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HEAPR Section 0:
Overview
February 20, 2018

Stephan E. Kent, Vice President of Finance & Facilities
North Hennepin Community College
7411 85th Avenue North
Brooklyn Park, MN 55445

Dear President McDonald,

We are pleased to submit to you the final predesign for the Boiler Replacement. The attached document has been prepared in accordance with the Minnesota State Predesign Guidelines and in collaboration with you, Joe Moran, Facility Services Director and the operations staff.

The scope of our work on the project has been to review the existing heating system installed in the Plant Services building, analyze the circa 1988 equipment’s energy efficiency and develop a schematic design that replaces these boilers with new equipment that will provide higher efficiency, lower energy and maintenance costs and relieve staff of the impact of 24/7 manual system optimization. Estimated project cost was developed from input from the mechanical service contractor and his in-depth knowledge of the NHCC campus utilities. If funded with 2018 HEAPR funds, boiler replacement will be completed, installed and ready for the 2019 heating season.

Sincerely,

Kimberly Pierson
Kimberly Pierson, PE, LEED AF
Senior Associate/Mechanical
MN Registrar #26482

I certify that this report was prepared by me and that I am a duly licensed engineer under the laws of the state of Minnesota.
HEAPR Section 1:
Summary
HEAPR Section 1: Summary

Scope of Work

North Hennepin Community College is an energy conscious institution. Recent boiler-steam-heating water system control optimization has made a profound improvement in energy usage. The facility recognizes that the existing boilers, circa 1968 and 2002, need replacement to continue this trend of energy optimization, reduce annual maintenance expenditures and improve system reliability.

The scope of work was developed through discussion with NHCC operations staff and, includes demolition and replacement of (2) 1968 boilers with high efficiency, condensing boilers. In addition, replacement of pumps, ancillary equipment and a boiler water-to-domestic hot water heater will modernize key system components.

Project Funding

Higher Education Asset Preservation and Replacement (HEAPR) project funding will be sought. The project will also eliminate deferred maintenance on aging burners and failing safety control sensors for (2) steam boilers.

Major Facility Issues

Two of the three boilers, which produce the low pressure steam that is used to heat eight (8) of the nine (9) buildings on the Brooklyn Park, MN campus were built and installed in 1968. As is expected with equipment that is 50 years old, the effort and expense of maintaining the boilers in operational status is burdensome and time consuming. The facility does experience boiler outages via failure of its safety control equipment. Of the three boilers, it is a challenge, at times, to keep a single boiler online. These boilers are listed in NHCC’s December 2015 Facilities Master Plan for replacement.

Cost Breakdown

<table>
<thead>
<tr>
<th>Cost Breakdown</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demolition and Installation Costs</td>
<td>$1,360,000</td>
</tr>
<tr>
<td>Construction Contingency (10%)</td>
<td>$136,000</td>
</tr>
<tr>
<td>Permit (2%)</td>
<td>$28,000</td>
</tr>
<tr>
<td>General Liability (1.5%)</td>
<td>$21,000</td>
</tr>
<tr>
<td>Soft Costs (engineering, owner; 25%)</td>
<td>$340,000</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$1,940,000</td>
</tr>
<tr>
<td>Inflation (4%)*</td>
<td>$75,000</td>
</tr>
<tr>
<td><strong>Total Project Cost</strong></td>
<td><strong>$1,950,000</strong></td>
</tr>
</tbody>
</table>

*Inflation based on construction completion 2nd quarter of 2019
Project Schedule
A detailed schedule is attached in Section 7.

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Approval Schedule</td>
<td>Oct 2018 – Jan 2019</td>
</tr>
<tr>
<td>Equipment Submittal Review</td>
<td>Jan 2019 – Mar 2019</td>
</tr>
<tr>
<td>Construction Schedule</td>
<td>Mar 2019 – Jun 2019</td>
</tr>
</tbody>
</table>

Past Appropriations
2012: Boiler Upgrade (HEAPR); deferred maintenance on boiler tubes

Summary of Backlog Reduction
The current $10,000,000 backlog for NHCC will be reduced by $1,950,000 at the completion of this project.
HEAPR Section 2:
Project Background Narrative
HEAPR Section 2: Project Background Narrative

**Project fit with Comprehensive Facilities Plan**

The proposed project is listed in the 2015 North Hennepin Community College (NHCC) Master Plan under the description of ‘Heating-How Water Utilities.’ As the Master Plan states, the boilers are outdated and inefficient. The proposed boiler replacement responds directly to the objective to modernize the Plant Services equipment as well as to the campus’ philosophy of energy efficiency.

**Existing facilities systems summary**

North Hennepin Community College was founded in 1966 and has grown dramatically into a 490,000 SF campus that includes nine (9) buildings for student learning and a Plant Services building that supplies the heating and cooling water to eight (8) of those buildings. Refer to Figure 2 for campus building layout. The 2014 Bioscience & Health Careers Center (BHCC) building is the most recent building addition and contains standalone heating and cooling equipment.

![Campus Map](image)

There is an emphasis on energy efficiency at NHCC and, while the energy efficiency has increased dramatically over recent years due to optimization of control of existing equipment, additional energy savings are possible with a replacement of the existing steam boilers.

