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.

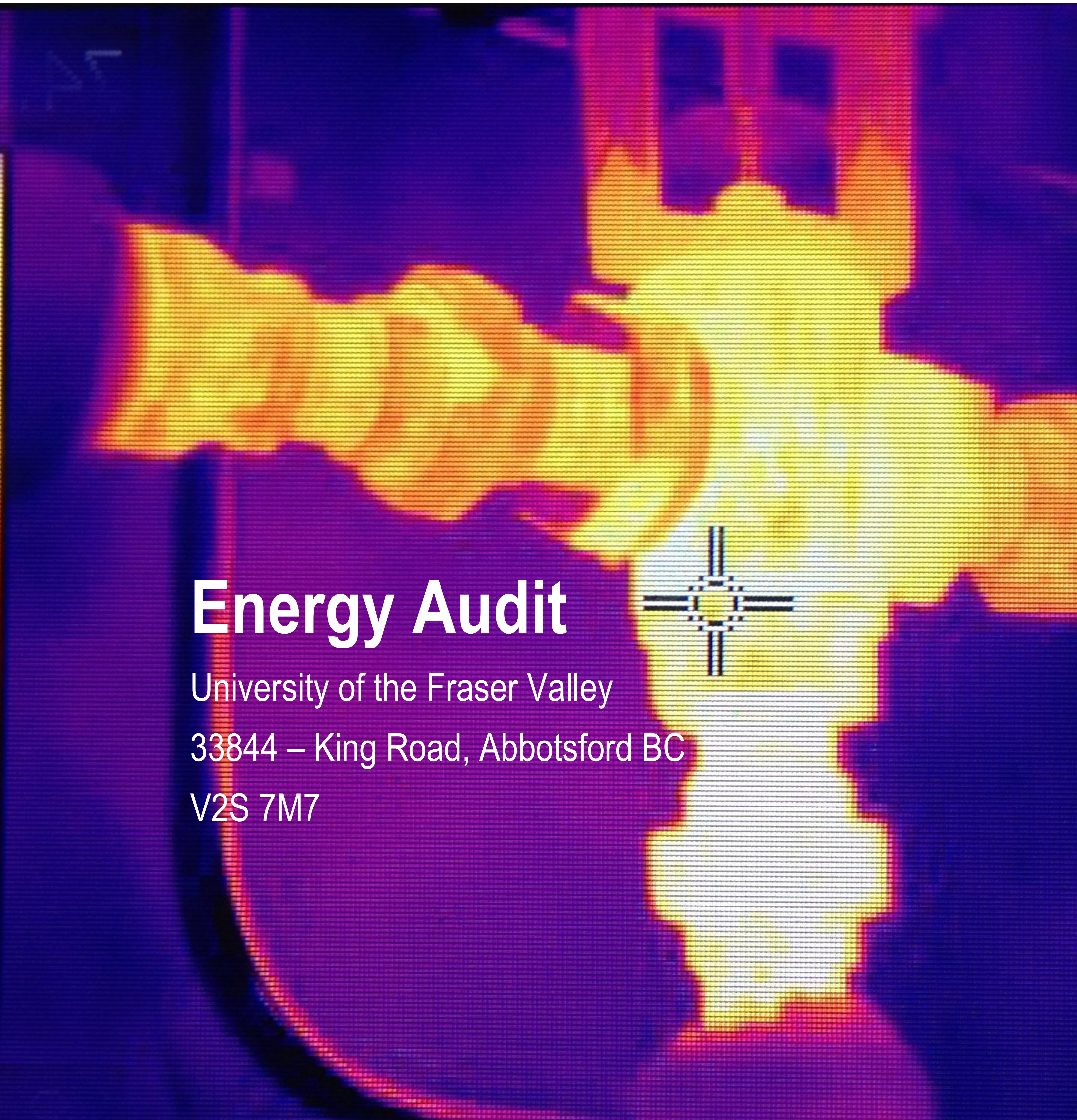
Please do not hesitate to contact me should you have any additional questions.
Thank you,

Peter Ielimi

Executive Director
Mechanical Insulators Labor Management Cooperative Trust

SALAMANDER INSPECTIONS LTD

Mechanical Insulation Energy Audits



Energy Audit

University of the Fraser Valley
33844 – King Road, Abbotsford BC
V2S 7M7

Executive Summary

The University of the Fraser Valley is located at 33844 – King Road, Abbotsford British Columbia. The university offers more than 100 programs, including two master's degrees, 15 bachelor's degrees, majors, minors and extended minors in more than 30 subject areas, and more than dozen trades and technology programs.

