MECHANICAL INSULATORS
LMCT
Labor Management Cooperative Trust
ENERGY CONSERVATION SPECIALISTS

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The following pages will outline a case study, which shows the benefits in energy and cost savings of properly installed mechanical insulation.

Insulation is a proven means for conserving energy, reducing greenhouse gas emissions, increasing process productivity, providing a safer and more productive work environment, controlling condensation (which can lead to mold growth), supporting sustainable design technology and a host of other benefits.

Mechanical insulation does all of this, while providing a return on investment (ROI) rate, which is seldom rivaled. Despite the proven ROI, insulation is often overlooked and its benefits undervalued. Insulation is truly the lost or forgotten technology. Can you think of a more important time than now to think about how insulation can help you?

An insulation system is a technology, which needs to be engineered and maintained throughout the entire process. Several studies have estimated roughly 10 to 30 percent of all installed insulation is now missing or damaged.

The practice of not replacing or maintaining an insulation system in a timely and correct manner reduces the full benefits of insulation, and in return, decreases the ROI. In many cases, significant other issues - such as excessive energy loss, corrosion under insulation (CUI), mold development, increased cost of operations and reduced process productivity or efficiency - develop.

You can learn more on www.MechanicalInsulatorsLMCT.com, where additional case studies can be viewed.

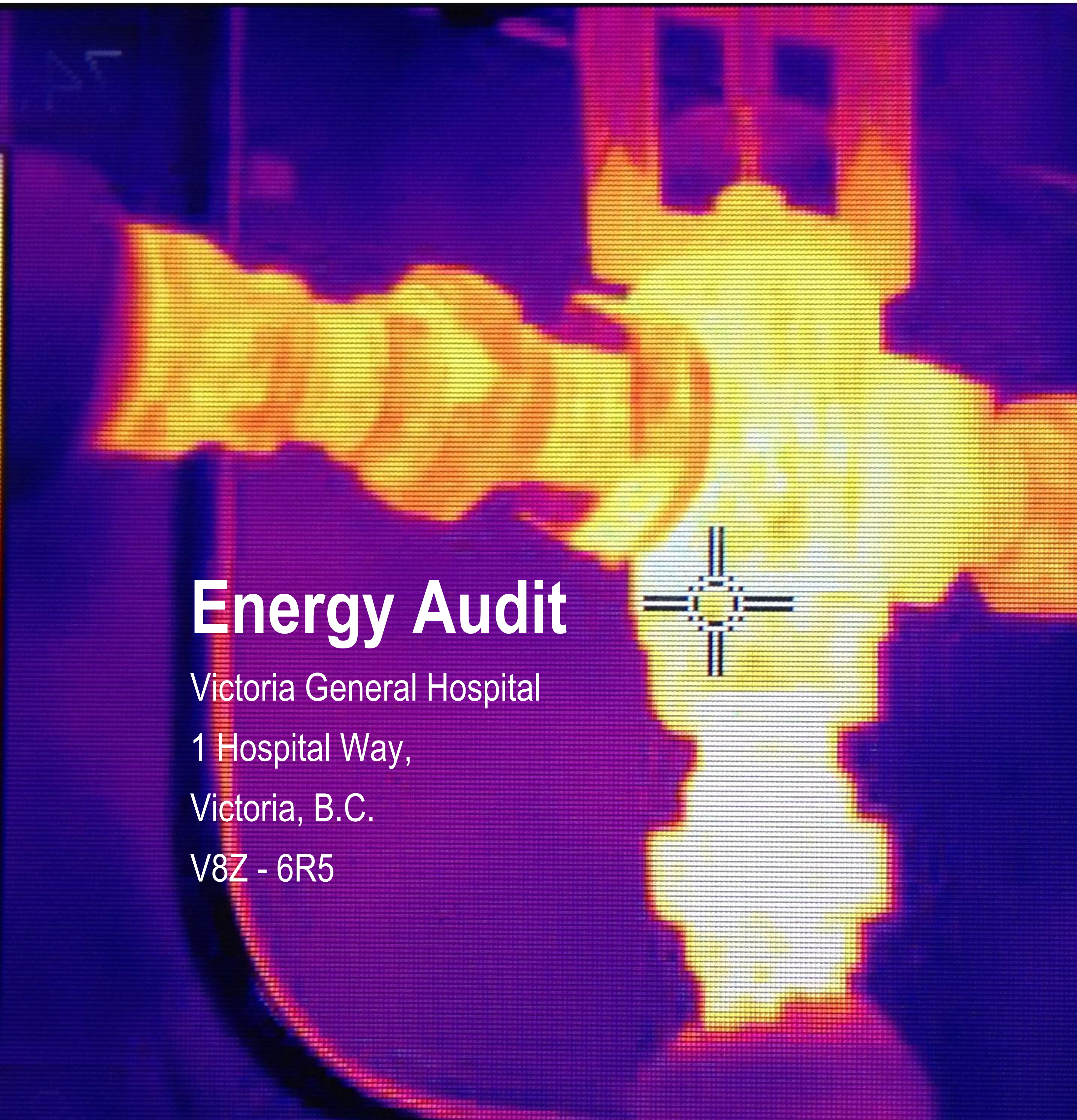
Please do not hesitate to contact me should you have any additional questions.
Thank you,

