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.

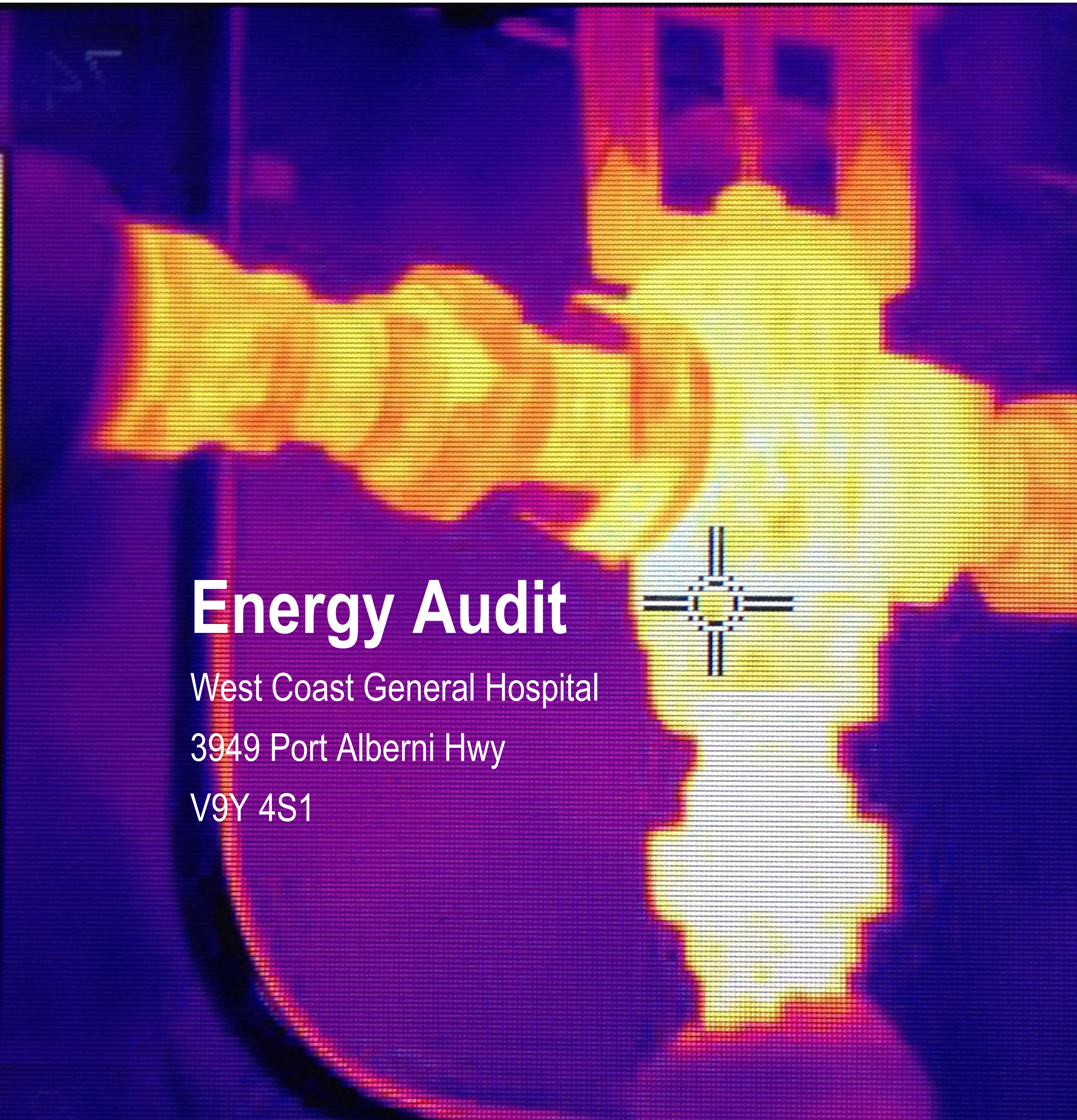
Please do not hesitate to contact me should you have any additional questions.
Thank you,

Peter Ielimi

Executive Director
Mechanical Insulators Labor Management Cooperative Trust

SALAMANDER INSPECTIONS LTD

Mechanical Insulation Energy Audits



Energy Audit

West Coast General Hospital

3949 Port Alberni Hwy

V9Y 4S1

Executive Summary

West Coast General Hospital is located at 3949 Port Alberni Hwy, Port Alberni British Columbia. The hospital houses a number of health related services for the local community.

