772	1.803	0.410	1.273	0.000	10.225
	LAT CL					0.394			1.392		0.000	0.000	1.786
	HEATNG	-0.067	0.000	0.000	0.000	-0.141	-0.924	0.386	0.045	0.079	0.118	0.000	-0.502
SEP	SEN CL	0.179	0.000	0.000	0.000	-0.233	-1.357	8.101	1.695	0.562	1.160	0.000	10.106
	LAT CL					0.140			1.323		0.000	0.000	1.463
	HEATNG	-0.270	0.000	0.000	0.000	-0.352	-2.344	0.840	0.124	0.178	0.235	0.000	-1.590
OCT	SEN CL	-0.173	0.000	0.000	0.000	-0.454	-2.200	7.313	1.537	0.614	0.999	0.000	7.637
	LAT CL					0.032			1.232		0.000	0.000	1.264
	HEATNG	-0.625	0.000	0.000	0.000	-0.598	-3.863	0.795	0.269	0.377	0.359	0.000	-3.285
NOV	SEN CL	-0.278	0.000	0.000	0.000	-0.499	-2.111	3.908	1.385	0.855	0.866	0.000	4.127
	LAT CL					0.006			1.154		0.000	0.000	1.160
	HEATNG	-0.999	0.000	0.000	0.000	-0.948	-5.824	1.044	0.444	0.542	0.491	0.000	-5.251
DEC	SEN CL	-0.386	0.000	0.000	0.000	-0.609	-2.433	4.402	1.301	0.628	0.795	0.000	3.697
	LAT CL					0.000			1.085		0.000	0.000	1.085
	HEATNG	-5.259	0.000	0.000	0.000	-5.731	-36.135	9.795	2.420	2.938	3.256	0.000	-28.716
TOT	SEN CL	-1.215	0.000	0.000	0.000	-4.630	-22.006	73.247	18.303	6.102	12.008	0.000	81.809
	LAT CL					1.326			14.643		0.000	0.000	15.969

REPORT- LS-E Space Monthly Load Components EL1 East Perim Spc (M.E12) WEATHER FILE- Toronto ON CWEC

	(UNITS=MBTU)	WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.912	0.000	0.000	0.000	-0.845	-5.132	0.727	0.363	0.387	0.371	0.000	-5.041
JAN	SEN CL	-0.215	0.000	0.000	0.000	-0.308	-1.222	1.014	0.636	0.236	0.379	0.000	0.520
	LAT CL					0.000			0.548		0.000	0.000	0.548
	HEATNG	-0.753	0.000	0.000	0.000	-0.742	-4.408	0.833	0.375	0.388	0.362	0.000	-3.945
FEB	SEN CL	-0.222	0.000	0.000	0.000	-0.321	-1.338	1.465	0.623	0.212	0.375	0.000	0.794
	LAT CL					0.000			0.537		0.000	0.000	0.537
	HEATNG	-0.537	0.000	0.000	0.000	-0.565	-3.490	0.847	0.285	0.297	0.315	0.000	-2.848
MAR	SEN CL	-0.242	0.000	0.000	0.000	-0.408	-1.732	3.197	0.922	0.257	0.565	0.000	2.559
	LAT CL					0.000			0.771		0.000	0.000	0.771
	HEATNG	-0.264	0.000	0.000	0.000	-0.305	-2.019	0.574	0.124	0.154	0.190	0.000	-1.546
APR	SEN CL	-0.168	0.000	0.000	0.000	-0.347	-1.604	4.084	1.032	0.291	0.652	0.000	3.941
	LAT CL					0.004			0.848		0.000	0.000	0.852
	HEATNG	-0.089	0.000	0.000	0.000	-0.149	-1.068	0.391	0.049	0.071	0.114	0.000	-0.679
MAY	SEN CL	0.013	0.000	0.000	0.000	-0.229	-1.279	6.149	1.003	0.191	0.669	0.000	6.518
	LAT CL					0.015			0.799		0.000	0.000	0.813
	HEATNG	-0.017	0.000	0.000	0.000	-0.060	-0.440	0.185	0.014	0.027	0.051	0.000	-0.240
JUN	SEN CL	0.196	0.000	0.000	0.000	-0.047	-0.560	5.753	1.140	0.233	0.792	0.000	7.507
	LAT CL					0.177			0.885		0.000	0.000	1.062
	HEATNG	-0.003	0.000	0.000	0.000	-0.024	-0.181	0.069	0.013	0.019	0.032	0.000	-0.074
JUL	SEN CL	0.339	0.000	0.000	0.000	0.031	-0.157	5.682	1.092	0.291	0.783	0.000	8.062
	LAT CL					0.307			0.846		0.000	0.000	1.153
	HEATNG	-0.003	0.000	0.000	0.000	-0.041	-0.300	0.126	0.015	0.026	0.046	0.000	-0.131
AUG	SEN CL	0.297	0.000	0.000	0.000	0.009	-0.281	5.021	1.139	0.218	0.801	0.000	7.204
	LAT CL					0.262			0.884		0.000	0.000	1.146
	HEATNG	-0.062	0.000	0.000	0.000	-0.113	-0.764	0.255	0.043	0.070	0.103	0.000	-0.468
SEP	SEN CL	0.068	0.000	0.000	0.000	-0.136	-0.799	4.296	1.060	0.318	0.707	0.000	5.516
	LAT CL					0.089			0.838		0.000	0.000	0.927
	HEATNG	-0.274	0.000	0.000	0.000	-0.293	-1.969	0.483	0.132	0.168	0.198	0.000	-1.554
OCT	SEN CL	-0.147	0.000	0.000	0.000	-0.245	-1.141	2.471	0.921	0.387	0.585	0.000	2.830
	LAT CL					0.019			0.756		0.000	0.000	0.776
	HEATNG	-0.510	0.000	0.000	0.000	-0.458	-2.981	0.445	0.216	0.293	0.267	0.000	-2.728
NOV	SEN CL	-0.182	0.000	0.000	0.000	-0.274	-1.093	0.872	0.833	0.514	0.510	0.000	1.180
	LAT CL					0.004			0.707		0.000	0.000	0.711
	HEATNG	-0.805	0.000	0.000	0.000	-0.754	-4.493	0.512	0.429	0.442	0.412	0.000	-4.256
DEC	SEN CL	-0.206	0.000	0.000	0.000	-0.284	-1.133	0.748	0.677	0.360	0.403	0.000	0.564
	LAT CL					0.000			0.579		0.000	0.000	0.579
	HEATNG	-4.226	0.000	0.000	0.000	-4.348	-27.245	5.447	2.059	2.340	2.463	0.000	-23.511
TOT	SEN CL	-0.468	0.000	0.000	0.000	-2.558	-12.339	40.752	11.079	3.508	7.223	0.000	47.195
	LAT CL					0.876			8.998		0.000	0.000	9.874

REPORT- LS-E Space Monthly Load Components EL1 North Perim Spc (M.N13) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.631	0.000	0.000	0.000	-1.500	-8.511	0.939	0.969	0.802	0.831	0.000	-8.101
JAN	SEN CL	-0.196	0.000	0.000	0.000	-0.230	-0.957	0.313	0.606	0.449	0.351	0.000	0.335
	LAT CL					0.000			0.515		0.000	0.000	0.515
	HEATNG	-1.419	0.000	0.000	0.000	-1.349	-7.578	1.213	0.930	0.656	0.782	0.000	-6.765
FEB	SEN CL	-0.196	0.000	0.000	0.000	-0.246	-1.004	0.427	0.645	0.354	0.380	0.000	0.360
	LAT CL					0.000			0.554		0.000	0.000	0.554
	HEATNG	-1.063	0.000	0.000	0.000	-0.994	-5.962	1.193	0.617	0.490	0.613	0.000	-5.106
MAR	SEN CL	-0.355	0.000	0.000	0.000	-0.466	-1.845	1.235	1.287	0.409	0.773	0.000	1.037
	LAT CL					0.000			1.087		0.000	0.000	1.087
	HEATNG	-0.566	0.000	0.000	0.000	-0.538	-3.496	0.831	0.268	0.267	0.358	0.000	-2.876
APR	SEN CL	-0.359	0.000	0.000	0.000	-0.440	-1.920	2.231	1.555	0.455	0.970	0.000	2.493
	LAT CL					0.006			1.280		0.000	0.000	1.286
	HEATNG	-0.239	0.000	0.000	0.000	-0.296	-1.993	0.666	0.115	0.147	0.233	0.000	-1.365
MAY	SEN CL	-0.217	0.000	0.000	0.000	-0.271	-1.525	3.640	1.546	0.272	1.002	0.000	4.447
	LAT CL					0.021			1.241		0.000	0.000	1.263
	HEATNG	-0.048	0.000	0.000	0.000	-0.101	-0.735	0.263	0.029	0.048	0.096	0.000	-0.450
JUN	SEN CL	0.051	0.000	0.000	0.000	-0.059	-0.763	4.515	1.792	0.374	1.232	0.000	7.142
	LAT CL					0.265			1.394		0.000	0.000	1.658
	HEATNG	-0.008	0.000	0.000	0.000	-0.046	-0.341	0.119	0.028	0.036	0.063	0.000	-0.150
JUL	SEN CL	0.222	0.000	0.000	0.000	0.057	-0.182	4.120	1.716	0.454	1.222	0.000	7.610
	LAT CL					0.455			1.331		0.000	0.000	1.786
	HEATNG	-0.024	0.000	0.000	0.000	-0.079	-0.564	0.179	0.037	0.056	0.098	0.000	-0.295
AUG	SEN CL	0.153	0.000	0.000	0.000	0.031	-0.336	3.373	1.784	0.315	1.237	0.000	6.556
	LAT CL					0.387			1.389		0.000	0.000	1.776
	HEATNG	-0.157	0.000	0.000	0.000	-0.197	-1.324	0.307	0.090	0.128	0.194	0.000	-0.959
SEP	SEN CL	-0.129	0.000	0.000	0.000	-0.178	-1.020	2.341	1.651	0.522	1.083	0.000	4.271
	LAT CL					0.129			1.315		0.000	0.000	1.444
	HEATNG	-0.535	0.000	0.000	0.000	-0.471	-3.192	0.643	0.212	0.269	0.327	0.000	-2.747
OCT	SEN CL	-0.271	0.000	0.000	0.000	-0.335	-1.431	1.452	1.449	0.648	0.907	0.000	2.418
	LAT CL					0.027			1.200		0.000	0.000	1.227
	HEATNG	-0.825	0.000	0.000	0.000	-0.693	-4.472	0.511	0.343	0.465	0.425	0.000	-4.246
NOV	SEN CL	-0.305	0.000	0.000	0.000	-0.405	-1.590	0.677	1.311	0.910	0.800	0.000	1.399
	LAT CL					0.005			1.118		0.000	0.000	1.123
	HEATNG	-1.341	0.000	0.000	0.000	-1.236	-7.069	0.597	0.840	0.774	0.754	0.000	-6.682
DEC	SEN CL	-0.269	0.000	0.000	0.000	-0.320	-1.334	0.376	0.904	0.666	0.532	0.000	0.554
	LAT CL					0.000			0.774		0.000	0.000	0.774
	HEATNG	-7.857	0.000	0.000	0.000	-7.499	-45.238	7.462	4.477	4.137	4.775	0.000	-39.743
TOT	SEN CL	-1.871	0.000	0.000	0.000	-2.863	-13.906	24.699	16.246	5.827	10.489	0.000	38.620
	LAT CL					1.295			13.199		0.000	0.000	14.494