Peter Ielimi

Executive Director
Mechanical Insulators Labor Management Cooperative Trust

SALAMANDER INSPECTIONS LTD

Mechanical Insulation Energy Audits



Energy Audit

Victoria General Hospital

1 Hospital Way,

Victoria, B.C.

V8Z - 6R5

Executive Summary

Victoria General is located in View Royal at 1 – Hospital Way, Victoria, British Columbia. This hospital is a multi level healthcare facility is operated by Island Health Authority. For this report our inspection was for this buildings mechanical room and fan rooms only.

Salamander Inspections performed an energy audit of the insulation systems within the main Boiler Room and Fan Rooms. The purpose of the audit was to determine the current state of mechanical insulation applied to the systems.

Our findings indicate that there are opportunities to improve the mechanical insulation systems in a cost effective manner. The benefits are itemized below. Any deviation from following the Best Practices Guideline[1] developed by the North American Insulation Institute will reduce the potential savings and benefits. For example, we know that the elimination of canvas jacket can shorten the lifespan of fiberglass with an ASJ finish because of the lack of a protective cladding system. We also recommend using removable insulating pads where necessary or required for maintenance to ensure that the insulation systems remain intact for as long as possible.

Undertaking the projects we have identified in our review will yield:

1) Annual reduction of heat loss **- 1043 Gj** and a **ROI of 3.44 years**
2) Annual cost savings derived through properly insulated piping - **$9,240.00**
3) Potential savings on maintenance costs for equipment
4) Elimination of personal protection hazards

[1] Refer to http://insulationinstitute.org/tools-resources/resource-library/codes-standards/ for more information in mechanical insulation systems.

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Introduction

Ms. Claudette Poirier, Energy Specialist for Island Health retained Salamander Inspections Ltd. to complete a review of mechanical insulation systems applied to the heating systems at Victoria General Hospital located in Victoria, British Columbia. The goal of the assessment is to find energy savings for the hospital.

About Salamander Inspections and the FLIR Thermographic Camera

Salamander Inspections Ltd. is a third party inspection service providing energy audits for mechanical systems in the Commercial/Institutional sector. We are utilizing a state of the art FLIR thermographic camera to provide us with accurate measurements and photographs of heat loss and gain on mechanical systems within the scope of work determined by our clients.

This heating plate exchanger, as photographed by the FLIR camera uses sensors built within the camera to show the heat radiating from the valve. The brighter the color the hotter the temperature of the object. The camera must be set up to filter out the ambient heat from surrounding objects to ensure that the temperatures are accurate. The camera then takes a thermal image as well as a digital picture for reference.

