Q. Reference Section 5.1 - Kenmount Road Building Renovations - Please provide a copy of the April 2006 Newton Engineering report/analysis pertaining to the HVAC systems at the Kenmount Road building referred at p. 2.

A. Attachment A includes a copy of the April 2006 Newton Engineering report pertaining to the HVAC systems at the Kenmount Road building. This report was originally submitted as Appendix A of report *4.1 HVAC System Replacement* included with the 2007 Capital Budget Application.

Attachment B includes a June 2009 review of the 2nd and 3rd floor HVAC systems at the Kenmount Road building. This review was completed by the same engineer that authored the 2006 report that is provided as Attachment A.[1]

[1] CORE Engineering Inc. was known as Newton Engineering in April 2006.

HVAC Systems Analysis
NF Power Corporate Building
Kenmount Road, St. John's

HVAC Systems Analysis

NF Power Corporate Building
Kenmount Road, St. John's

Completed by:

Newton Engineering Limited 2005

Client:

Newfoundland Power – A Fortis Company

Date:
March 2006

Table of Contents

1.0 INTRODUCTION

Newton Engineering(2005) Limited(NEL) was retained by Newfoundland Power to re-evaluate the heating, ventilation and air-conditioning (HVAC) systems for the Kenmount Road office building. The first review of the system was completed in 1999 and the scope of this report includes updating capital cost estimates and energy consumption estimates for various replacement options. This evaluation will also outline the existing equipment and systems, their condition, and provide recommendations detailing upgrades based on cost, energy, and comfort.

Andrew Small, P. Eng., from NEL has visited the site on several occasions and has reviewed drawings that were available. This report will provide the Owner with an update as to the operation of the various systems and their conditions. Replacing the existing system components will be discussed and options for replacing the entire HVAC system with a much more energy efficient model will also be evaluated.

The Kenmount Road office building was built in 1968 as a two storey structure, consisting of a ground and first floor. One air-handling unit serviced these two floors with electric heat as the primary heat source. In 1979 two more floors were added and each floor was provided with its own air-handling system and again heated electrically. The total building contains approximately 4800 square meters of space.

2.0 DESCRIPTION

2.1 Existing H.V.A.C. System

The existing building consists of three existing air-handling systems, which provides both ventilation and air-conditioning for the entire complex, except for a special dedicated system, which serves the lower level computer room. These three systems are as follows:

1. Ground Floor/First Floor System - installed in 1968.
2. Second Floor System - installed in 1979.
3. Third Floor System - installed in 1979.

2.2 Ground Floor/First Floor System

The system designed for the original building in 1968 is commonly known as a multi-zone system, which consists of an air-handling unit, complete with a supply air fan, heating deck, cooling deck, return air fan, filters, mixing box and pneumatic control system. The system heating is generated using an electric heating coil and the cooling is obtained from what is generally referred to as a DX (Direct Expansion) system using refrigerant gas, compressors, condensers and cooling coils.

A multi-zone system is designed to control several unique zones in a building which have their own supply air duct and distribution. A temperature controller (thermostat) in a particular zone will call for either cooling or heating. This will operate a damper system in the air handling unit to supply either cold air or hot air to this particular zone from the cold deck or hot deck. Multi-zone systems were used frequently during this period of time until variable air volume (V.A.V) systems became more popular.

This multi-zone system was modified in 1985 to become a V.A.V. system. Changes were made to the unit and to the duct system in order to have this system installed. The V.A.V. system supplies conditioned air to V.A.V. boxes located in separate zones throughout the building. A thermostat in a zone will then control the air flow from a V.A.V. box. On a call for cooling, the maximum air will flow from a box and on a call for heating the box will supply a minimum air flow. V.A.V. systems are generally used in most environmentally controlled office spaces today. However, the type of V.A.V. boxes used here are dumping boxes, which means that any excess air not required for cooling is dumped into the ceiling space. This dumped excess air generally pressurizes the space above the ceiling tiles with cold air. A return fan located in the basement mechanical room pulls air from the ceiling space, exhausts a small portion and recycles the rest through the air handling unit.

The controls for this system have two components, the original pneumatic system, and a Direct Digital Control (D.D.C) computerized control system which has been added to control some aspects of the HVAC systems. The control system for this unit utilizes what is referred to as a free cooling option. This option allows outside air to be used to provide free cooling when needed provided outside conditions will allow it. The space control temperature has thermostats controlling V.A.V. boxes which will vary the air flow from a maximum position on a call for cooling to a minimum position on a call for heating. However, on a call for heating, a second stage of control will energize an electric baseboard heater in a particular zone.