REPORT- LS-E Space Monthly Load Components EL1 West Perim Spc (M.W14) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.972	0.000	0.000	0.000	-0.934	-5.524	0.934	0.526	0.415	0.477	0.000	-5.078
JAN	SEN CL	-0.159	0.000	0.000	0.000	-0.219	-0.895	0.961	0.473	0.214	0.273	0.000	0.647
	LAT CL					0.000			0.393		0.000	0.000	0.393
	HEATNG	-0.796	0.000	0.000	0.000	-0.798	-4.691	1.075	0.479	0.387	0.431	0.000	-3.914
FEB	SEN CL	-0.191	0.000	0.000	0.000	-0.265	-1.125	1.527	0.519	0.194	0.306	0.000	0.965
	LAT CL					0.000			0.430		0.000	0.000	0.430
	HEATNG	-0.570	0.000	0.000	0.000	-0.590	-3.607	0.968	0.333	0.300	0.346	0.000	-2.820
MAR	SEN CL	-0.275	0.000	0.000	0.000	-0.384	-1.682	2.388	0.874	0.296	0.534	0.000	1.752
	LAT CL					0.000			0.713		0.000	0.000	0.713
	HEATNG	-0.269	0.000	0.000	0.000	-0.302	-1.991	0.675	0.125	0.154	0.187	0.000	-1.420
APR	SEN CL	-0.236	0.000	0.000	0.000	-0.350	-1.670	3.632	1.031	0.338	0.656	0.000	3.400
	LAT CL					0.004			0.838		0.000	0.000	0.842
	HEATNG	-0.110	0.000	0.000	0.000	-0.168	-1.147	0.471	0.052	0.081	0.117	0.000	-0.705
MAY	SEN CL	-0.095	0.000	0.000	0.000	-0.210	-1.225	4.526	1.001	0.217	0.666	0.000	4.881
	LAT CL					0.016			0.793		0.000	0.000	0.809
	HEATNG	-0.021	0.000	0.000	0.000	-0.058	-0.406	0.211	0.012	0.026	0.044	0.000	-0.192
JUN	SEN CL	0.121	0.000	0.000	0.000	-0.049	-0.594	5.294	1.142	0.276	0.798	0.000	6.988
	LAT CL					0.178			0.883		0.000	0.000	1.061
	HEATNG	-0.003	0.000	0.000	0.000	-0.018	-0.126	0.059	0.009	0.015	0.021	0.000	-0.042
JUL	SEN CL	0.256	0.000	0.000	0.000	0.026	-0.211	5.211	1.096	0.387	0.794	0.000	7.560
	LAT CL					0.308			0.845		0.000	0.000	1.153
	HEATNG	-0.001	0.000	0.000	0.000	-0.029	-0.210	0.108	0.007	0.016	0.028	0.000	-0.080
AUG	SEN CL	0.239	0.000	0.000	0.000	-0.003	-0.375	4.715	1.147	0.294	0.819	0.000	6.836
	LAT CL					0.262			0.884		0.000	0.000	1.147
	HEATNG	-0.063	0.000	0.000	0.000	-0.106	-0.715	0.277	0.036	0.060	0.089	0.000	-0.422
SEP	SEN CL	-0.001	0.000	0.000	0.000	-0.143	-0.856	3.661	1.068	0.390	0.721	0.000	4.840
	LAT CL					0.092			0.839		0.000	0.000	0.930
	HEATNG	-0.264	0.000	0.000	0.000	-0.279	-1.913	0.584	0.107	0.140	0.182	0.000	-1.444
OCT	SEN CL	-0.180	0.000	0.000	0.000	-0.259	-1.212	2.422	0.946	0.405	0.601	0.000	2.724
	LAT CL					0.019			0.769		0.000	0.000	0.788
	HEATNG	-0.504	0.000	0.000	0.000	-0.458	-2.979	0.483	0.230	0.291	0.274	0.000	-2.662
NOV	SEN CL	-0.195	0.000	0.000	0.000	-0.274	-1.131	0.941	0.818	0.546	0.503	0.000	1.208
	LAT CL					0.004			0.690		0.000	0.000	0.694
	HEATNG	-0.845	0.000	0.000	0.000	-0.813	-4.755	0.592	0.524	0.472	0.477	0.000	-4.348
DEC	SEN CL	-0.177	0.000	0.000	0.000	-0.225	-0.946	0.658	0.582	0.340	0.339	0.000	0.570
	LAT CL					0.000			0.496		0.000	0.000	0.496
	HEATNG	-4.418	0.000	0.000	0.000	-4.552	-28.064	6.436	2.440	2.357	2.673	0.000	-23.126
TOT	SEN CL	-0.894	0.000	0.000	0.000	-2.355	-11.923	35.937	10.697	3.896	7.012	0.000	42.370
	LAT CL					0.882			8.573		0.000	0.000	9.455

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 Core Spc (M.C15) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JAN	SEN CL	0.000	0.000	0.000	0.000	-0.229	0.000	0.000	28.940	9.581	7.723	0.000	46.015
	LAT CL					0.000			23.172		0.000	0.000	23.172
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
FEB	SEN CL	0.000	0.000	0.000	0.000	-0.205	0.000	0.000	28.940	9.531	7.590	0.000	45.856
	LAT CL					0.000			23.172		0.000	0.000	23.172
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MAR	SEN CL	0.000	0.000	0.000	0.000	-0.185	0.000	0.000	35.009	11.483	9.061	0.000	55.368
	LAT CL					0.000			28.050		0.000	0.000	28.050
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
APR	SEN CL	0.000	0.000	0.000	0.000	-0.127	0.000	0.000	33.510	10.995	8.678	0.000	53.056
	LAT CL					0.001			26.831		0.000	0.000	26.831
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MAY	SEN CL	0.000	0.000	0.000	0.000	-0.078	0.000	0.000	30.487	10.067	8.064	0.000	48.540
	LAT CL					0.004			24.391		0.000	0.000	24.396
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JUN	SEN CL	0.000	0.000	0.000	0.000	-0.028	0.000	0.000	33.486	10.988	8.678	0.000	53.125
	LAT CL					0.030			26.831		0.000	0.000	26.861
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
JUL	SEN CL	0.000	0.000	0.000	0.000	-0.003	0.000	0.000	32.010	10.542	8.391	0.000	50.941
	LAT CL					0.059			25.611		0.000	0.000	25.670
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUG	SEN CL	0.000	0.000	0.000	0.000	-0.011	0.000	0.000	33.486	11.006	8.726	0.000	53.208
	LAT CL					0.053			26.831		0.000	0.000	26.884
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SEP	SEN CL	0.000	0.000	0.000	0.000	-0.050	0.000	0.000	31.987	10.519	8.347	0.000	50.802
	LAT CL					0.020			25.611		0.000	0.000	25.631
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OCT	SEN CL	0.000	0.000	0.000	0.000	-0.108	0.000	0.000	30.487	10.066	8.060	0.000	48.506
	LAT CL					0.006			24.391		0.000	0.000	24.398
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NOV	SEN CL	0.000	0.000	0.000	0.000	-0.144	0.000	0.000	30.432	10.030	8.005	0.000	48.323
	LAT CL					0.001			24.391		0.000	0.000	24.392
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DEC	SEN CL	0.000	0.000	0.000	0.000	-0.200	0.000	0.000	32.018	10.546	8.396	0.000	50.760
	LAT CL					0.000			25.611		0.000	0.000	25.611
	HEATNG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOT	SEN CL	0.000	0.000	0.000	0.000	-1.368	0.000	0.000	380.794	125.354	99.719	0.000	604.499
	LAT CL					0.175			304.895		0.000	0.000	305.070

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 South Perim Plnm (M.S16) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.952	0.000	0.000	0.000	-0.519	0.000	0.000	0.000	0.000	0.000	0.000	-1.471
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.842	0.000	0.000	0.000	-0.479	0.000	0.000	0.000	0.000	0.000	0.000	-1.321
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.699	0.000	0.000	0.000	-0.438	0.000	0.000	0.000	0.000	0.000	0.000	-1.137
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.433	0.000	0.000	0.000	-0.292	0.000	0.000	0.000	0.000	0.000	0.000	-0.725
APR	SEN CL	0.003	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.201	0.000	0.000	0.000	-0.164	0.000	0.000	0.000	0.000	0.000	0.000	-0.365
MAY	SEN CL	0.023	0.000	0.000	0.000	-0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.017
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.049	0.000	0.000	0.000	-0.059	0.000	0.000	0.000	0.000	0.000	0.000	-0.108
JUN	SEN CL	0.125	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.136
	LAT CL					0.064			0.000		0.000	0.000	0.064
	HEATNG	-0.011	0.000	0.000	0.000	-0.021	0.000	0.000	0.000	0.000	0.000	0.000	-0.032
JUL	SEN CL	0.242	0.000	0.000	0.000	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.267
	LAT CL					0.126			0.000		0.000	0.000	0.126
	HEATNG	-0.005	0.000	0.000	0.000	-0.025	0.000	0.000	0.000	0.000	0.000	0.000	-0.031
AUG	SEN CL	0.265	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.276
	LAT CL					0.113			0.000		0.000	0.000	0.113
	HEATNG	-0.063	0.000	0.000	0.000	-0.093	0.000	0.000	0.000	0.000	0.000	0.000	-0.155
SEP	SEN CL	0.131	0.000	0.000	0.000	-0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.112
	LAT CL					0.028			0.000		0.000	0.000	0.028
	HEATNG	-0.304	0.000	0.000	0.000	-0.237	0.000	0.000	0.000	0.000	0.000	0.000	-0.541
OCT	SEN CL	0.014	0.000	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.009
	LAT CL					0.002			0.000		0.000	0.000	0.002
	HEATNG	-0.584	0.000	0.000	0.000	-0.328	0.000	0.000	0.000	0.000	0.000	0.000	-0.912
NOV	SEN CL	0.001	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.899	0.000	0.000	0.000	-0.467	0.000	0.000	0.000	0.000	0.000	0.000	-1.366
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-5.042	0.000	0.000	0.000	-3.123	0.000	0.000	0.000	0.000	0.000	0.000	-8.164
TOT	SEN CL	0.805	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.819
	LAT CL					0.335			0.000		0.000	0.000	0.335

