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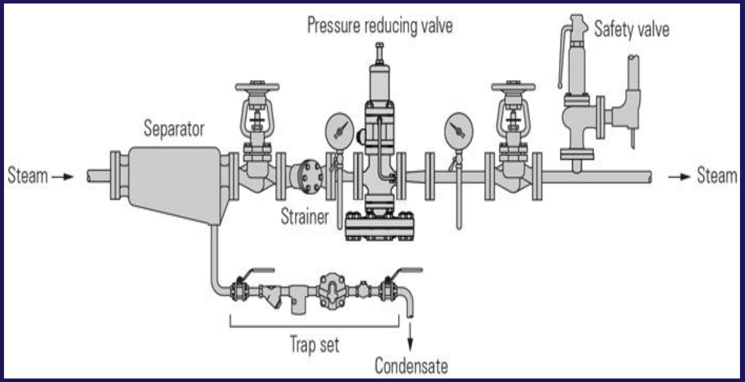
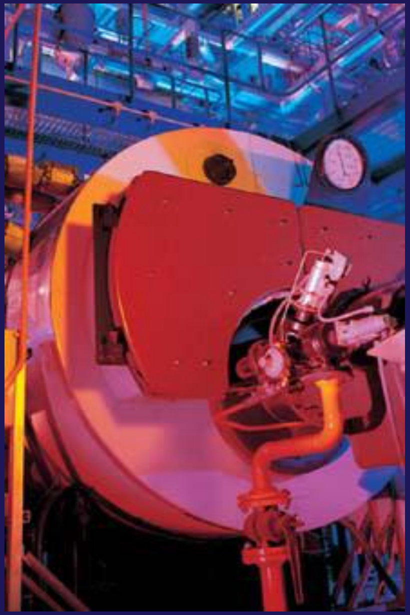
Steam, Hot Water Boiler Systems & Mechanical Insulation





April 16, 2014 – National Grid

Your Presenters

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- **David Gaudet** is a Senior Energy Engineer in the New Products Group at National Grid. david.gaudet2@nationalgrid.com
- **Bob Mulvey** – is the Director of Sales at Shannon NRG Resources. They provide Turn Key Energy Solutions in the form of custom engineered Thermal Blanket Insulation Systems to commercial real estate, healthcare, education, food processing and manufacturing customers. bmulvey@shannonnrg.net
- **Michael Blaney** – Sr. Specialist on the National Grid Marketing and Customer Experience Trade Ally Engagement Team michael.blaney@nationalgrid.com

Safety Moment:
Call before you dig!

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Spring is here. Don't gamble with your safety – if you're a professional excavator *or* homeowner, smart digging *always* requires a call to 811.

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How does your facility use valuable therms once they are produced?

Generating Steam: Boiler Schematic

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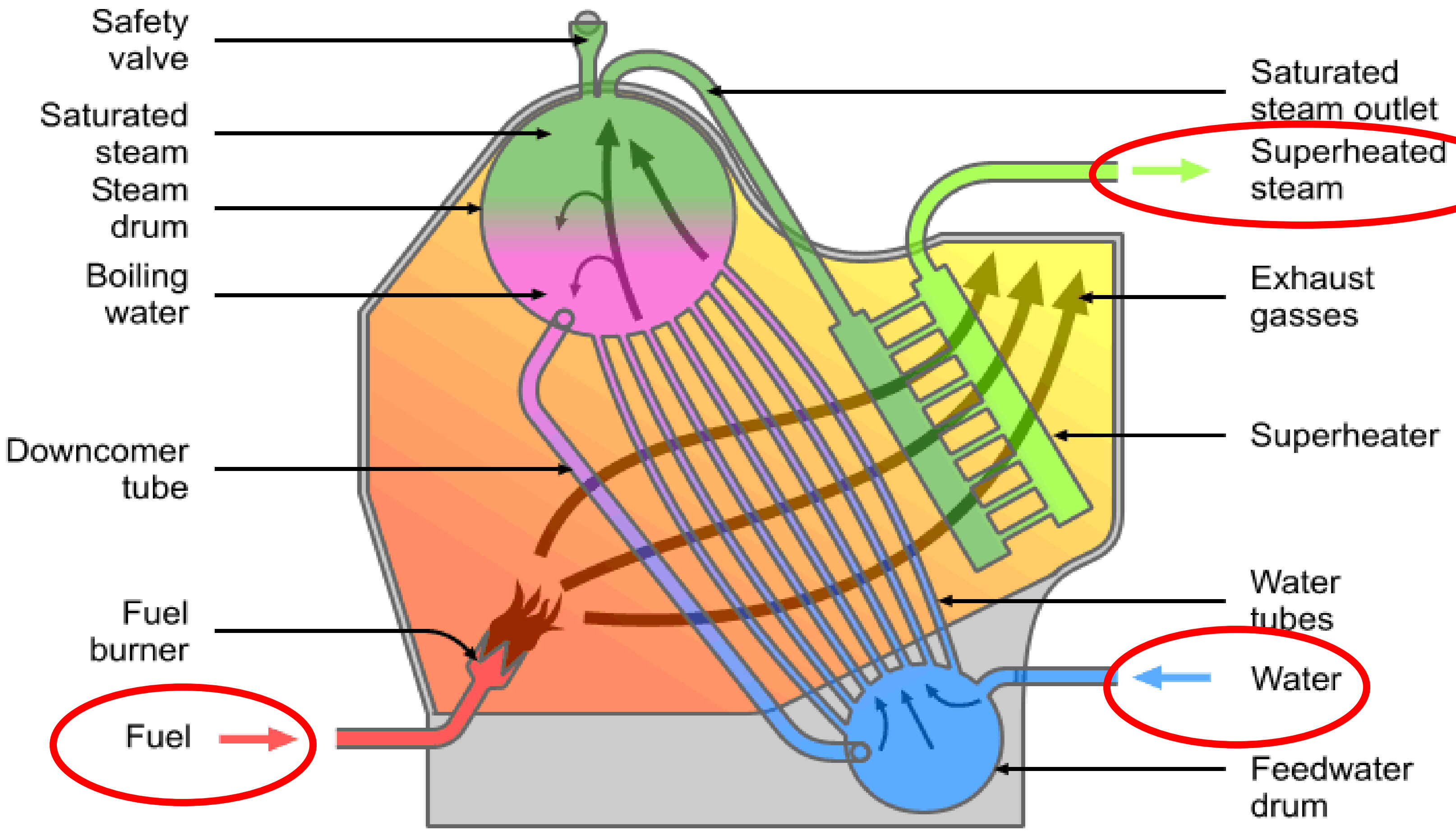