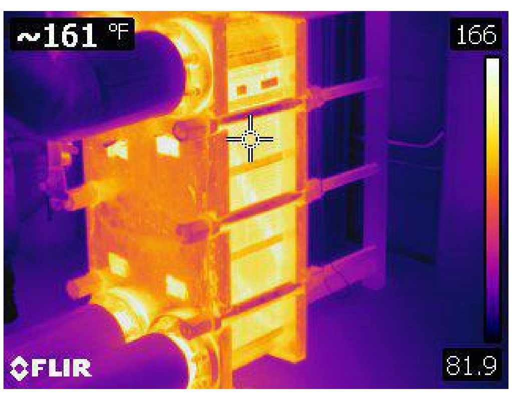


Figure 1 This is an infrared photo of a heat exchanger showing the areas with where large temperature differences create high rates of heat transfer.

Figure 2 This photo shows the same plate heat exchanger.

Methodology

The audit was performed by systematically inspecting the condition of all mechanical systems within the scope of work. The type of system, condition, temperature and footage was recorded and used to determine outcomes that will be beneficial to the operation of the building. The areas targeted within the scope of work have been checked using a FLIR digital thermal imaging camera which shows clearly problem areas that may not be seen with the naked eye. High rates of heat transfer are indicated in areas where there are large color differences between the background elements within the area.

After identifying the problem areas with an infrared camera, we then completed simulations of different mechanical insulation systems. In this way, we were able to develop a cost versus benefit model for different insulation systems

Study Findings

Boiler Room

In general, workmanship on the mechanical systems is good condition but there were some deficiencies if we compare the systems to the standards established in Best Practices Guideline[2] developed the North American Insulation Institute. For instance, valves, pumps, flanges and or fittings should have been insulated at the time of retro fit when new boilers were installed. We also noted that due to ongoing maintenance there are areas where insulation materials have been removed and not replaced. However, we note that some specifications expressly omit this requirement thereby increasing operating costs for the owner. We are continuing our efforts to reach out to the engineering community to get elements such as these changed in specifications.

We have assessed the boiler room and found that the insulation applied to the older existing mechanical systems is in generally good condition. We noted that the remaining insulation before the retro fit took place is 1 inch thick (25mm). Current best practices and ASHRAE 90.1 (2010) requires that the insulation applied to heating systems be 1 ½ inch thick (40mm). The new insulation that has been applied on the upgraded mechanical heating systems follows ASHRAE 90.1 but the installers (company) did not completely insulate the systems leaving opportunities to save energy and lower GHG output.

[2] Refer to http://insulationinstitute.org/tools-resources/resource-library/codes-standards/ for more information in mechanical insulation systems.

There are some instances where pumps, valves and piping have no insulation applied and therefore, there is an opportunity to reduce operation costs. During the course of this inspection we counted at least (57) valves, (103) valve bonnets, (5+) strainers, (9+ heat exchanger heads) and (12) pumps that should be insulated.

Sample photos are provided below showing various components of the mechanical systems where upgrading the mechanical insulation will reduce operating costs by reducing energy consumption and extending the service life of equipment and also improve personnel safety (Figures 3 to 44).

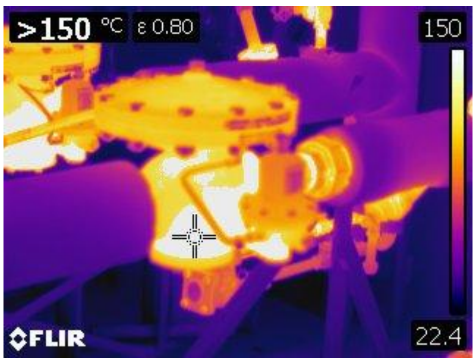


Figure 3 This thermographic image of an exposed valve assembly at 150º C or 302º F.

Figure 4 This is a conventional photo of the same pump. There are also an exposed valve spindles and unions.

Figure 5 This Thermographic image of a steam trap and piping below the previous valve assembly at 150º C or 302º F.