This project focuses on the existing steam boiler equipment and considers changes to the heating water and domestic heating water systems to increase system efficiency, especially at part load conditions.
Existing mechanical conditions

General

There are three (3) 400 BHP low pressure, natural draft, dual-fuel steam boilers on campus. Two (2) Kewanee boilers were installed in 1968 and a Burnham boiler was added in 2002. The American Society of Heating, Refrigeration, and Air Conditioning Engineers publishes a table of Median Service Life\(^1\) for various equipment. The median service life of a steel, gas-fired steam boiler is listed at 22 years. The existing boilers are aged at 50 years and 16 years, respectively.

Service life signifies the economic life of a particular system or component, or how long it is expected to remain in its original service application. End of service may occur for many reasons, including obsolescence, reduced reliability, excessive maintenance costs, changed system requirements, energy prices, environmental considerations, or failure. Systems or equipment can continue to operate beyond their service life, but with increased likelihood of some of the above risks.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manufacturer/ Model No.</th>
<th>Installed</th>
<th>Capacity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler B-1</td>
<td>Kewanee L3S-400-G02</td>
<td>1968</td>
<td>400 BHP</td>
<td>15 PSIG steam Dual Fuel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>13,390 MBH</td>
<td></td>
</tr>
<tr>
<td>Boiler B-2</td>
<td>Kewanee L3S-400-G02</td>
<td>1968</td>
<td>400 BHP</td>
<td>15 PSIG steam Dual Fuel</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>13,390 MBH</td>
<td></td>
</tr>
<tr>
<td>Boiler B-3</td>
<td>Burnham 5L-400-5-GO-GP</td>
<td>2002</td>
<td>400 BHP</td>
<td>15 PSIG steam Dual Fuel</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>13,390 MBH</td>
<td></td>
</tr>
<tr>
<td>Heat Exchanger 1</td>
<td>Bell and Gossett SU208-2</td>
<td>2002</td>
<td>13,175 MBH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>900 GPM</td>
<td>12”Ø steam</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>190F-160F</td>
<td>8”Ø HW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4”Ø condensate</td>
</tr>
<tr>
<td>Heat Exchanger 2</td>
<td>Bell and Gossett SU208-2</td>
<td>2002</td>
<td>13,175 MBH</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>900 GPM</td>
<td>12”Ø steam</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>190F-160F</td>
<td>8”Ø HW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4”Ø condensate</td>
</tr>
<tr>
<td>HWP-1</td>
<td>Bell and Gossett VSC 6x6x12L</td>
<td>2002</td>
<td>900 GPM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>85’ HD</td>
<td>30 HP</td>
</tr>
<tr>
<td>HWP-2</td>
<td>Bell and Gossett VSC 6x6x12L</td>
<td>2002</td>
<td>900 GPM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>85’ HD</td>
<td>30 HP</td>
</tr>
<tr>
<td>DWH-1</td>
<td>Lochinvar CWN1350</td>
<td>Unknown</td>
<td>1,350 MBH</td>
<td>Gas-fired</td>
</tr>
<tr>
<td>DWH-2</td>
<td>Lochinvar CWN1350</td>
<td>Unknown</td>
<td>1,350 MBH</td>
<td>Gas-fired</td>
</tr>
<tr>
<td>DWH-3</td>
<td>Ajax Boiler Co. SI-V-08-DW-SA400-D</td>
<td>2012</td>
<td>2,800 MBH</td>
<td>Steam-to-HW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>73 GPM</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Existing Heating Water and Domestic Heating Water Equipment

---

\(^1\) 2011 ASHRAE Handbook – HVAC Applications, Chapter 37, page 2.
HEAPR Section 2: Project Background Narrative

Existing Piping Arrangement

As shown in Figure 3, heating water is produced by steam-to-hot water heat exchangers. Generally, each heat exchanger is sized based on the heat output of one (1) boiler, 13,390 MBH. Heat exchangers and pumps are manifolded together to allow system redundancy (N+1) in all but a design winter day. Similarly, each pump is sized based on the water flow of one (1) heat exchanger, 900 GPM. The manifolded configuration allows either pump to be paired in operation with either heat exchanger.

![Figure 3: Existing Heating Water Piping Diagram](image)

Existing Steam Plant Capacity

The three (3) 400 BHP boilers have the capacity, in an N+1 arrangement, to produce 26,780 MBH. That steam production capacity originally included the demand from an absorption chiller that has since been demolished. Facility staff reports that the boilers are not fully loaded and that a single heat exchanger, operating at a delta T of 35°F, is sufficient to meet the heating demand. Demand is then quantified as follows:

- Heat Demand, MBH = \((\text{water flow [GPM]})\times500^2\times(\text{outlet-inlet water temperatures [°F]})\)
- Heat Demand = 15,750 MBH = 900 GPM \times 500 \times (35°F)

\[500 = \text{numeric conversion in units of Btu/hr per gal/min per °F}\]
Sustainability highlights
The two (2) existing 1968 Kewanee boilers are natural draft, non-condensing type. When new, a natural draft-type boiler has a listed efficiency of 80% at full fire. The Kewanee boilers are 50 years old and are no longer operating at peak performance due to fouling and degradation that occurs within the boiler.

Condensing boilers will improve system energy efficiency over a conventional boiler, when hot water return temperature is below 140°F. While NHCC's existing heating water system is designed for a return water temperature of 160°F, this temperature may be reduced in the spring and fall shoulder seasons to produce sub-140°F return water temperature and thermal efficiencies greater than the existing conventional boilers. For the purposes of the energy analysis found in Section 4, a thermal efficiency of 88% has been assumed for the condensing boilers.