As part of the ventilation system, the first two floors also have a number of washrooms which are provided with dedicated exhaust systems. These systems exhaust air directly to the exterior using roof mounted fans and were extended to the new roof after the extension occurred in 1979.

2.3 Second Floor/Third Floor System

The building's addition in 1979 added two floors to the building with separate air-handling V.A.V. systems. These systems consist of indoor air handling units with supply fans, electric heating coils, chilled water cooling coils, filters, mixing boxes and control systems. Cooling was achieved using a chilled water system which supplies chilled water to a cooling coil in each unit. The chilled water system consists of a roof mounted air-cooled condensing unit and a liquid cooler located in the third floor mechanical room.

The conditioned air from these units supplies air to V.A.V. boxes located throughout the space for various zones. The V.A.V. boxes in this case are ***NOT*** bypass boxes, but are referred to as true V.A.V. boxes. They are positioned to vary the air flow, however, as these boxes are controlled in a minimum position, the static pressure in the duct system rises. As the static pressure increases, a static pressure controller will decrease the air flow from the air-handling unit.

The controls for this system are also a pneumatic system modified to introduce a D.D.C interface. The system however does not have a free cooling cycle like the older units on the ground/first floor. This system does not have a return air fan to allow the removal of the total air to take advantage of free cooling when available.

These floors also have dedicated exhaust fans for washrooms, but in this case these fans provide the relief for the excess fresh air being introduced into the system from the air handling systems. The amount of fresh air being introduced into this system is equal to the capacity of the washroom exhaust system.

3.0 OPERATIONAL OBSERVATIONS

3.1 Ground Floor/First Floor System

As described earlier, the 38-year-old air-handling system for these two floors is a multi-zone air-handling system converted to V.A.V. operation using V.A.V. dumping boxes. Below are the main issues surrounding this system:

- The air-handling unit basically supplies a constant volume of air regardless of cooling need. This leads to wasted energy due to the fan running at full capacity even when the cooling loads are low.

- The V.A.V. boxes are dumping boxes, which are not recommended for large areas because they tend to cause cool pressurized ceiling spaces. This system is often responsible for comfort problems due to cold air dropping through return grilles and openings in the ceiling.

- The distribution of supply and return grilles, the zone airflows, and the number of V.A.V. boxes are not ideally balanced within the spaces because of changes to the building layouts that have occurred since the initial installation.

- The washroom exhaust system exhausts air directly to the exterior and does not have a heat recovery feature which would recover at least 60% of the energy contained in the warm exhaust air.

- The cooling system is operated using Freon R-22 refrigerant which is not considered an environmentally friendly refrigerant agent. This refrigerant is due to be phased out of commercial air conditioning equipment by the year 2010.

- This system is at the end of it's useful life and is generally in poor condition. It is expected that maintenance costs and reliability will cause problems in the near future.

- The fresh air dampers in the main air handling unit recently had to be changed due to excessive corrosion which implies that corrosion problems may be more extensive in other unit components.

- There are numerous comfort issues within the spaces due to the poor system layouts and operation.

3.2 Second/Third Floor System

These systems, as described earlier, are approximately twenty six years old and considered to be acceptable. However, we have identified several problems with the system:

- The air-handling unit static pressure controller is a motorized damper, which does not provide the accurate control needed in a V.A.V. system.

- The system does not have a return air fan which results in poor air circulation and the inability to provide free cooling when outdoor conditions permit.

- The distribution of supply and return grilles, the zone airflows, and the number of V.A.V. boxes are not ideally balanced within the spaces because of changes to the building layouts that have occurred since the initial installation.

- The washroom exhaust system exhausts air directly to the exterior and does not have a heat recovery feature which would recover at least 60% of the energy contained in the warm exhaust air.

- The refrigerant used is Freon R-22, which is not considered an environmental friendly refrigerant agent. This refrigerant is due to be phased out of commercial air conditioning equipment by the year 2010.

- There are comfort issues experienced with these systems, however not to the degree of the lower two floors.

4.0 EQUIPMENT DESCRIPTION

Following is a list and description of the major equipment being used for the three air-handling systems. We reviewed the condition of the equipment and discussed its operation with maintenance personnel.

