WEST HAYMARKET DEVELOPMENT
THERMAL PLANT
FEASIBILITY STUDY

DISTRICT ENERGY CORPORATION

1040 O STREET
LINCOLN, NEBRASKA 68501

PREPARED BY

FARRIS ENGINEERING
11239 CHICAGO CIRCLE
OMAHA, NEBRASKA

PHONE (402) 330-5900

DATE ISSUED: JULY 28, 2008

Farris Engineering
Consulting Engineers

August 7, 2008

Kent Morgan
City of Lincoln
555 South 10th Street
Lincoln, NE 68508

SUBJECT: West Haymarket Development Central Plant Feasibility Study, FE #082047

To Whom It May Concern:

The West Haymarket Development will enhance Lincoln's Downtown district with the addition of a Civic Arena, Conference Center and hotels, with accompanying residential, office, and retail space. Several characteristics of this project suggest the benefit of a district energy facility to serve the thermal energy needs of the area. As consulting engineers to the District Energy Corporation, Farris Engineering was approached to conduct a study to investigate the feasibility of a district energy plant to support the business development.

The West Haymarket Development offers an ideal setting for a district energy system due to the high heating and cooling load densities. The varying occupancy schedules for the mixed use facilities favor the consolidation of energy generation. The use of district energy provides this public development with a sustainable and environmentally responsible approach to meeting energy goals. A district energy system has the capacity and flexibility to operate at higher efficiencies, conserving fuels necessary for the generation and sharing of thermal energy.

The study results indicate that a district energy plant located in the West Haymarket provides the benefits of sustainability, efficiency, energy savings, and reduced environmental impact and ultimately provides the investment with significant life cycle cost savings. The conclusion of the study is that a central plant is a viable project for consideration. Although this study was commissioned by the DEC, it must be noted that there is no commitment by the DEC to construct or operate a central plant for this project. The City retains the right to engage any entity in the construction or operation of a central plant.

Sincerely,

FARRIS ENGINEERING

OFFICE LOCATIONS:
Omaha, Nebraska
Lincoln, Nebraska
Des Moines, Iowa
Colorado Springs, Colorado

11239 Chicago Circle Omaha, NE 68154 402.330.5900 Fax 402.330.5902

Certification Page

I hereby certify that this Technical Submission was prepared by me or under my direct supervision and responsible charge. I am a duly licensed Mechanical Engineer under the laws of the State Of Nebraska.

Gregory T. Kronaizl 7-28-08

SIGNATURE GREGORY T. KRONAIZL DATE

License No.: E-5523

MY LICENSE RENEWAL DATE IS DECEMBER 31, 2009.

Table of Contents

I. Executive Summary

II. Introduction
- Purpose
- Scope
- Process

III. Building Loads
- Load Assumptions
- Civic Arena
- Conference Center
- Hotel Complex(es)
- Central Utility Plant
- Building Load Summary

IV. Equipment Sizing and Capital Costs
- Civic Arena
- Conference Center
- Hotel Complex(es)
- Central Utility Plant
- Capital Cost Summary
- Material Cost Escalation

V. Energy Consumption and Costs
- Methodology
- Energy Rates
- Energy Cost Summary

VI. Operation and Maintenance Costs
- O&M Cost Analysis
- O&M Cost Summary

VII. Total Costs
- Costing Factors
- Cost Projection Methodology
- Cost Comparison

Appendices

Appendix A Cost Estimates
Appendix B Economic Analysis

I. Executive Summary

Purpose

The proposed development of the Lincoln West Haymarket area will include the construction of several facilities that will require a considerable level of reliable thermal services. The current plan under consideration will place an arena, conference center, two hotels, commercial space, and other space to include retail, residence, and office buildings throughout the West Haymarket. The relative location of the new buildings creates an area of high thermal load density, the nature of which suggests the construction of a central plant to provide this service. District Energy Corporation has commissioned this study to determine the feasibility of the installation of such a plant. The purpose of the study is to determine the potential benefits of a central plant to the development's building owners. Feasibility of the plant will only be proven by a lower life cycle cost when compared to the construction of mechanical spaces within each building.

Process

The method by which the advantage of the plant was determined was to first assume the buildings were self-sufficient, each with a completely independent mechanical system installed to provide for the building's thermal loads, and to compare these systems with the construction of a central plant to serve the loads of all the buildings. The advantage was quantified by totaling the capital recovery, energy costs, operating and maintenance costs, and replacement costs of the individual building systems and comparing this with the same costs incurred by the central plant.

Economic Analysis

Economic Analysis was performed by first creating a model of each building according to known parameters to determine the peak thermal loads and the load profile. It must be noted that the buildings have yet to be designed and are as such only in the concept stage. Real details regarding the buildings' architecture and construction are not known. Therefore, the building models were based on assumed building properties and architecture concepts available from preliminary layout diagrams. Building loads should be reevaluated when building designs are more complete.

Mechanical equipment was selected to satisfy the calculated thermal loads, both for the case of the individual building systems and the central plant. Capital costs were accumulated for each mechanical system. Then each building was modeled separately by simulating the operation of the

mechanical equipment selected. This energy simulation was then repeated for a central plant serving all the loads simultaneously. The results of these simulations provided the annual energy consumption, the cost of which was calculated using actual utility costs.

The Economic Analysis annualized and summed the capital cost, energy cost, operation and maintenance cost, and equipment replacement cost of each building to arrive at a Total Annual Cost for each. The Total Annual Cost for all the buildings combined is approximately 34.3% higher than the Total Annual Cost for the central plant. The results of the Economic Analysis are shown below:

Annual Cost Comparison				
Building	**Capital Cost**	**Annual Energy Cost**	**Annual O&M Cost**	**Total Annual Cost**
Civic Arena	$12,252,984	$265,169	$378,154	$1,512,702
Conference Center	$9,347,172	$100,853	$334,129	$1,098,187
Hotel #1	$9,082,392	$199,578	$334,129	$1,178,125
Hotel #2	$9,082,392	$201,724	$334,129	$1,180,271
Total Building Costs	$39,764,940	$767,324	$1,380,541	$4,969,285
Central Plant	$25,288,860	$733,178	$738,263	$3,265,748
Cost Savings	36.4%	4.45%	46.5%	34.3%

The Economic Analysis also calculated a 25 Year Lifecycle Cost as well as the Net Present Value of the Lifecycle Cost to illustrate the impact over a longer term. This allows a comprehensive comparison including all incurred operating costs and the financing of capital costs. These results are shown in the following table:

Life Cycle Cost Comparison		
Building	**Total Life Cycle Cost**	**Net Present Value of Total Cost**
Civic Arena	$56,903,083	$28,053,986
Conference Center	$39,710,754	$19,895,009
Hotel #1	$42,457,257	$21,404,959
Hotel #2	$42,540,006	$21,447,187
Total Buildings	$181,611,100	$90,801,141
Central Plant	$117,462,370	$59,022,249
Cost Savings	35.3%	35.0%

Environmental Impact

The energy savings available by operating the central plant instead of the individual building mechanical systems achieves not only economic benefits, but environmental benefits as well. The operation of a central plant results in the consumption of 489,800 fewer kWh of electricity and 500 fewer therms of natural gas on an annual basis. This equates to a decrease of 383.5 metric tons of carbon dioxide emissions, or the equivalent decrease in greenhouse gas emissions resulting from the removal 70 passenger vehicles from the roads, or the carbon sequestered annually by 87 acres of pine or fir trees.

This environmental benefit is realized with the installation of conventional mechanical equipment in the central plant. Considering the size of the plant and the high level of operator expertise, more advanced technologies could be employed at the plant to provide service with higher efficiency, further decreasing the energy consumption of the plant. These possibilities should be explored as the plant enters the design stage.

Conclusions and Recommendation

The designed layout of the West Haymarket Development positions several facilities with high thermal loads in close proximity to one another. Further, these facilities have varying occupancy such that the building loads throughout the day are not coincident, so that the combined peak load is less than the sum of individual building peak loads. This high thermal density and moderate level of load diversity support the construction of a central plant to serve the building loads. The Economic Analysis illustrates a clear economic advantage to the building owners if such a central plant is constructed. The central plant incurs lower capital costs, energy costs, operating and maintenance costs, and equipment replacement costs. Based on assumptions selected for this study, the building owners would pay approximately 35% less for thermal services to their buildings over a 25 year life cycle. This represents a significant savings to the building owner and achieves environmentally beneficial energy savings in the process. It is recommended that a central thermal energy plant be constructed to serve the West Haymarket Development.