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 East Perim Plnm (M.E17) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.748	0.000	0.000	0.000	-0.346	0.000	0.000	0.000	0.000	0.000	0.000	-1.094
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.647	0.000	0.000	0.000	-0.319	0.000	0.000	0.000	0.000	0.000	0.000	-0.966
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.518	0.000	0.000	0.000	-0.292	0.000	0.000	0.000	0.000	0.000	0.000	-0.810
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.292	0.000	0.000	0.000	-0.195	0.000	0.000	0.000	0.000	0.000	0.000	-0.487
APR	SEN CL	0.003	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.093	0.000	0.000	0.000	-0.104	0.000	0.000	0.000	0.000	0.000	0.000	-0.198
MAY	SEN CL	0.038	0.000	0.000	0.000	-0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.029
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.016	0.000	0.000	0.000	-0.035	0.000	0.000	0.000	0.000	0.000	0.000	-0.050
JUN	SEN CL	0.131	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.134
	LAT CL					0.044			0.000		0.000	0.000	0.044
	HEATNG	-0.005	0.000	0.000	0.000	-0.013	0.000	0.000	0.000	0.000	0.000	0.000	-0.018
JUL	SEN CL	0.224	0.000	0.000	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.239
	LAT CL					0.085			0.000		0.000	0.000	0.085
	HEATNG	-0.002	0.000	0.000	0.000	-0.017	0.000	0.000	0.000	0.000	0.000	0.000	-0.019
AUG	SEN CL	0.195	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.203
	LAT CL					0.077			0.000		0.000	0.000	0.077
	HEATNG	-0.057	0.000	0.000	0.000	-0.069	0.000	0.000	0.000	0.000	0.000	0.000	-0.127
SEP	SEN CL	0.060	0.000	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.055
	LAT CL					0.015			0.000		0.000	0.000	0.015
	HEATNG	-0.280	0.000	0.000	0.000	-0.161	0.000	0.000	0.000	0.000	0.000	0.000	-0.441
OCT	SEN CL	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.457	0.000	0.000	0.000	-0.219	0.000	0.000	0.000	0.000	0.000	0.000	-0.677
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.669	0.000	0.000	0.000	-0.311	0.000	0.000	0.000	0.000	0.000	0.000	-0.981
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-3.785	0.000	0.000	0.000	-2.083	0.000	0.000	0.000	0.000	0.000	0.000	-5.867
TOT	SEN CL	0.653	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.663
	LAT CL					0.223			0.000		0.000	0.000	0.223

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 North Perim Plnm (M.N18) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.185	0.000	0.000	0.000	-0.519	0.000	0.000	0.000	0.000	0.000	0.000	-1.705
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-1.045	0.000	0.000	0.000	-0.479	0.000	0.000	0.000	0.000	0.000	0.000	-1.523
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.919	0.000	0.000	0.000	-0.438	0.000	0.000	0.000	0.000	0.000	0.000	-1.357
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.603	0.000	0.000	0.000	-0.293	0.000	0.000	0.000	0.000	0.000	0.000	-0.896
APR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.302	0.000	0.000	0.000	-0.170	0.000	0.000	0.000	0.000	0.000	0.000	-0.472
MAY	SEN CL	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.073	0.000	0.000	0.000	-0.066	0.000	0.000	0.000	0.000	0.000	0.000	-0.138
JUN	SEN CL	0.070	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.087
	LAT CL					0.061			0.000		0.000	0.000	0.061
	HEATNG	-0.018	0.000	0.000	0.000	-0.025	0.000	0.000	0.000	0.000	0.000	0.000	-0.043
JUL	SEN CL	0.152	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.181
	LAT CL					0.124			0.000		0.000	0.000	0.124
	HEATNG	-0.029	0.000	0.000	0.000	-0.036	0.000	0.000	0.000	0.000	0.000	0.000	-0.065
AUG	SEN CL	0.110	0.000	0.000	0.000	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.132
	LAT CL					0.103			0.000		0.000	0.000	0.103
	HEATNG	-0.202	0.000	0.000	0.000	-0.116	0.000	0.000	0.000	0.000	0.000	0.000	-0.318
SEP	SEN CL	0.017	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.020
	LAT CL					0.015			0.000		0.000	0.000	0.015
	HEATNG	-0.521	0.000	0.000	0.000	-0.242	0.000	0.000	0.000	0.000	0.000	0.000	-0.763
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.730	0.000	0.000	0.000	-0.329	0.000	0.000	0.000	0.000	0.000	0.000	-1.059
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-1.040	0.000	0.000	0.000	-0.467	0.000	0.000	0.000	0.000	0.000	0.000	-1.507
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-6.666	0.000	0.000	0.000	-3.181	0.000	0.000	0.000	0.000	0.000	0.000	-9.847
TOT	SEN CL	0.350	0.000	0.000	0.000	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.423
	LAT CL					0.304			0.000		0.000	0.000	0.304

REPORT- LS-E Space Monthly Load Components EL1 West Perim Plnm (M.W19) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.752	0.000	0.000	0.000	-0.346	0.000	0.000	0.000	0.000	0.000	0.000	-1.098
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.655	0.000	0.000	0.000	-0.319	0.000	0.000	0.000	0.000	0.000	0.000	-0.975
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.561	0.000	0.000	0.000	-0.292	0.000	0.000	0.000	0.000	0.000	0.000	-0.853
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.340	0.000	0.000	0.000	-0.195	0.000	0.000	0.000	0.000	0.000	0.000	-0.535
APR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.153	0.000	0.000	0.000	-0.110	0.000	0.000	0.000	0.000	0.000	0.000	-0.263
MAY	SEN CL	0.011	0.000	0.000	0.000	-0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.008
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.030	0.000	0.000	0.000	-0.036	0.000	0.000	0.000	0.000	0.000	0.000	-0.066
JUN	SEN CL	0.091	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.095
	LAT CL					0.044			0.000		0.000	0.000	0.044
	HEATNG	-0.006	0.000	0.000	0.000	-0.011	0.000	0.000	0.000	0.000	0.000	0.000	-0.017
JUL	SEN CL	0.169	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.182
	LAT CL					0.087			0.000		0.000	0.000	0.087
	HEATNG	-0.002	0.000	0.000	0.000	-0.015	0.000	0.000	0.000	0.000	0.000	0.000	-0.018
AUG	SEN CL	0.157	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.163
	LAT CL					0.075			0.000		0.000	0.000	0.075
	HEATNG	-0.085	0.000	0.000	0.000	-0.072	0.000	0.000	0.000	0.000	0.000	0.000	-0.157
SEP	SEN CL	0.040	0.000	0.000	0.000	-0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.037
	LAT CL					0.015			0.000		0.000	0.000	0.015
	HEATNG	-0.295	0.000	0.000	0.000	-0.161	0.000	0.000	0.000	0.000	0.000	0.000	-0.457
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.463	0.000	0.000	0.000	-0.219	0.000	0.000	0.000	0.000	0.000	0.000	-0.682
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.677	0.000	0.000	0.000	-0.311	0.000	0.000	0.000	0.000	0.000	0.000	-0.988
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-4.019	0.000	0.000	0.000	-2.089	0.000	0.000	0.000	0.000	0.000	0.000	-6.108
TOT	SEN CL	0.468	0.000	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.485
	LAT CL					0.220			0.000		0.000	0.000	0.220

REPORT- LS-E Space Monthly Load Components EL1 Core Plnm (M.C20) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	0.000	0.000	0.000	0.000	-0.229	0.000	0.000	0.000	0.000	0.000	0.000	-0.229
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.205	0.000	0.000	0.000	0.000	0.000	0.000	-0.205
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.185	0.000	0.000	0.000	0.000	0.000	0.000	-0.185
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.127	0.000	0.000	0.000	0.000	0.000	0.000	-0.127
APR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.079	0.000	0.000	0.000	0.000	0.000	0.000	-0.079
MAY	SEN CL	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.036	0.000	0.000	0.000	0.000	0.000	0.000	-0.036
JUN	SEN CL	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.008
	LAT CL					0.016			0.000		0.000	0.000	0.016
	HEATNG	0.000	0.000	0.000	0.000	-0.017	0.000	0.000	0.000	0.000	0.000	0.000	-0.017
JUL	SEN CL	0.000	0.000	0.000	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.015
	LAT CL					0.034			0.000		0.000	0.000	0.034
	HEATNG	0.000	0.000	0.000	0.000	-0.022	0.000	0.000	0.000	0.000	0.000	0.000	-0.022
AUG	SEN CL	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
	LAT CL					0.032			0.000		0.000	0.000	0.032
	HEATNG	0.000	0.000	0.000	0.000	-0.054	0.000	0.000	0.000	0.000	0.000	0.000	-0.054
SEP	SEN CL	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003
	LAT CL					0.005			0.000		0.000	0.000	0.005
	HEATNG	0.000	0.000	0.000	0.000	-0.108	0.000	0.000	0.000	0.000	0.000	0.000	-0.108
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	0.000	0.000	0.000	0.000	-0.144	0.000	0.000	0.000	0.000	0.000	0.000	-0.144
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-0.200	0.000	0.000	0.000	0.000	0.000	0.000	-0.200
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	0.000	0.000	0.000	-1.406	0.000	0.000	0.000	0.000	0.000	0.000	-1.406
TOT	SEN CL	0.000	0.000	0.000	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.039
	LAT CL					0.087			0.000		0.000	0.000	0.087

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 South Perim Spc (T.S21) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.093	0.000	0.000	0.000	-1.046	-6.616	1.618	0.362	0.434	0.436	0.000	-5.905
JAN	SEN CL	-0.369	0.000	0.000	0.000	-0.684	-2.696	5.676	1.213	0.438	0.746	0.000	4.323
	LAT CL					0.000			0.997		0.000	0.000	0.997
	HEATNG	-0.905	0.000	0.000	0.000	-0.925	-5.622	1.521	0.418	0.434	0.447	0.000	-4.633
FEB	SEN CL	-0.388	0.000	0.000	0.000	-0.670	-2.802	5.978	1.156	0.409	0.714	0.000	4.398
	LAT CL					0.000			0.949		0.000	0.000	0.949
	HEATNG	-0.709	0.000	0.000	0.000	-0.785	-4.768	1.404	0.384	0.406	0.448	0.000	-3.621
MAR	SEN CL	-0.368	0.000	0.000	0.000	-0.676	-2.899	6.634	1.520	0.470	0.939	0.000	5.620
	LAT CL					0.000			1.244		0.000	0.000	1.244
	HEATNG	-0.369	0.000	0.000	0.000	-0.451	-2.856	0.893	0.202	0.228	0.300	0.000	-2.054
APR	SEN CL	-0.285	0.000	0.000	0.000	-0.526	-2.475	6.415	1.622	0.501	1.029	0.000	6.280
	LAT CL					0.006			1.311		0.000	0.000	1.317
	HEATNG	-0.173	0.000	0.000	0.000	-0.277	-1.830	0.674	0.104	0.137	0.213	0.000	-1.151
MAY	SEN CL	-0.092	0.000	0.000	0.000	-0.290	-1.649	6.272	1.557	0.304	1.022	0.000	7.124
	LAT CL					0.022			1.234		0.000	0.000	1.256
	HEATNG	-0.041	0.000	0.000	0.000	-0.108	-0.760	0.308	0.026	0.051	0.090	0.000	-0.433
JUN	SEN CL	0.165	0.000	0.000	0.000	-0.053	-0.736	5.894	1.795	0.411	1.238	0.000	8.714
	LAT CL					0.266			1.391		0.000	0.000	1.657
	HEATNG	-0.004	0.000	0.000	0.000	-0.045	-0.321	0.130	0.025	0.036	0.057	0.000	-0.122
JUL	SEN CL	0.369	0.000	0.000	0.000	0.056	-0.197	5.883	1.719	0.499	1.228	0.000	9.558
	LAT CL					0.459			1.330		0.000	0.000	1.789
	HEATNG	-0.003	0.000	0.000	0.000	-0.057	-0.408	0.182	0.018	0.035	0.062	0.000	-0.170
AUG	SEN CL	0.410	0.000	0.000	0.000	0.009	-0.451	6.772	1.803	0.410	1.273	0.000	10.225
	LAT CL					0.394			1.392		0.000	0.000	1.786
	HEATNG	-0.067	0.000	0.000	0.000	-0.141	-0.924	0.386	0.045	0.079	0.118	0.000	-0.502
SEP	SEN CL	0.179	0.000	0.000	0.000	-0.233	-1.357	8.101	1.695	0.562	1.160	0.000	10.106
	LAT CL					0.140			1.323		0.000	0.000	1.463
	HEATNG	-0.270	0.000	0.000	0.000	-0.352	-2.344	0.840	0.124	0.178	0.235	0.000	-1.590
OCT	SEN CL	-0.173	0.000	0.000	0.000	-0.454	-2.200	7.313	1.537	0.614	0.999	0.000	7.637
	LAT CL					0.032			1.232		0.000	0.000	1.264
	HEATNG	-0.625	0.000	0.000	0.000	-0.598	-3.863	0.795	0.269	0.377	0.359	0.000	-3.285
NOV	SEN CL	-0.278	0.000	0.000	0.000	-0.499	-2.111	3.908	1.385	0.855	0.866	0.000	4.127
	LAT CL					0.006			1.154		0.000	0.000	1.160
	HEATNG	-0.999	0.000	0.000	0.000	-0.948	-5.824	1.044	0.444	0.542	0.491	0.000	-5.251
DEC	SEN CL	-0.386	0.000	0.000	0.000	-0.609	-2.433	4.402	1.301	0.628	0.795	0.000	3.697
	LAT CL					0.000			1.085		0.000	0.000	1.085
	HEATNG	-5.259	0.000	0.000	0.000	-5.731	-36.135	9.795	2.420	2.938	3.256	0.000	-28.716
TOT	SEN CL	-1.215	0.000	0.000	0.000	-4.630	-22.006	73.247	18.303	6.102	12.008	0.000	81.809
	LAT CL					1.326			14.643		0.000	0.000	15.969