4.1 Ground Floor/First Floor System (H.V.A.C Equipment)

- **Air Handling Unit** - Carrier 39E, Size 21. This unit is approximately 38 years old and has been changed from a multi-zone to a single zone unit. The unit itself, the housing, fans and filters, are in reasonably good condition. However, other components such as motors, v-belt drives, dampers, heating and cooling coils are subject to breakdowns and failures after a 25 year life cycle. This unit should be replaced with a properly designed V.A.V. unit. This system, although its physical appearance looks reasonably good, it is approaching the end of it's life.

- **Return Fan** - Woods Fans, Model EMM68 is an inline tubular fan. The fan and its housing is in good condition, but 38 years old has outlived its service life and should be replaced with a V.A.V. controlled fan.

- **Humidifier** - Nortec NHB-100. The humidifier is also 38 years old and in our opinion has exceeded its useful life and should be replaced.

- **Controls** - The control system is a combination of pneumatics and D.D.C which have been reasonably upgraded and are sufficient for today's use. The only real concern with the controls is their inability to directly control/monitor some of the equipment due to the pneumatic control interface.

4.2 Second Floor System (H.V.A.C Equipment)

- **Air Handling Unit** - Carrier Model 39ED21. The unit is approximately 26 years old and is commonly referred to as a built-up unit consisting of a fan section, cooling and heating coil section, a filter section and a mixing box. Similar to the ground floor unit, the housing (casing) looks to be in reasonably good condition, but working parts such as motors, v-belts, bearing, dampers, heating and cooling coils are all subject to breakdowns and failures after 25 years. This system, although its physical appearance looks reasonably good, it is approaching the end of it's life.

- **Humidifier** - Nortec Model #ES400. This electric humidifier is 26 years old and in our opinion has lived its useful life.

- **Controls** - The controls system is a combination of pneumatic and D.D.C. The system appears to be adequate, however we would recommend replacing the pneumatic controls with D.D.C. devices.

4.3 Third Floor System (H.V.A.C Equipment)

- **Air Handling Unit** - Carrier Model 39ED21. The unit is approximately 26 years old and it is commonly referred to as a built-up unit consisting of a fan section, cooling and heating coil section, a filter section and a mixing box. Similar to the ground floor unit, the housing (casing) looks to be in reasonably good condition, but working parts such as motors, v-belts, heating and cooling coils are all subject to breakdowns and failures after 25 years. In our opinion this system is in reasonably good condition and if maintained can operate efficiently for another 10 to 15 years.

- **Humidifier** - Nortec Model #ES400. This electric humidifier is 26 years old and in our opinion has lived its useful life.

- **Controls** - The controls system is a combination of pneumatic and D.D.C. The system appears to be adequate for today's needs and can be reused, however we would recommend replacing the pneumatic controls with D.D.C. devices.

4.4 Cooling System

There are two condensing units on the roof; one serves the air-conditioning for the ground floor while the other serves the chiller for the units on the second/third floors. A chiller is also located on the third floor.

4.4.1 Ground Floor Condensing Unit

The condensing unit serving the ground floor air handling unit is a Carrier Model 38AB-064400, located on the roof. The unit is 38 years old and is showing signs of aging with rusting occurring around the housing. This unit supplies Freon R-22 to a direct expansion cooling coil in the unit. The system is nearing the end of its useful life and should be replaced. As well Freon R-22 refrigerant, is ***not*** considered an environmentally friendly agent.

4.4.2 Second/Third Floor Units

This Carrier Model 38AE-004 condensing unit is also located on the roof and provides cooling to a liquid cooler located in the third floor Mechanical Room. This unit is not rusting as badly as the ground floor unit but is nearing the end of useful life.

4.4.3 Liquid Cooler

This Carrier chiller is located in the third floor Mechanical Room. This unit looks to be in good condition and has operated effectively for the past 26 years. However, it is nearing the end of its useful life.

5.0 RECOMMENDATIONS

The existing systems as described are at or very close to the end of their useful lives and several system options are available for replacement and upgrading. Energy costs for various systems will also be estimated using Carrier hourly analysis software. These operating costs can then be used to determine paybacks periods for the higher capital cost options.

Three system options are considered in the following analysis. Each of these options have some unique features from the other, especially with capital cost considerations. The three options we offer for consideration are as follows:

- Upgrade the existing systems utilizing the V.A.V. system approach
- Install a new Closed Loop Heat Pump System - conventional
- Install a new Ground Source Closed Loop Heat Pump System

5.1 Upgrade the Existing System (Option 1)

The recommended upgrades to the existing system will address problems and concerns that were raised in our observations. It will also bring the system up to today's indoor air quality standards.