One-Pipe Steam System

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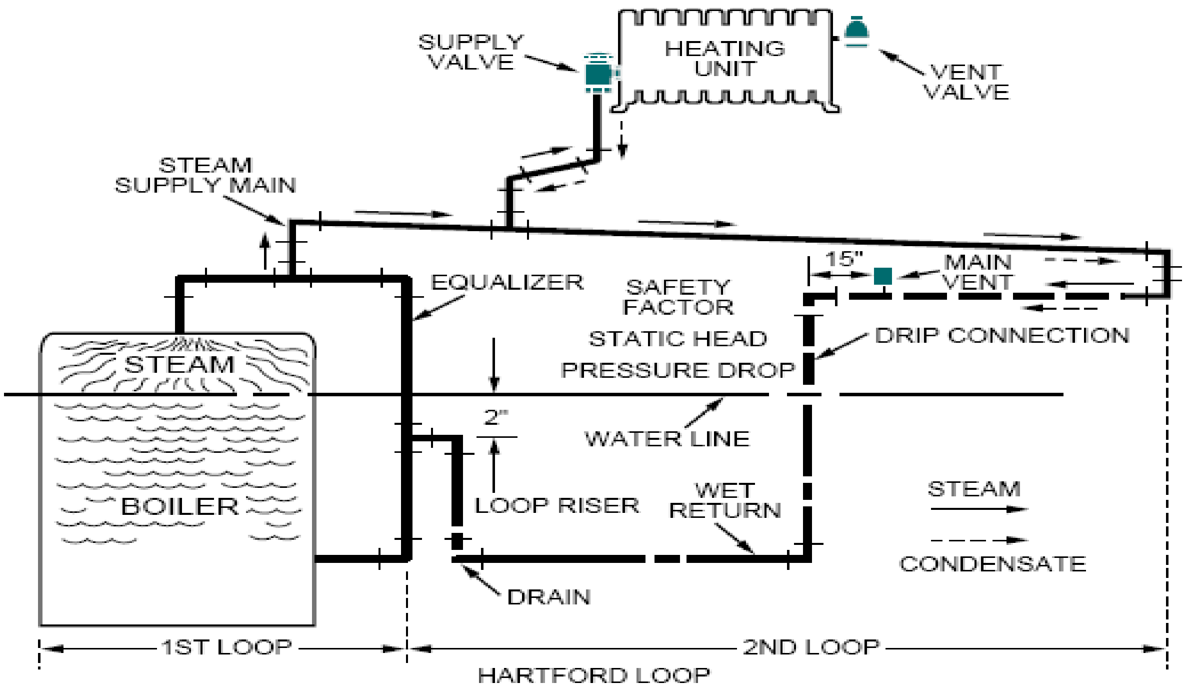