Figure 6 This conventional photo shows the same steam trap and piping.

Figure 7 This is a thermographic image of a bare valve bonnet at 140º C or 284º F.

Figure 8 This is a conventional photo of the same valve bonnet.

Figure 9 This is a thermographic image of bare 1 ¼ steam line in the boiler room at 91º C or 195º F. (over 40 ft)

Figure 10 This is the conventional image of the same bare steam line from sterilizer.

Figure11 This is a thermographic image of pipe supports without insulation behind them at 79º C or 174º F. (12 of)

Figure 12 This is the conventional image of the same pipe supports.

Figure 13 Thermographic image of one specific valve bonnet but the image shows many bare areas missing insulation.

Figure 14 This is a conventional image of the same mechanical piping with all the areas of heat loss invisible to the naked eye.

Figure 15 This thermographic image is of bare piping and valves at 102º C or 215º F

Figure 16 conventional image of the same piping and valves.

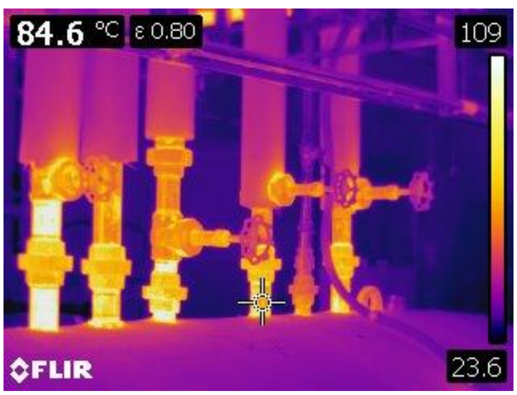


Figure 17 Thermographic image of valves and unions on top of a vessel at 84º C or 183º F

Figure 18 Conventional image of the same valves and unions.

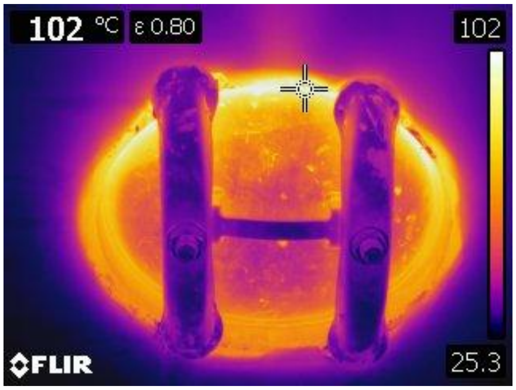


Figure 19 Thermographic image of the access hatch to this vessel at 102º C or 215º F

Figure 20 Conventional image of the same access hatch.

Figure 21 Thermographic image of a flow meter at 140º C or 284º F.

Figure 22 Conventional picture of the same flow meter.

Figure 23 Thermographic image of a large bore bare valve bonnet at 140º C or 302º F.

Figure 24 Conventional image of the same valve above boiler .

Figure 25 Thermographic image of sightglass and piping at front of the boiler at 68º C or 154º F.

Figure 26 conventional image of the same sightglass and piping.

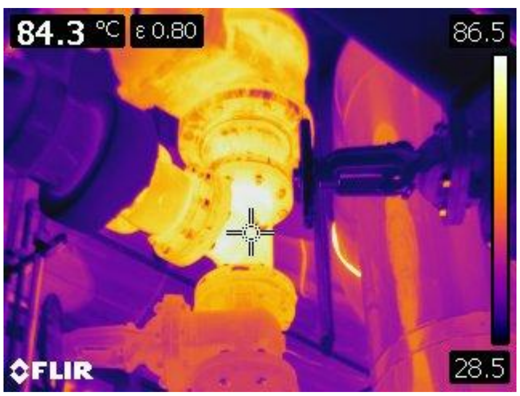


Figure 27 Thermographic image of large bore valves above boilers to heating pumps at 84º C or 183º F.

Figure 28 Conventional image of the same cluster of valves.