For this report our inspection and assessment included facilities on the Abbotsford Campus only.

The Abbotsford Campus has several buildings of concrete construction with multiple levels housing offices, classrooms, common areas and service rooms. The major components of the heating and ventilation systems are typically contained in mechanical rooms for each building.

Salamander Inspections performed an energy audit of the insulation systems within the each Mechanical Room. 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 **- 676.83 GJ** and a **ROI of 2.1 years**
2) Annual cost savings derived through properly insulated piping - **$5,150.67**
3) Potential savings on maintenance costs for equipment
4) Elimination of personal protection hazards

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[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. Blair McFarlane, Energy Manager for the University of the Fraser Valley retained Salamander Inspections Ltd. to complete a review of mechanical insulation systems for the heating systems at the Abbotsford campus. The goal of the assessment is to find energy savings for the University.

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.

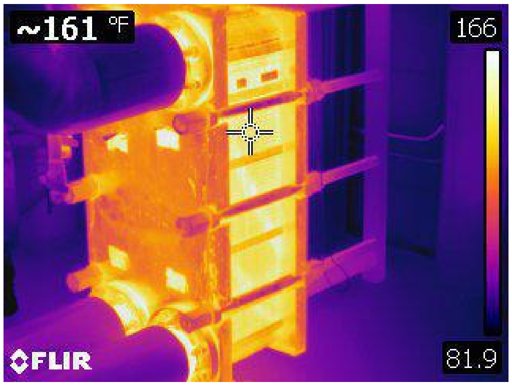

Figure 1 This is an infrared photo of the heat exchanger showing the areas with where large temperature differences create high rates of heat transfer.

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 Building "B"

In general, workmanship on the existing insulation systems is 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 noted 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 1 (25mm) inch to 1-½ inches (37 mm) thick. 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 (26) valves, (5) strainers, (29) pumps and (3) heating return/expansion tanks 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 vertical pump within the mechanical room.

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

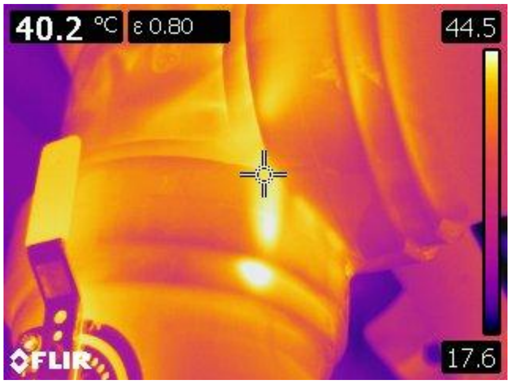

Figure 5 This Thermographic image of a Victaulic Tee which has been insulated with flex wrap. Note the high rate of heat loss as indicated by the bright color.

Figure 6 This conventional photo shows the PVC fitting applied to the Victaulic Tee. The fitting looks great but the thermographic image shows a high rate of heat loss.

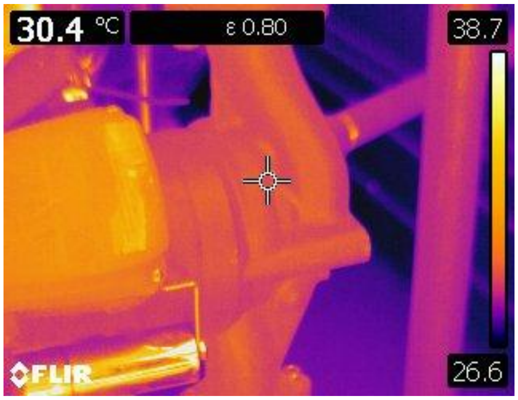

Figure 7 This is a thermographic image of a circulation pump adjacent to the boiler.

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

Figure 9 This is a thermographic image of the supply and return lines at the back of the boiler. These two lines are operating at a high temperature and pose a personal protection hazard.