Two-Pipe Steam System

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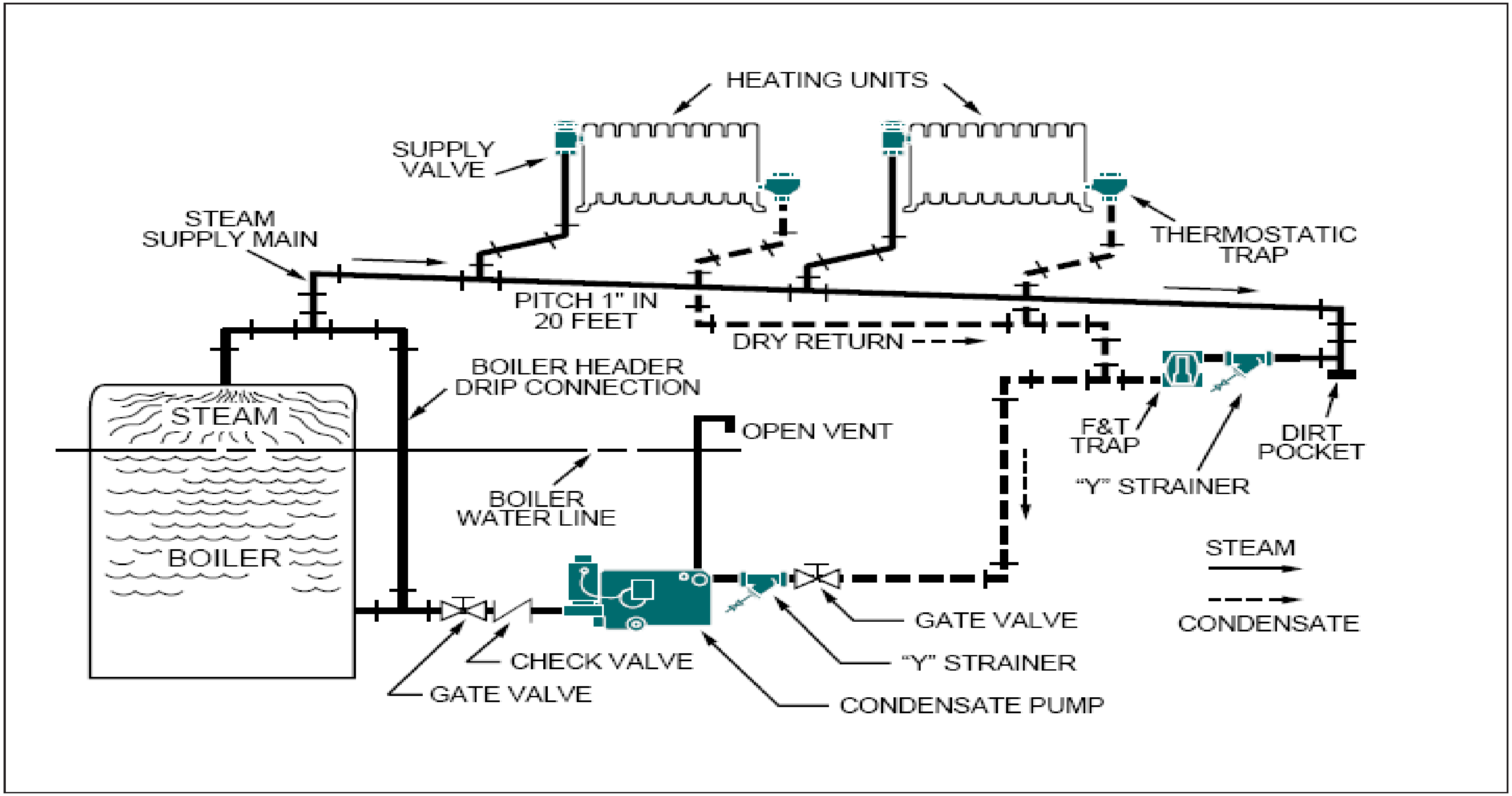

Steam System Schematic

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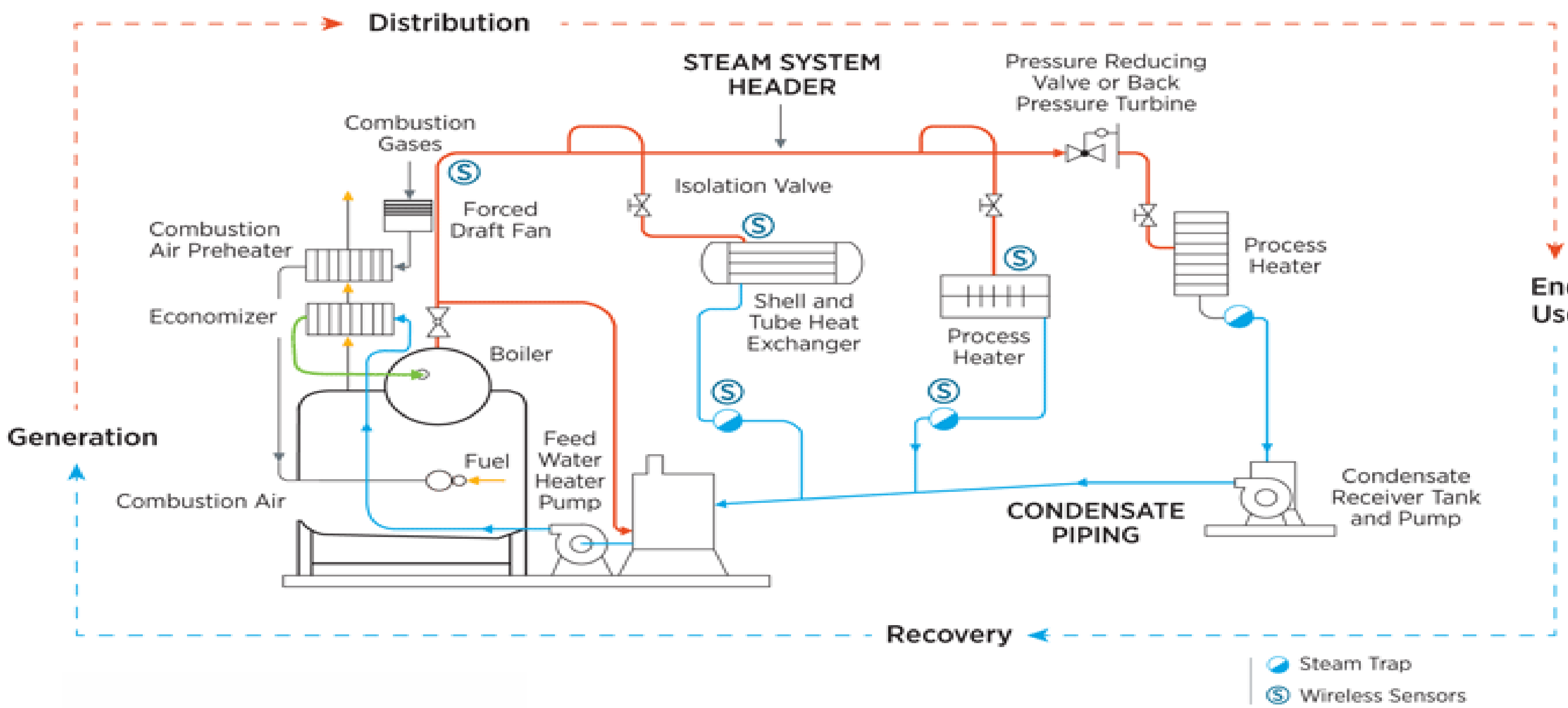

