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www.MechanicalinsulatorsLMCT.com
**Pete Ielmini,** *Executive Director* 732-210-7084 **Gina Walsh,** *Deputy Director* 314-683-6136

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.

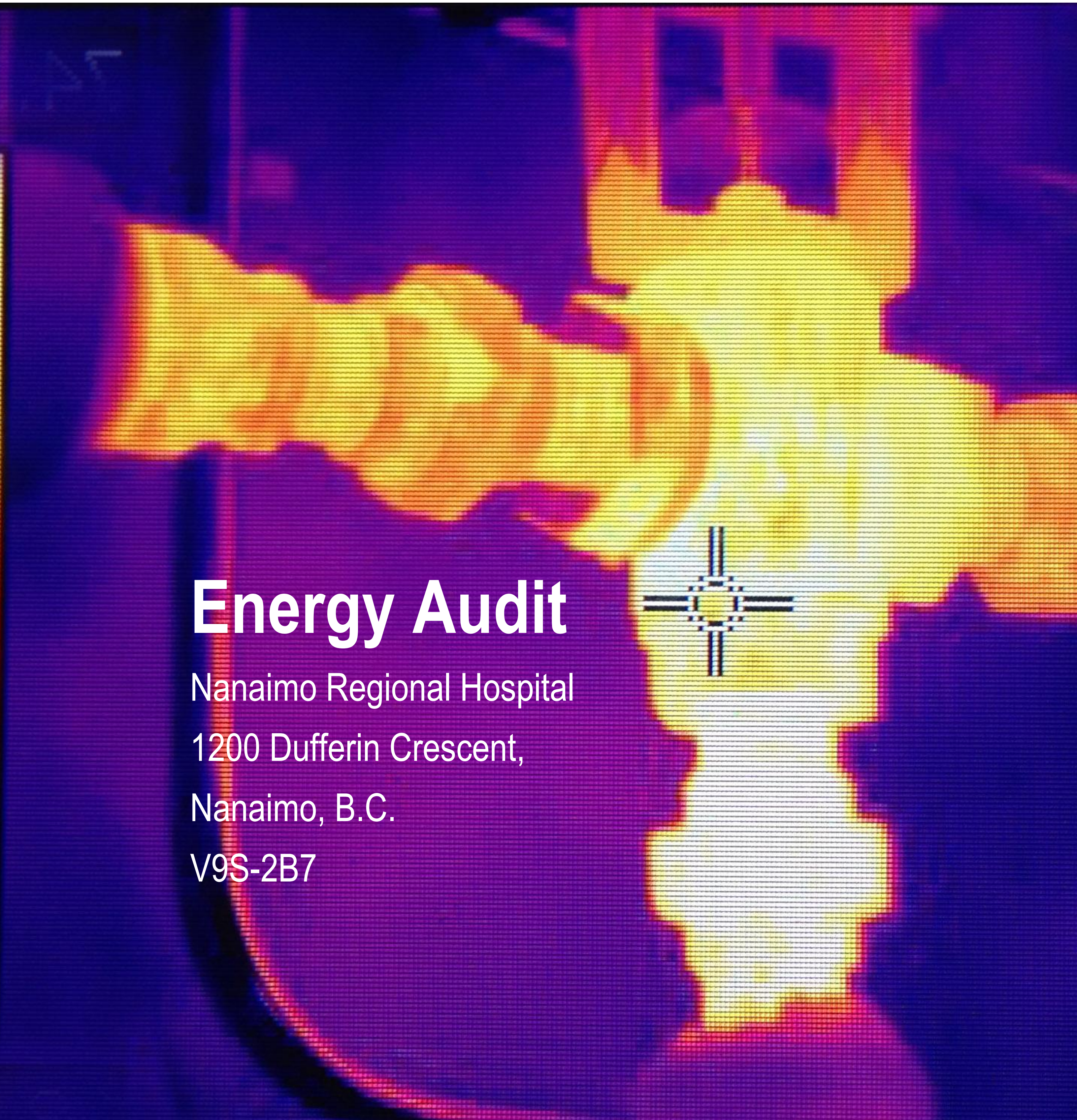
Please do not hesitate to contact me should you have any additional questions.
Thank you,

Peter Ielimi

Executive Director
Mechanical Insulators Labor Management Cooperative Trust

## SALAMANDER INSPECTIONS LTD

**Mechanical Insulation Energy Audits**



# Energy Audit

Nanaimo Regional Hospital

1200 Dufferin Crescent,

Nanaimo, B.C.