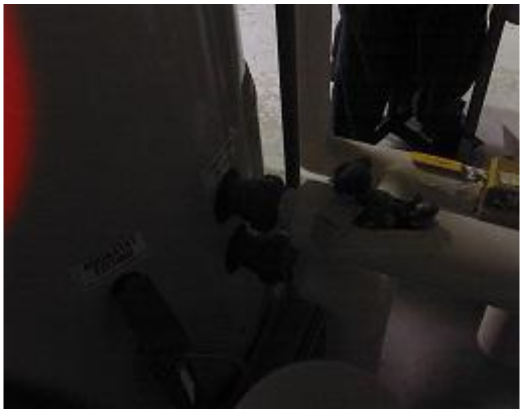

Figure 10 This is the conventional image of the supply and return lines at the back of the boiler.

1016 – Mechanical Room

We inspected the 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 11 through 18).

Figure 11 This thermographic image is of a small motorized pump.

Figure12 This is a conventional image of the same pump.

Figure 13 This thermographic image is of a bare 1.25 inch pipe 21 feet in length against the ceiling of the room.

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

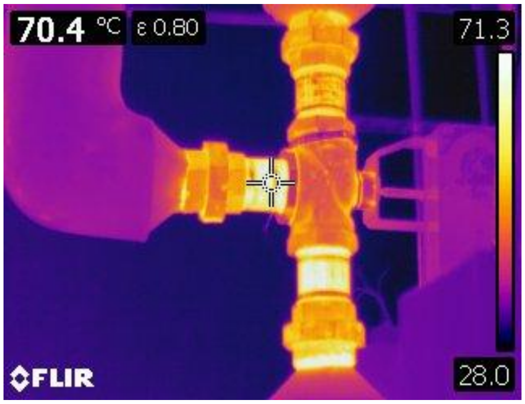

Figure 15 This thermographic image is of a bare three way valve operating at a high temperature.

Figure 16 This conventional image is of the same three way 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 77ºC. (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 17 Thermographic image of a Personnel protection hazard at floor level

Figure 18 conventional image of the same pump.

S- 301 Building D

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 19 through 32).

Figure 19 Thermographic image of a pump adjacent to the domestic hot water tank.

Figure 20 Conventional image of the pump adjacent to the domestic hot water tank.

Figure 21 Thermographic image of a control valve adjacent to boiler.

Figure 22 Conventional image of the same control valve.

Figure 23 Thermographic image of motorized pump on heating system.

Figure 24 Conventional image of the same pump and associated flanges requiring

Figure 25 Thermographic image of three way valve requiring insulation.

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

Figure 27 Thermographic image of control valve.

Figure 28 Conventional image of same control valve.

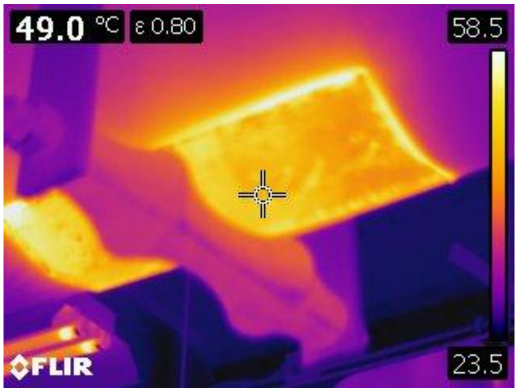

Figure 29 Thermographic image of hanger supports without insulation behind plates.

Figure 30 Conventional picture of hanger support.

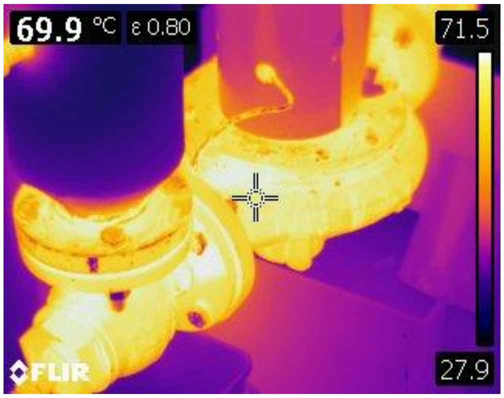

Figure 31 Thermographic image of hanger supports without insulation behind plates.

