3E Plus Module

9/30/2009

Begin Introduction

<u>Slide 1:</u> Hello, and welcome to this introduction of the Steam System Tool Suite's 3E Plus Insulation Tool.

<u>Slide 2:</u> This tool is one of the Steam System Tool Suite, and is available for download from the DOE Industrial Technology Program's Technology Delivery website.

<u>Slide 3:</u> Technology Delivery is a program area within the Industrial Technologies Program (ITP) that supports ITP's mission to improve the energy intensity of the U.S. industrial sector through a coordinated program of research and development, validation, and dissemination of energy-efficient technologies and practices. One of the ways Technology Delivery keeps you in touch with the latest developments is through training, publications, and software tools.

Using the 3EPlus Insulation Tool, we can estimate the effects of insulating 20 feet of bare piping which was left off during a line repair.

We will show you how insulating this short section can save you 11,000 dollars and pay for itself in less than one month.

Slide 4: In order to see how the 3E Plus software tool can help us, let's take a look at one area of the Scoping Tool in which we may have opportunities for improvement.

STEAM SYSTEM SCOPING TOOL, Version 1.0d 6/12/2002

STEAM DISTRIBUTION, END USE, RECOVERY - OPERATING PRACTICES

OPTIONS FOR REDUCING STEAM PRESSURE - MINIMIZE STEAM FLOW THROUGH PRVs

What To Do Investigate potential to use backpressure turbines in parallel with pressure reducing valves in your steam system.

Why Important In many steam systems, pressure reducing valves (PRVs) are used to provide steam at pressures lower than generated from the boiler. A potential opportunity for improving a steam system is to minimize the flow of steam through PRVs. One opportunity for doing this is to install backpressure turbines in parallel with PRVs in your steam system; in this way you can provide the low-pressure steam required and generate electricity or shaft power that can be utilized. A detailed economic analysis must be performed to evaluate this type of opportunity.

QUESTION NUMBER	QUESTION	ACTIONS	POSSIBLE SCORE	YOUR SCORE
PR1	How do you reduce steam pressure in your steam system?	steam generated at required pressure, or PRVs appropriately applied	10	
		backpressure turbines used in parallel with PRVs	10	
		boiler control used to reduce pressure	5	
		excess steam vented and/or used inefficiently	0	

Go back to the Summary Results by clicking on the Section 7 tab.

SUMMARY RESULTS

1. STEAM SYSTEM PROFILING	POSSIBLE SCORE	YOUR SCORE
STEAM COSTS		
SC1: Measure Fuel Cost To Generate Steam	10	10
SC2: Trend Fuel Cost To Generate Steam	10	5
STEAM/PRODUCT BENCHMARKS		
BM1: Measure Steam/Product Benchmarks	10	10
BM2: Trend Steam/Product Benchmarks	10	5
STEAM SYSTEM MEASUREMENTS		
MS1: Measure/Record Steam System Critical Energy Parameters	30	20
MS2: Intensity Of Measuring Steam Flows	20	10
STEAM SYSTEM PROFILING SCORE	90	60

2. STEAM SYSTEM OPERATING PRACTICES	POSSIBLE SCORE	YOUR SCORE
STEAM TRAP MAINTENANCE		
ST1: Steam Trap Maintenance Practices	40	30
WATER TREATMENT PROGRAM		
WT1: Water Treatment - Ensuring Function	10	10
WT2: Cleaning Boiler Fireside/Waterside Deposits	10	10
WT3: Measuring Boiler TDS, Top/Bottom Blowdown Rates	10	10
SYSTEM INSULATION		
IN1: Insulation - Boiler Plant	10	7
IN2: Insulation - Distribution/End Use/Recovery	20	5
STEAM LEAKS		
LK1: Steam Leaks - Severity	10	3
WATER HAMMER		
WH1: Water Hammer - How Often	10	10
MAINTAINING EFFECTIVE STEAM SYSTEM OPERATIONS		
MN1: Inspecting Important Steam Plant Equipment	20	15
STEAM SYSTEM OPERATING PRACTICES SCORE	140	100

Slide 5: Look at Section 2, 'Steam System Operating Practices,' rows 28-30, under Steam Insulation. It looks like there is some room for improvement in insulation. You scored a 7 out of 10 for question IN1, and a 5 out of 20 for question IN2. So, how do we improve?

SYSTEM INSULATION	POSSIBLE SCORE	YOUR SCORE
IN1: Insulation - Boiler Plant	10	7
IN2: Insulation - Distribution/End Use/Recovery	20	5

Well, let's go back to that question by navigating to the tab for Section 4 – Total Steam System.