Figure 29 Thermographic image of control valves adjacent to boilers at 78º C or 172º F.

Figure 30 Conventional image of the same control valves.

Figure 31 Thermographic image of heating supply pumps at 101º C or 213º F.

Figure 32 Conventional image of the same pumps.

Figure 33 Thermographic image of heating supply pumps at 96º C or 204º F.

Figure 34 Conventional image of the same pumps.

Figure 35 Thermographic image of bare valves at 80º C or 176º F.

Figure 36 Conventional image of the same valves and flanges.

Figure 37 Thermographic image of a chem pot at 101º C or 213º F.

Figure 38 Conventional image of the chem. pot and associated piping.

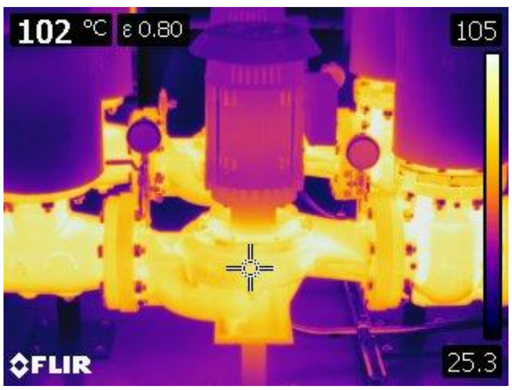


Figure 39 Thermographic image of bare heating pumps at 102º C or 215º F.

Figure 40 Conventional image of the same motorized heating pumps.

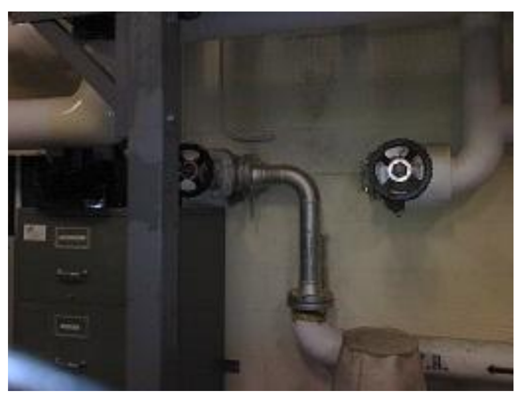


Figure 41 Thermographic image of bare piping to hot water tanks at 68º C or 154º F.

Figure 42 Conventional image of bare piping to hot water tanks.

Figure 43 Thermographic image of bare piping and heat exchanger at hot water tanks at 54º C or 129º F.

Figure 44 Conventional image of the same piping and heat exchanger.

Fan Rooms

The inspection of the fan room mechanical areas has revealed that the insulation was generally applied correctly and the majority of insulation that's applied is in good condition. However, the issue remains that in all (3) fan rooms insulation is missing on piping, valves, strainers and heat exchangers. Failure to have complete coverage of the insulation system has left opportunities to improve or upgrade the insulation and receive benefits to the cost of operation. (figures 45–72)

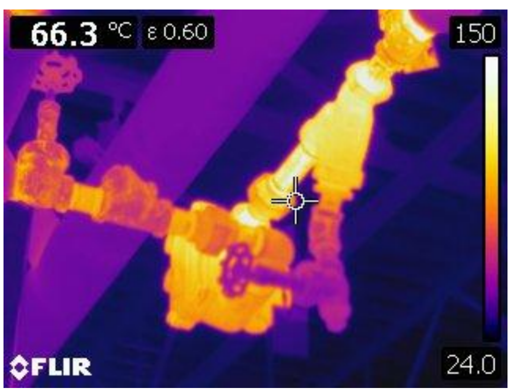


Figure 45 Thermographic image of bare steam trap in the penthouse fan room at 66º C or 150º F.

Figure 46 Conventional image of the same steam trap and associated piping.

Figure 47 Thermographic image of bare heating supply to 69º C or 156º F.

Figure 48 Conventional image of bare small bore heating supply and return to coils.