V9S-2B7

## Executive Summary

Nanaimo Regional General is located in Nanaimo at 1200 Dufferin Crescent, Nanaimo, British Columbia. This hospital is a multi level healthcare facility is operated by Island Health Authority. For this report our inspection was for the hospital Boiler 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 **- 1430 Gj** and a **ROI of 1.93 years**
2) Annual cost savings derived through properly insulated piping - **$19,333.00**
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.

# Table of Contents

## 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 Nanaimo Regional General Hospital located in Nanaimo, 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.

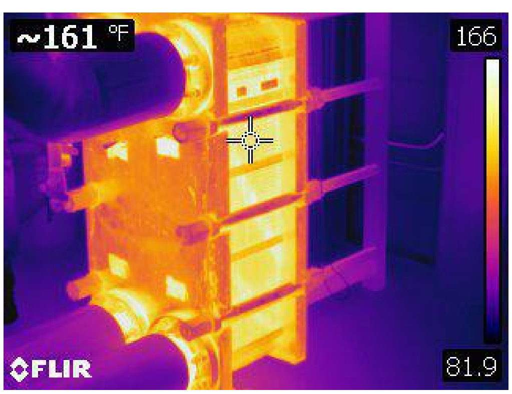



**Figure 1** This is an infrared photo of a heat exchanger showing the areas with where large temperature differences create high rates of heat transfer.

**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 fair condition but there are many 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 fittings are without insulation applied. 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 fair condition. We noted that the insulation is a combination of 1 inch thick (25mm) and 1 ½ inch thick (40mm). Current best practices and ASHRAE 90.1 (2010) requires that the insulation applied to heating systems be 1 ½ inch thick (40mm). There are areas where new insulation that has been applied on upgraded mechanical heating systems that follows ASHRAE 90.1 but the installers (company) did not completely insulate the systems leaving minor opportunities to save energy and lower GHG output.

There are some instances where pumps, valves and piping have no insulation applied and therefore, there is an opportunity to reduce operation costs. During

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

the course of this inspection we counted at least (93) valves, (57) valve bonnets, (16) strainers, (9+ heat exchanger heads) and (31) 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 58).