II. Introduction

Purpose

The City of Lincoln has entered the planning stages for a substantial development project in the West Haymarket area. Lincoln Traction Partners has been selected as the project's development team and has supplied the City with the initial vision of the future West Haymarket design. Preliminary plans for the project include the construction of a Civic Arena, a Convention Center, two hotels, and other commercial development, consisting of retail, office, and residential spaces. This arrangement of several large facilities in close proximity to one another presents an ideal opportunity to realize the advantages of a district energy system to serve the thermal needs of the buildings. To this end, the District Energy Corporation has commissioned a study to determine the economic and logistic feasibility of constructing a thermal plant onsite to serve the development's thermal loads.

Scope

The study will be conducted in two phases. Phase I will define the building loads and load profiles, estimate the size of required plant equipment and distribution pipelines, determine the required size of the central utility plant and the size of the plant site, calculate the cost of construction of the plant and the distribution piping, and finally state the conclusions and recommendations regarding the installation of a central utility plant. Phase I will only consider a plant built to serve the immediate loads planned for construction as part of the West Haymarket development project.

Phase II, to follow later, will expand the investigation to identify potential future loads to be served by the central utility plant. Future building loads and load schedules will be calculated to determine equipment and distribution pipe sizing. The available plant sites will be evaluated in terms of the cost and effort of construction on each site and distribution from each site. Recommendations will be stated regarding plant location, size, and utility corridor location.

Process

Initially, requests were made to obtain available information for the West Haymarket facility. As the project was only in the early planning phase, the only available resources were simulated renderings indicating the layout and relative sizes of the buildings and a list of approximations of building square footage. Since building loads had not yet been calculated, modeling software

IV. Equipment Sizing and Capital Cost

Equipment was selected for each building as if the buildings were operating independently. For each building, equipment was sized to provide firm capacity, or in other words sufficient equipment such that if the largest machine were inoperable, the remaining equipment could meet the peak load.

Civic Arena
The 19,770 MBh heating load of the Civic Arena will be served with the installation of two (2) 600 Boiler Horsepower (BHP) gas-fired firetube steam boilers. Each boiler is capable of generating 20,700 MBh of steam. All auxiliary equipment required to support the generation of steam, including pumps, deaerator equipment, condensate storage and blowdown, and controls, is included in this installation.

To meet the 1,120 ton peak cooling load, two (2) 1,200 ton electric centrifugal chillers will be installed. A cooling tower with two cells each designed for 3600 gpm will be erected to provide heat rejection from the chillers. Chilled water and condenser water pumps, as well as water treatment and control systems, are also included.

Associated electrical equipment and fuel handling equipment was selected and sized to support the mechanical systems. In addition, a cost was added to account for the building space occupied by this equipment. Since the absence of this installation would mean less constructed space or more profitable building space, a cost is in effect incurred by the building owner to house the mechanical equipment.

Costs for all equipment are itemized in Appendix A.

Conference Center
The Conference Center would require the installation of two (2) 300 BHP gas-fired firetube boilers to produce a total capacity of 20,700 MBh and a firm capacity of 10,350 MBh. As with the Arena installation, all auxiliary equipment is provided.

The 550 ton peak cooling load is served with two (2) 600 ton electric centrifugal chillers and a two cell cooling tower (1800 gpm per cell). Again, chilled water pumps, condenser water pumps, and other auxiliaries sized for the chillers are included in the installation.

Electrical and fuel handling equipment, as well as the required building space, are also incorporated into the cost estimate. A detailed list of all components is found in Appendix A.

Hotel Complex(es)
Since the peak loads of the two hotel complexes are identical, the equipment required to meet these loads is also the same. As such, the equipment will be described once but is intended to indicate installation in each hotel.

The peak heating load of 6,140 MBh can be served by two (2) 200 BHP gas-fired firetube boilers. Each of these boilers generates 6,900 MBh at full load, providing a total capacity of 13,800 MBh and a firm capacity of 6,900 MBh. Support equipment for the boilers is listed in the cost estimate.

Each hotel sees a peak cooling load of 316 tons, which can be met by installing two (2) 500 ton electric centrifugal chillers. A small two cell cooling tower sized for 1500 gpm per cell, chilled water pumps, condenser water pumps, water treatment and controls are part of the installation as well.

The supporting electrical equipment, fuel handling systems, and allotted building space are found in the estimate. All equipment considered for the hotel mechanical system is listed in the cost estimate in Appendix A.

Central Utility Plant
The plant includes three (3) 600 BHP gas-fired firetube boilers each capable of producing 20,700 MBh of steam, three (3) 1200 ton electric centrifugal chillers, and three (3) 1500 kW emergency generators. Auxiliary equipment is also included and consists of the following:

- Boiler Stacks
- Deaerator
- Boiler Feedwater pumps
- Condensate Storage tank
- Condensate Transfer pumps
- Blowdown tank and piping
- Steam and condensate piping
- Boiler Controls
- Cooling Tower (3 cells @ 3600 gpm each)
- Condenser Water pumps with VFDs
- Chilled Water pumps with VFDs
- Chilled Water and Condenser Water piping

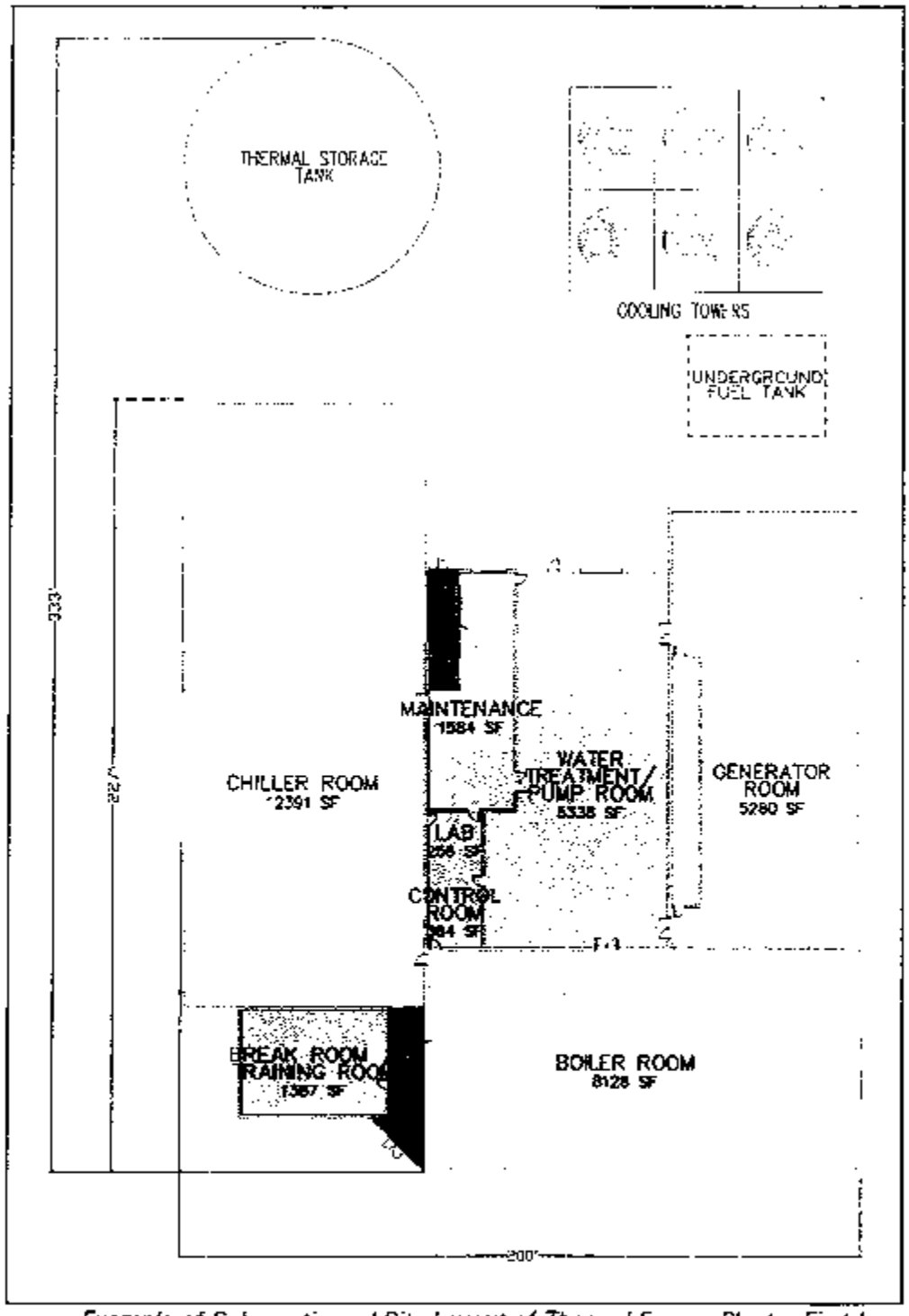
- Water Treatment
- Chiller and Cooling Tower Controls
- Electrical Equipment
- Fuel Oil tanks, pumps, and piping
- Direct Buried Piping from the plant to the buildings
- The Plant Building and Sitework

The chillers considered for the plant include VFDs. The chilled water will be pumped using a variable primary configuration. The cooling towers can be located either on the roof of the plant building or on grade adjacent to the building. Various factors affect the choice of cooling tower location, including available site space and soil conditions. Condenser water pumps will also be controlled via a VFD.