Figure 49 Thermographic image of bare three way valve and bare valve bonnet at 86º C or 186º F

Figure 50 Conventional image of the bare three way valve and valve bonnet.

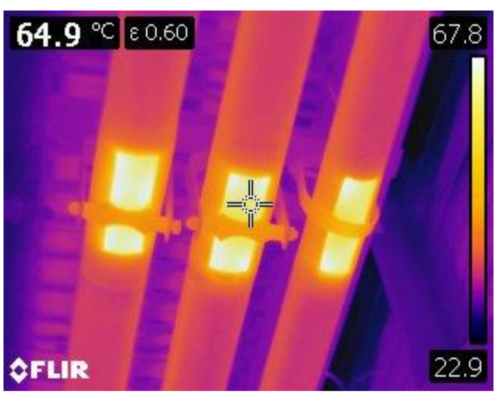


Figure 51 Thermographic image of pipe supports at 64º C or 147º F (67 of)

Figure 52 Conventional image of the same insulation supports.

Figure 53 Thermographic image of large three way valve and bare valve bonnet at 71º C or 159º F

Figure 54 Conventional image of the same three way valve and bare bonnet.

Figure 55 Thermographic image of valve bonnets and three way valve at 43º C or 109º F

Figure 56 Conventional image of the same three way valve and bare bonnets.

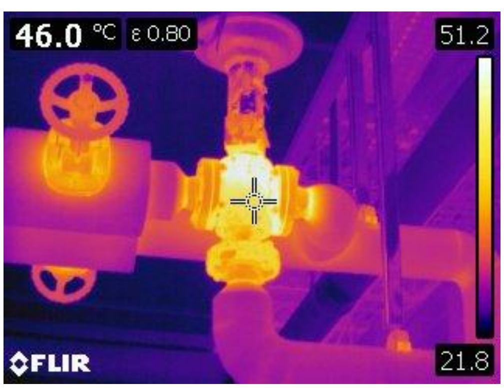
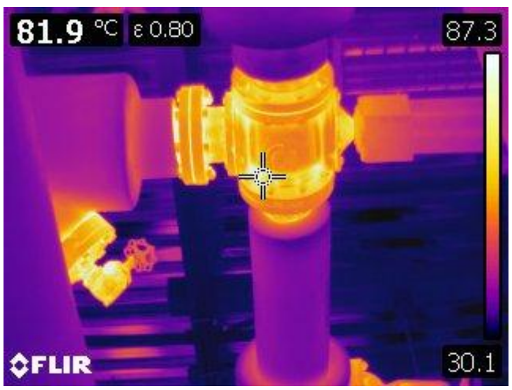


Figure 57 Thermographic image of bare three way valve and bare bonnets at 46º C or 114º F

Figure 58 Conventional image of the same valves.

Figure 59 Thermographic image of bare heat exchanger head at 69º C or 156º F

Figure 60 Conventional image of the same heat exchanger.



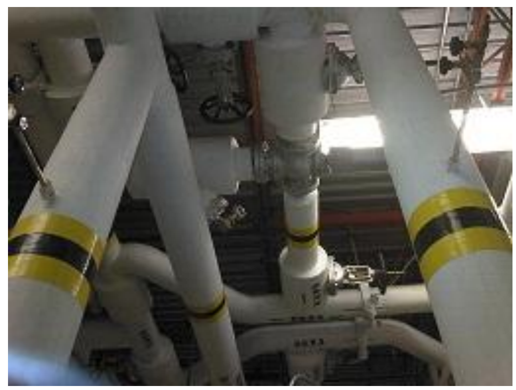


Figure 61 Thermographic image of bare three way valve and strainer at 81º C or 177º F

Figure 62 Conventional image of the same group of valves and strainer.

Figure 63 Thermographic image of bare motorized heating pump at 87º C or 188º F

Figure 64 Conventional image of the same motorized pump.