Salamander Inspections performed an energy audit of the insulation systems within the Boiler Room, Fan Room (1430) and the Penthouse Fan room of the Westhaven extended care facility. 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 in tact for as long as possible.

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

1) Annual reduction of heat loss **- 540.6 GJ** and a **ROI of 2.39 years**
2) Annual cost savings derived through properly insulated piping - **$7,308.91**
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

Mr. Kevin Ramlu, Energy Specialist for Island Health retained Salamander Inspections Ltd. to complete a review of mechanical insulation systems applied to the heating systems at West Coast General Hospital and Westhaven care home located in Port Alberni, 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.

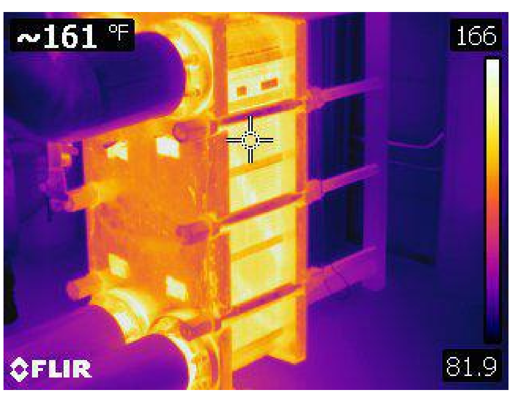

Figure 1 This is an infrared photo of the heat exchanger showing the areas with where large temperature differences create high rates of heat transfer.

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 colour 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 existing insulation systems is very good 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 construction. 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 mechanical systems is in generally good condition. We noted that the existing insulation is from 1inch thick (25mm) to 3 inches thick (76 mm). The 1 ½ thickness meets current best practices and ASHRAE 90.1 (2010).

However, 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 (24) valves, (5) strainers, (13) pumps and (270 meters) of missing insulation (1) heating return/expansion tank that should be insulated. In addition, there are other areas where there would be opportunities to install or upgrade the mechanical insulation systems.

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

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 10).

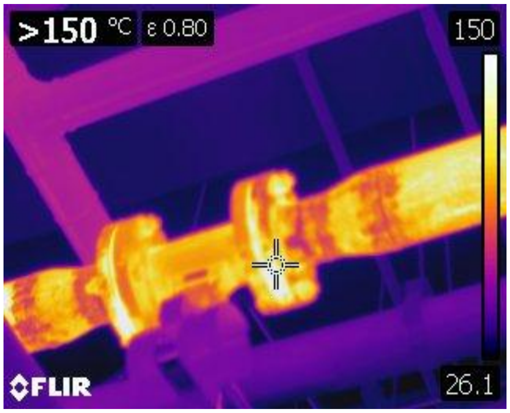


Figure 3 This thermographic image of a 100mm pipe, flanges and flow meter.

Figure 4 This is a conventional photo of the same line.

Figure 5 This Thermographic image of a 100 mm valve bonnet. Note the high rate of heat loss as indicated by the bright color.

Figure 6 This conventional photo shows the same valve bonnet.

Figure 7 This is a thermographic image of bare by-pass piping and associated valves and strainers.

Figure 8 This is a conventional photo of the same piping.

Figure 9 This is a thermographic image of the supply lines to a circulation pump on the hot water system. The lines and the pump should be insulated to conserve energy.

Figure 10 This is the conventional image of the supply and return lines at the back of the boiler.

The missing insulation is typical of projects where value engineering has been in effect. Typically the objects that are not insulated are more time consuming to apply and finish the insulation work. Without clear direction in the scope of work contained in the specifications, and the lack of inspection, this results in areas where insulation has not been applied increasing heat loss and increase of GHG.