REPORT- LS-E Space Monthly Load Components EL1 East Perim Spc (T.E22) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.912	0.000	0.000	0.000	-0.845	-5.132	0.727	0.363	0.387	0.371	0.000	-5.041
JAN	SEN CL	-0.215	0.000	0.000	0.000	-0.308	-1.222	1.014	0.636	0.236	0.379	0.000	0.520
	LAT CL					0.000			0.548		0.000	0.000	0.548
	HEATNG	-0.753	0.000	0.000	0.000	-0.742	-4.408	0.833	0.375	0.388	0.362	0.000	-3.945
FEB	SEN CL	-0.222	0.000	0.000	0.000	-0.321	-1.338	1.465	0.623	0.212	0.375	0.000	0.794
	LAT CL					0.000			0.537		0.000	0.000	0.537
	HEATNG	-0.537	0.000	0.000	0.000	-0.565	-3.490	0.847	0.285	0.297	0.315	0.000	-2.848
MAR	SEN CL	-0.242	0.000	0.000	0.000	-0.408	-1.732	3.197	0.922	0.257	0.565	0.000	2.559
	LAT CL					0.000			0.771		0.000	0.000	0.771
	HEATNG	-0.264	0.000	0.000	0.000	-0.305	-2.019	0.574	0.124	0.154	0.190	0.000	-1.546
APR	SEN CL	-0.168	0.000	0.000	0.000	-0.347	-1.604	4.084	1.032	0.291	0.652	0.000	3.941
	LAT CL					0.004			0.848		0.000	0.000	0.852
	HEATNG	-0.089	0.000	0.000	0.000	-0.149	-1.068	0.391	0.049	0.071	0.114	0.000	-0.679
MAY	SEN CL	0.013	0.000	0.000	0.000	-0.229	-1.279	6.149	1.003	0.191	0.669	0.000	6.518
	LAT CL					0.015			0.799		0.000	0.000	0.813
	HEATNG	-0.017	0.000	0.000	0.000	-0.060	-0.440	0.185	0.014	0.027	0.051	0.000	-0.240
JUN	SEN CL	0.196	0.000	0.000	0.000	-0.047	-0.560	5.753	1.140	0.233	0.792	0.000	7.507
	LAT CL					0.177			0.885		0.000	0.000	1.062
	HEATNG	-0.003	0.000	0.000	0.000	-0.024	-0.181	0.069	0.013	0.019	0.032	0.000	-0.074
JUL	SEN CL	0.339	0.000	0.000	0.000	0.031	-0.157	5.682	1.092	0.291	0.783	0.000	8.062
	LAT CL					0.307			0.846		0.000	0.000	1.153
	HEATNG	-0.003	0.000	0.000	0.000	-0.041	-0.300	0.126	0.015	0.026	0.046	0.000	-0.131
AUG	SEN CL	0.297	0.000	0.000	0.000	0.009	-0.281	5.021	1.139	0.218	0.801	0.000	7.204
	LAT CL					0.262			0.884		0.000	0.000	1.146
	HEATNG	-0.062	0.000	0.000	0.000	-0.113	-0.764	0.255	0.043	0.070	0.103	0.000	-0.468
SEP	SEN CL	0.068	0.000	0.000	0.000	-0.136	-0.799	4.296	1.060	0.318	0.707	0.000	5.516
	LAT CL					0.089			0.838		0.000	0.000	0.927
	HEATNG	-0.274	0.000	0.000	0.000	-0.293	-1.969	0.483	0.132	0.168	0.198	0.000	-1.554
OCT	SEN CL	-0.147	0.000	0.000	0.000	-0.245	-1.141	2.471	0.921	0.387	0.585	0.000	2.830
	LAT CL					0.019			0.756		0.000	0.000	0.776
	HEATNG	-0.510	0.000	0.000	0.000	-0.458	-2.981	0.445	0.216	0.293	0.267	0.000	-2.728
NOV	SEN CL	-0.182	0.000	0.000	0.000	-0.274	-1.093	0.872	0.833	0.514	0.510	0.000	1.180
	LAT CL					0.004			0.707		0.000	0.000	0.711
	HEATNG	-0.805	0.000	0.000	0.000	-0.754	-4.493	0.512	0.429	0.442	0.412	0.000	-4.256
DEC	SEN CL	-0.206	0.000	0.000	0.000	-0.284	-1.133	0.748	0.677	0.360	0.403	0.000	0.564
	LAT CL					0.000			0.579		0.000	0.000	0.579
	HEATNG	-4.226	0.000	0.000	0.000	-4.348	-27.245	5.447	2.059	2.340	2.463	0.000	-23.511
TOT	SEN CL	-0.468	0.000	0.000	0.000	-2.558	-12.339	40.752	11.079	3.508	7.223	0.000	47.195
	LAT CL					0.876			8.998		0.000	0.000	9.874

REPORT- LS-E Space Monthly Load Components EL1 North Perim Spc (T.N23) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.631	0.000	0.000	0.000	-1.500	-8.511	0.939	0.969	0.802	0.831	0.000	-8.101
JAN	SEN CL	-0.196	0.000	0.000	0.000	-0.230	-0.957	0.313	0.606	0.449	0.351	0.000	0.335
	LAT CL					0.000			0.515		0.000	0.000	0.515
	HEATNG	-1.419	0.000	0.000	0.000	-1.349	-7.578	1.213	0.930	0.656	0.782	0.000	-6.765
FEB	SEN CL	-0.196	0.000	0.000	0.000	-0.246	-1.004	0.427	0.645	0.354	0.380	0.000	0.360
	LAT CL					0.000			0.554		0.000	0.000	0.554
	HEATNG	-1.063	0.000	0.000	0.000	-0.994	-5.962	1.193	0.617	0.490	0.613	0.000	-5.106
MAR	SEN CL	-0.355	0.000	0.000	0.000	-0.466	-1.845	1.235	1.287	0.409	0.773	0.000	1.037
	LAT CL					0.000			1.087		0.000	0.000	1.087
	HEATNG	-0.566	0.000	0.000	0.000	-0.538	-3.496	0.831	0.268	0.267	0.358	0.000	-2.876
APR	SEN CL	-0.359	0.000	0.000	0.000	-0.440	-1.920	2.231	1.555	0.455	0.970	0.000	2.493
	LAT CL					0.006			1.280		0.000	0.000	1.286
	HEATNG	-0.239	0.000	0.000	0.000	-0.296	-1.993	0.666	0.115	0.147	0.233	0.000	-1.365
MAY	SEN CL	-0.217	0.000	0.000	0.000	-0.271	-1.525	3.640	1.546	0.272	1.002	0.000	4.447
	LAT CL					0.021			1.241		0.000	0.000	1.263
	HEATNG	-0.048	0.000	0.000	0.000	-0.101	-0.735	0.263	0.029	0.048	0.096	0.000	-0.450
JUN	SEN CL	0.051	0.000	0.000	0.000	-0.059	-0.763	4.515	1.792	0.374	1.232	0.000	7.142
	LAT CL					0.265			1.394		0.000	0.000	1.658
	HEATNG	-0.008	0.000	0.000	0.000	-0.046	-0.341	0.119	0.028	0.036	0.063	0.000	-0.150
JUL	SEN CL	0.222	0.000	0.000	0.000	0.057	-0.182	4.120	1.716	0.454	1.222	0.000	7.610
	LAT CL					0.455			1.331		0.000	0.000	1.786
	HEATNG	-0.024	0.000	0.000	0.000	-0.079	-0.564	0.179	0.037	0.056	0.098	0.000	-0.295
AUG	SEN CL	0.153	0.000	0.000	0.000	0.031	-0.336	3.373	1.784	0.315	1.237	0.000	6.556
	LAT CL					0.387			1.389		0.000	0.000	1.776
	HEATNG	-0.157	0.000	0.000	0.000	-0.197	-1.324	0.307	0.090	0.128	0.194	0.000	-0.959
SEP	SEN CL	-0.129	0.000	0.000	0.000	-0.178	-1.020	2.341	1.651	0.522	1.083	0.000	4.271
	LAT CL					0.129			1.315		0.000	0.000	1.444
	HEATNG	-0.535	0.000	0.000	0.000	-0.471	-3.192	0.643	0.212	0.269	0.327	0.000	-2.747
OCT	SEN CL	-0.271	0.000	0.000	0.000	-0.335	-1.431	1.452	1.449	0.648	0.907	0.000	2.418
	LAT CL					0.027			1.200		0.000	0.000	1.227
	HEATNG	-0.825	0.000	0.000	0.000	-0.693	-4.472	0.511	0.343	0.465	0.425	0.000	-4.246
NOV	SEN CL	-0.305	0.000	0.000	0.000	-0.405	-1.590	0.677	1.311	0.910	0.800	0.000	1.399
	LAT CL					0.005			1.118		0.000	0.000	1.123
	HEATNG	-1.341	0.000	0.000	0.000	-1.236	-7.069	0.597	0.840	0.774	0.754	0.000	-6.682
DEC	SEN CL	-0.269	0.000	0.000	0.000	-0.320	-1.334	0.376	0.904	0.666	0.532	0.000	0.554
	LAT CL					0.000			0.774		0.000	0.000	0.774
	HEATNG	-7.857	0.000	0.000	0.000	-7.499	-45.238	7.462	4.477	4.137	4.775	0.000	-39.743
TOT	SEN CL	-1.871	0.000	0.000	0.000	-2.863	-13.906	24.699	16.246	5.827	10.489	0.000	38.620
	LAT CL					1.295			13.199		0.000	0.000	14.494