Statutory requirements
Not applicable

Photos

Figure 4: Boiler Room
Boiler B-3 (l), Boiler B-2 (c), Boiler B-1 (r)
HEAPR Section 3:
Project Description
Project Description

The scope of work includes demolition and replacement of (2) 1968 boilers with high efficiency, condensing boilers. In addition, replacement of pumps, ancillary equipment and a boiler water-to-domestic hot water heater will modernize key system components.

Based on the facility's report of daily winter operation, the replacement equipment shall be sized to for a capacity of 15,750 MBH. Dunham recommends that five (5) 5,000 MBH condensing hot water boilers replace the (2) aged boilers. Boiler B-3, which is a dual fuel, natural gas/No. 2 fuel oil, boiler shall remain connected and in-service in case of a natural gas outage.

The five (5) new condensing boilers shall be arranged in a N+1 arrangement that provides full capacity in the event of an individual boiler malfunction or planned maintenance. Each of the 5,000 MBH boilers has a rated output of 4,725 MBH, which equates to a total system capacity of 18,900 MBH. See Figure 5: Proposed Piping Diagram.

In order to transition off the steam system and maintain current flow capacity, the instantaneous steam-to-domestic hot water heater that was installed in 2012 shall be replaced with a boiler water-to-domestic hot water heater.

In the proposed piping diagram, shown in Figure 5, the existing heat exchanger (HX-1) and pump (HWP-02) are removed. Heat exchanger (HX-2) and pump (HWP-1) remain to serve Boiler B-3, which allows the facility to continue to operate on interruptible natural gas and receive the corresponding lower gas rate. If the natural gas service is curtailed or suffers a storm outage, Boiler B-3 shall operate on No. 2 fuel oil to produce steam that is converted to heating water, as shown in Figure 3 and Figure 5.

New boilers B-1 through B-5 are manifolded together and controlled with integral, factory-installed software to optimize boiler performance and efficiency. Variable-speed primary pumps, in an N+1 parallel arrangement, shall connect to 8" HWS/HWR piping. Under normal operation, existing pump, HWP-01, and heat exchanger, HX-2, shall be manually valved off. A pair of 2-1/2"pipes shall be extended to Mechanical Room PS123 to serve the new boiler water-to-domestic hot water instantaneous water heater, which will continue to produce hot water in the case of a natural gas outage.
Figure 5: Proposed Piping Diagram
HEAPR Section 3: Project Description

Special security issues

None

Photos of existing mechanical equipment

Figure 6: Boiler Room
Boiler B-3 (l), Boiler B-2 (c), Boiler B-1 (r)

Figure 7: HWP-02

Figure 8: HWP-02 and HX#1 (above)
Deferred maintenance backlog and renewal data

The current $10,000,000 backlog for NHCC will be reduced by $1,950,000 at the completion of this project.

Hazardous material abatement needs

Visual inspection of the piping, indicates newer insulation that would not be expected to contain asbestos. The Hazardous Materials survey for the Plant Services building is scheduled to take place this year and will determine whether abatement will be necessary.
HEAPR Section 3: Project Description

Current conditions, adjacencies, spatial issues and user needs for affected academic programs

Not applicable

Project alternatives and options related to cost options, etc.

- In lieu of (5) 5,000 MBH boilers, (4) 6,000 MBH boilers for a total system capacity of 17,424 MBH.
- In lieu of a full boiler stainless steel heat exchanger, contractor provided a pricing option for a 2-stage copper and stainless steel heat exchanger.

Past Actions

Starting in 2015, in order to improve the energy efficiency of the boiler system, facility staff have utilized manual boiler fire adjustment and near 24/7 hands-on optimization in order to minimize excess combustion air and maximum heat output. Constant adjustment and observation take a toll on facility staff through extended hours on-site and diminished attention elsewhere on campus. Such a rigorous routine cannot be maintained indefinitely. As a result, new equipment with intelligent, factory-programed boiler fire optimization is required to relieve the stress on staff and minimize energy usage.

COPE issues

Not applicable.

Project Phasing

Demolition

- Remove the (2) Kewanee 400 BHP boilers, flues, HX-01 and HWP-01.
- Disconnect the natural gas service and cap pipe at main.
- Disconnect the steam piping and cap at header.
- Remove boiler feed water piping and cap at main. Remove feedwater tank and pumps.
- Cap 8" HWS and HWR at (former) connections to HX-01 and HWP-01.
- Remove the instantaneous steam-to-domestic hot water heat exchanger. Remove steam piping and cap at main header. Remove condensate piping and accessories
Project Phasing continued

Installation

- Install (5) 5000 MBH boilers with built-in Boiler Sequencing Technology, condensate neutralizer kit, double-wall, 14” AL29 stainless steel flue, insulated & galvanized 14” ducted air intake.
- Flash/repair roof at each boiler flue penetration.
- Extend 2”G, 6”HWS, 6”HWR and 1-1/2” condensate outlet for each boiler.
- Install feedwater tank and pumps. Extend piping to boilers.
- Install motorized valves to isolate each boiler.
- Install (2) horizontal, double suction pumps with 25HP motor and VFD in a variable primary pumping scheme.
- Extend new 8”HWS and HWR to existing mains to tunnel. Install valves at the pipe tee for system isolation.
- Extend existing BAS system to interface with the boiler controller system temp/monitoring points.
- Install a double wall, instantaneous boiler water domestic heat exchanger. Extend 2-1/2” CW in, 2-1/2” HW out, 2-1/2” HWS and HWR piping.