Figure 32 Conventional image of the same heating pumps.

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 77ºC. 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.

S- 3104 – Mechanical Room

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 33 through 42)

Figure 33 Thermographic image of the P6-B motorized pump.

Figure 34 Conventional image of the same pump.

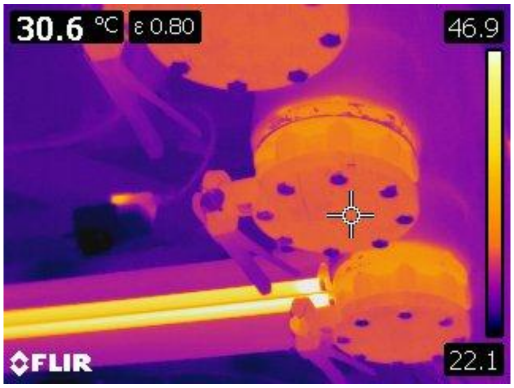

Figure 35 Thermographic image of the exposed gate valves on the Thermonex header.

Figure 36 Coventional image of the same header.

Figure 37 Thermographic image of a motorized heating pump.

Figure 38 Conventional image of the same pump.

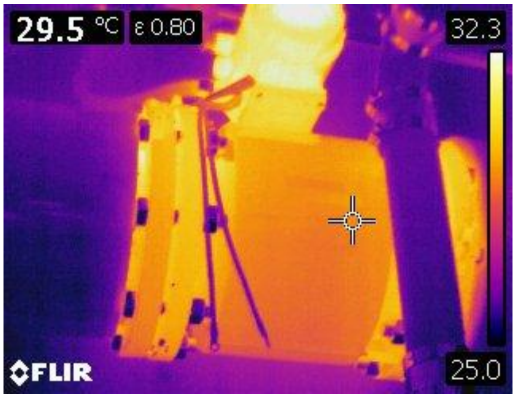

Figure 39 Thermographic image of a flow meter on the heating side.

Figure 40 Conventional image of the flow meter.

Figure 41 Thermographic image of exposed gate valves.

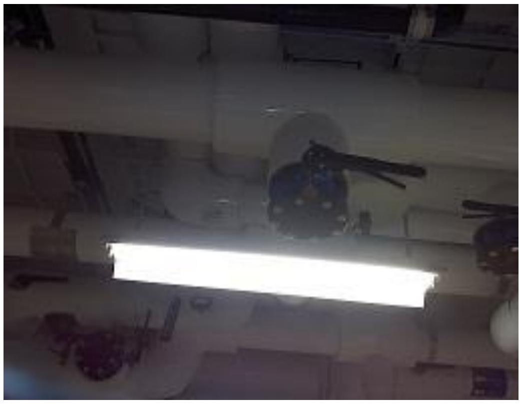

Figure 42 Conventional image of the same gate valves.

G003 – Mechanical Room

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 43 through 54)

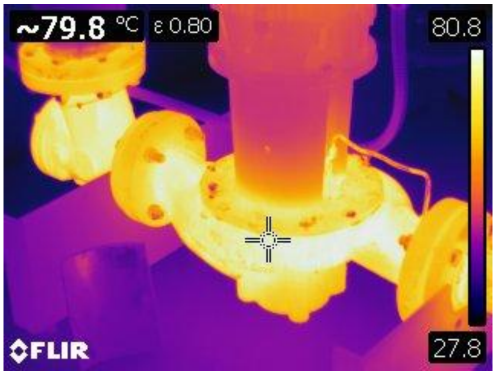

Figure 43 Thermographic image of exposed heating pump.

Figure 44 Conventional image of the same pump.

Figure 45 Thermographic image of exposed control valve.

Figure 46 Conventional image of the same valve.

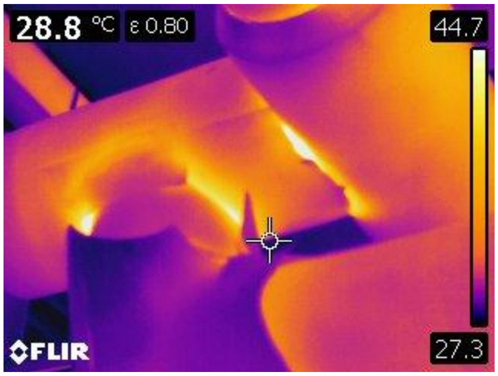

Figure 47 Thermographic image of poorly applied insulation and fitting.