REPORT- LS-E Space Monthly Load Components EL1 West Perim Spc (T.W24) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.972	0.000	0.000	0.000	-0.934	-5.524	0.934	0.526	0.415	0.477	0.000	-5.078
JAN	SEN CL	-0.159	0.000	0.000	0.000	-0.219	-0.895	0.961	0.473	0.214	0.273	0.000	0.647
	LAT CL					0.000			0.393		0.000	0.000	0.393
	HEATNG	-0.796	0.000	0.000	0.000	-0.798	-4.691	1.075	0.479	0.387	0.431	0.000	-3.914
FEB	SEN CL	-0.191	0.000	0.000	0.000	-0.265	-1.125	1.527	0.519	0.194	0.306	0.000	0.965
	LAT CL					0.000			0.430		0.000	0.000	0.430
	HEATNG	-0.570	0.000	0.000	0.000	-0.590	-3.607	0.968	0.333	0.300	0.346	0.000	-2.820
MAR	SEN CL	-0.275	0.000	0.000	0.000	-0.384	-1.682	2.388	0.874	0.296	0.534	0.000	1.752
	LAT CL					0.000			0.713		0.000	0.000	0.713
	HEATNG	-0.269	0.000	0.000	0.000	-0.302	-1.991	0.675	0.125	0.154	0.187	0.000	-1.420
APR	SEN CL	-0.236	0.000	0.000	0.000	-0.350	-1.670	3.632	1.031	0.338	0.656	0.000	3.400
	LAT CL					0.004			0.838		0.000	0.000	0.842
	HEATNG	-0.110	0.000	0.000	0.000	-0.168	-1.147	0.471	0.052	0.081	0.117	0.000	-0.705
MAY	SEN CL	-0.095	0.000	0.000	0.000	-0.210	-1.225	4.526	1.001	0.217	0.666	0.000	4.881
	LAT CL					0.016			0.793		0.000	0.000	0.809
	HEATNG	-0.021	0.000	0.000	0.000	-0.058	-0.406	0.211	0.012	0.026	0.044	0.000	-0.192
JUN	SEN CL	0.121	0.000	0.000	0.000	-0.049	-0.594	5.294	1.142	0.276	0.798	0.000	6.988
	LAT CL					0.178			0.883		0.000	0.000	1.061
	HEATNG	-0.003	0.000	0.000	0.000	-0.018	-0.126	0.059	0.009	0.015	0.021	0.000	-0.042
JUL	SEN CL	0.256	0.000	0.000	0.000	0.026	-0.211	5.211	1.096	0.387	0.794	0.000	7.560
	LAT CL					0.308			0.845		0.000	0.000	1.153
	HEATNG	-0.001	0.000	0.000	0.000	-0.029	-0.210	0.108	0.007	0.016	0.028	0.000	-0.080
AUG	SEN CL	0.239	0.000	0.000	0.000	-0.003	-0.375	4.715	1.147	0.294	0.819	0.000	6.836
	LAT CL					0.262			0.884		0.000	0.000	1.147
	HEATNG	-0.063	0.000	0.000	0.000	-0.106	-0.715	0.277	0.036	0.060	0.089	0.000	-0.422
SEP	SEN CL	-0.001	0.000	0.000	0.000	-0.143	-0.856	3.661	1.068	0.390	0.721	0.000	4.840
	LAT CL					0.092			0.839		0.000	0.000	0.930
	HEATNG	-0.264	0.000	0.000	0.000	-0.279	-1.913	0.584	0.107	0.140	0.182	0.000	-1.444
OCT	SEN CL	-0.180	0.000	0.000	0.000	-0.259	-1.212	2.422	0.946	0.405	0.601	0.000	2.724
	LAT CL					0.019			0.769		0.000	0.000	0.788
	HEATNG	-0.504	0.000	0.000	0.000	-0.458	-2.979	0.483	0.230	0.291	0.274	0.000	-2.662
NOV	SEN CL	-0.195	0.000	0.000	0.000	-0.274	-1.131	0.941	0.818	0.546	0.503	0.000	1.208
	LAT CL					0.004			0.690		0.000	0.000	0.694
	HEATNG	-0.845	0.000	0.000	0.000	-0.813	-4.755	0.592	0.524	0.472	0.477	0.000	-4.348
DEC	SEN CL	-0.177	0.000	0.000	0.000	-0.225	-0.946	0.658	0.582	0.340	0.339	0.000	0.570
	LAT CL					0.000			0.496		0.000	0.000	0.496
	HEATNG	-4.418	0.000	0.000	0.000	-4.552	-28.064	6.436	2.440	2.357	2.673	0.000	-23.126
TOT	SEN CL	-0.894	0.000	0.000	0.000	-2.355	-11.923	35.937	10.697	3.896	7.012	0.000	42.370
	LAT CL					0.882			8.573		0.000	0.000	9.455

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 Core Spc (T.C25) WEATHER FILE- Toronto ON CWEC

	(UNITS=MBTU)	WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	0.000	-0.244	0.000	0.000	-0.124	-6.837	0.474	0.388	0.581	1.298	0.000	-4.464
JAN	SEN CL	0.000	-0.212	0.000	0.000	-0.105	-5.672	1.386	28.339	8.931	6.401	0.000	39.069
	LAT CL					0.000			23.172		0.000	0.000	23.172
	HEATNG	0.000	-0.196	0.000	0.000	-0.098	-5.389	0.499	0.438	0.541	1.158	0.000	-3.048
FEB	SEN CL	0.000	-0.214	0.000	0.000	-0.107	-5.965	2.106	28.289	8.922	6.409	0.000	39.440
	LAT CL					0.000			23.172		0.000	0.000	23.172
	HEATNG	0.000	-0.143	0.000	0.000	-0.072	-4.081	0.466	0.304	0.459	1.029	0.000	-2.038
MAR	SEN CL	0.000	-0.230	0.000	0.000	-0.113	-6.200	3.633	34.456	10.945	8.004	0.000	50.495
	LAT CL					0.000			28.050		0.000	0.000	28.050
	HEATNG	0.000	-0.084	0.000	0.000	-0.041	-2.339	0.335	0.156	0.269	0.617	0.000	-1.087
APR	SEN CL	0.000	-0.182	0.000	0.000	-0.086	-4.641	5.109	33.106	10.648	8.033	0.000	51.988
	LAT CL					0.001			26.831		0.000	0.000	26.831
	HEATNG	0.000	-0.051	0.000	0.000	-0.024	-1.416	0.226	0.075	0.180	0.433	0.000	-0.578
MAY	SEN CL	0.000	-0.137	0.000	0.000	-0.054	-3.008	7.013	30.177	9.813	7.604	0.000	51.408
	LAT CL					0.004			24.391		0.000	0.000	24.395
	HEATNG	0.000	-0.024	0.000	0.000	-0.011	-0.696	0.139	0.023	0.092	0.235	0.000	-0.242
JUN	SEN CL	0.000	-0.068	0.000	0.000	-0.017	-1.065	7.537	33.225	10.821	8.417	0.000	58.850
	LAT CL					0.030			26.831		0.000	0.000	26.861
	HEATNG	0.000	-0.007	0.000	0.000	-0.003	-0.206	0.047	0.020	0.029	0.063	0.000	-0.056
JUL	SEN CL	0.000	-0.040	0.000	0.000	0.000	-0.304	7.786	31.744	10.435	8.300	0.000	57.921
	LAT CL					0.058			25.611		0.000	0.000	25.669
	HEATNG	0.000	-0.011	0.000	0.000	-0.004	-0.330	0.067	0.014	0.040	0.096	0.000	-0.129
AUG	SEN CL	0.000	-0.059	0.000	0.000	-0.006	-0.769	6.590	33.234	10.891	8.604	0.000	58.485
	LAT CL					0.051			26.831		0.000	0.000	26.882
	HEATNG	0.000	-0.026	0.000	0.000	-0.013	-0.760	0.109	0.046	0.100	0.235	0.000	-0.309
SEP	SEN CL	0.000	-0.100	0.000	0.000	-0.038	-2.237	5.027	31.704	10.344	8.085	0.000	52.786
	LAT CL					0.019			25.611		0.000	0.000	25.630
	HEATNG	0.000	-0.079	0.000	0.000	-0.039	-2.269	0.243	0.127	0.251	0.587	0.000	-1.178
OCT	SEN CL	0.000	-0.150	0.000	0.000	-0.069	-3.928	3.046	30.125	9.740	7.446	0.000	46.212
	LAT CL					0.005			24.391		0.000	0.000	24.396
	HEATNG	0.000	-0.133	0.000	0.000	-0.066	-3.687	0.360	0.194	0.384	0.900	0.000	-2.047
NOV	SEN CL	0.000	-0.161	0.000	0.000	-0.078	-4.421	1.232	30.024	9.579	7.081	0.000	43.255
	LAT CL					0.001			24.391		0.000	0.000	24.392
	HEATNG	0.000	-0.191	0.000	0.000	-0.097	-5.562	0.315	0.421	0.576	1.259	0.000	-3.278
DEC	SEN CL	0.000	-0.204	0.000	0.000	-0.103	-5.781	1.039	31.348	9.891	7.108	0.000	43.299
	LAT CL					0.000			25.611		0.000	0.000	25.611
	HEATNG	0.000	-1.191	0.000	0.000	-0.591	-33.573	3.280	2.206	3.503	7.910	0.000	-18.454
TOT	SEN CL	0.000	-1.757	0.000	0.000	-0.777	-43.990	51.504	375.772	120.961	91.492	0.000	593.206
	LAT CL					0.169			304.895		0.000	0.000	305.064

REPORT- LS-E Space Monthly Load Components EL1 South Perim Plnm (T.S26) WEATHER FILE- Toronto ON CWEC