Popular Energy Efficiency Measures

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- **Pipe Leaks**
- **Pipe Insulation**
- **Reduce Steam Pressure**
- **Steam Traps**
- **Combustion Controls**
- **Blowdown Heat Recovery**
- **Boiler Stack Economizer**
- **Flash Steam Heat Recovery**
- **Back-Pressure Turbines**
- **Combined Heat & Power**

energy
Money Isn't All You're Saving

COMPREHENSIVE
ENERGY EFFICIENCY

Indications you may be wasting money spent on gas:

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- Door to boiler room propped open with large fan to exhaust heat
- 20 degrees outside – exhaust blower going by loading dock
- You commonly refer to mechanical room A as “the hot room”
- Room above boiler is air conditioned 365 days

Pipe Insulation




- **Increases Boiler Capacity**
- **Reduces Fuel Usage**
- **Improves Heat Distribution**
- **Increases Personnel Safety**



Pipe Insulation

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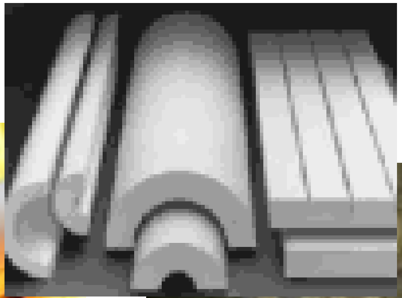
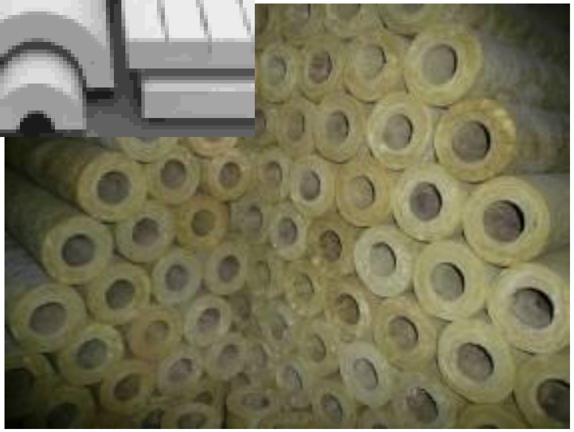
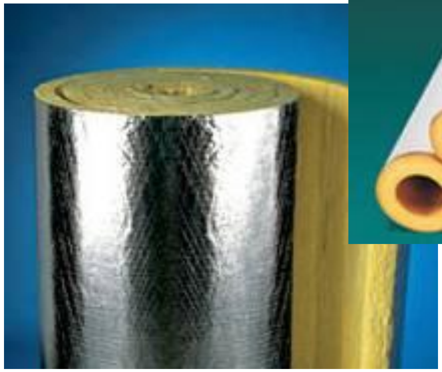
Fiberglass

1,000ºF





Mineral Wool



Calcium Silicate

1,200ºF

Rock Wool

1,200ºF

Pipe Insulation

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Heat Loss per 100 feet of Uninsulated Steam Line

Distribution Line Diameter (inches)	Heat Loss per 100 feet of Uninsulated Steam Line (MMBtu/yr)			
	Steam Pressure (psig)			
	15	**150**	**300**	**600**
1	140	285	375	495
2	235	480	630	840
4	415	850	1,120	1,500
8	740	1,540	2,030	2,725
12	1,055	2,200	2,910	3,920

Based on horizontal steel pipe, 75°F ambient air, no wind velocity, and 8,760 operating hr/yr.

In a plant where the value of steam is $4.50/MMBtu, a survey of the steam system identified 1,120 feet of bare 1-inch diameter steam line, and 175 feet of bare 2-inch line both operating at 150 psig. An additional 250 feet of bare 4-inch diameter line operating at 15 psig was found. From the table, the quantity of heat lost per year is:

1-inch line: 1,120 feet x 285 MMBtu/yr per 100 ft = 3,192 MMBtu/yr
2-inch line: 175 feet x 480 MMBtu/yr per 100 ft = 840 MMBtu/yr
4-inch line: 250 feet x 415 MMBtu/yr per 100 ft = 1,037 MMBtu/yr
Total Heat Loss = 5,069 MMBtu/yr

The annual operating cost savings from installing 90% efficient insulation is:

0.90 x $4.50/MMBtu x 5,069 MMBtu/yr = $20,530

Rule of Thumb

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Average Facility using steam:

- 250 Bare Exposed Fittings
- AVERAGE ENERGY LOSS $ 75,000.00 / Year
- Average Opportunity for Savings $68,000.00 / Year

Drawbacks of Conventional Insulation for Steam Loop Components

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- Complex Surface does not lend itself to medium
- Requirement for Quick Access.
- Each removal requires re-insulation.
- Field conditions (Flooding, Steam Leaks) may be severe.
- Re-insulating is not cost effective over time.
- Logistics when hiring a contractor each time is cumbersome

Result is exposed surfaces!