Figure 48 Conventional image of the same pipe covering and elbow with heat loss at intersection of materials.

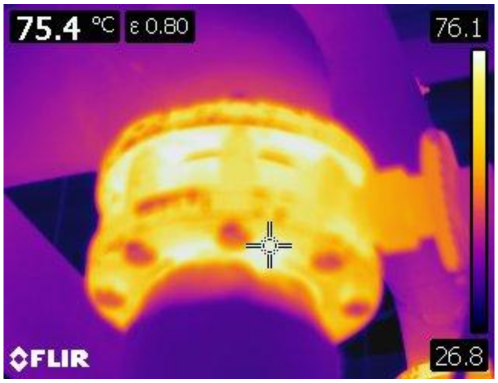

Figure 49 Thermographic image of bare gate valve operating at 75.4C or 167F.

Figure 50 Conventional image of bare gate valve operating at 167F.

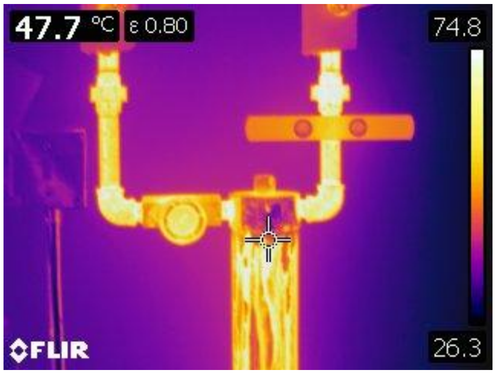

Figure 51 Thermographic image of chem. pot and piping.

Figure 52 Conventional image of chem pot and piping.

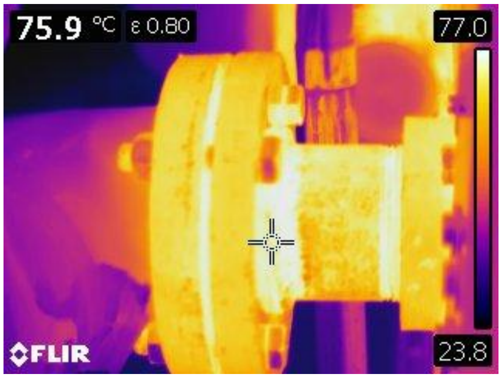

Figure 53 Thermographic image of exposed flanges at the back of the boiler

Figure 54 Conventional image of exposed flanges.

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 75ºC. 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.

A East – Mechanical Room

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 57 through 84)

Figure 57 Thermographic image of exposed three way valve.

Figure 58 Conventional image of exposed three way valve.

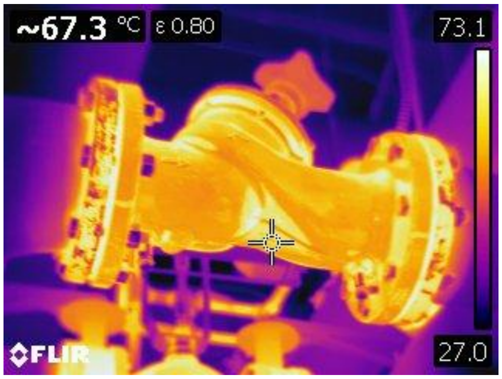

Figure 55 Thermographic image of exposed control valve.

Figure 56 Conventional picture of exposed control valve.

Figure 57 Thermographic image of exposed control valve.

Figure 58 Conventional picture of exposed control valve and flanges to unit.

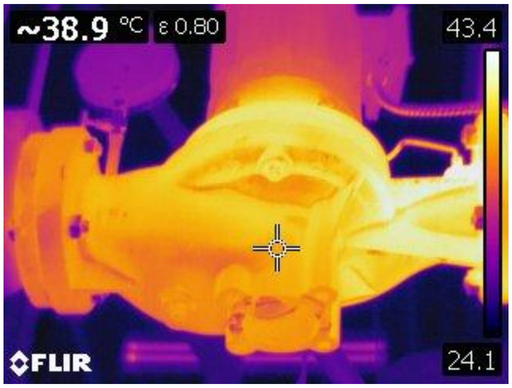

Figure 59 Thermographic image of exposed motorized heating pump.