**Figure 3** This thermographic image of exposed pumps and pipe at 111º C or 230º F.

**Figure 4** This is a conventional photo of the same pumps and piping.


**Figure 5** This thermographic image of piping and valves without insulation applied at 110º C or 230º F.

**Figure 6** This conventional photo shows the same piping and valves.

## 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.


**Figure 7** This is a thermographic image of a bare piping and valve at 88.4º C or 191º F.

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


**Figure 9** This is a thermographic image of bare steam trap in the boiler room at 116º C or 240º F.

**Figure 10** This is the conventional image of the same bare steam trap and piping.


**Figure11** This is a thermographic image of a 2 inch pipe and small vessel at 76.9º C or 170º F.

**Figure 12** This is the conventional image of the same pipe and vessel.


**Figure 13** Thermographic image of a bare flange to tank at 115º C or 239º F.

**Figure 14** Conventional image of the same flange and piping at tank.


**Figure 15** This thermographic image is of bare valve bonnets at 132º C or 269º F

**Figure 16** Conventional image of the same valve bonnets.


**Figure 17** Thermographic image of un finished elbows and fittings on new unit at 41.5º C or 106º F

**Figure 18** Conventional image of the same elbows and fittings.


**Figure 19** Thermographic image of the bare steam line at 150º C or 302º F

**Figure 20** Conventional image of the same steam line.

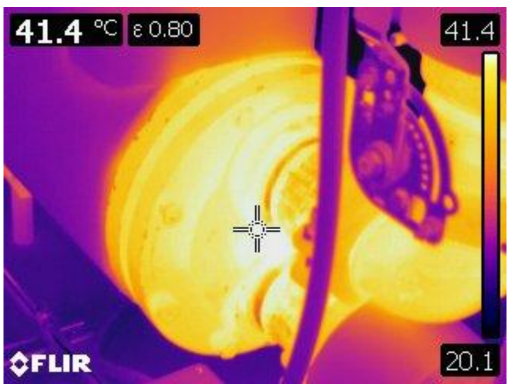



**Figure 21** Thermographic image of the heat exchanger head at 41.4º C or 106º F.

**Figure 22** Conventional image of the same heat exchanger head.


**Figure 23** Thermographic image of a three way mixing valve at 41º C or 106º F.

**Figure 24** Conventional image of the same valve above heat exchanger.

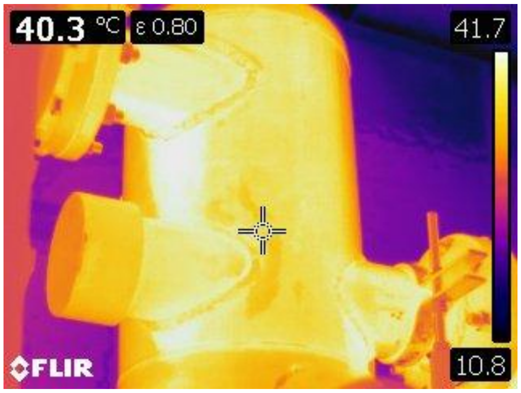



**Figure 25** Thermographic image of a receiver tank above heat exchanger at 40.3º C or 106º F.

**Figure 26** conventional image of the same tank and flanges above heat exchanger.


**Figure 27** Thermographic image of valve bonnets and piping at 57.4º C or 135º F. -note the heat loss under PVC fitting.

**Figure 28** Conventional image of the same valves and piping.

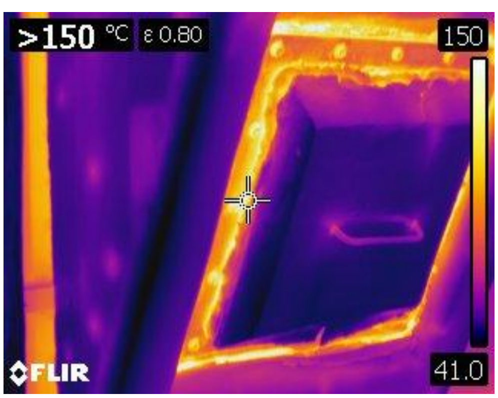



**Figure 29** Thermographic image of the access door to boiler at 150º C or 302º F.

**Figure 30** Conventional image of the same access door.


**Figure 31** Thermographic image of valves at top of boilers at 150º C or 302º F.

**Figure 32** Conventional image of the same valves.


**Figure 33** Thermographic image of bare piping at top of boiler at 110º C or 230º F.

**Figure 34** Conventional image of the same piping.


**Figure 35** Thermographic image of bare pumps and flanges at 97.4º C or 207º F.

**Figure 36** Conventional image of the same pumps and flanges.

**Figure 37** Thermographic image of valves, pumps and piping at 47.5º C or 117º F.

**Figure 38** Conventional image of the same valves, pumps and piping.

**Figure 39** Thermographic image of bare valves and flanges at 92.5º C or 198º F.

**Figure 40** Conventional image of the same valves and flanges.

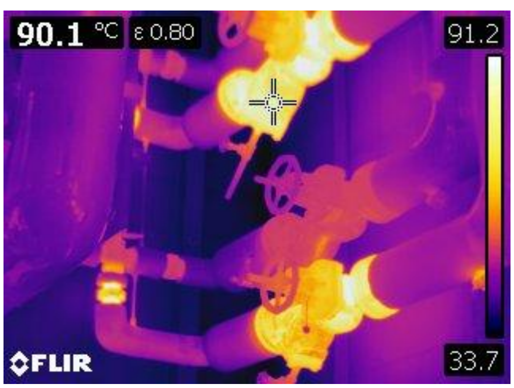


**Figure 41** Thermographic image of bare valves and fittings at 90.1º C or 194º F.

**Figure 42** Conventional image of bare valves and fittings.


**Figure 43** Thermographic image of bare valves above heat exchanger at 109º C or 228º F.

**Figure 44** Conventional image of the same valves above heat exchanger.


**Figure 45** Thermographic image of bare stainless flex hoses from pumps at 96.9º C or 206º F.

**Figure 46** Conventional image of the same stainless hoses and associated piping.


**Figure 47**Thermographic image of bare vale bonnets at 132º C or 269º F.

**Figure 48** Conventional image of bare vale bonnets.


**Figure 49** Thermographic image of bare valve bonnets and a pressure reducing valve at 119º C or 246º F

**Figure 50** Conventional image of valve bonnets and pressure reducing valve.


**Figure 51** Thermographic image of bare valves at 150º C or 302º F

**Figure 52** Conventional image of the same bare valves.


**Figure 53** Thermographic image of pressure reducing valve at 150º C or 302º F

**Figure 54** Conventional image of the same pressure reducing valve and other items.


**Figure 55** Thermographic image of bare valves on steam header at 150º C or 302º F

**Figure 56** Conventional image of the same header and bare valves.


**Figure 57** Thermographic image of bare flanges at 150º C or 302º F

**Figure 58** Conventional image of the same flanges.

There are a number of items that are identified in this report that need to be addressed because of their high temperature. At the time of this inspection maintenance personnel were measuring some of the large bore valves for removable high temp insulating pads.