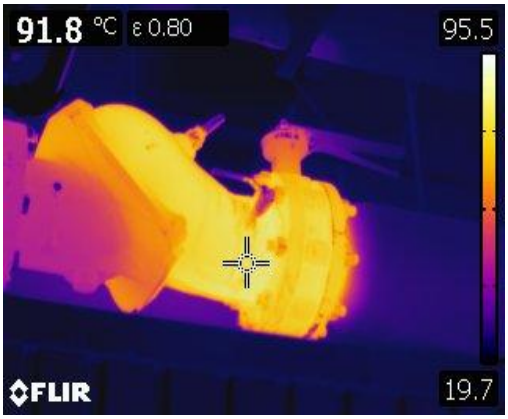


Figure 11 This thermographic image is of the large bore valves above the boilers.

Figure12 This is a conventional image of the same valve assemblies.

Figure 13 This thermographic image is of a large bore pipe and flange to the boiler.

Figure 14 This is a conventional image of the same pipe.

Figure 15 This thermographic image is of instrument gauges and piping at front of the boilers.

Figure 16 This conventional image is of the same piping and gauge.

Figure 17 Thermographic image of a wall mounted heat exchanger that is a source of heat loss.

Figure 18 conventional image of a similar heat exchanger.

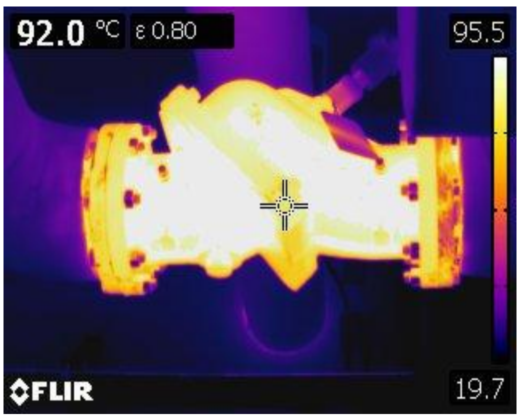


Figure 19 Thermographic image of a control valve overhead in boiler room.

Figure 20 Conventional image of the same control valve.

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 over 45ºC. The average temperature observed was above 85C (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.

Fan Room - 1430

We inspected this mechanical room and found the many of the same conditions. There were examples of missing insulation on the valves, pumps and poorly insulated piping. In some instances, the insulation may not meet the requirements of the original specification. The pictures below provide some examples of our findings. (See Figures 21 through 40).

Figure 21 Thermographic image of bare steam lines above the entrance of the fan room.

Figure 22 Conventional image of the same steam lines.

Figure 23 Thermographic image of a bare steam supply line at the entrance of the fan room.

Figure 24 Conventional image of the same bare steam line at the entrance to the fan room. This line is within reach to touch and is a burning hazard.

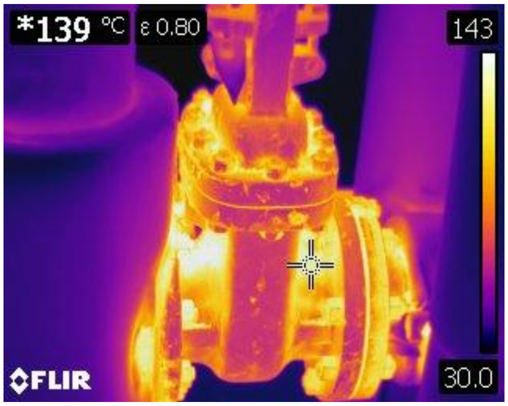


Figure 25 Thermographic image of steam valve requiring insulation.

Figure 26 Conventional image of the same valve and flanges requiring insulation.

Figure 27 Thermographic image of steam piping.

Figure 28 Conventional image of same pipes.

Figure 29 Thermographic image of heat exchangers and pipe flanges to heat exchangers.

Figure 30 Conventional picture of the same heat exchangers and flanges.

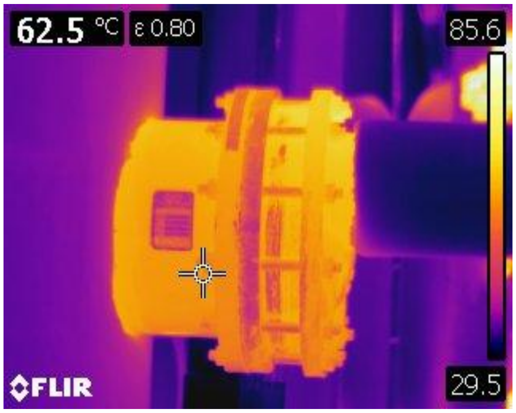


Figure 31 Thermographic image of heat exchangers in the hot water tanks.