Figure 60 Conventional picture of exposed heating pump.

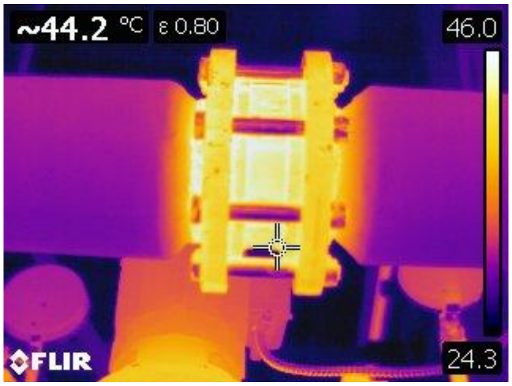

Figure 59 Thermographic image of exposed valve and flanges.

Figure 60 Conventional picture of same valve and flanges.

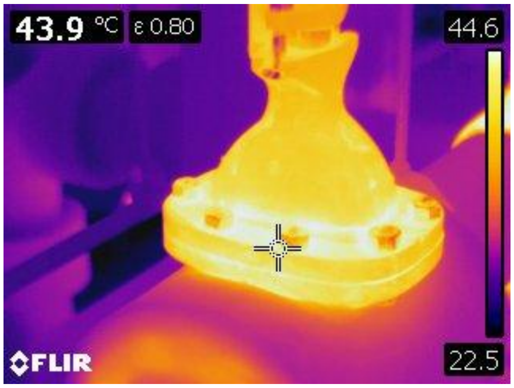

Figure 61 Thermographic image exposed valve bonnet.

Figure 62 Conventional image of exposed valve bonnet and other exposed valves and flanges.

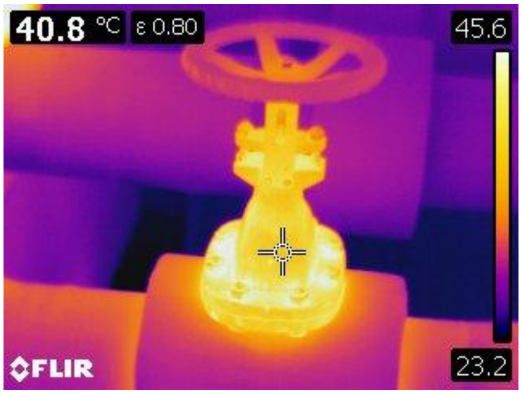

Figure 63 Thermographic image of exposed valve bonnet.

Figure 64 Conventional image of exposed valve bonnet and other exposed valves and flanges.

Figure 65 Thermographic imag**e** exposed motorized three way valve.

Figure 66 Conventional image of exposed valve bonnets and motorized three way valve.

Figure 67 Thermographic image of bare control valve

Figure 68 Conventional picture of the same control valve.

Figure 69 Thermographic image of damaged piping from hot water tank.

Figure 70 Conventional image of the same pipes to and from hot water tank.

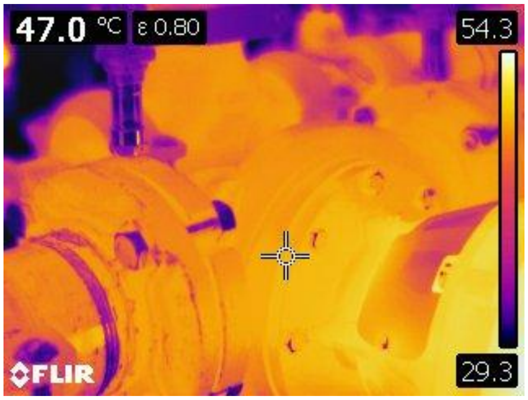

Figure 71 Thermographic image of motorized circulation pump.

Figure 72 Conventional picture of the same pump and associated piping.

Figure 73 Thermographic image of bare Victaulic cap and clamp.

Figure 74 Conventional picture of the same un- finished fitting.