Many surfaces are never insulated

Conventional Insulation will "fail" over time

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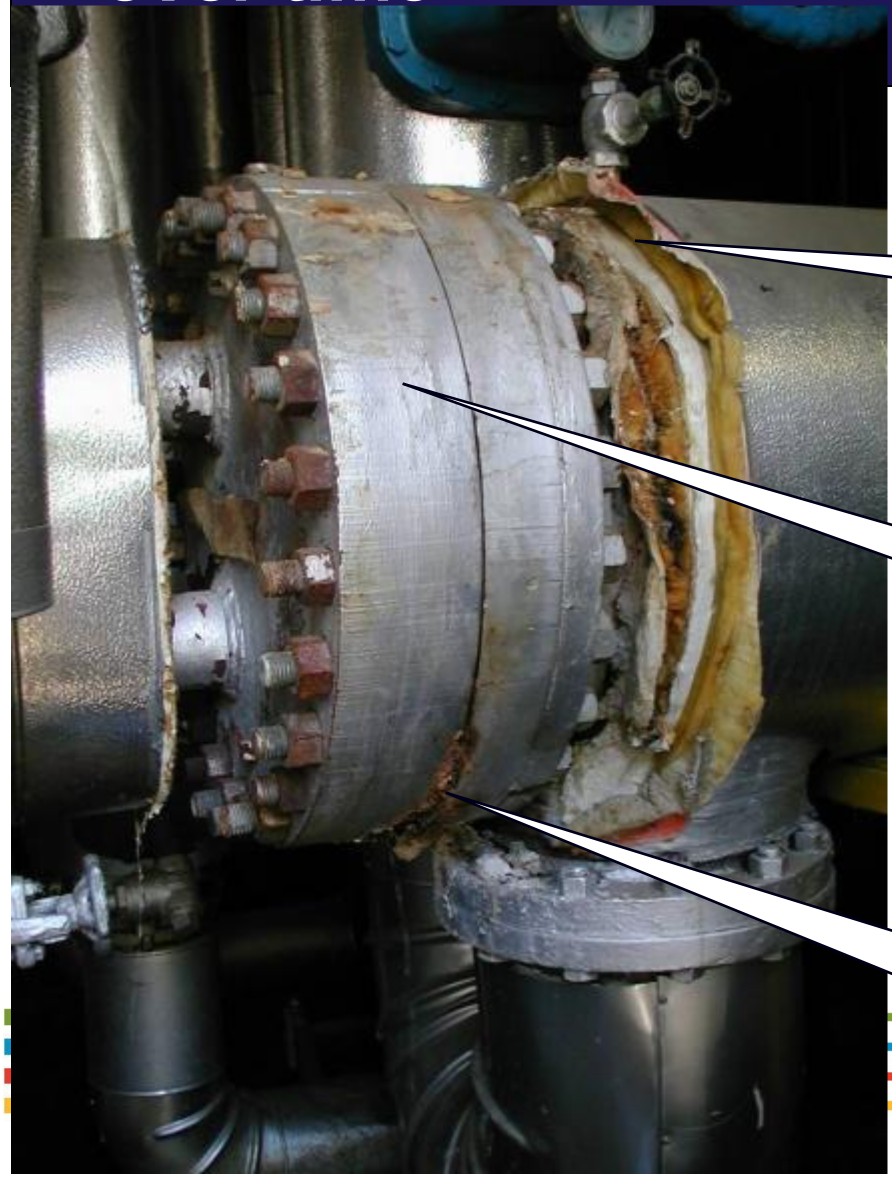

Conventional Insulation is removed and never replaced.

As a result complex surfaces remain untreated.

Leaks, service or inspection create problems for access.

Typical mechanical room assembly

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- **Gate Valve, Strainer, control valve & fittings left un-insulated**

NEW Steam Distribution Substation

What is wrong with this picture?

If it were bare pipe the need to insulate would be obvious.

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- Each 10” 150# Gate Valves = 5.9 LF 10” Pipe
- Each 6” 150# Gate Valves = 5.2 LF 6”Pipe
- Each 2 ½” 150# Gate Valves = 5.7 LF Pipe

Savings for Bare Gate Valves
Fuel Cost $ 14.00 / 1000# Steam / 250F

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Valve Size	Cost Bare (Un-insulated)	Cost Insulated	Annual Savings
10" 150# Gate Valve	$ 893.60 / Year	$ 88.00 / Year	$ 805.60
8" 150# Gate Valve	$ 666.97 / Year	$ 65.76 / Year	$ 601.21
6" 150# Gate Valve	$ 455.22 / Year	$ 44.88 / Year	$ 410.34
4" 150# Gate Valve	$ 303.05 / Year	$ 29.88 / Year	$ 272.17
2 ½" 150# Gate Valve	$ 192.32 / Year	$ 18.96 / Year	$ 172.36

Savings for Bare Gate Valves
Fuel Cost $ 14.00 / 1000# Steam / 350F

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Valve Size	Cost Bare (Un-insulated)	Cost Insulated (Shannon-Insultech)	Annual Savings
10" 150# Gate Valve	$ 1,267.29 / Year	$ 67.49 / Year	$ 1,199.80
8" 150# Gate Valve	$ 945.00 / Year	$ 51.00 / Year	$ 894.00 /
6" 150# Gate Valve	$ 635.58 / Year	$ 34.38 / Year	$611.20
4" 150# Gate Valve	$ 429.78 / Year	$ 22.89 / Year	$ 406.89
2 ½" 150# Gate Valve	$ 272.75 / Year	$ 14.52 / Year	$ 258.23

Calculating the $avings

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Designation: C 1129 – 89 (Reapproved 2001)

Standard Practice for Estimation of Heat Savings by Adding Thermal Insulation to Bare Valves and Flanges[1]

This standard is issued under the fixed designation C 1129; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 The mathematical methods included in this practice provide a calculational procedure for estimating heat loss or heat savings when thermal insulation is added to bare valves and flanges.

1.2 Questions of applicability to real systems should be resolved by qualified personnel familiar with insulation systems design and analysis.