## Roof Top Fan Room

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 this fan room 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 59–82)

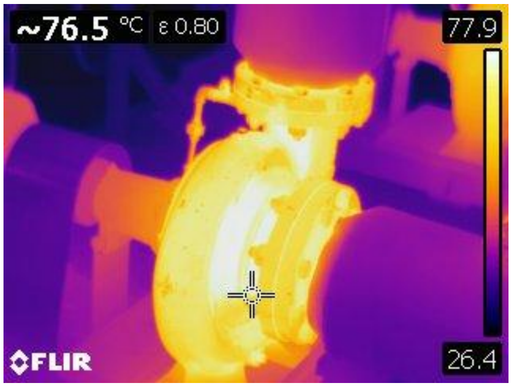



**Figure 59** Thermographic image of bare heating supply pump at 76.5º C or 169º F

**Figure 60** Conventional image of the same heating pumps.


**Figure 61**Thermographic image of bare 6 inch heating supply pipe at 70.9º C or 159º F

**Figure 62** Conventional image of the same heating supply pipe.


**Figure 63**Thermographic image of bare valves bonnets and strainers at 58º C or 136º F

**Figure 64** Conventional image of the same valve bonnets and strainers.

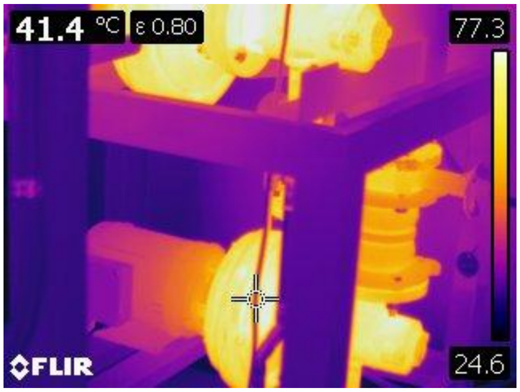



**Figure 65**Thermographic image of bare motorized heating pump and piping at 41º C or 105º F

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


**Figure 67**Thermographic image of bare pipe and flanges at 74º C or 165º F

**Figure 68** Conventional image of the same piping and flanges.


**Figure 69** Thermographic image of a heat exchanger at 74.9º C or 165º F

**Figure 70** Conventional image of the same heat exchanger head.

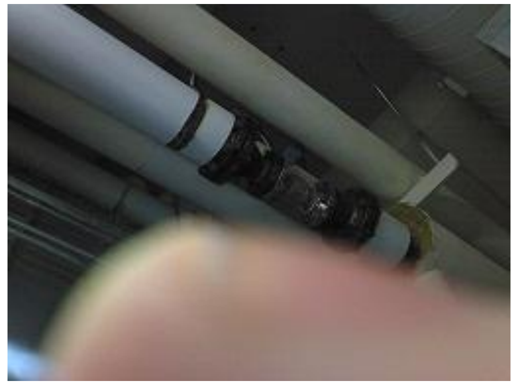



**Figure 71** Thermographic image of a bare flow meter and flanges at 150º C or 302º F

**Figure 72** Conventional image of the same flow meter and flanges.


**Figure 73** Thermographic image of a motorized valve at 142º C or 287º F

**Figure 74** Conventional image of the same motorized valve.

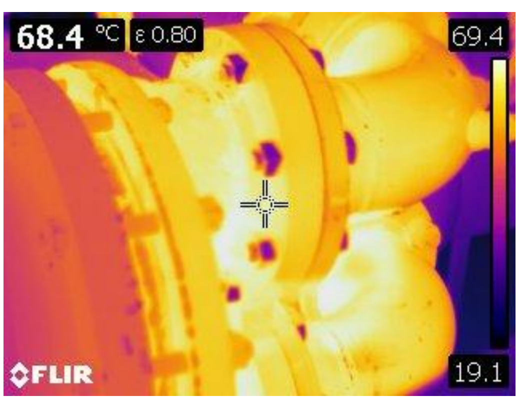



**Figure 75** Thermographic image of a heat exchanger at 68.4º C or 155º F

**Figure 76** Conventional image of the same heat exchanger.

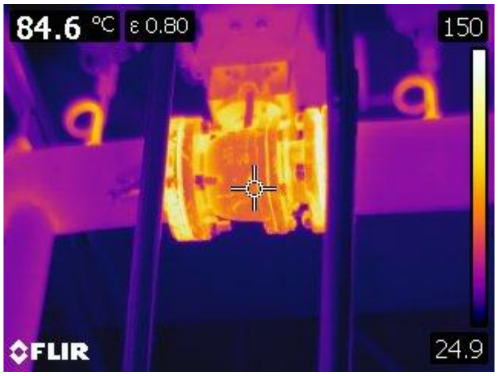



**Figure 77** Thermographic image of a bare valve at 84.6º C or 184º F

**Figure 78** Conventional image of the same bare heating valve.


**Figure 79** Thermographic image of a bare steel 2 inch line at 43.1º C or 109º F

**Figure 80** Conventional image of the same bare steel line.


**Figure 81** Thermographic image of 2 flow meters at 126º C or 258º F

**Figure 82** Conventional image of the same bare flow meters.

## Fan Room - East

The inspection of this fan room mechanical area has revealed that the insulation was generally applied correctly but the majority of insulation that's applied is in fair condition. However, the issue remains that in this fan room 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 83–116 )