Figure 32 Conventional image of the same heat exchanger.

Figure 33 Thermographic image of exposed steam lines at blow offs.

Figure 34 Conventional image of the same pipes.

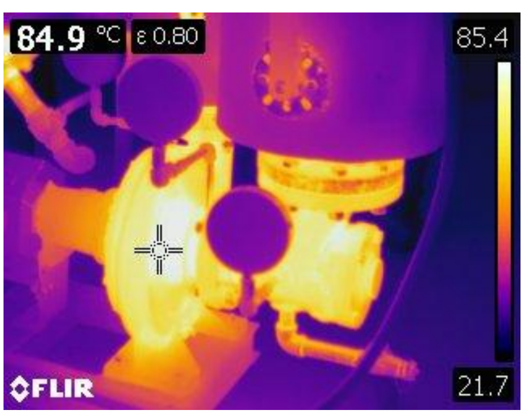


Figure 35 Thermographic image of a motorized heating pump.

Figure 36 Conventional image of the same pump.

Figure 37 Thermographic image of heating supply lines to unit.

Figure 38 Conventional image of the same lines to unit. Bare three way mixing valves and control valves.

Figure 39 Thermographic image of the pipe supports that have no insulation behind them. There are over 60 of these.

Figure 40 Conventional image of the pipe supports in the fan room.

Penthouse Fan Room – Westhaven

We inspected this mechanical room and found the many of the same conditions. There were examples of missing insulation on the valves, pumps and poorly insulated piping. In some instances, the insulation may not meet the requirements of the original specification. The pictures below provide some examples of our findings. (See Figures 41 through 57)

Figure 41 Thermographic image of bare copper heating line in penthouse fan room.

Figure 42 Conventional image of the same copper line.

Figure 43 Thermographic image of exposed heating pump.

Figure 44 Conventional image of the same pump.

Figure 45 Thermographic image of bare supply heating lines.

Figure 46 Conventional image of the same piping.

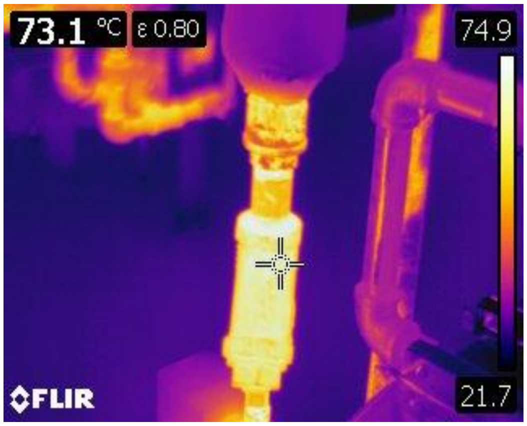


Figure 47 Thermographic image of more bare heating supply lines to coils.

Figure 48 Conventional image of the same iron heating lines to the coils.

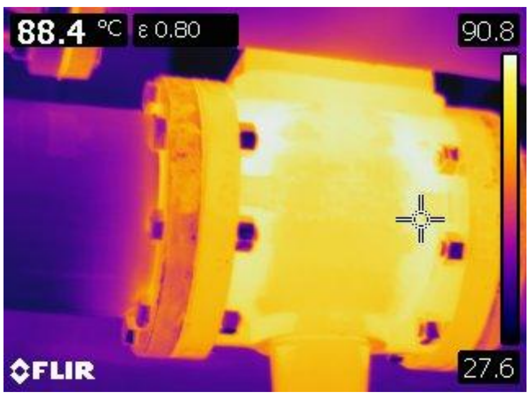


Figure 49 Thermographic image of bare flow meter.

Figure 50 Conventional image of the same flow meter.

Figure 51 Thermographic image of three way mixing valve.

Figure 52 Conventional image of the same three way mixing valve.