1.3 Estimated accuracy is limited by the following:

1.3.1 The range and quality of the physical property data for the insulation materials and system,

1.3.2 The accuracy of the methodology used in calculation of the bare valve and insulation surface areas, and

1.3.3 The quality of workmanship, fabrication, and installation.

1.4 This procedure is considered applicable both for conventional-type insulation systems and for removable/reuseable covers. In both cases, for purposes of heat transfer calculations, the insulation system is assumed to be homogenous.

1.5 This practice does not intend to establish the criteria required in the design of the equipment over which thermal insulation is used, nor does this practice establish or recommend the applicability of thermal insulation over all surfaces.

1.6 The values stated in inch-pound units are to be regarded as the standard. The SI units in parentheses are provided for information only.

1.7 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

Thermal Insulation Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments[2]

C 680 Practice for Determination of Heat Gain or Loss and the Surface Temperatures of Insulated Pipe and Equipment Systems by the Use of a Computer Program[2]

C 1094 Guide for Removable Insulation Covers[2]

2.2 *American National Standards Institute Standard:*

ANSI B16.5 Fittings, Flanges, and Valves[3]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology C 168.

3.2 *Symbols:*—The following symbols are used in the development of the equations for this practice. Other symbols will be introduced and defined in the detailed description of the development. See Figs. 1 and 2.

A_B = outer surface area of the bare valve or flange (does not include the wheel and stem of the valve), ft^2 (m^2).

A_I = surface area of the insulation cover over the valve or flange, ft^2 (m^2).

C = distance from the center-line axis of the pipe (to which the valve is attached) to the uppermost position of the valve that is to be insulated (recommended to be below the gland seal), ft (m).

D_F = the valve flange and the bonnet flange outer diameter (assumed equal), ft (m).

D_P = the actual diameter of the pipe, ft (m).

L_V = overall length of the valve, flange to flange, ft (m).

T = thickness of the valve flange and of the bonnet flange, ft (m).

q_B = time rate of heat loss per unit area from the bare valve or flange surface, Btu/h·ft^2 (W/m^2).

q_I = time rate of heat loss per unit area from the insulation

Heat loss Calculation Simplified

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- **Q = K (Delta T) / L+(K/Ht) * <u>Area Ea. Sq. Ft</u>. * Quantity**
- Q = Heat loss (BTU/Hr. / Sq. Ft.)
- K = Bare Thermal Conductivity(STL and C.I. = 26.9)
- K = Insulated Thermal Conductivity(T.M.=.525)
- L = Insulation Thickness Delta
- T = Surface Temp - Ambient Temp.
- Ht = Combined Coefficients (300 Deg F. = 3.2) (Radiation, Convection, & Conduction)

SF Calculations follow ASTM C1129
Thermal Conductivity follows ASTM C335

Elements of a Quality Fitting

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- Double Sewn Construction
  Stainless Steel Hardware
  Embossed Metal Tagging
  Weep Hole Grommet for Leak Detection
  Integral Fastening Hardware (Many Options)
  24 Month Warranty
  Guaranteed Fit.
  CAD / CNC Allows accuracy & efficiency
  Custom design for your specific locations
  Support Documents (Assembly Drawings, Cad Files)
- **All insulation should be "removable"**

Difficult to Quantify Savings

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- Low quality fabric, no coating
- “lacing” closure, VERY difficult to re-install
- Gaps on actuator loose heat
- No integration with the adjacent insulation
- No ID tag
- No install manual
- Low quality steel and wire rot out

A Quality Comparison

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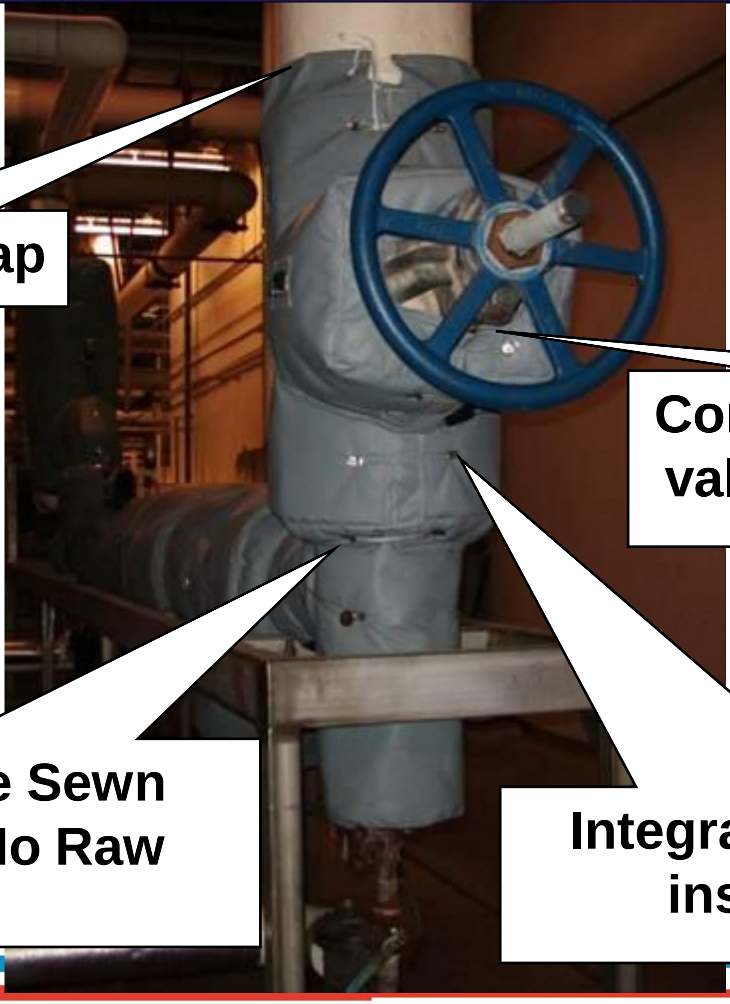

Correct Overlap

Correct match up around the valve bonnet, minimal gaps.