	(UNITS=MBTU)	WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.940	-2.571	0.000	0.000	-0.519	0.000	0.000	0.000	0.000	0.000	0.000	-4.030
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.832	-2.248	0.000	0.000	-0.479	0.000	0.000	0.000	0.000	0.000	0.000	-3.559
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.690	-1.912	0.000	0.000	-0.438	0.000	0.000	0.000	0.000	0.000	0.000	-3.041
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.426	-1.209	0.000	0.000	-0.293	0.000	0.000	0.000	0.000	0.000	0.000	-1.928
APR	SEN CL	0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.198	-0.549	0.000	0.000	-0.160	0.000	0.000	0.000	0.000	0.000	0.000	-0.908
MAY	SEN CL	0.023	0.032	0.000	0.000	-0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.045
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.052	-0.127	0.000	0.000	-0.050	0.000	0.000	0.000	0.000	0.000	0.000	-0.229
JUN	SEN CL	0.127	0.249	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.378
	LAT CL					0.062			0.000		0.000	0.000	0.062
	HEATNG	-0.013	-0.041	0.000	0.000	-0.015	0.000	0.000	0.000	0.000	0.000	0.000	-0.069
JUL	SEN CL	0.242	0.494	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.755
	LAT CL					0.128			0.000		0.000	0.000	0.128
	HEATNG	-0.007	-0.035	0.000	0.000	-0.020	0.000	0.000	0.000	0.000	0.000	0.000	-0.062
AUG	SEN CL	0.264	0.440	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.709
	LAT CL					0.116			0.000		0.000	0.000	0.116
	HEATNG	-0.037	-0.337	0.000	0.000	-0.103	0.000	0.000	0.000	0.000	0.000	0.000	-0.477
SEP	SEN CL	0.105	0.088	0.000	0.000	-0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.184
	LAT CL					0.020			0.000		0.000	0.000	0.020
	HEATNG	-0.287	-1.081	0.000	0.000	-0.242	0.000	0.000	0.000	0.000	0.000	0.000	-1.610
OCT	SEN CL	0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.575	-1.580	0.000	0.000	-0.329	0.000	0.000	0.000	0.000	0.000	0.000	-2.485
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.888	-2.267	0.000	0.000	-0.467	0.000	0.000	0.000	0.000	0.000	0.000	-3.621
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-4.946	-13.958	0.000	0.000	-3.115	0.000	0.000	0.000	0.000	0.000	0.000	-22.019
TOT	SEN CL	0.763	1.302	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	2.072
	LAT CL					0.329			0.000		0.000	0.000	0.329

REPORT- LS-E Space Monthly Load Components EL1 East Perim Plnm (T.E27) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.739	-1.632	0.000	0.000	-0.346	0.000	0.000	0.000	0.000	0.000	0.000	-2.717
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.639	-1.428	0.000	0.000	-0.319	0.000	0.000	0.000	0.000	0.000	0.000	-2.385
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.511	-1.214	0.000	0.000	-0.292	0.000	0.000	0.000	0.000	0.000	0.000	-2.017
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.286	-0.768	0.000	0.000	-0.195	0.000	0.000	0.000	0.000	0.000	0.000	-1.250
APR	SEN CL	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.082	-0.346	0.000	0.000	-0.106	0.000	0.000	0.000	0.000	0.000	0.000	-0.534
MAY	SEN CL	0.027	0.018	0.000	0.000	-0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.038
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.011	-0.078	0.000	0.000	-0.033	0.000	0.000	0.000	0.000	0.000	0.000	-0.121
JUN	SEN CL	0.125	0.155	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.281
	LAT CL					0.043			0.000		0.000	0.000	0.043
	HEATNG	-0.004	-0.023	0.000	0.000	-0.011	0.000	0.000	0.000	0.000	0.000	0.000	-0.038
JUL	SEN CL	0.220	0.311	0.000	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.544
	LAT CL					0.086			0.000		0.000	0.000	0.086
	HEATNG	-0.001	-0.019	0.000	0.000	-0.013	0.000	0.000	0.000	0.000	0.000	0.000	-0.034
AUG	SEN CL	0.192	0.276	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.472
	LAT CL					0.078			0.000		0.000	0.000	0.078
	HEATNG	-0.049	-0.214	0.000	0.000	-0.070	0.000	0.000	0.000	0.000	0.000	0.000	-0.334
SEP	SEN CL	0.052	0.056	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.104
	LAT CL					0.013			0.000		0.000	0.000	0.013
	HEATNG	-0.276	-0.687	0.000	0.000	-0.161	0.000	0.000	0.000	0.000	0.000	0.000	-1.124
OCT	SEN CL	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.451	-1.003	0.000	0.000	-0.219	0.000	0.000	0.000	0.000	0.000	0.000	-1.674
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.661	-1.439	0.000	0.000	-0.311	0.000	0.000	0.000	0.000	0.000	0.000	-2.411
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-3.710	-8.852	0.000	0.000	-2.077	0.000	0.000	0.000	0.000	0.000	0.000	-14.639
TOT	SEN CL	0.617	0.816	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	1.439
	LAT CL					0.222			0.000		0.000	0.000	0.222

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 North Perim Plnm (T.N28) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-1.171	-2.571	0.000	0.000	-0.519	0.000	0.000	0.000	0.000	0.000	0.000	-4.260
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-1.031	-2.248	0.000	0.000	-0.479	0.000	0.000	0.000	0.000	0.000	0.000	-3.758
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.907	-1.912	0.000	0.000	-0.438	0.000	0.000	0.000	0.000	0.000	0.000	-3.257
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.596	-1.210	0.000	0.000	-0.293	0.000	0.000	0.000	0.000	0.000	0.000	-2.099
APR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.294	-0.544	0.000	0.000	-0.165	0.000	0.000	0.000	0.000	0.000	0.000	-1.004
MAY	SEN CL	-0.002	0.028	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.020
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.072	-0.125	0.000	0.000	-0.053	0.000	0.000	0.000	0.000	0.000	0.000	-0.249
JUN	SEN CL	0.069	0.247	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.321
	LAT CL					0.061			0.000		0.000	0.000	0.061
	HEATNG	-0.020	-0.040	0.000	0.000	-0.017	0.000	0.000	0.000	0.000	0.000	0.000	-0.076
JUL	SEN CL	0.152	0.493	0.000	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.666
	LAT CL					0.127			0.000		0.000	0.000	0.127
	HEATNG	-0.030	-0.032	0.000	0.000	-0.023	0.000	0.000	0.000	0.000	0.000	0.000	-0.085
AUG	SEN CL	0.110	0.437	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.556
	LAT CL					0.112			0.000		0.000	0.000	0.112
	HEATNG	-0.199	-0.336	0.000	0.000	-0.110	0.000	0.000	0.000	0.000	0.000	0.000	-0.645
SEP	SEN CL	0.016	0.087	0.000	0.000	-0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.100
	LAT CL					0.017			0.000		0.000	0.000	0.017
	HEATNG	-0.514	-1.082	0.000	0.000	-0.242	0.000	0.000	0.000	0.000	0.000	0.000	-1.838
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.721	-1.580	0.000	0.000	-0.329	0.000	0.000	0.000	0.000	0.000	0.000	-2.630
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-1.027	-2.267	0.000	0.000	-0.467	0.000	0.000	0.000	0.000	0.000	0.000	-3.761
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-6.580	-13.947	0.000	0.000	-3.135	0.000	0.000	0.000	0.000	0.000	0.000	-23.662
TOT	SEN CL	0.345	1.291	0.000	0.000	0.026	0.000	0.000	0.000	0.000	0.000	0.000	1.662
	LAT CL					0.319			0.000		0.000	0.000	0.319

REPORT- LS-E Space Monthly Load Components EL1 West Perim Plnm (T.W29) WEATHER FILE- Toronto ON CWEC

	(UNITS=MBTU)	WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-0.742	-1.632	0.000	0.000	-0.346	0.000	0.000	0.000	0.000	0.000	0.000	-2.721
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.647	-1.428	0.000	0.000	-0.319	0.000	0.000	0.000	0.000	0.000	0.000	-2.394
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.554	-1.214	0.000	0.000	-0.292	0.000	0.000	0.000	0.000	0.000	0.000	-2.060
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.335	-0.768	0.000	0.000	-0.195	0.000	0.000	0.000	0.000	0.000	0.000	-1.299
APR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.152	-0.348	0.000	0.000	-0.107	0.000	0.000	0.000	0.000	0.000	0.000	-0.608
MAY	SEN CL	0.012	0.020	0.000	0.000	-0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.026
	LAT CL					0.001			0.000		0.000	0.000	0.001
	HEATNG	-0.031	-0.082	0.000	0.000	-0.032	0.000	0.000	0.000	0.000	0.000	0.000	-0.145
JUN	SEN CL	0.092	0.160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.251
	LAT CL					0.041			0.000		0.000	0.000	0.041
	HEATNG	-0.006	-0.026	0.000	0.000	-0.009	0.000	0.000	0.000	0.000	0.000	0.000	-0.042
JUL	SEN CL	0.167	0.314	0.000	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.493
	LAT CL					0.086			0.000		0.000	0.000	0.086
	HEATNG	-0.004	-0.023	0.000	0.000	-0.012	0.000	0.000	0.000	0.000	0.000	0.000	-0.039
AUG	SEN CL	0.156	0.280	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.439
	LAT CL					0.077			0.000		0.000	0.000	0.077
	HEATNG	-0.084	-0.217	0.000	0.000	-0.070	0.000	0.000	0.000	0.000	0.000	0.000	-0.370
SEP	SEN CL	0.040	0.059	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.093
	LAT CL					0.012			0.000		0.000	0.000	0.012
	HEATNG	-0.291	-0.687	0.000	0.000	-0.161	0.000	0.000	0.000	0.000	0.000	0.000	-1.140
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.457	-1.003	0.000	0.000	-0.219	0.000	0.000	0.000	0.000	0.000	0.000	-1.680
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-0.668	-1.439	0.000	0.000	-0.311	0.000	0.000	0.000	0.000	0.000	0.000	-2.419
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	-3.973	-8.868	0.000	0.000	-2.075	0.000	0.000	0.000	0.000	0.000	0.000	-14.916
TOT	SEN CL	0.467	0.832	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	1.303
	LAT CL					0.218			0.000		0.000	0.000	0.218

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-E Space Monthly Load Components EL1 Core Plnm (T.C30) WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	0.000	-13.307	0.000	0.000	-0.229	0.000	0.000	0.000	0.000	0.000	0.000	-13.536
JAN	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	-11.640	0.000	0.000	-0.205	0.000	0.000	0.000	0.000	0.000	0.000	-11.845
FEB	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	-9.901	0.000	0.000	-0.185	0.000	0.000	0.000	0.000	0.000	0.000	-10.086
MAR	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	-6.265	0.000	0.000	-0.126	0.000	0.000	0.000	0.000	0.000	0.000	-6.391
APR	SEN CL	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	-2.851	0.000	0.000	-0.071	0.000	0.000	0.000	0.000	0.000	0.000	-2.923
MAY	SEN CL	0.000	0.176	0.000	0.000	-0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.170
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	-0.684	0.000	0.000	-0.020	0.000	0.000	0.000	0.000	0.000	0.000	-0.704
JUN	SEN CL	0.000	1.317	0.000	0.000	-0.008	0.000	0.000	0.000	0.000	0.000	0.000	1.309
	LAT CL					0.022			0.000		0.000	0.000	0.022
	HEATNG	0.000	-0.223	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	-0.228
JUL	SEN CL	0.000	2.569	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	2.572
	LAT CL					0.054			0.000		0.000	0.000	0.054
	HEATNG	0.000	-0.196	0.000	0.000	-0.007	0.000	0.000	0.000	0.000	0.000	0.000	-0.203
AUG	SEN CL	0.000	2.293	0.000	0.000	-0.004	0.000	0.000	0.000	0.000	0.000	0.000	2.289
	LAT CL					0.050			0.000		0.000	0.000	0.050
	HEATNG	0.000	-1.773	0.000	0.000	-0.046	0.000	0.000	0.000	0.000	0.000	0.000	-1.819
SEP	SEN CL	0.000	0.483	0.000	0.000	-0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.478
	LAT CL					0.009			0.000		0.000	0.000	0.009
	HEATNG	0.000	-5.602	0.000	0.000	-0.108	0.000	0.000	0.000	0.000	0.000	0.000	-5.710
OCT	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	-8.181	0.000	0.000	-0.144	0.000	0.000	0.000	0.000	0.000	0.000	-8.325
NOV	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	-11.736	0.000	0.000	-0.200	0.000	0.000	0.000	0.000	0.000	0.000	-11.936
DEC	SEN CL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	LAT CL					0.000			0.000		0.000	0.000	0.000
	HEATNG	0.000	-72.359	0.000	0.000	-1.346	0.000	0.000	0.000	0.000	0.000	0.000	-73.706
TOT	SEN CL	0.000	6.839	0.000	0.000	-0.021	0.000	0.000	0.000	0.000	0.000	0.000	6.818
	LAT CL					0.136			0.000		0.000	0.000	0.136

