Thermal Assessment Report

Plant Name
City, State

Prepared On:
11/09/2018

Prepared By:
Name - Title
Rep Company

Armstrong International
INTELLIGENT SOLUTIONS IN STEAM, AIR AND HOT WATER
816 Maple Street, Three Rivers, Michigan 49093 Phone: (269) 273-3415 Fax: (269) 273-8742

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1. INTRODUCTION

Armstrong/Rep conducted a Thermal Assessment of the steam and condensate systems at Plant, City, State on Month Date, 20XX.

We appreciate the opportunity to visit your facility and the time and knowledge of your team helping us and making it possible to conduct this assessment.

The following areas were assessed:

- Overall Utilities (metering, management and benchmarking)
- Steam Generation (boilers, efficiency, deaeration, blowdown)
- Steam Distribution (headers, pressure reducing valves, piping practices, leaks, insulation, steam traps)
- Steam Utilization (all users including but not limited to heat exchangers, tanks, tracers, coils)
- Condensate Collection and Return (high pressure and low-pressure headers, receivers, trapping systems, water hammer and back pressure issues)
- Hot Water Generation, Distribution, and Use
- Air Conditioning and Air Heating

The objective of the assessment was to:

- Collect up to date information for the steam and condensate systems and their operation
- Identify opportunities to improve the efficiency of the existing systems resulting in the conservation of fuel, treated water, chemicals, and reducing CO_2 emissions
- Identify opportunities to improve the system's safety, reliability, and integrity

Abbreviations used in the Observation Section:

Energy - Fuel, Water, Sewer, Electricity
M&R - Maintenance and Reliability
Prod - Production and Product thru-put
Safety - Safety

2. UTILITIES AND STEAM SYSTEM

Site Energy Information

Company Name						Date	Aug-18
Address							
City		State		ZIP		Phone	
Name / Title					e-mail		
Name / Title					e-mail		

Utilities Cost Information

Utility	Cost		Total Consumption		Annual cost
	Unit Cost	Units	Qty	Units	$/year
Raw Water:		$/kgal		kgal	
Treated Water	6.55	$/kgal	5514.5	kgal	$ 36,106
Sewer 1	5.72	$/kgal	5514	kgal	$ 31,548
Chem Treatment					
Primary Fuel	4.22	$/MMBtu	530240	MMBTU	$ 225,057
Back Up Fuel	4.00	$/gal	4092	MMBTU	$ 16,377
If fueloil #6, S%		%			
Electricity	0.0623	$/kWh	2844	MWh	$177,117
Own/Purchased Steam		$/klb		klb	

Facility details

Production	Units/year			
Total Capacity	Units/year			
Operation	Hours/year			
Operation	days/week			
Operation	hours/day			
Shutdown Date				

Cogeneration and Steam Generated as By-product

Power Generation Capacity		kW		Manufacturer
Heat Recovery - Steam		lb/h		Psig
- Hot water		MMBTU		gpm
Steam as by-product?		lb/h		Psig

Steam Generation

Boilers #	Units	1	2	3	4
Manufacturer		Johnston			
Year		1998			
Type	WT/FT	FT	FT		
Rated Capacity	HP	150	100		
Rated Pressure / Temp	Psig / F				
Operating Press/Temp	Psig / F	150	125		
Avg. Firing Rate	0 - 100%				
Main Fuel Used		Natural Gas	Natural Gas		
Back-up Fuel					
% Back-up Fuel Used	0 - 100%				
Flue Gas - O_2 %	0 - 21%	Not availab	Not available		
Flue Gas Temperature	F	370	Not available		
Economizer	Yes/No	No	No		
Air Preheater (Yes/No)	Yes/No	No	No		
D/A Pressure	Psig	8			
Feed Water Temperature	F	225			
Boiler Efficiency	%	NA	NA		
Boiler House Efficiency	%	NA			
Boiler Blowdown	%	10-25%	BD Heat r	Yes / No	No

Major Steam Users

Equipment (fill details in next tab)	Flow lb/h	Pressure Psig	Operation Cont/Batch
Tanks			Cont
Tracers			Cont
Rail Cars			Batch