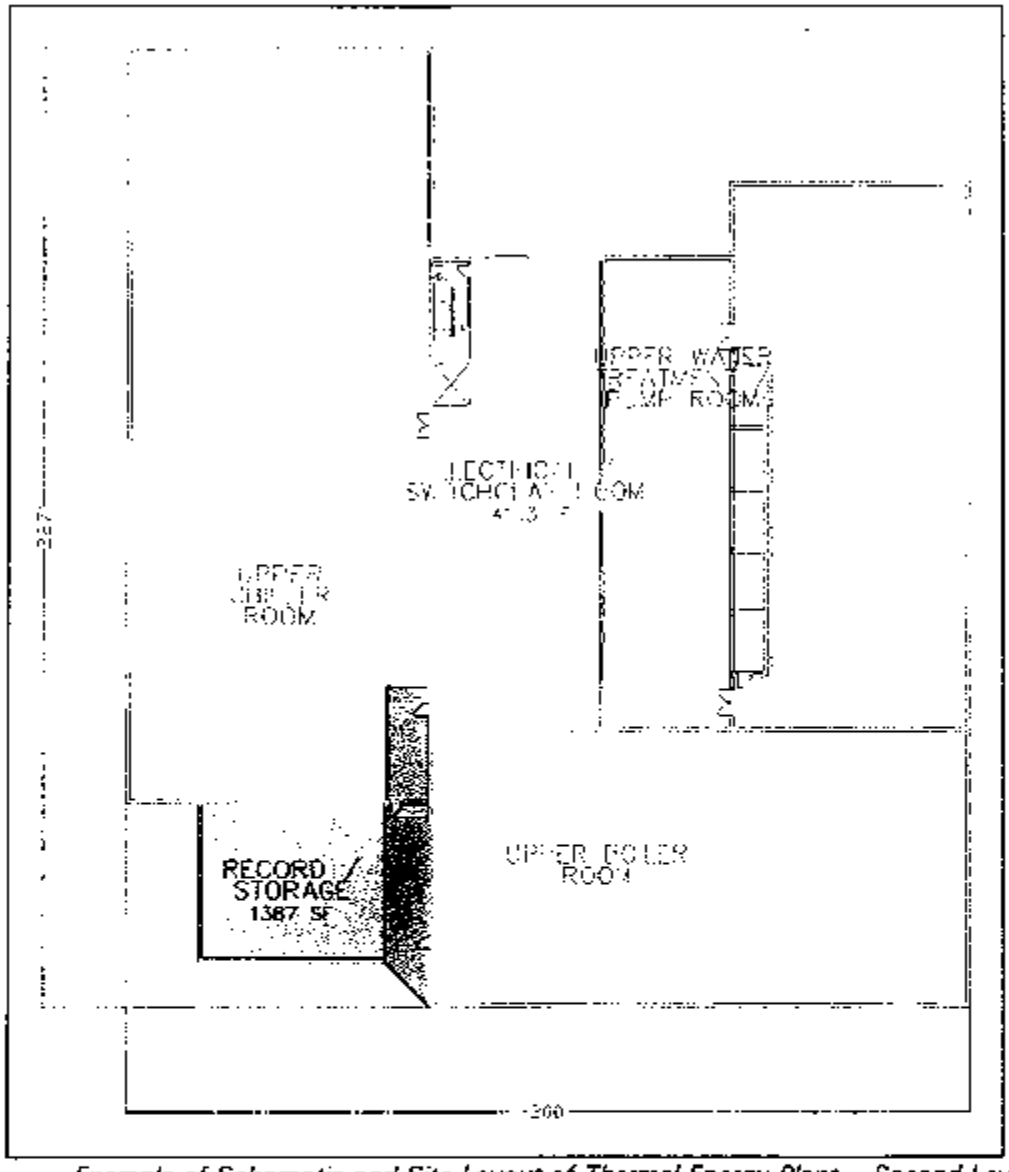
The boilers included in this option do not include a low NOx burner, but this option can be added for an additional cost.

The building area required to house the central plant equipment as described in Phase I is approximately 18,000 ft^2. This will be a two-story building with a proposed rectangular footprint to minimize construction costs. The footprint can be altered within the confines of maintaining the equipment layout for efficient operation. In such case, the cost of the building should be reassessed. The actual footprint area cannot be determined until plant design is initiated. However, the building footprint will be larger than 9,000 ft^2 due to the required two-story height of the boiler and chiller areas. In the actual construction of the central plant, additional space may be allocated for future installations of equipment to serve added loads. To this end, the plant's ultimate construction will likely include at least 40,000 ft^2.

The site on which the plant is built must have area not only for the plant building, but also for cooling towers, fuel storage tanks, parking, delivery routing, and possibly thermal storage tanks. The required site must encompass a minimum of a half of a city block in total. The following images show a possible plant and site layout indicating the spaces required. The building as shown includes the total 40,000 ft^2 buildout. The building can obviously be altered to suit the site on which it is constructed. These diagrams are only an example showing one of many possible site layout options.



Example of Schematic and Site Layout of Thermal Energy Plant – First Level



Example of Schematic and Site Layout of Thermal Energy Plant – Second Level

Distribution piping from the plant to the buildings served was sized to carry the peak load calculated for the plant plus an additional load for the undefined 125,000 ft^2 of commercial space and 100,000 ft^2 of other space indicated for development. This will allow for a certain amount of future expansion of the system without replacing or adding main distribution lines. The piping included in the cost estimate consists of 24" chilled water supply and return lines, a 10" steam line, and an 8" condensate line. The main distribution line was assumed to extend 2500 feet, from the southern most location considered for the DEC plant to the Arena on the north end of the

development. Of course as loads are refined and building locations are confirmed, these costs may be modified.

A detailed cost estimate is available in Appendix A. The cost estimate includes a 10% contingency on equipment costs.

Capital Cost Summary

The capital costs for each option were gained by various methods. Where possible, actual budget estimates were received from equipment vendors. This represents a conservative but realistic value. If vendor pricing was not available, experience of actual purchase prices offered in recent equipment acquisitions was used. Lastly, prices unavailable from other sources were obtained from an engineering estimating resource book. The Capital Costs for each building are listed below:

Capital Costs	
Building	**Total Capital Cost**
Civic Arena	$12,252,984
Conference Center	$9,347,172
Hotel #1	$9,082,392
Hotel #2	$9,082,392
Total Building Costs	$39,764,940
Central Plant	$25,288,860
Capital Cost Savings	36.4%

Material Cost Escalation

It must be noted that preliminary cost estimates included in this report may be subject to significant material price escalation. Certain materials, such as copper, steel, and concrete, have seen notable price increases in recent months. Speculation is that these rate increases will likely continue at least in the short term. The cost estimate should be updated as plant construction approaches.

V. Energy Consumption and Costs

Methodology

The simulation software uses the building characteristics and occupancy to create a load profile including the actual energy use for every hour of the year. From this profile, actual electrical and natural gas use and peaks can be displayed for every component of the mechanical system. This information was compiled and the energy consumption of the plant-side equipment was extracted and summed. The current utility rates were applied to these consumption values to obtain monthly and annual energy costs.

Energy Rates

The plant and the arena will be subject to Lincoln Electric System's (LES) Large Light and Power rate for customers whose consumption exceeds 100,000 kWh for each of six consecutive months or whose demand exceeds 400 kW in two summer months within the current and preceding 11 months. The energy rate is $0.0182 per kWh for the months of October through May and $0.0249 for the months of June through September. The demand charge is $14.20 per kW of demand. A customer charge of $185 is charged monthly. The LES rate structure includes a demand ratchet. The billed demand is the greater of the actual demand or 65% of the highest demand for previous summer period (June through September).