Figure 75 Thermographic image of control valve and piping at boiler.

Figure 76 Conventional picture of bare valves, pumps and piping.

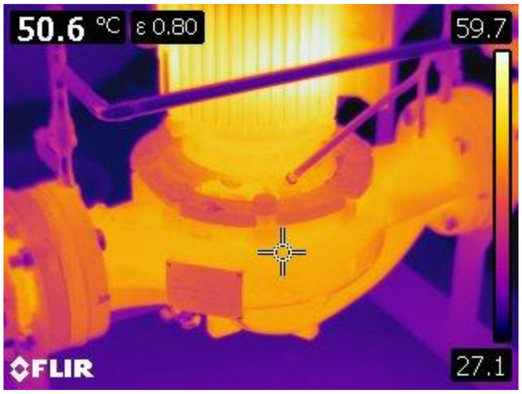

Figure 77 Thermographic image of heating pump and associated piping.

Figure 78 Conventional picture of the same pump and piping.

Figure 79 thermographic image of a receiver tank.

Figure 80 Conventional image of the same tank.

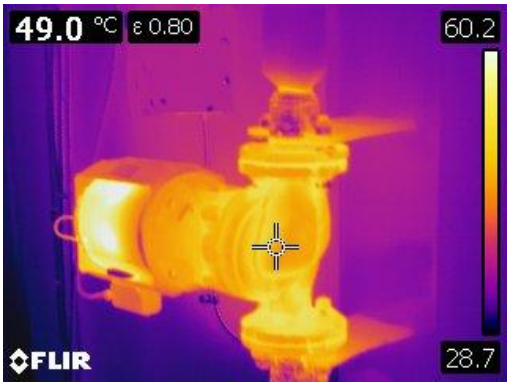

Figure 81 Thermo graphic image of heating pump and associated piping.

Figure 82 Conventional picture of heating pump and associated piping.

Figure 83 thermographic image of un-finished heating piping.

Figure 84 conventional image of the same heating piping.

The inspection of all these mechanical areas has revealed that the insulation is generally applied correctly. The issue remains however that there are many areas where insulation has not been applied i.e.: pumps (heating and chilled) valves, piping and more. The level of finishing is inadequate in many of these areas where the installer stopped short of complete coverage of piping, valves and flanges. Failure to complete the insulation system has left many opportunities to improve or upgrade the insulation and receive benefits to the cost of operation.

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

Hours of Operation	BTU from Spreadsheet	Gigajoules Saved
6000	641,514,000	676.83
	Cost of fuel	$7.61
	total	**$5,150**

Greenhouse Gas	CO2	NOx
before	14567	29.40
after	1689	3.38
Total removed	33.6 tonnes	.2 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	233sqft @ $1.66	$ 386.78
5/8		
½	30 ft @ $1.77	$110.70
¾	5 ft @$1.92	$ 19.65
1 1/4	26 ft @$2.41	$116.48
1 1/8		
1 ½		
2	28 ft@ $5.12	$143.36
2 1/8		
2 ½	17 ft @$5.61	$ 95.37
2 5/8		
3	14 ft@ $6.10	$ 85.40
3 1/8		
4	8 ft @$7.04	$56.32
4 1/8		
6	131 ft @$8.81	$ 1154.11
7	2 ft @$9.60	$ 19.20
8	68 ft @$10.79	$ 733.72
10	27 ft@$13.20	$ 356.40
12	12 ft @$14.78	$ 177.36
14	12 ft @$16.79	$ 201.48
	Total	$3656.33

Valve Sizes	Square footage or Lineal feet	Cost of Material
2		
2 ½		
3		
3 1/8		
4		
4 1/8		
6		
8		
10		
	Total	$3,656.00
	Labor @ $400.00 per day	$7,200.00
	Total	$10,856.00

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 do not reflect any finish (cladding) or PVC elbows or fittings.

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 **- 677 GJ**
2) Annual cost savings derived through properly insulated piping - **$5,150**
3) Potential savings on maintenance costs for equipment
4) Elimination of personal protection hazards Disclosure

We have no relevant financial or non-financial relationships to disclose.

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

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[3] Ibid.

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.

J.R. BESANT

Jeff Besant, MBA, P.Eng.