- Replacing the air-handling unit for the ground/first floors.
- Replace all V.A.V. dumping boxes that exist on the ground/first floors.
- Add a new chilled water cooling system for all units.
- Revamp the duct system with an upgrading of the air distribution system and additional V.A.V. boxes.
- Add return air fans to the second and third floor units to enable proper air control and free cooling.

- Adjust air flow from V.A.V. boxes to meet today's fresh air requirements.
- Add variable frequency drive fan speed controllers to the air distribution system to control static pressure.
- Add a heat recovery unit for all washroom exhaust systems.
- Revamp the control system to add CO_2 sensors for fresh air control.

5.2 Closed Loop Heat Pump System (Option 2)

A more energy efficient system suited to this application is a closed loop heat pump system (CLHP). This system operates on the principle of moving heat around a building. If a space needs cooling because of equipment loads or solar loads, the heat from these areas is transferred to other areas needing heating. The transfer is achieved using water piping connecting water-to-air heat pumps strategically located throughout the ceiling space. Each heat pump would be considered a zone for a particular office or group of offices, and it supplies a constant volume of air flow to the space. If additional heat is needed in the system (winter), than an electric boiler will provide heat as required and conversely if heat is must be rejected (summer), then a cooling tower will remove excess heat from the system.

This system will provide both the heating and cooling while the introduction of fresh air will be achieved using a heat recovery system. The heat recovery unit will introduce 100% outside air into the ceiling space at or near the heat pumps. The return air will be extracted from the washrooms or from general areas to be exhausted through the heat recovery unit. The heat recovery unit will extract approximately 60% of the heat from the exhaust air.

5.3 Ground Source Heat Pump System (Option 3)

This system is very similar to the CLHP system described in 5.2, but the key difference lies in the heat source and heat sink. Piping installed in drilled wells provides the needed heat in winter and also provide the means to reject heat in the summer. Even though the temperature of the ground wells is 7.2°C there is sufficient heat available to heat this building. The low ground temperature also provides almost free cooling throughout the summer regardless of the outdoor temperatures. To prevent freezing an environmentally friendly food grade anti-freeze solution is used in the circulation loop between the building and the multiple wells. A heat exchanger will transfer the heat gained from the wells to the building loop where the heat pumps will then operate to cool or heat the spaces.

This system has the lowest energy costs of all conventional building heating and cooling systems and is a proven system. There are numerous buildings throughout the city, which are served by a ground source heat pump system. Another advantage is the reduction in the building connected electrical load as the ground source heat pump requires only one unit of electrical energy to produce 3 units of heat output. This translates into an overall estimated demand reduction for the building of approximately 200kVa.