The conference center and the hotels will be billed according to LES's General Service Demand rate for customers whose consumption exceeds 25,000 kWh for each of six consecutive months or whose demand exceeds 100 kW in two summer months within the current and preceding 11 months. The energy rate is $0.0220 per kWh for the months of October through May and $0.0308 for the months of June through September. The demand charge is $12.10 per kW of demand. A customer charge of $30 is charged monthly. This rate structure again includes a 65% demand ratchet.

Natural gas is subject to a customer charge of $20 per month and a consumption rate that is reestablished on a monthly basis. For the purposes of this study, the rates for the previous twelve months were used. These rates on a per therm basis are as follows:

Natural Gas Prices (2007-2008)	
Month	$/therm
January	$0.96053
February	$1.00157
March	$1.08037
April	$1.15798
May	$0.97695
June	$0.99222
July	$0.90207
August	$0.82708
September	$0.76671
October	$0.84520
November	$0.95339
December	$0.96353

For the purposes of energy cost estimates, energy rates are escalated at 3% per year.

Energy Cost Summary

The operating costs detailed in Appendix B apply the earlier described electrical and natural gas rates to the energy consumption and demand values as calculated in energy model simulations performed for each building. These consumption and demand values are based on load calculations for buildings that have yet to be designed. As such, the basis for the loads, and therefore the energy use and cost values, are subject to change as the building parameters become more clearly defined. The Building Energy Consumption and Costs are as follows:

Annual Electrical Energy Costs			
Building	Total Electrical Use (kWh)	Peak Electrical Demand (kW)	Annual Electrical Cost
Civic Arena	862,500	890	$132,906
Conference Center	351,400	425	$52,829
Hotel #1	844,100	265	$49,766
Hotel #2	844,300	264	$49,823
Total Buildings	2,902,300	1,844	$285,324
Central Plant	2,412,500	1,600	$252,363
Cost Savings			11.55%

Annual Natural Gas Energy Costs			
Building	Total Natural Gas Use (MBtu)	Peak Natural Gas Demand (MBh)	Annual Natural Gas Cost
Civic Arena	13,450,000	20,000	$132,263
Conference Center	4,860,000	10,280	$48,024
Hotel #1	15,350,000	7,280	$149,812
Hotel #2	15,560,000	7,270	$151,901
Total Buildings	49,220,000	44,830	$482,000
Central Plant	49,170,000	35,850	$480,816
Cost Savings			0.25%

Please refer to Appendix B for Economic Analysis, including energy costs.

VI. Operation and Maintenance Costs

O&M Cost Analysis

Operations and maintenance costs are complicated and difficult to predict. The operations and maintenance costs for the plant were obtained from two sources. Equipment manufacturers were consulted to gather expected maintenance costs or the cost of annual maintenance contracts. Secondly, actual operating and maintenance costs were gathered from a similar plant currently in operation. These costs were tailored to reflect the size, complexity, and reliability of the equipment planned for installation in the Central Plant. Then the same operating and maintenance costs were estimated for the individual building systems.

For the building systems, only additive costs were considered, that is costs that would only be incurred with the installation of the described mechanical and electrical equipment. For instance, maintenance of air handling units would exist in the buildings regardless of whether the primary equipment is installed in the plant or in the building, and therefore this cost was omitted.

For purposes of cost estimating, it was assumed that the building mechanical systems would be operated by two staff members, while the DEC plant would be manned by three full time operators and one part time operator.

The plant O&M costs include administrative costs obtained from DEC. Since the buildings already have administrative functions and personnel in place, this was not considered an additive cost for the building systems.

Operation and Maintenance Cost Summary

Building Operation and Maintenance Costs are calculated as follows:

Annual Operating and Maintenance Costs	
Building	**Annual O&M Cost**
Civic Arena	$378,154
Conference Center	$334,129
Hotel #1	$334,129
Hotel #2	$334,129
Building Total	$1,380,541
Central Plant	$738,263
Cost Savings	46.5%

VII. Economic Analysis

Costing Factors

The evaluation period used in the economic analysis was 25 years. This period was selected on the basis of the service life of various pieces of plant equipment. This time period is sufficient to incorporate a replacement cycle for all major pieces of equipment. The interest rate and discount rate applied in the analysis is 5%. Although these rates may not be the exact finance terms available to the developer, they result in a conservative comparison to illustrate the feasibility of the DEC Thermal Energy Plant. These factors combine for a capital recovery rate of 0.070952. Energy Costs and Operation and Maintenance Costs were escalated at a rate of 3% per year.

Cost Projection Methodology

Economic analyses were performed for each of the buildings independently and for the plant serving the total building load. The capital cost of each option was annualized on a capital recovery basis. The energy cost and O&M cost values were annualized and projected over the total evaluation period.

To account for equipment replacement costs, the expected service life for each piece of major equipment was determined as defined by ASHRAE (American Society of Heating, Refrigeration, and Air-Conditioning Engineers), and the future value of the replacement cost was calculated for the expected year of equipment expiration. This cost was added to the other annualized costs in the year that the cost is expected to be incurred. The following replacement schedule was used in the calculations:

Equipment Replacement Schedule	
Component	**Expected Service Life**
Boiler Controls	15 years
Chiller/Cooling Tower Controls	15 years
Boiler/Condensate Pumps	20 years
Chilled Water Pumps	20 years
Condenser Water Pumps	20 years
Boiler	25 years
Blowdown Tank	25 years
Boiler Stack	25 years
Chiller	25 years

The sum of the Capital Cost Recovery, Projected Annual Energy Cost, Projected Annual O&M Cost, and Projected Annual Equipment Replacement Cost is defined as the Total Projected Annual Cost. The sum of the Total Projected Annual Costs over the 25 year analysis period is defined as the Total Life Cycle Cost. In addition, the Net Present Value of the annualized costs was calculated for another means of comparison.

Cost Comparison

The feasibility of the DEC Central Plant lies in the potential for cost savings to the building owners. The cost avoided by eliminating the installation of mechanical systems in the buildings must be compared against the cost charged to the buildings for DEC thermal services.

Since DEC is a non-profit organization, the costs incurred by DEC through the operation of its systems are charged directly to its customers on the basis of either the energy provided or the building square footage served. Therefore, over the 25 year period, the building owners will be charged the total of the Central Plant Life Cycle Cost. Each building owner will be responsible for a fraction of the cost according to the proportion of energy use or square footage of their respective building. (Although this is admittedly an oversimplification of the rate structure set by DEC, it is an effective method by which to illustrate the cost comparison.)

The following illustrates the cost savings in terms of the Total Life Cycle Cost and the Net Present Value. The construction of a Central Utility Plant to serve the building loads offers significant cost savings over a 25 year period.

Cost Comparison		
Building	**Total Life Cycle Cost**	**Net Present Value of Total Cost**
Civic Arena	$56,903,083	$28,053,986
Conference Center	$39,710,754	$19,895,009
Hotel #1	$42,457,257	$21,404,959
Hotel #2	$42,540,006	$21,447,187
Total Buildings	$181,611,100	$90,801,141
Central Plant	$117,462,370	$59,022,249
Cost Savings	35.3%	35.0%

VIII. Conclusions and Recommendations

The West Haymarket Development presents the ideal environment for a central thermal energy plant. The buildings to be served are located close together, making the distribution of steam and chilled water more feasible and cost effective. The buildings also have varying schedules of occupancy, meaning that the peak thermal loads of the buildings occur at different times throughout the day. Therefore, the combined peak load is less than the sum of the individual building peak loads. The plant can take advantage of this load diversity by installing equipment sized at this lower peak and will achieve energy savings by decreasing the required energy use and peak energy demand.

Although the equipment at the central plant is larger than the equipment required in individual building installations, the capital costs are appreciably less than the combined building systems cost. The central plant's energy savings results in lower operating cost for the building owner and lower levels of emitted greenhouse gases. By decreasing the energy consumption of the buildings, both economic and environmental gains are realized. The operating and maintenance cost for the central plant is far less than the cost of operating four separate building mechanical systems since the plant will have fewer operators and fewer pieces of equipment. Lastly, the cost to replace equipment as it meets the limitations of its service life is higher when considering the costs incurred in all four buildings as compared to the central plant. The cumulative effect of these cost savings is a 35% Life Cycle Cost savings available to the building owners over a 25 year period. This substantial economic benefit demonstrates the feasibility of the construction of a central thermal energy plant to support the West Haymarket Development.