Feed Water/Make Up Water/Condensate Quality

	Units	Condensat	MUW	FW	Boiler
Oil content	mg/l				
Conductivity	µS/cm			500-700	2500-5500
Ferric Oxides	µg/l				
pH	-				

Condensate Return System

Condensate Returned	%	25-50%
Condensate Pressure	Psig	
Condensate Temperature	F	210
Where is Condensate Returned To?		To Condensate Tank
How is Condensate Returned?		By Mechanical Pump

Hot Water Generation

Hot Water System #		1	2	3
Method of production				
Capacity installed	MMBTU/hr			
Temperature	F			
Once Trough/Closed Loop	OT or CL			
Average Hot Water Production	kgal/day			

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Steam Distribution System

Distribution Header #		1	2	3
Head. Pressure	Psig	125	150	
Head. Temperature	F	saturated	saturated	
Winter Flow Rate (average)	klb/h	NA	Peak:	
Summer Flow Rate (average)	klb/h	NA	Peak:	
Est. No. of Steam Traps		350		
Date of Last Trap Survey		Not Available		
Estim. % failure		>15%		

Major Hot Water Users

Equipment	Flow	Water Temperatur	Operation	
	gpm	F	Direct Injection/Once Through/Closed loop	

Projects (What Energy Projects Are Known But Not Funded - Any Additional Comments)
1
2
3

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3. OBSERVATIONS

Issue:	Condensate Receiver Venting			
Category:	Energy	Safety	M & R	
Location:	All condensate receivers			

Excessive steam venting at the condensate receiver vent. Venting steam is a waste of heat (fuel), treated water and chemicals. If recovered the vented steam will save energy and water.

Issue:	Condensate Receiver Venting			
Category:	Safety	Energy	M & R	
Location:	Main Process Condensate Receiver			

Excessive venting and liquid draining through the receiver vent due to undersized pump.
Draining 210F water is a safety concern . The pressurized stream of hot water and steam deteriorates the concrete

Issue:	Excessive Blowdown and No Heat Recovery			
Category:	M & R	Prod	Safety	Energy
Location:	Boiler room			

The heat of the continuous blowdown is not recovered and is lost to the atmosphere. Also, cold city water is added to reduce the temperature before the drain. Better control of the blowdown rates and recovering the heat of the blowdown can substantially reduce the water usage and the energy losses, as the water temperature is the same as the temperature of the steam generated in the boiler.

Excessive Blowdown and No Blowdown Heat Recovery

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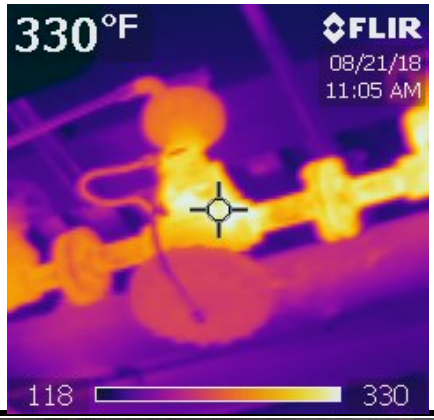
Issue:	Condensate Return Line connected to Drain			
Category:	M & R	Prod	Safety	Energy
Location:	Blowdown drain line			

Condensate return line connected to the drain is a waste of heat (fuel), treated water and chemicals. If recovered the condensate will save energy, water and sewer charges.
The valve was closed after the discovery.



Issue:	Missing Insulation			
Category:	M & R	Prod	Safety	Energy
Location:				

Insulation is missing or damaged. There will be greater heat transfer losses through radiation and convection resulting in fuel waste. Also, due to the heat losses, steam will condense faster which can lead to water hammer.

Issue:	Undersized Drip Leg and Missapplied Drip Trap			
Category:	M & R	Prod	Safety	Energy
Location:	Near 150 HP Boiler			

The drip legs are main components of the steam distribution system, assuring the quality of the steam at the point of usage. They are provided to:
• Let condensate escape by gravity from the fast moving steam
• Store condensate until the pressure differential can discharge through the steam trap
If not properly installed or sized, the condensate cannot be removed from the steam headers and the quality of the steam deteriorates. Wet steam can induce water hammer or damage valves and equipment.