Project effects on infrastructure

Effects on the existing infrastructure surrounding the new equipment is limited to the following items:

- creation of new boiler flue roof penetrations and accompanying flashing
- removal of existing concrete pump bases and installation of new concrete bases to coordinate with new pump size.
- installation of new floor sinks and/or drains for condensate removal; saw cutting of equipment room floor for modification of and connection to the existing sanitary sewer system
- removal of existing pipe hangers and installation of new hangers attached to existing structural members (no change to the structural members themselves is anticipated)
HEAPR Section 4:
Sustainability and Energy
HEAPR Section 4: Sustainability and Energy

B3 Benchmarking

The scope of this project does not qualify as a “Major Renovation” as defined by version 3.0 of the MN B3 Guidelines. A Non-Applicability Request Form will be completed and submitted to the B3 Project Website.

Energy analysis

While the project scope does not meet the definition of a “Major Renovation” and B3 Benchmarking, a major impetus behind the project is energy savings. The following analysis has been prepared to demonstrate that the replacement of the 1968 boilers with modern condensing boilers will save approximately 110,000 therms of natural gas annually.

The two (2) existing 1968 Kewanee boilers are natural draft, non-condensing type. When new, a natural draft-type boiler has a listed efficiency of 80% at full fire. The Kewanee boilers are 49 years old and are no longer operating at peak performance due to fouling and degradation that occurs within the boiler. Refer to Figure 10, which shows the expected efficiency of each type of boiler at different load levels. Based on their age, the Kewanee boilers are expected to have an efficiency of 75% at full fire. With the removal of the absorption chiller, the existing boilers do not operate at full fire. As a result, a boiler part load factor of 30% has been assumed, with a corresponding thermal efficiency value of 67%, for use in the following analysis.
Condensing boilers will improve system energy efficiency over a conventional boiler, when hot water return temperature is below 140°F. For example, see Figure 11. NHCC’s existing heating water system is designed for a leaving water temperature of 190°F and a return water temperature of 160°F, as listed in the 2002 heat exchanger submittal shown in Section 9.

Overall system capacity is dictated by an outdoor temperature that is realized for only a short time period over the course of boiler operation. In the shoulder seasons of spring and fall, heating demand can be met at less-than-peak supply water temperatures. As a result, the hot water supply temperature is reduced, producing sub-140°F return water temperatures and thermal efficiencies greater than conventional boilers.

For the purposes of this analysis, a thermal efficiency of 88% has been assumed for condensing boilers that operate with a return water temperature ranging from 130°F to 160°F.
Figure 11: Condensing Boiler Thermal Efficiency Curve
Courtesy of Aerco
North Hennepin Community College gas meter history was accessed from the B3 Benchmarking Database and was reviewed to obtain an annual boiler gas consumption estimate. Table 2 shows the annual gas consumption history for the gas meter serving the existing boilers.

<table>
<thead>
<tr>
<th>Annual Boiler Consumption (Therms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
</tr>
<tr>
<td>2007</td>
</tr>
<tr>
<td>2008</td>
</tr>
<tr>
<td>2009</td>
</tr>
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<td>2011</td>
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<td>2012</td>
</tr>
<tr>
<td>2013</td>
</tr>
<tr>
<td>2014</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>2016</td>
</tr>
</tbody>
</table>

**Average** 270,400

/+/- 29,200

Table 2: Boiler Gas Meter History from B3 Benchmarking Database

Between 2006 and 2014 the annual gas consumption average was 270,400 therms. During that time, the maximum and minimum gas consumption values differed from the average by approximately 29,200 therms.

In 2015 modifications were made to the existing system controls and with continuous 24/7 monitoring and manual optimization, the annual gas consumption dropped significantly. Due to the stress on staff, continuation of manual optimization is not viable, if this project is not funded, we expect energy use to increase back to pre-2015 levels.

The annual gas consumption for the boilers in 2015 and 2016, registered by the boiler gas meter, was 187,700 therms and 156,200 therms respectively. The past two winters have been mild and the winter of 2015-2016 ranks as the 6th warmest winter on record since 1895. With 156,000 therms on the low end and assuming a 58,400 therm range between minimum and maximum gas usage, the estimated average natural gas consumption for the existing heating system is 200,000 therms.

The net gas consumption savings is calculated from:

- Estimated existing boiler plan efficiency
- Estimated annual boiler natural gas consumption
- Proposed boiler plant efficiency
- Estimated annual gas load (demand) on the campus
- Annual boiler gas consumption
At $20/sf applied to the available green space of 275ft x 75ft, translates to an increase of $20,000, or approximately 30%, to the estimated installation cost.

### Energy efficient equipment

The 2015 MN Energy Code requires a 80% thermal efficiency of hot water, gas-fired boilers of the size needed for NHCC. The proposed condensing boilers have a minimum thermal efficiency of 88%. Boiler thermal efficiencies greater than 88% will be achieved using a setback schedule that varies supply water temperature based on outdoor air temperature. When return water temperature drops to 100°F, thermal efficiency increases to 94%.

### Waste Management and Recycling Program Plan

The construction manager shall implement and oversee a plan to divert a goal of 75% of nonhazardous construction and demolition waste from the landfill. Skips shall be clearly labeled to ensure that packaging and demolition waste are segregated into either paper and cardboard or metal subdivisions. Items will be evaluated for re-use, recycling and, as a last resort, landfill.

### Alternative energy source – Geothermal

There is an open area to the north of the Boiler Plant. Assuming that the soil in this area has a thermal resistance that supports heat transfer, thirty six (36) vertical wells spaced at 25-foot interval and extending 200-feet deep could provide 138 MBH, or approximately 1%, of the estimated maximum heat demand for the campus.