**Figure 83** Thermographic image of 2 motorized pumps at hot water tanks at 79.6º C or 175º F

**Figure 84** Conventional image of the same bare pumps.


**Figure 85** Thermographic image of missing insulation at hot water tanks at 45.7º C or 114º F

**Figure 86** Conventional image of the same missing insulation.

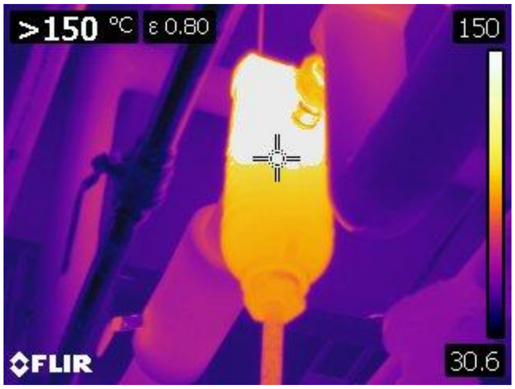



**Figure 87** Thermographic image of missing insulation on steam condensate line at 150º C or 302º F

**Figure 88** Conventional image of the steam condensate line.

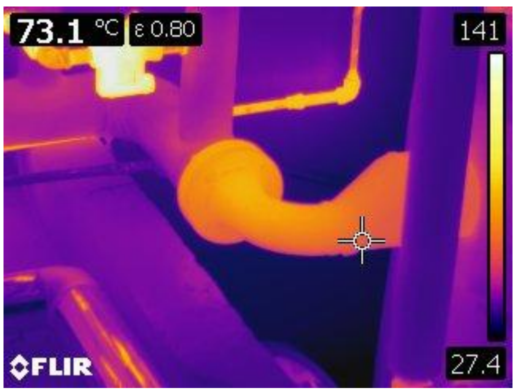



**Figure 89** Thermographic image of missing insulation on steam condensate line at 73.1º C or 163º F

**Figure 90** Conventional image of the steam condensate line.


**Figure 91** Thermographic image of bare valve bonnet on steam line at 150º C or 302º F

**Figure 92** Conventional image of the valve bonnet.

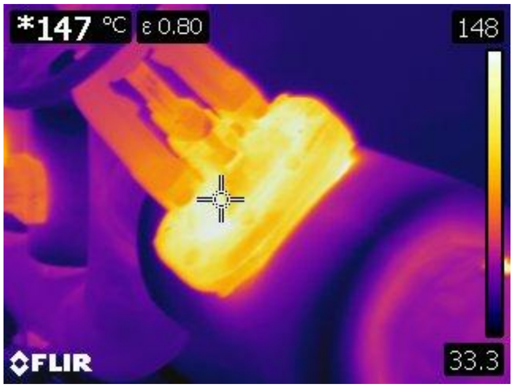



**Figure 93** Thermographic image of bare valve bonnet on steam line at 147º C or 296º F

**Figure 94** Conventional image of six (6) valve bonnets.

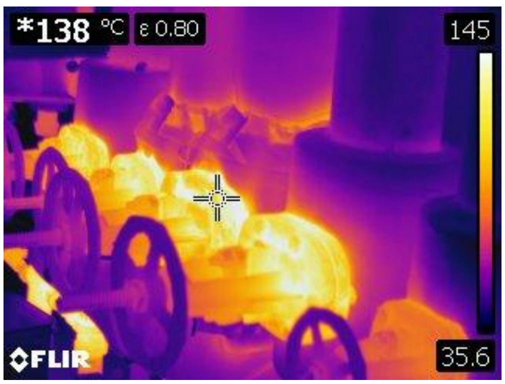



**Figure 95** Thermographic image of bare valve bonnets on steam line at 138º C or 280º F

**Figure 96** Conventional image of six (6) valve bonnets.

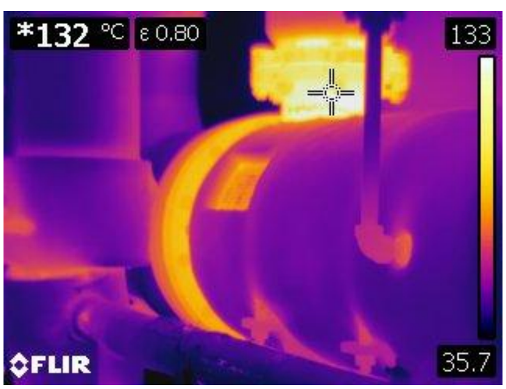



**Figure 97** Thermographic image of heat exchanger flange at 132º C or 269º F

**Figure 98** Conventional image of same heat exchanger flange.


**Figure 99** Thermographic image of a motorized heating pump at 76º C or 168º F

**Figure 100** Conventional image of motorized heating pump.

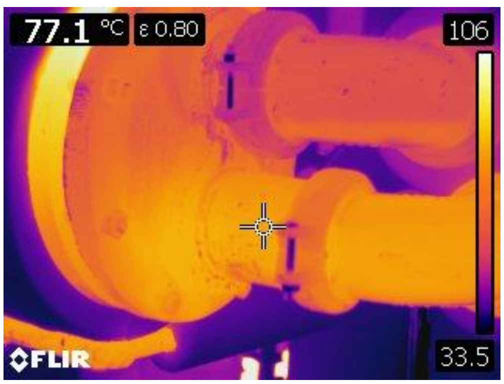