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4. ASSESSMENT RESULTS / VERIFICATIONS COMPLETED DURING THE AUDIT

Potential Optimization	Comment
OVERALL STEAM SYSTEM PROFILE	
Steam System - Measurements and Monitoring	To be Improved
Steam Generation	To be Improved
Fuel	To be Improved
Feedwater	To be Improved
Make-up Water	To be Improved
Steam Distribution - to plant, to areas and/or to individual users	To be Improved
Costs Tracking - fuel, water, sewer, chemicals, steam	To be Improved
Safety	To be Improved
BOILER HOUSE	
Boiler Efficiency - is it measured or calculated?	No
Stack temperature	Not Available
Oxygen in flue gas	Not Available
Combustion Air Supply Temperature	To be Improved
Boiler/Burner Tune-Up	Not Available
Steam Pressure Setting	OK
Gauges and Instrumentation	To be Improved
Boiler Sizing and Reliability	To be Improved
Steam Quality	To be Improved
Boiler Blow-Down Rate	To be Improved
Boiler Blow-Down Recovery	To be Improved
Deaerator Pressure	OK
Feed Water Temperature	OK
Heat Recovery - MUW Pre-Heating	To be Improved
Vents	To be Improved
STEAM DISTRIBUTION	
Proper Piping Practices	To be Improved
Water Hammer	To be Improved
Steam Quality	To be Improved
External Leaks of Steam or Condensate from Pipes, Flanges, etc.	To be Improved
Steam Pressure	To be Improved
Internal Leaks	To be Improved
Insulation	To be Improved
Steam Traps and Steam Trap Management	To be Improved

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STEAM USERS	
Steam Users / Heat Exchangers Performance - Stall, Air Locked, Vacuum	To be Improved
Point of Use Pressure	OK
Piping Practices - Users	To be Improved
CONDENSATE AND FLASH STEAM RECOVERY	
Condensate Return - Quantity and Quality	To be Improved
Condensate Return Piping Practices and Sizing	To be Improved
Water Hammer	To be Improved
Flash Steam Recovery/Utilization	To be Improved
HOT WATER	
Hot Water Generation (once through) - Domestic HW, Once Through Hoses	Not Applicable
Hot Water Generation (Recirculation) - HW for Heating, For Process	Not Applicable
Hot Water Distribution	Not Applicable
Hot Water Use	Not Applicable
HVAC	
HVAC - AHU, Unit Heaters, Make-up Air	Not Applicable
Humidification	Not Applicable

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5. CLOSING

Rep/Armstrong appreciates the opportunity to assist Plant with the thermal assessment of the steam and condensate systems and welcomes the opportunity to be Plant's partner.

We are pleased to report there is potential for improvement in the areas of safety, reliability, and energy and water waste. During this assessment, the following opportunities were identified:

• Improve the condensate return system
There are multiple locations where the condensate is drained and vents are blowing flash steam and water. An properly designed and operating system will not only reduce costs (makeup water, heating and treating, and sewer charges), but will improve safety and reduce operational and maintenance issues.

• Improve piping practices
There are distribution pipes that do not have properly designed (location, size and depth) drip legs and have missapplied drip traps. Excess condensate in steam lines can errode/corrode PRVs, control valves, or any downstream fitting. It can also result in water hammer which will quickly damage fittings, valves, or heating equipment. Excessive pressure drops in the steam distribution system can also be asociated with the bad steam quality

• Improve metering/monitoring
Additional meters (natural gas, water, feed water, steam) and instrumentation could be installed on strategic locations (individual boilers and/or headers) to provide the plant management with better tools to evaluate the system and its efficiency, as well as measure the results of implemented projects.

•Improve steam generation efficiency
The high boiler flue gas temperatures present an opportunity for heat recovery. Utilizing the excess heat before discharging the flue gas will improve the system efficiency. The boiler room will benefit from online oxygen monitoring, blowdown optimization and heat recovery, insulation of hot surfaces will yield substantial savings and improve safety.

Armstrong and Hatfield would welcome the opportunity to work with the facility on further analysis of the findings and their development into definitive projects.

Recommended next steps:
- Perform a site-wide steam trap survey and establish a trap/leak/insulation management program
- Training either on site or at our Armstrong facility
- System audit- a complete engineering audit in order to study in details the technical feasibility and the economic interest of each one of the above opportunities
- Develop a Monitoring plan