Test bores are recommended during the beginning of schematic design to determine the practicality of vertical and/or horizontal well fields. The estimated capacity, listed above, assumes a favorable soil structure and conductivity.

The possible annual savings, first cost and payback are estimated in the following table.

<table>
<thead>
<tr>
<th>Energy Cost Savings for Geothermal</th>
<th>$0.50/sf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental First Costs for Geothermal</td>
<td>$20/sf</td>
</tr>
<tr>
<td>Simple Payback</td>
<td>40 Years</td>
</tr>
</tbody>
</table>

Table 3: Annual Natural Gas Consumption Savings

At $20/sf applied to the available green space of 275ft x 75ft, translates to an increase of $400,000, or approximately 30%, to the estimated installation cost.
Alternative energy source – Photovoltaic

The State of Minnesota design guidelines require inclusion of an alternative energy source to provide 2% of the project’s energy use.

From Section 2, the estimated annual energy (heating) demand for the campus is 15,750 MMBH. The 2% target is 315 MBH, which is equivalent to 95,000 kWh/year. The following table shows a renewable system configuration that would satisfy the 2% renewable energy goal.

<table>
<thead>
<tr>
<th>Description</th>
<th>75 kW Photovoltaic Array</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Production/ Savings</td>
<td>95,000 kWh</td>
</tr>
<tr>
<td>% of Total Modeled Energy</td>
<td>2.0%</td>
</tr>
<tr>
<td>Energy Cost Savings</td>
<td>$6,440</td>
</tr>
<tr>
<td>First Costs</td>
<td>$216,000</td>
</tr>
<tr>
<td>Simple Payback</td>
<td>33.5 Years</td>
</tr>
</tbody>
</table>

The estimated simple payback of a 75 kW photovoltaic system to meet 2% of the campus’ heating demand is 33.5 years. This PV payback period exceeds the anticipated service life of components in the renewable system.

Renewable energy systems rarely directly pay for themselves in a time frame that is acceptable to the building owner. To see an acceptable return, renewable projects need to identify value in other benefits and/or access some of the ever-changing financial incentives. The most common types of incentives are utility and state rebates and preferential tax treatment. As a tax-exempt state facility, this project would not receive tax benefits from owning renewable energy systems.
HEAPR Section 5:
Capital Expenditures
HEAPR Section 5: Capital Expenditures

**Estimate of capital expenditures**

Project construction estimates from Owens Air Conditioning and Heating are provided in the Appendix.

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler Demolition and Installation Costs</td>
<td>$1,180,000</td>
</tr>
<tr>
<td>Domestic Water Heater Demolition and</td>
<td>$59,000</td>
</tr>
<tr>
<td>Installation Costs</td>
<td></td>
</tr>
<tr>
<td>Feedwater Tank and Pump Demolition and</td>
<td>$69,000</td>
</tr>
<tr>
<td>Installation Costs</td>
<td></td>
</tr>
<tr>
<td>BAS Integration</td>
<td>$30,000</td>
</tr>
<tr>
<td>Roofing</td>
<td>$25,000</td>
</tr>
<tr>
<td>Construction Subtotal</td>
<td>$1,360,000</td>
</tr>
<tr>
<td>Construction Contingency (10%)</td>
<td>$136,000</td>
</tr>
<tr>
<td>Permit (2%)</td>
<td>$28,000</td>
</tr>
<tr>
<td>General Liability (1.5%)</td>
<td>$21,000</td>
</tr>
<tr>
<td>Soft Costs (engineering, owner; 25%)</td>
<td>$340,000</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$1,880,000</td>
</tr>
<tr>
<td>Inflation (4%)*</td>
<td>$75,000</td>
</tr>
<tr>
<td><strong>Total Project Cost</strong></td>
<td><strong>$1,950,000</strong></td>
</tr>
</tbody>
</table>

Project construction must be phased to be completed while the boilers are shutdown for the summer.

**Project funding**

HEAPR funds will be sought to fund this project.

**Project procurement and delivery method**

The preferred project procurement method for this project is a Department of Administration, Master Contract with Owens Air Conditioning and Heating. Owens project manager, John Albers, has been performing construction on the North Hennepin CC campus for many years and is intimately aware of the existing steam and hydronic systems. For example, John Albers was in charge of a heat exchanger/pump/air separator replacement project completed in 2003. NHCC facilities management is comfortable working with John and trust in the workmanship and knowledge that he brings to the facility.
HEAPR Section 6:
Ongoing Operating Expenses
HEAPR Section 6: Ongoing Operating Expenses

**Total Ownership Cost of the Project**

The lifespan of the proposed boilers is 30-years. Energy and maintenance have been estimated for the first year and annualized over the 30-year lifespan.

<table>
<thead>
<tr>
<th>Project First Cost</th>
<th>$1,950,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Cost, NPV*</td>
<td>$1,730,000</td>
</tr>
<tr>
<td>Maintenance, NPV*</td>
<td>$200,000</td>
</tr>
<tr>
<td>Total Ownership</td>
<td>$3,880,000</td>
</tr>
</tbody>
</table>

NPV – net present value; 3% inflation and 6% discount value

**Operating Budget for ongoing repair, replacement and maintenance**

Annual boiler maintenance on the existing wetback scotch marine boilers includes draining and cleaning the firebox, punching the tubes and inspection by the state boiler or insurance inspector. Burners, original to the boilers, are retuned annually. Due to the age of the boilers, unexpected safety component failures like low water and flame sensors, trigger the need for immediate replacement and drive up the costs of annual maintenance. Annual maintenance budget for the three (3) existing gas/oil boilers is $25,000.