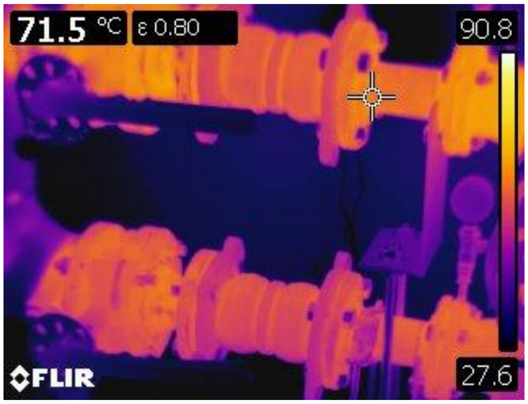


Figure 53 Thermographic image of exposed heating supply to pumps.

Figure 54 Conventional image of exposed heating supply lines to pumps.

Figure 55 Thermographic image of exposed heating pumps and associated piping.

Figure 56 Thermographic image of heating supply lines to coils.

Figure 57 Thermographic image of exposed control valve.

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 over 45ºC. The average temperature observed was above 85C. 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.

This heat exchanger was photographed with the Flir camera but the thermal image was not saved and not reproduced. This exchanger should be insulated as it will be a source of heat loss or gain.

There are many sources of heat loss in this fan room. Heating pumps, valves and flanges and large bore control valves are primary sources of heat loss and need to be insulated. There are also many steam traps of various sizes that can and should be insulated to maximize efficiency.

Chilled System

During the inspection of this fan room we noticed that the work done on the chilled systems was done very well with a couple of exceptions. We observed missing insulation in a number of areas. The stains on the floor and the rust on the unpainted surfaces are a clear indication of the pipes sweating. This can destroy the insulation system as there is not a 100% vapor barrier seal and it can also affect the surface of the pipe itself by causing corrosion of the substrate.

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	150,178	540.6
	Cost of fuel	$13.52
	total	**$7,308.91**

Table 2.0 Greenhouse Gas Emission Reduction

Greenhouse Gas	CO2	NOx
Total removed	27 tonnes	.1 tonnes

Insulation Materials

Table 2.0 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 2.0 Insulation Upgrade Pricing Summary

Pipe Sizes	Square footage or Lineal feet	Cost of Material
Tank Wrap	193.78 sq ft @ $21.66	$ 4197.45
5/8		
½	24 ft @ $ 17.53	$420.72
¾	110 ft @$ 17.92	$ 1,971.20
1	40 ft @$ 18.08	$ 733.20
1 1/4	12 ft @$ 18.64	$ 223.68
1 ½	61 ft @ $ 18.92	$ 1154.12
2	21 ft @ $ 19.35	$ 406.35
2 1/8		
2 ½	22 ft @$ 20.19	$ 444.18
2 5/8		
3	35.31 ft @ $ 20.63	$ 728.44
3 1/8		
4	28.22 ft @ $ 21.88	$ 617.45
5	14ft @ $ 23.00	$ 322.00
6	125.04 ft @ $ 24.14	$ 3,018.46
7	17 ft @$25.12	$ 427.04
8	38 ft @$ 26.59	$ 1,010.42
10	15.05 ft @$ 29.56	$ 444.87
12	21.88 ft @$ 31.65	$ 692.50
14	21.41 ft @$ 33.87	$ 725.15
	Total	$ 17,537.23

All materials noted in the above tables 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 - **540.6 GJ**
2) Annual cost savings derived through properly insulated piping **- $7,308.91**
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.

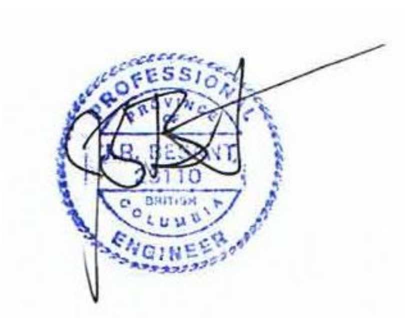
Please contact the undersigned should you have questions about this report.

Best regards,

Report prepared by:
Salamander Inspections

Bob Barter (Project Coordinator)

Reviewed by:
Besant and Associates Engineers Ltd.



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Jeff Besant, MBA, P.Eng.