APPENDIX A
Cost Estimates

COST ESTIMATE - DEC CENTRAL PLANT

SYSTEM	EQUIPMENT	QUANTITY	TOTAL COST/UNIT	TOTAL COST
BUILDING				
	THERMAL PLANT BUILDING	18,000 SF	135.00	2,430,000
	INTERIOR LIGHTING	1.00 LS	84,000.00	84,000
	DOCK DRAIN	1.00 LS	3,500.00	3,500
	EQUIPMENT FOUNDATIONS	1.00 LS	68,000.00	68,000
	PLATFORM & LADDERS	1.00 LS	65,000.00	65,000
	PLUMBING	1.00 LS	118,000.00	118,000
	FIRE PROTECTION	1.00 LS	210,000.00	210,000
	LANDSCAPING, GRADING, & PAVEMENT	1.00 LS	332,000.00	332,000
BUILDING TOTAL				3,310,500
BOILER				
	BOILER (600 BHP GAS-FIRED)	3.00 EA	430,000.00	1,290,000
	BOILERFEED PUMPS	3.00 EA	9,350.00	28,050
	CONDENSATE TRANSFER PUMPS	3.00 EA	11,800.00	35,400
	STEAM PIPING, INSUL, VALVES, FITTINGS, & HANGER	1.00 LS	282,000.00	282,000
	CONDENSATE BLOWDOWN PIPING & ACCESSORIES	1.00 LS	7,000.00	7,000
	BLOWDOWN TANK	1.00 EA	11,000.00	11,000
	DEAERATOR (60,000 LB/HR)	1.00 EA	135,000.00	135,000
	CONDENSATE STORAGE TANK	1.00 EA	72,500.00	72,500
	CONTROL & INSTRUMENTS	1.00 LS	175,000.00	175,000
	BOILER STACK	3.00 EA	23,000.00	69,000
BOILER TOTAL				2,104,950
CHILLER				
	CHILLER (1200 TON ELECTRIC CENTRIFUGAL)	3.00 EA	649,000.00	1,947,000
	COOLING TOWER 3600 GPM 95/85/78	3.00 EA	151,000.00	453,000
	CHILLED WATER PUMP 2880 GPM	3.00 EA	28,000.00	84,000
	CONDENSER WATER PUMP 3600 GPM	3.00 EA	33,750.00	101,250
	CHILLED & CONDENSER WATER PIPING ALLOWANCE	1.00 LS	788,000.00	788,000
	WATER TREATMENT	1.00 LS	45,000.00	45,000
	VARIABLE FREQUENCY DRIVE	6.00 EA	35,000.00	210,000
	CONTROL & INSTRUMENTS	1.00 LS	300,000.00	300,000
CHILLER TOTAL				3,928,250
FUEL HANDLING				
	NO. 2 FUEL OIL TANK 20000 GAL	2.00 EA	72,000.00	144,000
	FUEL OIL TANK FOUNDATION, MONITORING, EXCAVATI	1.00 LS	68,000.00	68,000
	NO. 2 FUEL OIL PUMPS & DOUBLE WALL PIPE	1.00 LS	45,000.00	45,000
FUEL HANDLING TOTAL				257,000
DIRECT BURIED PIPING				
	STEAM PIPING	2500.00 LF	578.60	1,446,500
	CHW PIPING	2500.00 LF	1,270.00	3,175,000
	EXCAVATION AND BACKFILL FOR DISTRIBUTION	2500.00 LF	360.00	900,000
	DW/FIRE LINE TO CUP	300.00 LF	85.00	25,500
	BLDG SANITARY SEWER TO CUP	300.00 LF	40.00	12,000
	TRUCK DOCK STORM DRAIN FROM CUP	300.00 LF	40.00	12,000
	BLDG STORM DRAIN FROM CUP	300.00 LF	120.00	36,000
	NATURAL GAS SERVICE TO CUP	300.00 LF	65.00	19,500
DIRECT BURIED PIPING TOTAL				5,626,500
ELECTRICAL				
	BOILER AND CHILLER SYSTEMS ELECTRICAL	1.00 LS	1,402,500.00	1,402,500
	SWITCHGEAR AND FEEDERS	1.00 LS	2,008,400.00	2,008,400
	GENERATOR (1500 kW)	3.00 EA	730,000.00	2,190,000
	SERVICE TO PLANT	1.00 LS	430,000.00	430,000
ELECTRICAL TOTAL				6,030,900
OTHER				
	ENGINEERING FEE	1.00 LS	2,015,380.00	2,015,380
	PROJECT MANAGEMENT FEE	1.00 LS	2,015,380.00	2,015,380
OTHER TOTAL				4,030,760
TOTAL				25,288,860

COST ESTIMATE - ARENA

SYSTEM	EQUIPMENT	QUANTITY	TOTAL COST/UNIT	TOTAL COST
MECHANICAL ROOM				
	MECHANICAL ROOM SPACE	7285 SF	135.00	983,475
	EQUIPMENT FOUNDATIONS	1.00 LS	63,000.00	63,000
	PLATFORM & LADDERS	1.00 LS	45,000.00	45,000
	PLUMBING	1.00 LS	20,000.00	20,000
MECHANICAL ROOM TOTAL				**1,111,475**
BOILER				
	BOILER (600 BHP GAS-FIRED)	2.00 EA	430,000.00	860,000
	BOILERFEED PUMPS	2.00 EA	9,350.00	18,700
	CONDENSATE TRANSFER PUMPS	2.00 EA	11,800.00	23,600
	STEAM PIPING, INSUL, VALVES, FITTINGS, & HANGER	1.00 LS	225,600.00	225,600
	CONDENSATE BLOWDOWN PIPING & ACCESSORIES	1.00 LS	7,000.00	7,000
	BLOWDOWN TANK	1.00 EA	11,000.00	11,000
	DEAERATOR (40,000 LB/HR)	1.00 EA	123,000.00	123,000
	CONDENSATE STORAGE TANK	1.00 EA	64,000.00	64,000
	CONTROL & INSTRUMENTS	1.00 LS	120,000.00	120,000
	BOILER STACK	2.00 EA	23,000.00	46,000
BOILER TOTAL				**1,496,900**
CHILLER				
	CHILLER (1200 TON ELECTRIC CENTRIFUGAL)	2.00 EA	650,000.00	1,300,000
	COOLING TOWER 3600 GPM 95/85/78	2.00 EA	151,000.00	302,000
	CHILLED WATER PUMP 2880 GPM	2.00 EA	28,000.00	56,000
	CONDENSER WATER PUMP 3600 GPM	2.00 EA	33,750.00	67,500
	CHILLED & CONDENSER WATER PIPING ALLOWANCE	1.00 LS	604,000.00	604,000
	WATER TREATMENT	1.00 LS	45,000.00	45,000
	VARIABLE FREQUENCY DRIVE	4.00 EA	35,000.00	140,000
	CONTROL & INSTRUMENTS	1.00 LS	240,000.00	240,000
CHILLER TOTAL				**2,754,500**
FUEL HANDLING				
	NO. 2 FUEL OIL TANK 15000 GAL	2.00 EA	54,000.00	108,000
	FUEL OIL TANK FOUNDATION, MONITORING, EXCAVATI	1.00 LS	55,000.00	55,000
	NO. 2 FUEL OIL PUMPS & DOUBLE WALL PIPE	1.00 LS	50,000.00	50,000
FUEL HANDLING TOTAL				**213,000**
ELECTRICAL				
	BOILER AND CHILLER SYSTEMS ELECTRICAL	1.00 LS	974,000.00	974,000
	SWITCHGEAR AND FEEDERS	1.00 LS	1,807,600.00	1,807,600
	GENERATOR (1000 kW)	3.00 EA	617,115.00	1,851,345
ELECTRICAL TOTAL				**4,632,945**
OTHER				
	ENGINEERING FEES	1.00 LS	1,021,082.00	1,021,082
	PROJECT MANAGEMENT FEES	1.00 LS	1,021,082.00	1,021,082
OTHER TOTAL				**2,042,164**
TOTAL				**12,252,984**