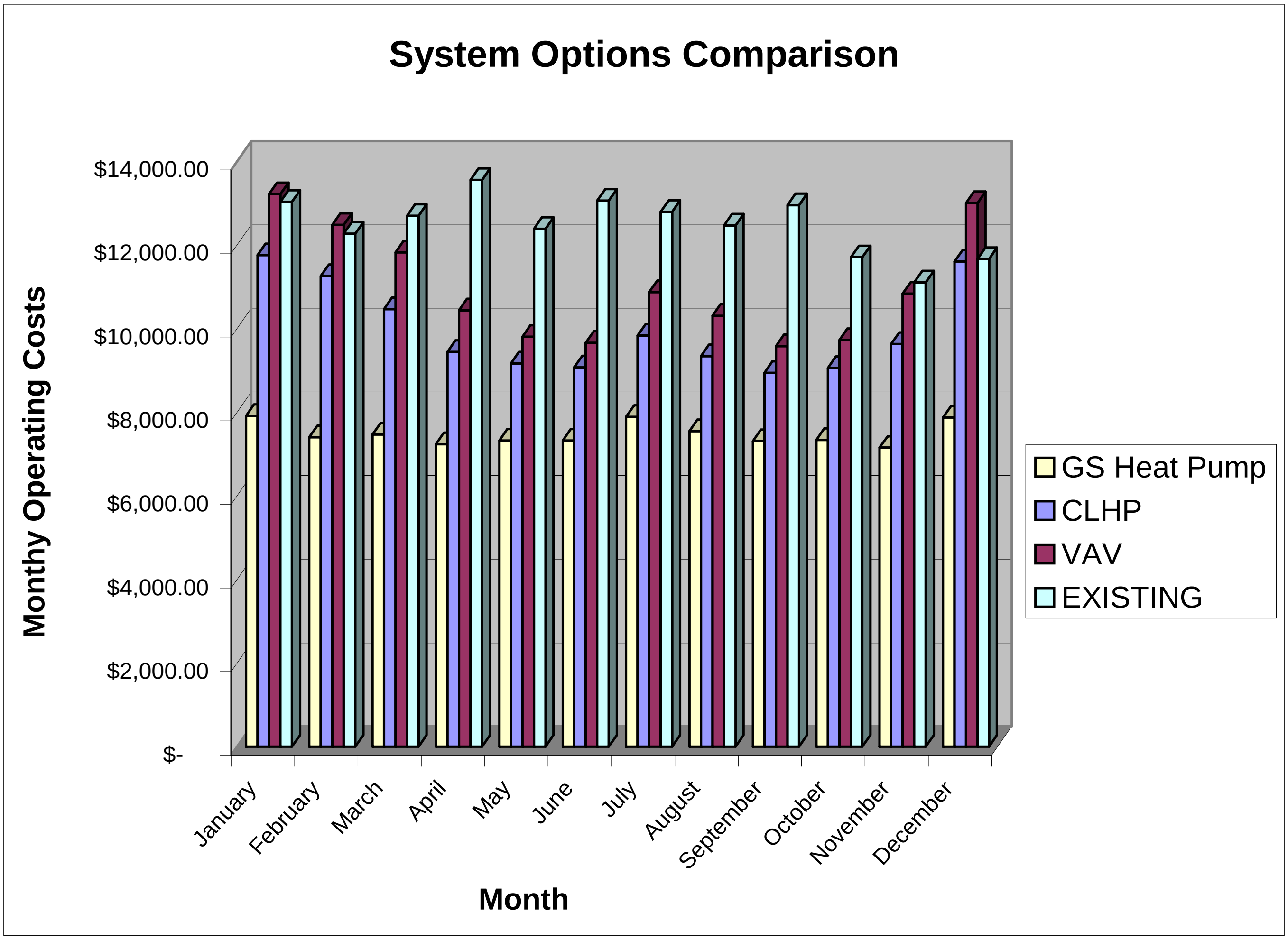
6.0 OPERATING AND CAPITAL COSTS

The estimated operating and budget capital costs for a V.A.V., CLHP and ground source systems are provided in the table below with the energy model summary provided in Attachment A. The electric energy costs calculated are based on an energy rate of 6.7 ¢/kWh while the demand rates are calculated using $6.64/kVa. The operating costs given below are estimates of the energy consumption of the systems options as described in section 5.0 including the savings associated with upgrades to the existing lighting systems. The maintenance costs associated with each system is also considered and provided in the analysis table.

Component	New V.A.V. System	C.L.H.P.	Ground Source Heat Pumps
LEVEL 1 AND 2 SYSTEMS			
Est. Demolition Costs (Level 1&2)	$35,000	$35,000	$35,000
Est. Construction Costs (Level 1&2)	$350,000	$460,000	$528,000
Est. Engineering Costs (Level 1&2)	$42,000	$55,000	$62,000
Total Est. Capital Costs (Level 1&2)	**$427,000**	**$550,000**	**$625,000**
LEVEL 3 AND 4 SYSTEMS			
Est. Demolition Costs (Level 3&4)	$20,000	$35,000	$35,000
Est. Construction Costs (Level 3&4)	$210,000	$460,000	$528,000
Est. Engineering Costs (Level 3&4)	$20,000	$55,000	$62,000
Total Est. Capital Costs (Level 3&4)	**$250,000**	**$550,000**	**$625,000**
TOTAL Est. Annual Building Energy Costs	**$131,701.00**	**$119,534.00**	**$89,730.00**
TOTAL Est. Annual HVAC Energy Costs	**$58,344.00**	**$40,642.00**	**$15,750.00**
Estimated Annual Maintenance Costs	**$14,350.00**	**$17,400.00**	**$16,350.00**

The current energy consumption and demand levels are provided in Attachment B for the previous 12 months. These costs were determined using 6.7 ¢/kWh and $6.64/kVa Maintenance costs estimates are based on ASHRAE 2003 Applications Handbook.