**Figure 101** Thermographic image of heat exchanger head and piping at 77.1º C or 170º F

**Figure 102** Conventional image of the heat exchanger head and piping.


**Figure 103** Thermographic image of motorized pump at 77.1º C or 170º F

**Figure 104** Conventional image of (2) motorized pumps.

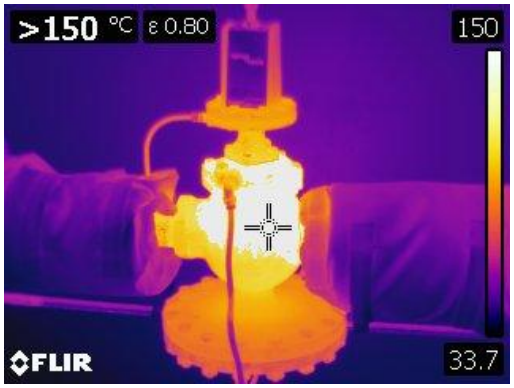



**Figure 105** Thermographic image of pressure reducing valve at 150º C or 302º F

**Figure 106** Conventional image of the same valve.

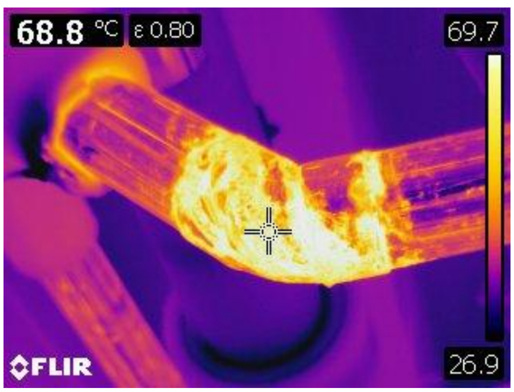



**Figure 107** Thermographic image of bare copper pipe at 68.6º C or 155º F

**Figure 108** Conventional image of the same copper pipe.


**Figure 109** Thermographic image of a small heat exchanger at 111º C or 231º F

**Figure 110** Conventional image of the same exchanger.



**Figure 111** Thermographic image of a small heat exchanger at 111º C or 231º F

**Figure 112** Conventional image of the same exchanger.


**Figure 113** Thermographic image of a motorized pump and piping at 53.5º C or 128º F

**Figure 114** Conventional image of the same pump and piping.


**Figure 115** Thermographic image of a steam trap at 54º C or 129º F

**Figure 116** Conventional image of the same trap and piping.

## Fan Room – E0054

The inspection of the fan room mechanical area 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 this fan room, insulation is missing on piping, valves, strainers and heat exchangers. We have also observed that the canvas applied to piping has no lagging adhesive (white in color) rather, the canvas has been applied with wheat paste. When the canvas becomes damp or wet the wheat paste will start to mold and create further problems. 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 117–128)