COST ESTIMATE - CONVENTION CENTER

SYSTEM	EQUIPMENT	QUANTITY	TOTAL COST/UNIT	TOTAL COST
MECHANICAL ROOM				
	MECHANICAL ROOM SPACE	6370 SF	135.00	859,950
	EQUIPMENT FOUNDATIONS	1.00 LS	62,000.00	62,000
	PLATFORM & LADDERS	1.00 LS	40,000.00	40,000
	PLUMBING	1.00 LS	20,000.00	20,000
MECHANICAL ROOM TOTAL				981,950
BOILER				
	BOILER (300 BHP GAS-FIRED)	2.00 EA	229,200.00	458,400
	BOILERFEED PUMPS	2.00 EA	4,940.00	9,880
	CONDENSATE TRANSFER PUMPS	2.00 EA	8,800.00	17,600
	STEAM PIPING, INSUL, VALVES, FITTINGS, & HANGER	1.00 LS	199,750.00	199,750
	CONDENSATE BLOWDOWN PIPING & ACCESSORIES	1.00 LS	7,000.00	7,000
	BLOWDOWN TANK	1.00 EA	9,000.00	9,000
	DEAERATOR (21,000 LB/HR)	1.00 EA	102,000.00	102,000
	CONDENSATE STORAGE TANK	1.00 EA	61,000.00	61,000
	CONTROL & INSTRUMENTS	1.00 LS	120,000.00	120,000
	BOILER STACK	2.00 EA	18,400.00	36,800
BOILER TOTAL				1,021,430
CHILLER				
	CHILLER (600 TON ELECTRIC CENTRIFUGAL)	2.00 EA	348,000.00	696,000
	COOLING TOWER 1800 GPM 95/85/78	2.00 EA	113,000.00	226,000
	CHILLED WATER PUMP 1440 GPM	2.00 EA	20,000.00	40,000
	CONDENSER WATER PUMP 1800 GPM	2.00 EA	20,000.00	40,000
	CHILLED & CONDENSER WATER PIPING ALLOWANCE	1.00 LS	550,000.00	550,000
	WATER TREATMENT	1.00 LS	45,000.00	45,000
	VARIABLE FREQUENCY DRIVE	4.00 EA	35,000.00	140,000
	CONTROL & INSTRUMENTS	1.00 LS	240,000.00	240,000
CHILLER TOTAL				1,977,000
FUEL HANDLING				
	NO. 2 FUEL OIL TANK 10000 GAL	2.00 EA	36,200.00	72,400
	FUEL OIL TANK FOUNDATION, MONITORING, EXCAVAT	1.00 LS	50,000.00	50,000
	NO. 2 FUEL OIL PUMPS & DOUBLE WALL PIPE	1.00 LS	50,000.00	50,000
FUEL HANDLING TOTAL				172,400
ELECTRICAL				
	BOILER AND CHILLER SYSTEMS ELECTRICAL	1.00 LS	896,000.00	896,000
	SWITCHGEAR AND FEEDERS	1.00 LS	1,506,300.00	1,506,300
	GENERATOR (1000 kW)	2.00 EA	617,115.00	1,234,230
ELECTRICAL TOTAL				3,636,530
OTHER				
	ENGINEERING FEES	1.00 LS	778,931.00	778,931
	PROJECT MANAGEMENT FEES	1.00 LS	778,931.00	778,931
OTHER TOTAL				1,557,862
TOTAL				9,347,172

COST ESTIMATE - HOTEL 1

SYSTEM	EQUIPMENT	QUANTITY	TOTAL COST/UNIT	TOTAL COST
MECHANICAL ROOM				
	MECHANICAL ROOM SPACE	6200 SF	135.00	837,000
	EQUIPMENT FOUNDATIONS	1.00 LS	52,700.00	52,700
	PLATFORM & LADDERS	1.00 LS	40,000.00	40,000
	PLUMBING	1.00 LS	20,000.00	20,000
MECHANICAL ROOM TOTAL				**949,700**
BOILER				
	BOILER (200 BHP GAS-FIRED)	2.00 EA	206,000.00	412,000
	BOILERFEED PUMPS	2.00 EA	4,940.00	9,880
	CONDENSATE TRANSFER PUMPS	2.00 EA	8,800.00	17,600
	STEAM PIPING, INSUL, VALVES, FITTINGS, & HANGER	1.00 LS	199,750.00	199,750
	CONDENSATE BLOWDOWN PIPING & ACCESSORIES	1.00 LS	7,000.00	7,000
	BLOWDOWN TANK	1.00 EA	9,000.00	9,000
	DEAERATOR (15,000 LB/HR)	1.00 EA	89,000.00	89,000
	CONDENSATE STORAGE TANK	1.00 EA	56,000.00	56,000
	CONTROL & INSTRUMENTS	1.00 LS	120,000.00	120,000
	BOILER STACK	2.00 EA	18,400.00	36,800
BOILER TOTAL				**957,030**
CHILLER				
	CHILLER (500 TON ELECTRIC CENTRIFUGAL)	2.00 EA	290,000.00	580,000
	COOLING TOWER 1500 GPM 95/85/78	2.00 EA	113,000.00	226,000
	CHILLED WATER PUMP 1200 GPM	2.00 EA	18,000.00	36,000
	CONDENSER WATER PUMP 1500 GPM	2.00 EA	18,000.00	36,000
	CHILLED & CONDENSER WATER PIPING ALLOWANCE	1.00 LS	550,000.00	550,000
	WATER TREATMENT	1.00 LS	45,000.00	45,000
	VARIABLE FREQUENCY DRIVE	4.00 EA	35,000.00	140,000
	CONTROL & INSTRUMENTS	1.00 LS	240,000.00	240,000
CHILLER TOTAL				**1,853,000**
FUEL HANDLING				
	NO. 2 FUEL OIL TANK 10000 GAL	2.00 EA	36,200.00	72,400
	FUEL OIL TANK FOUNDATION, MONITORING, EXCAVATI	1.00 LS	50,000.00	50,000
	NO. 2 FUEL OIL PUMPS & DOUBLE WALL PIPE	1.00 LS	50,000.00	50,000
FUEL HANDLING TOTAL				**172,400**
ELECTRICAL				
	BOILER AND CHILLER SYSTEMS ELECTRICAL	1.00 LS	896,000.00	896,000
	SWITCHGEAR AND FEEDERS	1.00 LS	1,506,300.00	1,506,300
	GENERATOR (1000 kW)	2.00 EA	617,115.00	1,234,230
ELECTRICAL TOTAL				**3,636,530**
OTHER				
	ENGINEERING FEE	1.00 LS	756,866.00	756,866
	PROJECT MANAGEMENT FEE	1.00 LS	756,866.00	756,866
OTHER TOTAL				**1,513,732**
TOTAL				**9,082,392**

COST ESTIMATE - HOTEL 2

SYSTEM	EQUIPMENT	QUANTITY	TOTAL COST/UNIT	TOTAL COST
MECHANICAL ROOM				
	MECHANICAL ROOM SPACE	6200 SF	135.00	837,000
	EQUIPMENT FOUNDATIONS	1.00 LS	52,700.00	52,700
	PLATFORM & LADDERS	1.00 LS	40,000.00	40,000
	PLUMBING	1.00 LS	20,000.00	20,000
MECHANICAL ROOM TOTAL				949,700
BOILER				
	BOILER (200 BHP GAS-FIRED)	2.00 EA	206,000.00	412,000
	BOILERFEED PUMPS	2.00 EA	4,940.00	9,880
	CONDENSATE TRANSFER PUMPS	2.00 EA	8,800.00	17,600
	STEAM PIPING, INSUL. VALVES, FITTINGS, & HANGER	1.00 LS	199,750.00	199,750
	CONDENSATE BLOWDOWN PIPING & ACCESSORIES	1.00 LS	7,000.00	7,000
	BLOWDOWN TANK	1.00 EA	9,000.00	9,000
	DEAERATOR (15,000 LB/HR)	1.00 EA	89,000.00	89,000
	CONDENSATE STORAGE TANK	1.00 EA	56,000.00	56,000
	CONTROL & INSTRUMENTS	1.00 LS	120,000.00	120,000
	BOILER STACK	2.00 EA	18,400.00	36,800
BOILER TOTAL				957,030
CHILLER				
	CHILLER (500 TON ELECTRIC CENTRIFUGAL)	2.00 EA	290,000.00	580,000
	COOLING TOWER 1500 GPM 95/85/78	2.00 EA	113,000.00	226,000
	CHILLED WATER PUMP 1200 GPM	2.00 EA	18,000.00	36,000
	CONDENSER WATER PUMP 1500 GPM	2.00 EA	18,000.00	36,000
	CHILLED & CONDENSER WATER PIPING ALLOWANCE	1.00 LS	550,000.00	550,000
	WATER TREATMENT	1.00 LS	45,000.00	45,000
	VARIABLE FREQUENCY DRIVE	4.00 EA	35,000.00	140,000
	CONTROL & INSTRUMENTS	1.00 LS	240,000.00	240,000
CHILLER TOTAL				1,853,000
FUEL HANDLING				
	NO. 2 FUEL OIL TANK 10000 GAL	2.00 EA	36,200.00	72,400
	FUEL OIL TANK FOUNDATION, MONITORING, EXCAVATI	1.00 LS	50,000.00	50,000
	NO. 2 FUEL OIL PUMPS & DOUBLE WALL PIPE	1.00 LS	50,000.00	50,000
FUEL HANDLING TOTAL				172,400
ELECTRICAL				
	BOILER AND CHILLER SYSTEMS ELECTRICAL	1.00 LS	896,000.00	896,000
	SWITCHGEAR AND FEEDERS	1.00 LS	1,506,300.00	1,506,300
	GENERATOR (1000 kW)	2.00 EA	617,115.00	1,234,230
ELECTRICAL TOTAL				3,636,530
OTHER				
	ENGINEERING FEE	1.00 LS	756,866.00	756,866
	PROJECT MANAGEMENT FEE	1.00 LS	756,866.00	756,866
OTHER TOTAL				1,513,732
TOTAL				9,082,392