Durable Double Sewn Construction-No Raw Edges.

Integral Fasteners for easy install and removal

Case Study:
Small Hospital Boiler Room

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- 49 Fittings (159 objects) / 14’ of 3” pipe / 64’ 4”pipe

- Total Project Cost $43,834.00
- National Grid Incentive 50% $ 21,917.00

Net Cost of Project: $ 21,917.00

- Anticipated Annual Fuel cost Savings = $15,282.18
- Simple Payback **1.43 years**

A Perfect Storm for Engagement

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- Understanding that Therms produced then lost out boiler room door or into mechanical rooms cost money.
- Continuous improvement/energy program in place
- Ability to fund and execute projects with better than 2 year simple ROI
- Requirement for durable high quality measurable solutions to energy losses.

How many opportunities here?

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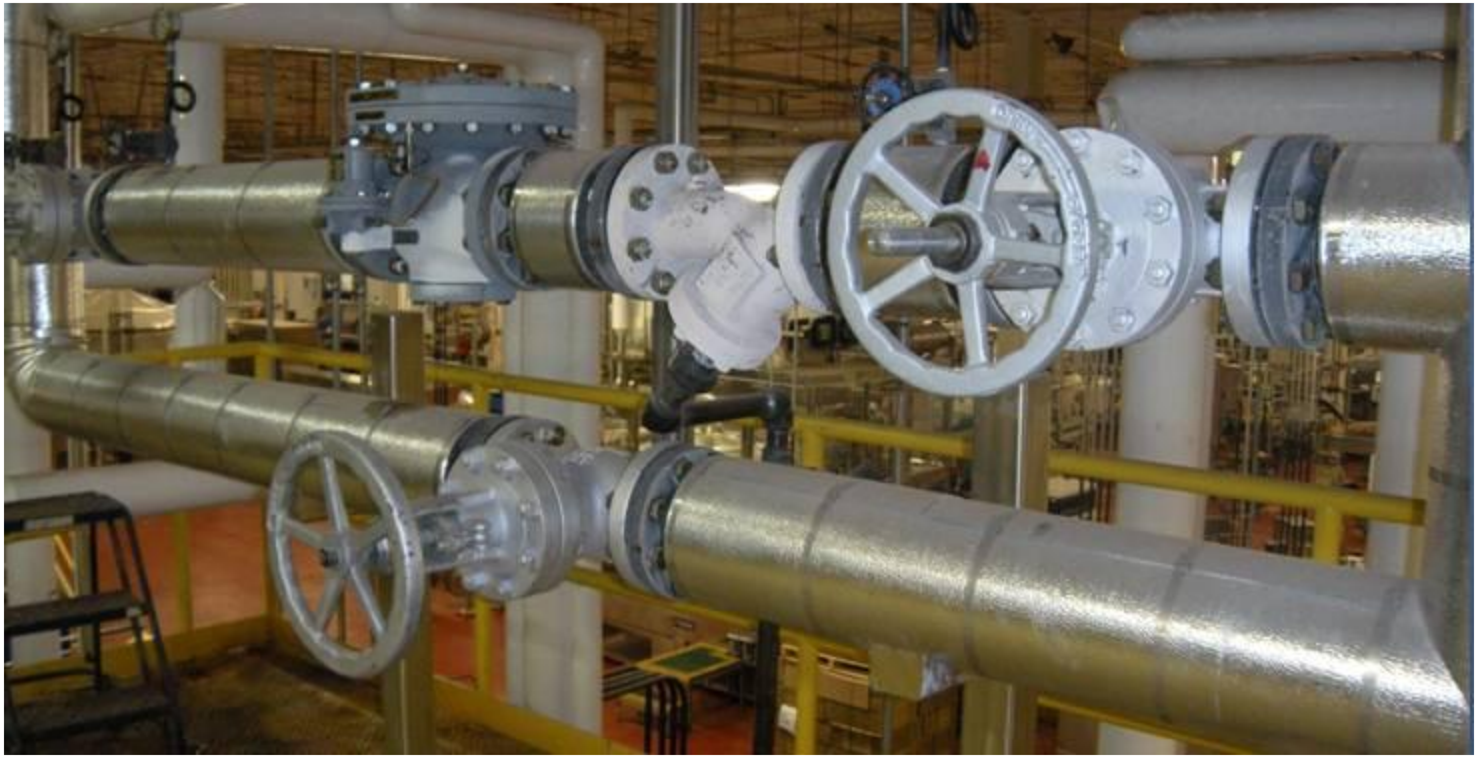