REPORT- LS-F Building Monthly Load Component WEATHER FILE- Toronto ON CWEC

(UNITS=MBTU)		WALLS	ROOFS	INT SUR	UND SUR	INFIL	WIN CON	WIN SOL	OCCUP	LIGHTS	EQUIP	SOURCE	TOTAL
	HEATNG	-14.424	-0.244	0.000	-4.858	-13.982	-86.745	16.710	7.140	8.289	7.313	0.000	-80.802
JAN	SEN CL	-2.204	-0.212	0.000	-2.965	-4.005	-19.476	21.385	92.209	31.006	25.492	0.000	141.230
	LAT CL					0.000			75.129		0.000	0.000	75.129
	HEATNG	-12.188	-0.196	0.000	-4.485	-12.404	-74.888	17.932	7.149	7.414	6.817	0.000	-64.850
FEB	SEN CL	-2.397	-0.214	0.000	-3.346	-4.169	-21.218	25.827	92.236	30.553	25.428	0.000	142.701
	LAT CL					0.000			75.186		0.000	0.000	75.186
	HEATNG	-9.257	-0.143	0.000	-4.441	-9.799	-60.623	18.285	5.733	6.004	6.021	0.000	-48.221
MAR	SEN CL	-3.076	-0.230	0.000	-4.303	-5.357	-26.766	38.534	114.125	37.361	32.432	0.000	182.721
	LAT CL					0.000			93.246		0.000	0.000	93.246
	HEATNG	-4.714	-0.084	0.000	-3.047	-5.280	-34.976	13.075	2.694	3.180	3.556	0.000	-25.595
APR	SEN CL	-2.833	-0.182	0.000	-5.026	-4.874	-25.574	49.715	112.375	37.138	33.309	0.000	194.046
	LAT CL					0.064			91.512		0.000	0.000	91.576
	HEATNG	-1.867	-0.051	0.000	-1.631	-2.744	-19.431	8.847	1.119	1.608	2.200	0.000	-11.951
MAY	SEN CL	-1.142	-0.137	0.000	-5.095	-3.157	-19.797	65.447	103.981	32.989	32.099	0.000	205.188
	LAT CL					0.246			84.051		0.000	0.000	84.297
	HEATNG	-0.367	-0.024	0.000	-0.456	-0.942	-7.204	3.620	0.267	0.526	0.919	0.000	-3.660
JUN	SEN CL	1.584	-0.068	0.000	-4.488	-0.748	-9.397	70.367	114.334	36.642	35.908	0.000	244.133
	LAT CL					2.758			92.740		0.000	0.000	95.498
	HEATNG	-0.058	-0.007	0.000	-0.115	-0.343	-2.642	1.180	0.226	0.327	0.466	0.000	-0.966
JUL	SEN CL	3.555	-0.040	0.000	-3.589	0.453	-2.953	69.536	109.985	36.611	35.210	0.000	248.768
	LAT CL					4.787			88.538		0.000	0.000	93.325
	HEATNG	-0.093	-0.011	0.000	-0.125	-0.528	-4.020	1.789	0.220	0.383	0.633	0.000	-1.752
AUG	SEN CL	3.295	-0.059	0.000	-2.688	0.017	-5.759	65.427	114.515	36.701	36.411	0.000	247.860
	LAT CL					4.110			92.736		0.000	0.000	96.846
	HEATNG	-1.018	-0.026	0.000	-0.389	-1.584	-11.067	4.324	0.688	1.124	1.469	0.000	-6.479
SEP	SEN CL	0.326	-0.100	0.000	-2.255	-2.308	-14.923	58.731	109.130	37.004	33.988	0.000	219.594
	LAT CL					1.430			88.429		0.000	0.000	89.860
	HEATNG	-4.109	-0.079	0.000	-1.142	-4.366	-30.519	9.727	1.999	2.908	3.090	0.000	-22.491
OCT	SEN CL	-2.219	-0.150	0.000	-2.307	-4.019	-21.344	41.786	103.074	36.041	31.190	0.000	182.054
	LAT CL					0.327			83.611		0.000	0.000	83.938
	HEATNG	-7.742	-0.133	0.000	-2.247	-7.246	-48.045	9.065	3.767	6.022	4.665	0.000	-41.894
NOV	SEN CL	-2.505	-0.161	0.000	-2.408	-4.161	-20.036	18.523	100.380	37.157	29.306	0.000	156.094
	LAT CL					0.058			82.329		0.000	0.000	82.387
	HEATNG	-12.627	-0.191	0.000	-3.683	-12.281	-74.779	11.010	7.481	9.266	7.310	0.000	-68.493
DEC	SEN CL	-2.431	-0.204	0.000	-2.695	-3.887	-19.591	16.460	102.740	35.622	28.384	0.000	154.399
	LAT CL					0.001			83.480		0.000	0.000	83.481
	HEATNG	-68.464	-1.191	0.000	-26.623	-71.498	-454.936	115.565	38.484	47.050	44.455	0.000	-377.158
TOT	SEN CL	-10.047	-1.757	0.000	-41.164	-36.215	-206.836	541.734	1269.045	424.821	379.188	0.000	2318.769
	LAT CL					13.781			1030.954		0.000	0.000	1044.736

REPORT- LS-G Space Daylighting Summary EL1 South Perim Spc (G.S1) WEATHER FILE- Toronto ON CWEC

SPACE EL1 South Perim Spc (G.S1)

	PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (ALL HOURS)			PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (REPORT SCHEDULE HOURS)			REPORT SCHEDULE HOURS WITH SUN UP: AVERAGE DAYLIGHT ILLUMINANCE (FOOTCANDLES)		PERCENT HOURS DAYLIGHT ILLUMINANCE ABOVE SETPOINT		AVERAGE GLARE INDEX		PERCENT HOURS GLARE TOO HIGH	
MONTH	TOTAL ZONE	REF PT 1	REF PT 2	TOTAL ZONE	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2
JAN	51.9	51.9	0.0	51.9	51.9	0.0	153.1	0.0	51.4	0.0	14.6	0.0	34.2	0.0
FEB	53.2	53.2	0.0	53.2	53.2	0.0	170.0	0.0	58.8	0.0	16.8	0.0	40.3	0.0
MAR	58.5	58.5	0.0	58.5	58.5	0.0	157.1	0.0	58.1	0.0	16.0	0.0	40.9	0.0
APR	64.2	64.2	0.0	64.2	64.2	0.0	145.9	0.0	62.9	0.0	16.6	0.0	43.9	0.0
MAY	76.7	76.7	0.0	76.7	76.7	0.0	137.9	0.0	66.0	0.0	17.0	0.0	49.2	0.0
JUN	78.0	78.0	0.0	78.0	78.0	0.0	128.3	0.0	66.7	0.0	17.7	0.0	48.3	0.0
JUL	73.4	73.4	0.0	73.4	73.4	0.0	123.4	0.0	65.4	0.0	17.6	0.0	46.1	0.0
AUG	76.8	76.8	0.0	76.8	76.8	0.0	142.7	0.0	68.6	0.0	18.2	0.0	49.7	0.0
SEP	66.6	66.6	0.0	66.6	66.6	0.0	175.1	0.0	65.2	0.0	17.9	0.0	51.1	0.0
OCT	58.8	58.8	0.0	58.8	58.8	0.0	163.5	0.0	61.8	0.0	16.5	0.0	45.7	0.0
NOV	34.3	34.3	0.0	34.3	34.3	0.0	110.2	0.0	41.0	0.0	13.5	0.0	26.9	0.0
DEC	41.6	41.6	0.0	41.6	41.6	0.0	126.3	0.0	41.3	0.0	12.4	0.0	26.5	0.0
ANNUAL	61.5	61.5	0.0	61.5	61.5	0.0	143.9	0.0	60.2	0.0	16.5	0.0	43.0	0.0

REPORT- LS-G Space Daylighting Summary EL1 East Perim Spc (G.E2) WEATHER FILE- Toronto ON CWEC

SPACE EL1 East Perim Spc (G.E2)

	PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (ALL HOURS)			PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (REPORT SCHEDULE HOURS)			REPORT SCHEDULE HOURS WITH SUN UP: AVERAGE DAYLIGHT ILLUMINANCE (FOOTCANDLES)		PERCENT HOURS DAYLIGHT ILLUMINANCE ABOVE SETPOINT		AVERAGE GLARE INDEX		PERCENT HOURS GLARE TOO HIGH	
MONTH	TOTAL ZONE	REF PT 1	REF PT 2	TOTAL ZONE	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2
JAN	44.2	44.2	0.0	44.2	44.2	0.0	60.8	0.0	44.0	0.0	12.6	0.0	12.9	0.0
FEB	47.2	47.2	0.0	47.2	47.2	0.0	87.7	0.0	51.6	0.0	14.9	0.0	17.9	0.0
MAR	58.8	58.8	0.0	58.8	58.8	0.0	116.2	0.0	56.6	0.0	14.9	0.0	25.4	0.0
APR	65.1	65.1	0.0	65.1	65.1	0.0	126.3	0.0	61.3	0.0	15.7	0.0	28.2	0.0
MAY	78.3	78.3	0.0	78.3	78.3	0.0	157.9	0.0	69.1	0.0	16.8	0.0	38.4	0.0
JUN	79.7	79.7	0.0	79.7	79.7	0.0	152.4	0.0	69.4	0.0	17.7	0.0	40.0	0.0
JUL	75.0	75.0	0.0	75.0	75.0	0.0	142.9	0.0	68.7	0.0	17.4	0.0	35.6	0.0
AUG	81.2	81.2	0.0	81.2	81.2	0.0	137.4	0.0	69.9	0.0	17.6	0.0	33.8	0.0
SEP	66.6	66.6	0.0	66.6	66.6	0.0	131.8	0.0	63.7	0.0	16.6	0.0	28.3	0.0
OCT	53.7	53.7	0.0	53.7	53.7	0.0	95.2	0.0	54.8	0.0	14.9	0.0	26.1	0.0
NOV	31.4	31.4	0.0	31.4	31.4	0.0	52.9	0.0	36.7	0.0	12.1	0.0	9.8	0.0
DEC	35.7	35.7	0.0	35.7	35.7	0.0	48.2	0.0	33.5	0.0	10.7	0.0	10.3	0.0
ANNUAL	60.2	60.2	0.0	60.2	60.2	0.0	115.3	0.0	58.6	0.0	15.5	0.0	27.3	0.0