The high efficiency replacement boilers have the following recommended schedule (as taken from the Aerco Benchmark Boiler Operation-Service-Maintenance Guide). Annual budget for this maintenance schedule for (5) 5,000 MBH Aerco boilers is $8,500.

![TABLE 4-1: Maintenance Schedule](image-url)

*Only performed after initial 6 month period after initial startup.*
HEAPR Section 6: Ongoing Operating Expenses

**Alternative Funding Sources**

No alternative funding sources are being sought.

**Review COPE findings**

Not applicable.
HEAPR Section 7:
Schedule
HEAPR Section 8:
Technology Plan/Budget
HEAPR Section 8: Technology Plan/Budget

**Existing Technology Plan and Information Technology Infrastructure**

Not applicable for a maintenance update project.

**Improvement of existing infrastructure**

Not applicable

**Technology alternates**

None.
HEAPR Section 9:
Appendix
Form P-0c: Applicability Form
B3 Guidelines Version 3.0

This form is used to review General Obligation (G.O.) Bond Funded projects to determine if the B3 Guidelines are applicable. Projects identified as receiving bond funds that are not following the guidelines will be listed as “not compliant” (including possible documentation in the B3 Case Study Database) until they have submitted this form. It has been reviewed, and, if approved, the project has been designated as “not-applicable”.

If the design team is seeking variances on specific guidelines, use the variance process facilitated through the B3 Guidelines Tracking tool. If non-applicability is pursued, this form is due by the end of the Schematic Design Phase. If a project team is unsure whether the guidelines apply to a specific project, they may submit this form to clarify their requirements. Please complete the yellow boxes below and submit to guidelines@b3mn.org. This form is not needed if a project is compliant with the B3 Guidelines.

| Project Name: | NHCC Boiler Replacement |
| Project Address: | 7411 85th Avenue North, Brooklyn Park, MN 55445 |
| Appropriated Agency: | MNSCU |

Appropriated Agency Contact: Person and Contact Information:

| Name: | Joe Moran |
| Email: | JMoran@nhcc.edu |
| Phone Number: | 651-523-2800 |

Almost all not-applicable projects will fall under Part 1 (see below) due to clearly being outside of the scope of the guidelines applicability. Rarely, however, because of the wide variety of state-funded projects, valid reasons for not-applicability may occur that are not currently covered under the applicability criteria for the B3 Guidelines. In these cases some projects may be designated as not-applicable from the B3 Guidelines for reasonable cause (see Part 2 below) upon review by the State of Minnesota B3 Executive Team.

Description of the project (size program and cost):

The scope of work includes demolition and replacement of (2) 1968 boilers with high efficiency, condensing boilers. In addition, replacement of pumps, ancillary equipment and a boiler water-to-domestic hot water heater will modernize key system components.

Existing heat exchanger (HX-1) and pump (HWP-02) are removed. Heat exchanger (HX-2) and pump (HWP-1) remain to serve Boiler B-3, which allows the ability to continue to operate on interruptible natural gas and receive the corresponding lower gas rate. If the natural gas service is curtailed or suffers a storm outage, Boiler B-3 shall operate on No. 2 fuel oil to produce steam that is converted to heating water.

New boilers B-1 through B-5 are manifolded together and controlled with integral, factory-installed software to optimize boiler performance and efficiency. Variable-speed primary pumps, in an N+1 parallel arrangement, shall connect to 8” HWS/HWR piping. Under normal operation, existing pump, HWP-01, and heat exchanger, HX-2, shall be manually valved off. A pair of 2-1/2” pipes shall be extended to Mechanical Room PS123 to serve the new boiler water-to-domestic hot water instantaneous water heater, which will continue to produce hot water in the case of a natural gas outage.

Estimated project cost, including a 4% inflation factor, is $1,700,000.
Use Part 1a if the project is new construction or addition, use Part 1b for major renovations.
A “false” response to one or more questions in the appropriate part below may enable the project to be designated “not-applicable” after review.


Applicability criteria for the B3 Guidelines. Use this table for new construction projects and additions.

<table>
<thead>
<tr>
<th>This new construction or addition project is: (true, false or n/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funded directly or indirectly, and in whole or part by Minnesota bond monies after January 1, 2004</td>
</tr>
<tr>
<td>Considered a building under the Minnesota Building Code.</td>
</tr>
<tr>
<td>(mark this section n/a if project is not an addition)</td>
</tr>
<tr>
<td>This addition includes new heating systems for parts of the addition that are heated and new cooling systems for parts of the addition that are cooled.</td>
</tr>
</tbody>
</table>

### Part 1b: Major Renovations Path: Applicability Checklist For Major Renovations

Applicability criteria for the B3 Guidelines. Use this table for major renovation projects that are limited to remodeling and renovations of an existing structure.

<table>
<thead>
<tr>
<th>This major renovation project is: (true, false or n/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funded directly or indirectly, and in whole or part by Minnesota bond monies after January 1, 2009</td>
</tr>
<tr>
<td>Equal to or larger than 0,000 square feet in area</td>
</tr>
<tr>
<td>Includes at least the replacement of the mechanical, ventilation or cooling system of a portion of the building</td>
</tr>
</tbody>
</table>

### Part 2: Other Reason for Proposed Non-Applicability of B3 MSBG Guidelines (Either Path): If B3 Guideline does not apply to the project according to either checklist (no “false” entries in one of the above checklists) and the appropriated agency still believes that it should not apply, please state the reasons for proposed non-applicability below.