Search for bare surfaces

M&V with Thermographic Imaging

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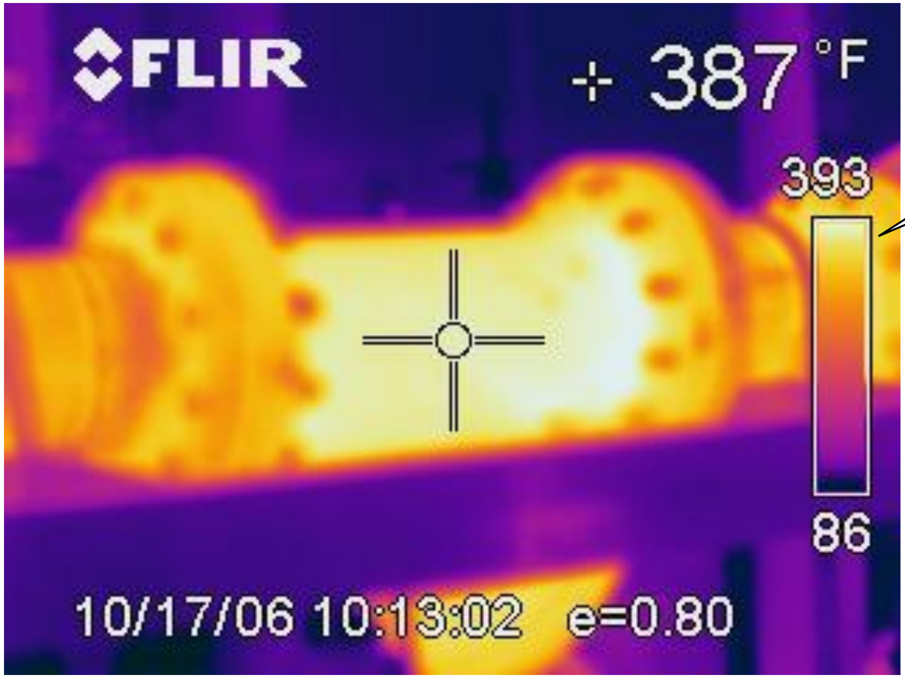

Before

After

Control Valve Case

Before

After w/ Blanket

Tremendous Heat Loss – Great Opportunity for Saving

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Before

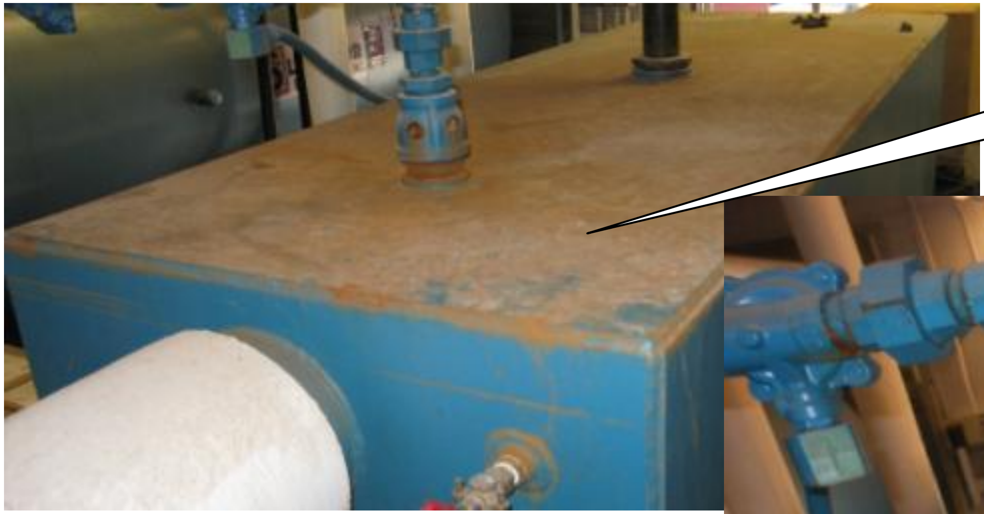
After w/ Blanket

Level Indicator

Before

After w/ Blanket

Condensate Tank



Before

After w/ Blanket

Keeping Heat in a Heat Exchanger

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After w/ Blanket

Boiler Applications

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Boiler Feed - Feed Water Pump

Boiler Head & Doors

Boiler Feed - Threaded Valve Assembly

Steam Pasteurizer and Condensate Returns

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Commercial Baking Oven

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Liquid Chiller – Water Heads and Valves

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Condensate Receiving Tank

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- Mechanical Room temp reduced 20 degrees **F**

Steam Distribution – "Wet Manhole" Application

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- 20" Pipe and Expansion Joint

Extruder Barrel Application

Large Plastic Product Manufacturer

Is this you?

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- You understand that Therms produced then lost into mechanical spaces or vented outdoors cost money.
- You place value on durable high quality measurable solutions to energy losses.
- You have the ability to fund and execute projects with better than 2 year simple ROI

A Solution Process

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1. Detailed Measurement: Each identified location will be individually measured and ID tagged. CAD files are maintained for 15 years should a fitting be lost or destroyed.

2. Incentive Administration: We explore all available utility incentives, where applicable, to reduce the net program cost and ensure maximum return on investment. We take responsibility for the application process, and collection of incentive dollars, leaving the customer responsible only for the net program cost.

3. Fabrication: Your custom, thermal efficiency fittings are constructed in a state of the art Buffalo, NY manufacturing facility, meeting ARRA and other made in the USA requirements.

4. Turn-key Installation: Factory trained and supervised personnel will perform the initial program installation of all components.

5) 5 Year Efficacy Program: After initial installation, program performance is maintained via a <u>4 year series of annual site visits</u>.

National Grid Incentives for Insulation

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- Upstate New York – Custom Gas Measure for Jackets and Prescriptive Forms for pipe, wall and roof insulation.
- Downstate NY - (Metro and Long Island) - Custom
- Massachusetts – Custom
- Rhode Island – Custom

Please note that Insulation is an offering in our Small Business and Multi-Family Programs.

Popular Energy Efficiency Measures

- **Pipe Leaks**
- **Pipe Insulation**
- **Reduce Steam Pressure**
- **Steam Traps**
- **Combustion Controls**
- **Blowdown Heat Recovery**
- **Boiler Stack Economizer**
- **Flash Steam Heat Recovery**
- **Back-Pressure Turbines**
- **Combined Heat & Power**

Questions?

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Poll Question 6

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Thank you!

Thank you for participating today!

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Shannon NRG resources

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