Attachment A
Energy Analysis Summary


System Options Comparison
Monthy Operating Costs
$14,000.00
$12,000.00
$10,000.00
$8,000.00
$6,000.00
$4,000.00
$2,000.00
$-
January
February
March
April
May
June
July
August
September
October
November
December
Month
GS Heat Pump
CLHP
VAV
EXISTING

Estimated Energy Consumption Variable Air Volume System NF Power Corporate Building Kenmount Road					
Date	**Demand**	**Energy**	**Demand Cost***	**Energy Cost**	**Total Monthly**
January	468	150477	$ 3,134.08	$ 10,081.96	$ 13,216.04
February	472	139484	$ 3,134.08	$ 9,345.43	$ 12,479.51
March	423	129576	$ 3,134.08	$ 8,681.59	$ 11,815.67
April	395	108959	$ 3,134.08	$ 7,300.25	$ 10,434.33
May	361	99544	$ 3,134.08	$ 6,669.45	$ 9,803.53
June	358	97313	$ 3,134.08	$ 6,519.97	$ 9,654.05
July	408	115432	$ 3,134.08	$ 7,733.94	$ 10,868.02
August	389	106965	$ 3,134.08	$ 7,166.66	$ 10,300.74
September	361	96148	$ 3,134.08	$ 6,441.92	$ 9,576.00
October	359	98280	$ 3,134.08	$ 6,584.76	$ 9,718.84
November	400	114903	$ 3,134.08	$ 7,698.50	$ 10,832.58
December	453	147290	$ 3,134.08	$ 9,868.43	$ 13,002.51
		Totals	**$ 37,608.96**	**$ 94,092.86**	**$ 131,701.82**

Total Annual Estimated Energy/Demand Cost: $ 131,701.82

Notes:

1. Using: $6.64/kVa for demand and $0.067/kWh for energy costs
2. * Demand based on highest monthly demand(ie. 472kVa)
3. Estimates include all loads including lighting, computers, equipment, etc.

Estimated Energy Consumption
Closed Loop Heat Pump

NF Power Corporate Building

Kenmount Road

Date	Demand	Energy	Demand Cost*	Energy Cost	Total Monthly
January	479	125077	$ 3,373.12	$ 8,380.16	$ 11,753.28
February	508	117638	$ 3,373.12	$ 7,881.75	$ 11,254.87
March	405	105764	$ 3,373.12	$ 7,086.19	$ 10,459.31
April	369	90536	$ 3,373.12	$ 6,065.91	$ 9,439.03
May	318	86415	$ 3,373.12	$ 5,789.81	$ 9,162.93
June	281	85048	$ 3,373.12	$ 5,698.22	$ 9,071.34
July	304	96416	$ 3,373.12	$ 6,459.87	$ 9,832.99
August	293	88995	$ 3,373.12	$ 5,962.67	$ 9,335.79
September	282	83015	$ 3,373.12	$ 5,562.01	$ 8,935.13
October	301	84771	$ 3,373.12	$ 5,679.66	$ 9,052.78
November	363	93358	$ 3,373.12	$ 6,254.99	$ 9,628.11
December	450	122773	$ 3,373.12	$ 8,225.79	$ 11,598.91
		Totals	**$ 40,477.44**	**$ 79,047.03**	**$ 119,524.47**

Total Annual Estimated Energy/Demand Cost: $ 119,524.47

Notes:

1. Using: $6.64/kVa for demand and $0.067/kWh for energy costs
2. * Demand based on highest monthly demand(ie. 508kVa)
3. Estimates include all loads including lighting, computers, equipment, etc.

Estimated Energy Consumption Ground Source Heat Pump NF Power Corporate Building Kenmount Road					
Date	**Demand**	**Energy**	**Demand Cost***	**Energy Cost**	**Total Monthly**
January	304	85256	$ 2,197.84	$ 5,712.15	$ 7,909.99
February	331	77618	$ 2,197.84	$ 5,200.41	$ 7,398.25
March	240	78649	$ 2,197.84	$ 5,269.48	$ 7,467.32
April	217	75146	$ 2,197.84	$ 5,034.78	$ 7,232.62
May	227	76445	$ 2,197.84	$ 5,121.82	$ 7,319.66
June	240	76494	$ 2,197.84	$ 5,125.10	$ 7,322.94
July	252	84862	$ 2,197.84	$ 5,685.75	$ 7,883.59
August	247	79764	$ 2,197.84	$ 5,344.19	$ 7,542.03
September	240	76193	$ 2,197.84	$ 5,104.93	$ 7,302.77
October	223	76627	$ 2,197.84	$ 5,134.01	$ 7,331.85
November	213	73899	$ 2,197.84	$ 4,951.23	$ 7,149.07
December	275	84665	$ 2,197.84	$ 5,672.56	$ 7,870.40
		Totals	**$ 26,374.08**	**$ 63,356.41**	**$ 89,730.49**