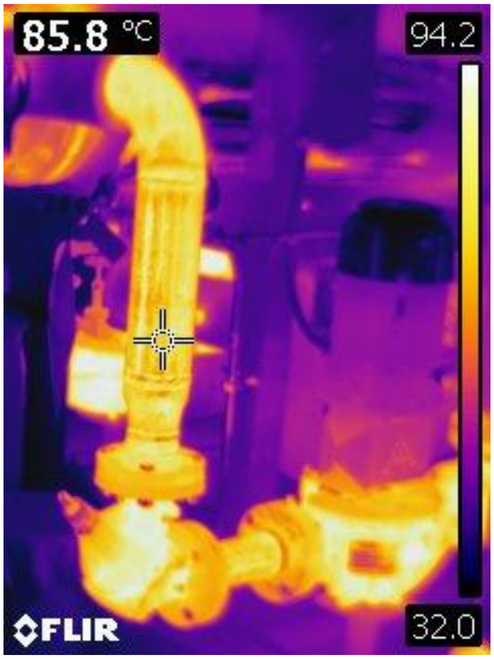


Figure 65 Thermographic image of bare motorized heating pump and piping at 85º C or 185º F

Figure 66 Conventional image of the same motorized pumps and piping.

Figure 67 Thermographic image of bare pipe and control valve and motorized pipe at 97º C or 206º F

Figure 68 Conventional image of the same motorized pumps, piping and control valve.

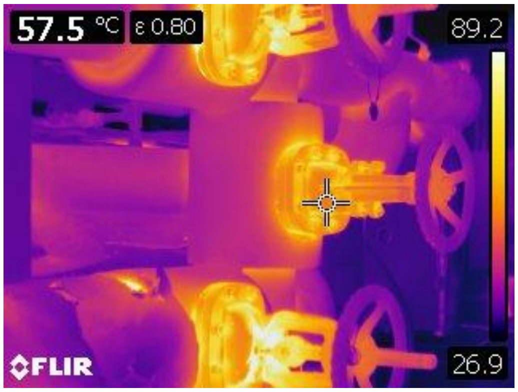


Figure 69 Thermographic image of bare valve bonnets at 57º C or 134º F

Figure 70 Conventional image of the same valve bonnets and damaged insulation .

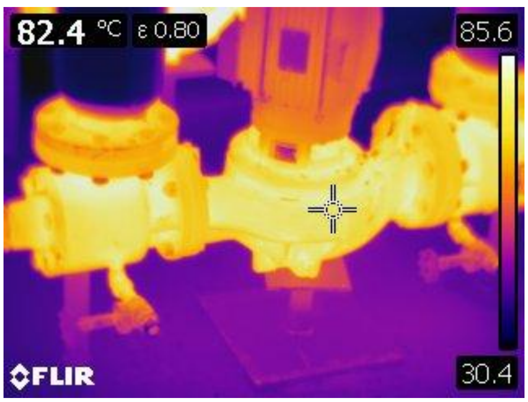


Figure 71 Thermographic image of bare motorized heating pumps at 82º C or 179º F

Figure 72 Conventional image of the same heating pumps.

Note: in my conversation with the Chief Engineer these ducts coming from the penthouse fan room may be heating/cooling supply. It appears that these ducts are without any insulation applied. We have not included any results or costs for these ducts and feel that further investigation may be required.

Personnel Protection

It is also important to recognize the hazards that hot exposed surfaces present to personnel. The boiler rooms and fan rooms generally are tightly packed with equipment and piping systems operating at temperatures of nearly 62ºC. (People experience burns at temperatures above 65C). Un-insulated or exposed surfaces at these high temperatures are to be considered a serious risk for staff and personnel. Properly insulated systems and equipment eliminate the possibility of individuals coming into contact with these hot surfaces and will prevent accidental burns. This is an important life safety and financial consideration.

Energy Calculations

Table 1.0 below summarizes our energy calculation. We completed our calculations using a program developed by the Insulation Institute (see insulationinstitute.org) called 3E Plus. We can make our detailed calculations available upon request**.**

The summary provides an aggregate heat loss rate for...