### Applicability Review & Approval (B3 Guidelines Administrator Only)

Date that request was sent from Appropriated Agency to B3 Executive Team for review

Date that request was reviewed by B3 Executive Team

B3 Executive Team Applicability Review Result:

(Either accepted and project designated as “Not Applicable” or rejected and project designated as “Applicable,” project will be designated “Non-Compliant” unless project proceeds with compliance.)
September 21, 2017

Ms. Kimberly Pierson, PE, LEED AP, ASHRAE HFDP  
Senior Associate/Mechanical  
Dunham  
50 South Sixth Street  
Suite 1100  
Minneapolis, MN 55402

SUBJECT: Boiler Budget Proposal P-12403

Dear Ms. Pierson:

Thank you very much for considering Owens Companies for this project. Both prices include all labor and material, roofing/electrical/temp control/pipe insulation. Information is as follows:

Boiler - Option 1

RBI Flexcore Condensing Boiler; 6000 MBH input/ 5808 MBH output; 95%+ efficient full linear modulation w/ 5:1 turndown; CSO-1 compliant; ASME symmetrical firetube series 300 stainless steel heat exchanger; sealed stainless steel combustion chamber; low Nox mesh burner; turbo pilot ignition; temp/pressure gauge; flow switch; manual reset high limit; blocked flue detection switch; low air pressure switch; self diagnostic control panel; flame safeguard; variable speed blower; ASME relief valve; modulating gas valve; pilot regulator and valve; gas safety valve; ignition valve; carbon steel jacket panels; HEATNET full board with touch screen boiler controller; 230V/60/3 WT.: 4150 lbs each.

Iron lookup regulator; 2-inch NPT; inlet pressure 2 PSI outlet pressure 5-9 inches. Maxitrol gas filter; 2-inch NPT. Part No B38R WT.: 15 lbs each.

B&G In-Line Pump Series e-80, Model 5 x 5 x 7B, 3S, 3HP, 1800RPM with 5.5 inch impeller, STD-Buna/Carbon/Ceramic/SS/Bronze Seal, BG Choice, ODP, Nema Premium Efficient, 230/460/3/60 Motor 360 GPM, 20 FTTDH WT.: 265 lbs each.

ABB VFD; 3HP at 460V; Model #ACH550-UH-06A9-4; Standard VFD in NEMA 1 – UL Type 1 enclosure; 5% swinging DC reactor; EMI/RFI filter; 6.9 amps at 460V; 14.5 inches H x 4.9 inches W x 8.3 inches D. WT.: 14 lbs each.

B&G 3DS-5B Triple Duty Valve; Straight Pattern; 5 IN. WT.: 110 lbs each.

One trip for onsite certified start-up assistance. Installer to be present at time of start-up to assist. We request a two week notice to schedule start-up for Monday – Friday 8:00 – 5:00.
Axiom NT25 Condensate Neutralization Tank – 45gal/hr capacity. Polypropylene construction. Includes 40lbs LipHer neutralization media. Two 1 inch FNPT inlet/outlet connectons. 17.5L x 13.5W x 8H. WT.: 46 lbs each.

RBI HeatNet BACnet MStP/IP ProtoCessor WT.: 1 lbs each.

RBI HeatNet Common Header Supply Sensor 10K (less well) WT.: 1 lbs each.

RBI HeatNet 3in Sensor Well WT.: 1 lbs each.

**Boiler – Option 1 Price:** ................................................................. $978,892

**Boiler – Option 2**

Aerco Benchmark BMK Platinum 5000, condensing boiler with an input of up to 5000 MBH, fired on natural gas. Boiler has a 12:5:1 turndown and is rated at 150 PSIG max. working pressure and has 460/60/3 electrical input. NOx emissions are 20ppm or less. Unit has 14" venting.

Complete with the following:

- (1) Outdoor sensor and header sensor kit.
- (1) BACnet communication card.
- (5) Motorized control valves.
- (5) Neutralization tubes.
- (1) Factory start-up by certified Aerco technician.

(2) - Taco TA1229/10.4, 6" x 5" horizontal split case, centrifugal pumps, bronze fitted with bronze shaft sleeves, silicon seals and flexible coupled with a 25 HP, 1750 RPM, 460/60/3 premium efficiency, TEFC motor with Aegis SGK. Each pump to have a capacity of 550 GPM at 65 ft. head.

(4) - Spare seal kits; each pump has two seals.

(2) - Taco #SD08060, 8" x 6" flanged x flanged suction diffusers with strainer, adjustable foot and start-up screen.

(2) - Taco #MPV-060, 6" flanged multi-purpose valves with non-slam check and two flow meter fittings.

(4) – Twin City hose #MS2-8R, 8" x 13" OAL, Twin sphere, EDPM Neoprene rubber flexible pump connectors with 150 lb. floating type flanges at each end with control rods.

(2) – Taco/Danfoss, variable frequency drives, (2) 25 HP, 460V wth disconnect, line reactor, H-O-A speed pot, pilot lights and BACnet card.

**Boiler – Option 2 Price:** ................................................................. $1,170,818
Domestic Water Heater

(1) – Aerco #SPDW61 double wall water heater with the capacity to heat 56 GPM of water from 40 to 140 ceg. F. when supplied with 76 GPM of 170 deg. F. boiler water. Unit to have a plate heat exchanger with a three way control valve with electronic controls.