APPENDIX B
Economic Analysis

DEC Central Plant

Total Capital Cost	$25,288,860

Operating Costs	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh)	99,700	93,800	108,600	127,600	227,800	337,000	424,200	415,500	238,200	142,500	85,500	112,100
LES (kW)	150.000	150.000	530.000	600.000	730.000	1210.000	1600.000	1570.000	1156.000	730.000	230.000	150.000
Energy Charge	1,814.54	1,707.16	1,976.52	2,322.32	4,145.96	8,391.30	10,562.58	10,345.95	5,931.18	2,593.50	1,556.10	2,040.22
Demand Charge	14,768.00	14,768.00	14,768.00	14,768.00	14,768.00	17,182.00	22,720.00	22,294.00	16,415.20	14,768.00	14,768.00	14,768.00
Customer Charge	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00
Total Monthly Electrical Charge	16,767.54	16,660.16	16,929.52	17,275.32	19,098.96	25,758.30	33,467.58	32,824.95	22,531.38	17,546.50	16,509.10	16,993.22
Natural Gas Consumption (MBtu)	10,220,000	8,300,000	5,440,000	2,310,000	1,420,000	1,140,000	1,080,000	1,060,000	1,140,000	2,150,000	5,040,000	9,870,000
Natural Gas Peak (MBh)	35850	28880	22980	11220	4710	2800	2580	2600	3280	13250	22420	34480
Total Monthly Natural Gas Charge	98,186.24	83,150.39	58,792.21	26,769.42	13,892.83	11,331.45	9,762.50	8,787.10	8,760.54	18,191.85	48,070.93	95,120.48

Projected Annual Energy Costs		
Electrical Energy	55,607.33	
Electrical Demand	196,755.20	
Natural Gas	480,815.93	
Total Annual Energy Costs		733,178.46
Total Annual O&M Costs		688,685.00
Total Annual Operating Costs		1,421,863.46

Total Annualized Costs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307
Projected Annual Energy Cost	733,178	755,174	777,829	801,164	825,199	849,955	875,453	901,717	928,769	956,632	985,331	1,014,890	1,045,337
Projected Annual O&M Cost	738,263	760,411	783,223	806,720	830,922	855,849	881,525	907,970	935,209	963,266	992,164	1,021,929	1,052,587
Projected Replacement Cost*	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Projected Annual Costs	3,265,748	3,309,891	3,355,359	3,402,191	3,450,427	3,500,111	3,551,285	3,603,994	3,658,285	3,714,204	3,771,801	3,831,126	3,892,230

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307	1,794,307
1,076,697	1,108,998	1,142,268	1,176,536	1,211,832	1,248,187	1,285,633	1,324,202	1,363,928	1,404,846	1,446,991	1,490,401	1,535,113
1,084,164	1,116,689	1,150,190	1,184,695	1,220,236	1,256,843	1,294,549	1,333,385	1,373,387	1,414,588	1,457,026	1,500,737	1,545,759
0	0	987,491	0	0	0	0	1,861,819	0	0	0	0	11,232,539
3,955,168	4,019,994	5,074,255	4,155,538	4,226,375	4,299,337	4,374,488	6,313,713	4,531,621	4,613,741	4,698,324	4,785,444	16,107,718

*Equipment Replacement Schedule is described in Feasibility Study document.

Total Life Cycle Cost	$117,462,370
Net Present Value	$59,022,249

Civic Arena

Total Capital Cost	$12,252,984

Operating Costs	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh)	4,100	3,600	13,900	31,800	85,500	164,500	210,200	202,600	97,200	41,700	3,300	4,100
LES (kW)	20,000	20,000	280,000	370,000	610,000	740,000	860,000	890,000	630,000	530,000	20,000	20,000
Energy Charge	74.62	65.52	252.98	578.76	1,556.10	4,096.05	5,233.98	5,044.74	2,420.28	758.94	60.06	74.62
Demand Charge	8,214.70	8,214.70	8,214.70	8,214.70	8,662.00	10,508.00	12,212.00	12,638.00	8,946.00	8,214.70	8,214.70	8,214.70
Customer Charge	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00	185.00
Total Monthly Electrical Charge	8,474.32	8,465.22	8,652.68	8,978.46	10,403.10	14,789.05	17,630.98	17,867.74	11,551.28	9,158.64	8,459.76	8,474.32
Natural Gas Consumption (MBtu)	3,230,000	2,580,000	1,480,000	490,000	190,000	120,000	110,000	110,000	150,000	460,000	1,400,000	3,130,000
Natural Gas Peak (MBh)	20,000	16,230	14,170	5,530	2,710	760	620	750	1,380	8,270	11,880	15,990
Total Monthly Natural Gas Charge	31,045.19	25,860.59	16,009.56	5,694.18	1,876.35	1,210.80	1,012.42	929.84	1,170.12	3,907.97	13,367.53	30,178.56

Projected Annual Energy Costs		
Electrical Energy	22,436.65	
Electrical Demand	110,468.90	
Natural Gas	132,263.09	
Total Annual Energy Costs		265,168.64
Total Annual O&M Costs		378,154.00
Total Annual Operating Costs		643,322.64

Total Annualized Costs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379
Projected Annual Energy Cost	265,169	273,124	281,317	289,757	298,450	307,403	316,625	326,124	335,908	345,985	356,364	367,055	378,067
Projected Annual O&M Cost	378,154	389,499	401,184	413,219	425,616	438,384	451,536	465,082	479,034	493,405	508,207	523,454	539,157
Projected Replacement Cost*	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Projected Annual Costs	1,512,702	1,532,002	1,551,880	1,572,355	1,593,445	1,615,167	1,637,540	1,660,585	1,684,321	1,708,769	1,733,951	1,759,888	1,786,604

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379	869,379
389,409	401,091	413,124	425,518	438,283	451,432	464,975	478,924	493,292	508,091	523,333	539,033	555,204
555,332	571,992	589,152	606,826	625,031	643,782	663,095	682,988	703,478	724,582	746,320	768,709	791,770
0	0	748,414	0	0	0	0	1,241,213	0	0	0	0	7,507,549
1,814,120	1,842,463	2,620,069	1,901,723	1,932,694	1,964,593	1,997,449	3,272,504	2,066,149	2,102,052	2,139,032	2,177,122	9,723,903

*Equipment Replacement Schedule is described in Feasibility Study document

Total Life Cycle Cost	$56,903,083
Net Present Value	$28,053,986

Conference Center

Total Capital Cost	$9,347,172

Operating Costs	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh/Month)	10,700	14,200	15,000	15,000	31,100	53,200	67,700	69,300	34,300	17,700	9,100	14,100
LES (kW)	110.10	115.10	141.10	154.10	203.60	305.30	425.00	305.90	287.90	152.00	88.50	110.30
Energy Charge	235.40	312.40	330.00	330.00	684.20	1,638.56	2,085.16	2,134.44	1,056.44	389.40	200.20	310.20
Demand Charge	3,342.63	3,342.63	3,342.63	3,342.63	3,342.63	3,694.13	5,142.50	3,701.39	3,483.59	3,342.63	3,342.63	3,342.63
Customer Charge	30	30	30	30	30	30	30	30	30	30	30	30
Total Monthly Electrical Charge	3,608.03	3,685.03	3,702.63	3,702.63	4,056.83	5,362.69	7,257.66	5,865.83	4,570.03	3,762.03	3,572.83	3,682.83
Natural Gas Consumption (MBtu)	1,210,000	970,000	550,000	150,000	30,000	20,000	20,000	20,000	30,000	140,000	560,000	1,160,000
Natural Gas Peak (MBh)	10,280	8,740	7,140	3,920	740	180	100	100	680	3,560	6,550	9,150
Total Monthly Natural Gas Charge	11,642.48	9,735.31	5,962.12	1,757.05	313.23	218.58	200.55	185.47	250.06	1,203.33	5,359.05	11,197.02