REPORT- LS-G Space Daylighting Summary EL1 North Perim Spc (G.N3) WEATHER FILE- Toronto ON CWEC

SPACE EL1 North Perim Spc (G.N3)

	PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (ALL HOURS)			PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (REPORT SCHEDULE HOURS)			REPORT SCHEDULE HOURS WITH SUN UP: AVERAGE DAYLIGHT ILLUMINANCE (FOOTCANDLES)		PERCENT HOURS DAYLIGHT ILLUMINANCE ABOVE SETPOINT		AVERAGE GLARE INDEX		PERCENT HOURS GLARE TOO HIGH	
MONTH	TOTAL ZONE	REF PT 1	REF PT 2	TOTAL ZONE	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2
JAN	25.6	25.6	0.0	25.6	25.6	0.0	33.5	0.0	27.4	0.0	10.9	0.0	0.0	0.0
FEB	43.2	43.2	0.0	43.2	43.2	0.0	47.7	0.0	46.4	0.0	13.7	0.0	0.3	0.0
MAR	57.9	57.9	0.0	57.9	57.9	0.0	58.0	0.0	56.4	0.0	14.1	0.0	4.0	0.0
APR	63.7	63.7	0.0	63.7	63.7	0.0	72.2	0.0	62.9	0.0	15.5	0.0	13.6	0.0
MAY	77.8	77.8	0.0	77.8	77.8	0.0	92.2	0.0	67.8	0.0	16.7	0.0	31.7	0.0
JUN	79.8	79.8	0.0	79.8	79.8	0.0	99.8	0.0	71.2	0.0	18.0	0.0	40.4	0.0
JUL	75.7	75.7	0.0	75.7	75.7	0.0	87.2	0.0	70.2	0.0	17.5	0.0	27.2	0.0
AUG	81.8	81.8	0.0	81.8	81.8	0.0	81.4	0.0	73.4	0.0	17.5	0.0	14.4	0.0
SEP	66.5	66.5	0.0	66.5	66.5	0.0	65.1	0.0	64.9	0.0	15.7	0.0	3.3	0.0
OCT	51.1	51.1	0.0	51.1	51.1	0.0	52.3	0.0	50.3	0.0	13.6	0.0	1.3	0.0
NOV	26.4	26.4	0.0	26.4	26.4	0.0	34.7	0.0	30.5	0.0	11.1	0.0	0.0	0.0
DEC	24.7	24.7	0.0	24.7	24.7	0.0	27.2	0.0	21.6	0.0	9.2	0.0	0.0	0.0
ANNUAL	56.8	56.8	0.0	56.8	56.8	0.0	66.5	0.0	56.4	0.0	14.9	0.0	13.4	0.0

Base Case Model-1 DOE-2.2-48r 5/01/2016 20:26:47 BDL RUN 3

REPORT- LS-G Space Daylighting Summary EL1 West Perim Spc (G.W4) WEATHER FILE- Toronto ON CWEC

SPACE EL1 West Perim Spc (G.W4)

MONTH	PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (ALL HOURS) TOTAL ZONE	REF PT 1	REF PT 2	PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (REPORT SCHEDULE HOURS) TOTAL ZONE	REF PT 1	REF PT 2	REPORT SCHEDULE HOURS WITH SUN UP: AVERAGE DAYLIGHT ILLUMINANCE (FOOTCANDLES) REF PT 1	REF PT 2	PERCENT HOURS DAYLIGHT ILLUMINANCE ABOVE SETPOINT REF PT 1	REF PT 2	AVERAGE GLARE INDEX REF PT 1	REF PT 2	PERCENT HOURS GLARE TOO HIGH REF PT 1	REF PT 2
JAN	42.8	42.8	0.0	42.8	42.8	0.0	64.3	0.0	42.8	0.0	12.2	0.0	10.8	0.0
FEB	47.5	47.5	0.0	47.5	47.5	0.0	94.4	0.0	53.2	0.0	14.9	0.0	17.9	0.0
MAR	55.7	55.7	0.0	55.7	55.7	0.0	99.3	0.0	56.4	0.0	14.6	0.0	17.7	0.0
APR	62.2	62.2	0.0	62.2	62.2	0.0	119.2	0.0	61.7	0.0	15.7	0.0	24.2	0.0
MAY	74.2	74.2	0.0	74.2	74.2	0.0	130.7	0.0	66.2	0.0	16.3	0.0	32.6	0.0
JUN	76.1	76.1	0.0	76.1	76.1	0.0	143.3	0.0	67.9	0.0	17.6	0.0	38.3	0.0
JUL	68.0	68.0	0.0	68.0	68.0	0.0	132.7	0.0	64.8	0.0	17.2	0.0	32.9	0.0
AUG	75.1	75.1	0.0	75.1	75.1	0.0	128.7	0.0	69.9	0.0	17.5	0.0	30.1	0.0
SEP	61.8	61.8	0.0	61.8	61.8	0.0	118.8	0.0	62.9	0.0	16.3	0.0	24.6	0.0
OCT	53.6	53.6	0.0	53.6	53.6	0.0	98.4	0.0	55.9	0.0	14.8	0.0	19.4	0.0
NOV	28.9	28.9	0.0	28.9	28.9	0.0	57.6	0.0	36.1	0.0	12.0	0.0	7.2	0.0
DEC	35.3	35.3	0.0	35.3	35.3	0.0	48.9	0.0	33.5	0.0	10.4	0.0	6.8	0.0
ANNUAL	57.2	57.2	0.0	57.2	57.2	0.0	107.9	0.0	57.8	0.0	15.3	0.0	23.5	0.0

REPORT- LS-G Space Daylighting Summary EL1 South Perim Spc (M.S11) WEATHER FILE- Toronto ON CWEC

SPACE EL1 South Perim Spc (M.S11)

MONTH	PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (ALL HOURS) TOTAL ZONE	REF PT 1	REF PT 2	PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (REPORT SCHEDULE HOURS) TOTAL ZONE	REF PT 1	REF PT 2	REPORT SCHEDULE HOURS WITH SUN UP: AVERAGE DAYLIGHT ILLUMINANCE (FOOTCANDLES) REF PT 1	REF PT 2	PERCENT HOURS DAYLIGHT ILLUMINANCE ABOVE SETPOINT REF PT 1	REF PT 2	AVERAGE GLARE INDEX REF PT 1	REF PT 2	PERCENT HOURS GLARE TOO HIGH REF PT 1	REF PT 2
JAN	52.3	52.3	0.0	52.3	52.3	0.0	160.4	0.0	51.7	0.0	14.5	0.0	33.5	0.0
FEB	53.7	53.7	0.0	53.7	53.7	0.0	178.0	0.0	59.7	0.0	16.6	0.0	37.0	0.0
MAR	60.0	60.0	0.0	60.0	60.0	0.0	164.4	0.0	60.1	0.0	15.8	0.0	37.7	0.0
APR	65.2	65.2	0.0	65.2	65.2	0.0	152.6	0.0	63.6	0.0	16.4	0.0	41.1	0.0
MAY	77.1	77.1	0.0	77.1	77.1	0.0	144.2	0.0	66.4	0.0	16.7	0.0	43.8	0.0
JUN	78.0	78.0	0.0	78.0	78.0	0.0	134.1	0.0	66.7	0.0	17.2	0.0	41.9	0.0
JUL	73.4	73.4	0.0	73.4	73.4	0.0	128.7	0.0	65.8	0.0	17.1	0.0	42.2	0.0
AUG	78.8	78.8	0.0	78.8	78.8	0.0	148.9	0.0	70.2	0.0	17.8	0.0	44.4	0.0
SEP	68.0	68.0	0.0	68.0	68.0	0.0	183.1	0.0	66.4	0.0	17.7	0.0	48.9	0.0
OCT	58.8	58.8	0.0	58.8	58.8	0.0	171.1	0.0	61.8	0.0	16.3	0.0	42.2	0.0
NOV	35.5	35.5	0.0	35.5	35.5	0.0	115.4	0.0	42.3	0.0	13.4	0.0	26.2	0.0
DEC	42.0	42.0	0.0	42.0	42.0	0.0	132.3	0.0	41.6	0.0	12.3	0.0	25.5	0.0
ANNUAL	62.2	62.2	0.0	62.2	62.2	0.0	150.6	0.0	61.0	0.0	16.2	0.0	39.6	0.0

REPORT- LS-G Space Daylighting Summary EL1 East Perim Spc (M.E12) WEATHER FILE- Toronto ON CWEC

SPACE EL1 East Perim Spc (M.E12)

	PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (ALL HOURS)			PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (REPORT SCHEDULE HOURS)			REPORT SCHEDULE HOURS WITH SUN UP: AVERAGE DAYLIGHT ILLUMINANCE (FOOTCANDLES)		PERCENT HOURS DAYLIGHT ILLUMINANCE ABOVE SETPOINT		AVERAGE GLARE INDEX		PERCENT HOURS GLARE TOO HIGH	
MONTH	TOTAL ZONE	REF PT 1	REF PT 2	TOTAL ZONE	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2	REF PT 1	REF PT 2
JAN	46.3	46.3	0.0	46.3	46.3	0.0	64.9	0.0	45.8	0.0	12.2	0.0	7.7	0.0
FEB	48.0	48.0	0.0	48.0	48.0	0.0	93.6	0.0	52.6	0.0	14.7	0.0	14.0	0.0
MAR	60.2	60.2	0.0	60.2	60.2	0.0	124.0	0.0	58.1	0.0	14.7	0.0	20.9	0.0
APR	66.6	66.6	0.0	66.6	66.6	0.0	134.8	0.0	62.4	0.0	15.5	0.0	22.8	0.0
MAY	78.5	78.5	0.0	78.5	78.5	0.0	168.4	0.0	69.7	0.0	16.6	0.0	30.9	0.0
JUN	80.4	80.4	0.0	80.4	80.4	0.0	162.4	0.0	70.2	0.0	17.5	0.0	31.2	0.0
JUL	75.7	75.7	0.0	75.7	75.7	0.0	152.1	0.0	69.3	0.0	17.2	0.0	26.3	0.0
AUG	81.7	81.7	0.0	81.7	81.7	0.0	146.3	0.0	71.5	0.0	17.4	0.0	25.9	0.0
SEP	69.5	69.5	0.0	69.5	69.5	0.0	140.5	0.0	65.9	0.0	16.3	0.0	24.1	0.0
OCT	54.5	54.5	0.0	54.5	54.5	0.0	101.5	0.0	55.6	0.0	14.6	0.0	16.7	0.0
NOV	33.4	33.4	0.0	33.4	33.4	0.0	56.5	0.0	38.7	0.0	11.9	0.0	4.3	0.0
DEC	37.2	37.2	0.0	37.2	37.2	0.0	51.4	0.0	35.5	0.0	10.3	0.0	5.5	0.0
ANNUAL	61.5	61.5	0.0	61.5	61.5	0.0	122.9	0.0	59.9	0.0	15.2	0.0	20.7	0.0

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