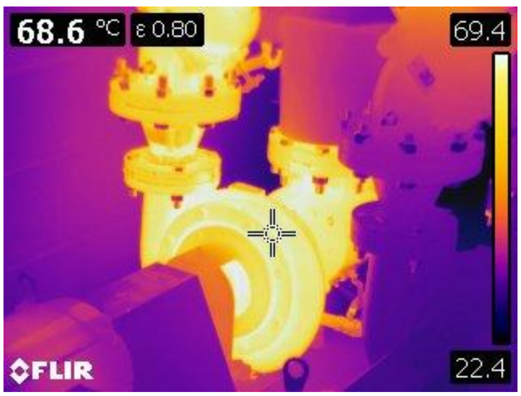



**Figure 117** Thermographic image of heating pumps and valves at 68.6º C or 155º F

**Figure 118** Conventional image of the same heating pumps and valves.


**Figure 119** Thermographic image of a control valve at 65.2º C or 149º F

**Figure 120** 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 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.


**Figure 121** Thermographic image of a heat exchanger and valves at 36.2º C or 97º F

**Figure 122** Conventional image of the same heat exchanger and valves.

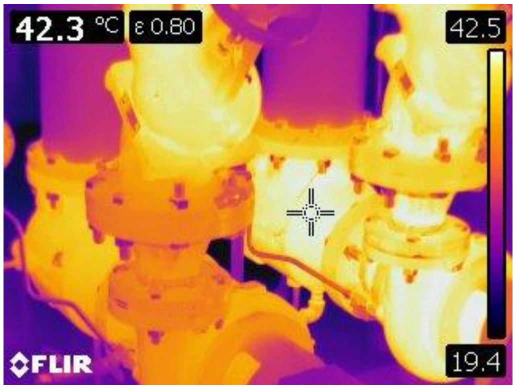



**Figure 123** Thermographic image of motorized heating pumps and valves at 42.3º C or 108º F

**Figure 124** Conventional image of the same heating pumps and valves.

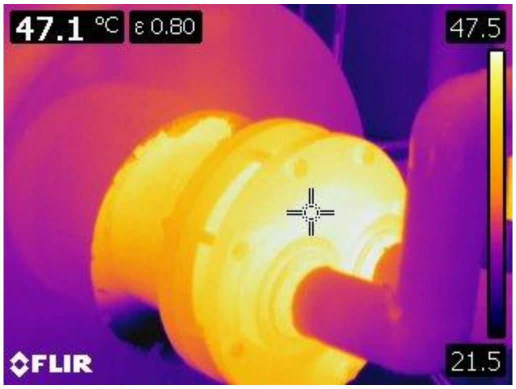



**Figure 125** Thermographic image of a heat exchanger in hot water tanks at 47.1º C or 116º F

**Figure 126** Conventional image of the same heat exchanger and hot water tank.

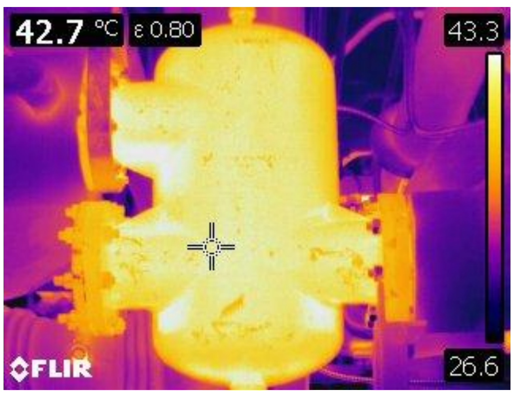



**Figure 127** Thermographic image of an expansion tank at 42.7º C or 108º F

**Figure 128** Conventional image of the same expansion tank.

## Fuel Oil Supply/Electrical Room

The inspection of this mechanical area revealed that the insulation was found in poor condition. However, the issue remains that in this room, insulation is missing on piping and valves with a small amount missing from the large tank in the area. 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 129–136)