Table 1.0 Energy and Financial Savings

Hours of Operation	KWh from Spreadsheet	Gigajoules Saved
8760	289,758.78	1043
	Cost of fuel	$ 8.86
	total	**$9,242.00**

Table 2.0 Greenhouse Gas Emission Reduction

Greenhouse Gas	CO2	NOx
before	128,014	256
after	10,959	21.98
Total removed	51.8 tonnes	.3 tonnes

*taken from www.nrcan.gc.ca/energy/software-tools/7417

Insulation Materials

Table 3.0 provides a list of materials needed to insulate areas noted during our inspection, these are used as input for the 3EPlus spreadsheet for heat loss calculations. The insulation costs are estimates only and should not be used as actual costs.

Table 3.0 Insulation Upgrade Pricing Summary

Pipe Sizes	Square footage or Lineal feet	Cost of Material
Tank Wrap	114 sq ft @ $ 2.75	$ 313.50
1	51 ft @ $ 18.08	$ 922.08
½	48 ft@ $ 17.53	$ 841.44
3/4	199 ft @ $ 17.92	$ 3,566.08
1 1/4	49.5 ft @ $ 18.64	$ 922.68
1 1/8		
1 ½	57.8 ft @ $ 18.92	$ 1093.57
2	195 ft @ $ 19.35	$ 3,773.25
2 1/8		
2 ½	72.75 ft @ $ 20.19	$ 1,468.82
2 5/8		
3	249 ft @ $ 20.63	$ 5,136.87
3 1/8		
4	94.81 ft @ $ 21.88	$ 2,074.44
5	21 ft @ $ 23.00	$ 483.00
6	136 ft @ $ 24.14	$ 3,283.04
7	48.34 ft @ $ 25.12	$ 1,214.30
8	54.46 ft @ $ 26.59	$ 1,448.09
10	52.71 ft @ $ 29.56	$ 1,558.10
12	49.50 ft @ $ 31.65	$ 1,566.67
14	64.80 ft @ $ 33.87	$ 2,194.77
	Total	**$ 31,860.70**

All materials noted in the above table are to be of a wall thickness of 1.5 inches or greater dependent upon temperature rating. The costs for insulation include PVC cladding, elbows and fittings. The cost of labor is also part of the lineal footage costs. Price also includes 5% for PST. We highly recommend that Island Health get three quotes to compare. This price is an estimate only and may not be considered an exact amount.

Recommendations and Conclusions

Our findings indicate that there are opportunities to improve the mechanical insulation systems in a cost effective manner. The benefits are itemized below. Any deviation from following the Best Practices Guideline[3] developed by the North American Insulation Institute will reduce the potential savings and benefits. For example, we know that the elimination of canvas jacket can shorten the lifespan of fiberglass with an ASJ finish because of the lack of a protective cladding system. We also recommend using removable insulating pads where necessary or required for maintenance to ensure that the insulation systems remain intact for as long as possible.

If all areas are addressed, the benefits shall include:

1) Annual reduction of heat loss - **1043 GJ**
2) Annual cost savings derived through properly insulated piping - **$9242.00**
3) Potential savings on maintenance costs for equipment
4) Elimination of personal protection hazards Disclosure
5) We have no relevant financial or non-financial relationships to disclose.

[3] Ibid.

Limitations

We have used information provided to us from various sources but information such as operational heating cycles and cooling cycles are based on conversations with maintenance personnel.

Disclaimer

Results stated in this report are estimated and based upon the data supplied or determined during the audit process. Only the previously agreed to areas have been included in this report. These results are not covered by warranty nor are they guaranteed. The results are intended to portray a reasonable estimate of potential energy savings and emissions reduction with the use of an upgraded and maintained insulation system.

Please contact the undersigned should you have questions about this report.

Best regards,

Report prepared by:
Salamander Inspections

Bob Barter (Project Coordinator)

Reviewed by:
Besant and Associates Engineers Ltd.

Jeff Besant, MBA, P.Eng.