Projected Annual Energy Costs		
Electrical Energy	10,066.40	
Electrical Demand	42,762.61	
Natural Gas	48,024.25	
Total Annual Energy Costs		100,853.26
Total Annual O&M Costs		334,129.00
Total Annual Operating Costs		434,982.26

Total Annualized Costs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205
Projected Annual Energy Cost	100,853	103,879	106,995	110,205	113,511	116,917	120,424	124,037	127,758	131,591	135,538	139,604	143,793
Projected Annual O&M Cost	334,129	344,153	354,477	365,112	376,065	387,347	398,967	410,937	423,265	435,963	449,041	462,513	476,388
Projected Replacement Cost*	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Projected Annual Costs	1,098,187	1,111,237	1,124,678	1,138,522	1,152,781	1,167,468	1,182,596	1,198,178	1,214,227	1,230,758	1,247,785	1,265,322	1,283,386

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205	663,205
148,106	152,550	157,126	161,840	166,695	171,696	176,847	182,152	187,617	193,245	199,043	205,014	211,164
490,680	505,400	520,562	536,179	552,264	568,832	585,897	603,474	621,578	640,226	659,432	679,215	699,592
0	0	748,414	0	0	0	0	884,822	0	0	0	0	4,064,303
1,301,991	1,321,155	2,089,307	1,361,224	1,382,164	1,403,733	1,425,949	2,333,653	1,472,400	1,496,676	1,521,680	1,547,434	5,638,264

*Equipment Replacement Schedule is described in Feasibility Study document.

Total Life Cycle Cost	$39,710,754
Net Present Value	$19,895,009

Hotel #1

Total Capital Cost	$9,082,392

Operating Costs	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh)	51,600	43,600	51,400	54,300	79,900	95,700	115,700	114,500	81,200	62,100	42,700	51,400
LES (kW)	71,000	71,300	120,200	123,400	154,500	191,700	248,800	264,500	133,800	155,900	91,200	71,300
Energy Charge	1,135.20	959.20	1,130.80	1,194.60	1,757.80	2,947.56	3,563.56	3,526.60	2,500.96	1,366.20	939.40	1,130.80
Demand Charge	2,080.29	2,080.29	2,080.29	2,080.29	2,080.29	2,319.57	3,010.48	3,200.45	2,080.29	2,080.29	2,080.29	2,080.29
Customer Charge	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Total Monthly Electrical Charge	3,245.49	3,069.49	3,241.09	3,304.89	3,868.09	5,297.13	6,604.04	6,757.05	4,611.25	3,476.49	3,049.69	3,241.09
Natural Gas Consumption (MBtu)	2,880,000	2,350,000	1,700,000	830,000	600,000	510,000	490,000	480,000	480,000	770,000	1,520,000	2,760,000
Natural Gas Peak (MBh)	7,150	7,280	5,350	3,890	1,850	1,240	1,120	1,050	1,400	3,410	4,550	7,020
Natural Gas Charge	27,491.23	23,556.98	18,386.37	9,631.31	5,881.84	5,080.46	4,440.28	3,990.03	3,700.26	6,528.09	14,511.80	26,613.50

Projected Annual Energy Costs		
Electrical Energy	22,512.68	
Electrical Demand	27,253.13	
Natural Gas	149,811.95	
Total Annual Energy Costs		199,577.76
Total Annual O&M Costs		334,129.00
Total Annual Operating Costs		533,706.76

Total Annualized Costs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418
Projected Annual Energy Cost	199,578	205,565	211,732	218,084	224,627	231,365	238,306	245,455	252,819	260,404	268,216	276,262	284,550
Projected Annual O&M Cost	334,129	344,153	354,477	365,112	376,065	387,347	398,967	410,937	423,265	435,963	449,041	462,513	476,388
Projected Replacement Cost*	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Projected Annual Costs	1,178,125	1,194,136	1,210,628	1,227,614	1,245,110	1,263,130	1,281,692	1,300,810	1,320,502	1,340,784	1,361,675	1,383,193	1,405,356

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418
293,087	301,879	310,936	320,264	329,872	339,768	349,961	360,460	371,273	382,412	393,884	405,700	417,872
490,680	505,400	520,562	536,179	552,264	568,832	585,897	603,474	621,578	640,226	659,432	679,215	699,592
0	0	748,414	0	0	0	0	863,595	0	0	0	0	3,514,359
1,428,184	1,451,697	2,224,330	1,500,861	1,526,554	1,553,018	1,580,276	2,471,947	1,637,270	1,667,055	1,697,734	1,729,334	5,276,241

*Equipment Replacement Schedule is described in Feasibility Study document.

Total Life Cycle Cost	$42,457,257
Net Present Value	$21,404,959

Hotel #2

Total Capital Cost	$9,082,392

Operating Costs	January	February	March	April	May	June	July	August	September	October	November	December
LES (kWh)	51,000	43,500	51,100	54,900	80,800	96,700	116,300	114,600	81,200	61,600	41,200	51,400
LES (kW)	71,700	92,200	121,100	124,000	154,300	193,000	251,300	264,400	134,100	153,900	91,700	72,000
Energy Charge	1,122.00	957.00	1,124.20	1,207.80	1,777.60	2,978.36	3,582.04	3,529.68	2,500.96	1,355.20	906.40	1,130.80
Demand Charge	2,079.51	2,079.51	2,079.51	2,079.51	2,079.51	2,335.30	3,040.73	3,199.24	2,079.51	2,079.51	2,079.51	2,079.51
Customer Charge	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Total Monthly Electrical Charge	3,231.51	3,066.51	3,233.71	3,317.31	3,887.11	5,343.66	6,652.77	6,758.92	4,610.47	3,464.71	3,015.91	3,240.31
Natural Gas Consumption (MBtu)	2,920,000	2,400,000	1,710,000	840,000	600,000	510,000	480,000	460,000	480,000	780,000	1,560,000	2,820,000
Natural Gas Peak (MBh)	7,250	7,270	5,220	3,770	1,720	1,240	1,110	1,040	1,440	3,450	4,570	7,040
Natural Gas Charge	28,067.55	24,057.76	18,494.41	9,747.11	5,881.84	5,080.46	4,350.08	3,824.62	3,700.26	6,612.61	14,892.95	27,191.62

Projected Annual Energy Costs		
Electrical Energy	22,532.04	
Electrical Demand	27,290.82	
Natural Gas	151,901.26	
Total Annual Energy Costs		201,724.12
Total Annual O&M Costs		334,129.00
Total Annual Operating Costs		535,853.12

Total Annualized Costs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Capital Recovery	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418
Projected Annual Energy Cost	201,724	207,776	214,009	220,429	227,042	233,854	240,869	248,095	255,538	263,204	271,100	279,233	287,610
Projected Annual O&M Cost	334,129	344,153	354,477	365,112	376,065	387,347	398,967	410,937	423,265	435,963	449,041	462,513	476,388
Projected Replacement Costs*	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Projected Annual Costs	1,180,271	1,196,347	1,212,905	1,229,959	1,247,525	1,265,619	1,284,255	1,303,450	1,323,221	1,343,585	1,364,560	1,386,164	1,408,416

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418	644,418
296,239	305,126	314,280	323,708	333,419	343,422	353,724	364,336	375,266	386,524	398,120	410,064	422,366
490,680	505,400	520,562	536,179	552,264	568,832	585,897	603,474	621,578	640,226	659,432	679,215	699,592
0	0	748,414	0	0	0	0	863,595	0	0	0	0	3,514,359
1,431,336	1,454,944	2,227,674	1,504,305	1,530,102	1,556,672	1,584,040	2,475,824	1,641,263	1,671,168	1,701,971	1,733,697	5,280,735

*Equipment Replacement Schedule is described in Feasibility Study document.

Total Life Cycle Cost	$42,540,006
Net Present Value	$21,447,187