Total Annual Estimated Energy/Demand Cost: $ 89,730.49

Notes:

1. Using: $6.64/kVa for demand and $0.067/kWh for energy costs
2. * Demand based on highest monthly demand(ie. 331kVa)
3. Estimates include all loads including lighting, computers, equipment, etc.

Attachment B
Existing Energy Use Summary

Existing Energy Consumption

NF Power Corporate Building

Kenmount Road

Date	Demand	Energy	Demand Cost*	Energy Cost	Total Monthly
March 17, 2005	500	130000	$ 3,984.00	$ 8,710.00	$ 12,694.00
April 18, 2005	480	142800	$ 3,984.00	$ 9,567.60	$ 13,551.60
May 17, 2005	440	125400	$ 3,984.00	$ 8,401.80	$ 12,385.80
June 17, 2005	480	135500	$ 3,984.00	$ 9,078.50	$ 13,062.50
July 19, 2005	480	131500	$ 3,984.00	$ 8,810.50	$ 12,794.50
August 18, 2005	500	126600	$ 3,984.00	$ 8,482.20	$ 12,466.20
September 19, 2005	500	133800	$ 3,984.00	$ 8,964.60	$ 12,948.60
October 18, 2005	400	115200	$ 3,984.00	$ 7,718.40	$ 11,702.40
November 16, 2005	440	106200	$ 3,984.00	$ 7,115.40	$ 11,099.40
December 15, 2005	420	114600	$ 3,984.00	$ 7,678.20	$ 11,662.20
January 16, 2006	500	135000	$ 3,984.00	$ 9,045.00	$ 13,029.00
February 15, 2006	600	123600	$ 3,984.00	$ 8,281.20	$ 12,265.20
		Totals	**$ 47,808.00**	**$ 101,853.40**	**$ 149,661.40**

Total Annual Cost **$ 149,661.40**

Notes:

1. Using: $6.64/kVa for demand and $0.067/kWh for energy costs
2. * Demand based on highest monthly demand(ie. 600kVa)

NF Power - 2^{nd} and 3^{rd} Floor HVAC Review

NF Power – 2nd and 3rd Floor HVAC Review

Completed By: Andrew Small, P. Eng (CORE Engineering Inc.)

Date: June 15, 2009

On June 15,2009 Shaun Marshall, P. Eng and Andrew Small, P. Eng of CORE Engineering Inc. visited the NF Power Kenmount Road office building to review the 2nd and 3rd floor HVAC systems. Our findings are as follows:

Air Handling Units(AHU -2 and AHU-3):

These units are built-up style air handling units serving the upper two floors. They contain a supply fan, chilled water cooling coil, electric heating coil dampers and humidifier distributor. There is a fresh air connection to the exterior however there is no exhaust air connection to the exterior nor are there any return fans. These units are almost 30 years old and are in poor condition with the following items identified during the site review:

- Cooling coil fins damaged
- Corrosion of drain plans and structural components evident inside unit.
- Corrosion of supply fan casing
- Several heating coil stages not functioning
- Internal thermal insulation in poor shape and many sections missing
- Lack of adequate access to supply fan for maintenance(Requires entering unit to access fan and motor)
- Steam humidifier not functioning

These units are at the end of their useful life with replacement and upgrading recommended.

Condensor:

Both AHU 2 and 3 are fed with chilled water generated by a rooftop condensing unit. This unit is approx 30 years old and in poor condition. There is evidence of corrosion in the unit frame and casing. Also the internal compressor components are expected to be in poor condition as well and have now exceeded their expected useful life.

Controls:

The existing 2nd and 3rd floor HVAC controls are a mixture of pneumatic and direct digital controls. This hybrid system is causing numerous control and comfort issues with many components not functioning correctly. The pneumatic controls are also approx 30 years old and at the end of their useful life. The recent high maintenance expenditures can be attributed to the age this system and it is recommended that the controls system be upgraded to a modern computer based DDC system.