**Figure 129** Thermographic image of an vertical heat exchanger piping at 135º C or 275º F

**Figure 130** Conventional image of the same exchanger and exposed piping.


**Figure 131** Thermographic image of exposed bare piping at 76.7º C or 170º F

**Figure 132** Conventional image of the same exposed piping.


**Figure 133**Thermographic image of exposed bare piping at 76.7º C or 170º F

**Figure 134** Conventional image of the same exposed piping.

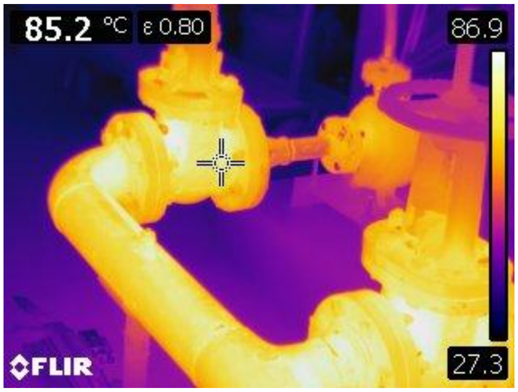



**Figure 135** Thermographic image of exposed bare piping and valves at 85.2º C or 185º F

**Figure 136** Conventional image of the same exposed piping and valves.

## Chilled Systems-E0054 Fan Room

During the inspection of this mechanical area the insulation found applied to the chilled systems was in good condition. However, the issue remains that in this room, insulation is missing on all the motorized pumps and associated filters etc. Failure to have complete coverage of the insulation system has resulted in an incomplete vapor barrier which will lead to corrosion of piping and equipment. There are opportunities to improve or upgrade the insulation and receive benefits to the cost of operation and longer life for the equipment. (figures137–144)


**Figure 137** Thermographic image of bare pumps and filter housings which result in condensation and corrosion.

**Figure 138** Conventional image of the same exposed pump housings.


**Figure 139** Thermographic image of bare Tee with flanges, lack of vapor barrier will lead to future issues.

**Figure 140** Conventional image of the same exposed pipe Tee.

**Figure 141** This image shows why an integral vapor barrier is necessary. Lack of a vapor barrier will lead to future corrosion issues.

**Figure 142** This image shows the wrong use of pipe supports on chilled systems where the vapor barrier is compromised.

**Figure 143** The flange pictured here shows rusting which will allow moisture into the insulation.

**Figure 144** The result of moisture forming on the exposed steel allows for the formation of mold in the canvas. This happening in many areas where vapor barrier is incomplete.

## 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** | 397,248 | 1430 |
| | Cost of fuel | $ 13.52 |
| | total | **$19,333.00** |
| | | |

**Table 2.0 Greenhouse Gas Emission Reduction**

| Greenhouse Gas | CO2 | NOx |
|---|---|---|
| **before** | 210631 | 422 |
| **after** | 19,177 | 38.46 |
| | | |
| **Total removed** | 71 tonnes | .4 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** | 143.15 sq ft @ $ 2.75 | $ 393.66 |
| **1** | ft @ $ 18.08 | $ 714.16 |
| **½** | 84.83 ft@ $ 17.53 | $ 1,487.06 |
| **3/4** | 175 ft @ $ 17.92 | $ 3,486.00 |
| **1 1/4** | 10.6 ft @ $ 18.64 | $ 197.58 |
| **1 1/8** | | |
| **1 ½** | 19.74 ft @ $ 18.92 | $ 373.48 |
| **2** | 195 ft @ $ 19.35 | $ 4,562.53 |
| **2 1/8** | | |
| **2 ½** | ft @ $ 20.19 | $ 195.84 |
| **2 5/8** | | |
| **3** | 275 ft @ $ 20.63 | $ 5,673.25 |
| **3 1/8** | | |
| **4** | 274.94 ft @ $ 21.88 | $ 6,015.68 |
| **5** | | |
| **6** | 210 ft @ $ 24.14 | $ 5,075.91 |
| **7** | 10.32 ft @ $ 25.12 | $ 259.23 |
| **8** | 134.33 ft @ $ 26.59 | $ 3,571.83 |
| **10** | 54.65 ft @ $ 29.56 | $ 1,615.45 |
| **12** | 71.12 ft @ $ 31.65 | $ 2,250.94 |
| **14** | 42.84 ft @ $ 33.87 | $ 1,450.99 |
| | Total | **$ 37,323.59** |

**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 - **1430 GJ**
2) Annual cost savings derived through properly insulated piping - **$19,333.00**
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.

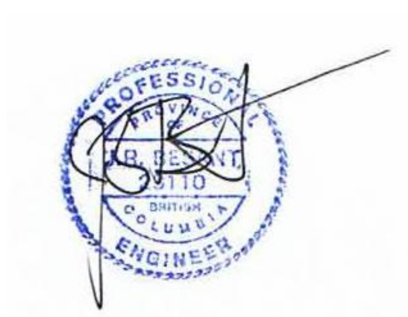
Please contact the undersigned should you have questions about this report.

Best regards,

Report prepared by:
Salamander Inspections

Bob Barter (Project Coordinator)

Reviewed by:
Besant and Associates Engineers Ltd.

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