Domestic Water Heater Price: .............................................................................. $58,329

Terms and Conditions

The repair, correction or modification of pre-existing HVAC and/or electrical deficiencies unless specifically detailed is not included. Any additional repairs found necessary during the course of this work will be brought to your attention with the appropriate pricing before proceeding.

This proposal is firm for 30 days. Our terms are NET 15 DAYS from date of invoice. Please refer to our attached General Terms and Conditions.

Please feel free to reach out to me with any questions or concerns you may have regarding this project. My direct line is 952-703-5790. If you wish to proceed with this work, please sign and return a copy to Owens Companies. I look forward to working with you on this project.

Sincerely,

OWENS COMPANIES, INC.

John H. Albers
Senior Project Manager

Accepted By:

PURCHASER: DUNHAM

Signature

Title Date
February 9, 2018

Ms. Kimberly Pierson, PE, LEED AP, ASHRAE HFDP
Senior Associate/Mechanical
Dunham Associates, Inc.
50 South Sixth Street, Suite 1100
Minneapolis, MN 55402

SUBJECT: Add on to Boiler Replacement Project

Dear Ms. Pierson:

Thank you for your request for additional pricing on the replacement of the boiler feedwater pumps and feedwater tank.

We propose to provide one boiler feedwater tank with Duplex pumps for one 400-HP low pressure steam boiler. This scope of work is an add-on to the boiler replacement project – 12403.

Installed price is:
Sixty-Eight Thousand Three Hundred Eleven and No/100 Dollars............................ $68,311.00

Terms and Conditions

The repair, correction or modification of pre-existing HVAC and/or electrical deficiencies unless specifically detailed is not included. Any additional repairs found necessary during the course of this work will be brought to your attention with the appropriate pricing before proceeding.

This proposal is firm for 30 days. Our terms are NET 15 DAYS from date of invoice. Please refer to our attached General Terms and Conditions.

Please feel free to contact at my direct line 952-703-5790, with any questions or concerns you may have regarding this project. If you wish to proceed with this work, please sign and return a copy to Owens Companies. I look forward to working with you on this project.

Sincerely,

John H. Albers
Senior Project Manager

Accepted By:

PURCHASER: DUNHAM ASSOCIATES, INC.

Signature

Title Date

Owens Companies, Inc.
930 East 80th Street
Bloomington, MN 55420-1499
952.854.3800 FAX: 952.854.3769
www.owensco.com

Building Services • Mechanical Contracting
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GENERAL TERMS AND CONDITIONS

1. All orders are subject to approval by the Credit Department of the Seller.

2. A 1 1/2% per month late payment charge will be applied to all past due invoices.

3. Materials or equipment must not be returned except by prior written approval from Seller. Transportation charges must be prepaid. Items not found to be defective are subject to a 20% restocking charge.

4. Seller warrants its workmanship against defect for thirty (30) days from date the work is completed, unless other terms are agreed to in writing by Seller. During that period, Seller will correct the defect in workmanship without charge for labor. Warranty service does not include routine maintenance. Parts, materials, and equipment warranty is limited to the same warranty terms that Seller receives from the manufacturer. Seller shall not be liable for loss, damage, or injury caused by failure or delay in performing services when such failure or delay arises from causes beyond our control.

This warranty is in lieu of all other warranties or liabilities, either express or implied, including any implied warranties of merchantability or fitness for a particular purpose. In no event shall Seller be liable for any incidental or consequential damages.

5. Purchaser shall assume risk of loss or damage to equipment furnished by Seller on the date that such equipment is set in place on the job. Purchaser shall insure such equipment and all other work supplied by Seller under this project against loss or damage in an amount sufficient to protect the interests of Seller against all risk of loss. Purchaser shall cause Seller to be added as a named insured on such insurance policy until final payment is made by Purchaser to Seller.

6. Purchaser understands and agrees that:
   a. This Proposal does not include the detection, abatement, encapsulation, or removal of asbestos or products, materials, or equipment containing asbestos. In the event that Seller encounters any asbestos product or material in the course of performing its work, Seller shall have the right to discontinue its work and remove its employees from the project site, or that portion of the project site wherein such product or material was encountered, until such product or materials, and any hazards connected therewith are abated, encapsulated or removed, and/or it is determined that no hazard exists; further, Seller shall receive an extension of time to complete the work, and/or comply with its obligations under this Proposal.
   b. Seller may rely upon Purchaser’s representations and warranties regarding asbestos and Purchaser's compliance with Asbestos Evaluation Requirements. Any other site investigation requirements notwithstanding, Seller shall have no duty to identify, detect, or evaluate asbestos.
   c. To the extent permitted by law, Purchaser shall defend, indemnify, and hold Seller harmless for any and all penalties, actions, liabilities, and damages arising from or relating to asbestos at this project site, including without limitation: inscription, disturbance, or removal of any product containing asbestos or violation of governmental regulations relating to asbestos. Purchaser releases Seller from all claims and liability relating to asbestos at this project site, including claims for subrogation.

7. All agreements are contingent upon strikes, fire, flood, accidents, or delays caused by circumstances beyond our control.

Seller agrees that it will not discriminate against or harass any employee or applicant for employment because of race, color, creed, religion, disability, national origin, sex, member or activity in a local commission, sexual orientation, age, marital status, status with regard to public assistance or any other characteristic protected by law and will include a similar provision in any subcontracts entered into for the performance thereof.