Slide 6: ***[slide in motion]***

STEAM SYSTEM SCOPING TOOL, Version 1.0d **6/12/2002**

STEAM SYSTEM OPERATING PRACTICES

STEAM TRAP MAINTENANCE

What To Do Implement a comprehensive program to correctly select, test, and maintain your steam traps.

Why Important Steam traps play three important functions: a) prevent steam from escaping from the system before the heat is utilized; b) remove condensate from the system; and c) vent noncondensable gases. Poor steam trap selection, testing, and maintenance can result in many system problems including water hammer, ineffective process heat transfer, steam leakage, and system corrosion. An effective steam trap selection and maintenance program is often an excellent investment with paybacks of less than half a year.

QUESTION NUMBER	QUESTION	ACTIONS	POSSIBLE SCORE	YOUR SCORE
ST1	Does Your System Steam Trap Maintenance Program Include The Following Activities?			
	Proper Trap Selection For Application	yes	10	
	At Least Annual Testing Of All Traps	yes	10	
	Maintaining A Steam Trap Database	yes	10	
	Repairing/Replacing Defective Traps	yes	10	
		none of the above	0	

Slide 6: We go down to System Insulation, beginning at row 40.

SYSTEM INSULATION

What To Do Ensure that the appropriate major components of your steam system are well insulated. Determine the economic insulation thickness for your system components, and perform system insulation reviews to identify exposed surfaces that should be insulated and/or unrestored or damaged insulation.

Why Important Effective insulation - on piping, valves, fittings, and vessels - serves many important purposes. Insulation keeps steam energy within the system to be effectively used by processes, it can reduce temperature fluctuations in the system, it can reduce space conditioning requirements, and it can reduce the potential for personnel burns.

QUESTION NUMBER	QUESTION	ACTIONS	POSSIBLE SCORE	YOUR SCORE
IN1	Is your Boiler Plant equipment and piping system insulation (refractory, piping, valves, flanges, vessels, etc.) maintained and in good condition?	insulation excellent	10	
		insulation good, but can be improved	7	
		insulation inadequate	0	
IN2	Is your Steam Distribution, End Use, and Condensate Recovery equipment insulation (piping, valves, flanges, heat exchangers, etc.) maintained and in good condition?	insulation excellent	20	
		insulation good, but can be improved	14	
		insulation inadequate	0	

Slide 8: Here you provided a response to the insulation questions. For IN1, on Row 45, you indicated that your boiler plant equipment and utilities piping system has appropriate insulation, but also a few areas in which insulation is missing. For IN2, on Row 49, you indicated that your distribution piping insulation is very old and damaged, and many valves are not insulated.

So, for insight on how to improve, look up at row 41, the 'What to do" section. This section asks you to perform system insulation reviews to identify exposed surfaces that should be insulated and/or unrestored or damaged insulation. Luckily, we have a tool that does exactly that!

> **SYSTEM INSULATION**
>
> **What To Do** Ensure that the appropriate major components of your steam system are well insulated. Determine the economic insulation thickness for your system components, and perform system insulation reviews to identify exposed surfaces that should be insulated and/or unrestored or damaged insulation.

Begin 3EPlus Insulation Tool software

Slide 9: So now, we will show you the 3E Plus, Insulation Thickness Computer Program. It is also called simply 3EPlus, or the Insulation Tool. This program is designed to calculate the energy impacts associated with thermal insulation projects. It will calculate the energy and cost savings from various thicknesses and types of insulation, as well as the conceptual installation costs. It will also estimate greenhouse gas emissions and reductions.

3EPlus- Main Screen - Visual Description

Sections of the Program [buttons at top of page, descriptions on main screen]

Energy

- Insulation Thickness
- Energy Loss/Gain
- Cost of Energy

Environment

- CO2 Reduction with Insulation Thickness

Economics

- Calculations for New Insulation Projects
- Calculations from Previous Projects

Options

Determining your insulation needs has never been easier.

3EPlus Insulation Thickness Computer Program

- Calculates Thermal Performance of Piping and Equipment
- Translates BTU Losses into Actual Dollars
- Calculates Greenhouse Gas Emissions and Reductions.

This is the main screen. Go up to the top and you will see 4 tabs for each one of the different sections of the tool. We'll start by clicking on 'ENERGY.'

Energy Tab

Energy Tab Inputs - Visual Description

Insulation Thickness (Data Entry Screen)

Item Description:*[blank]*
System Application: Pipe Horizontal
System Units: ASTM C585
Calculation Type: Personnel Protection
Process Temp: 350.0 ^{o}F
Ambient Temperature: 75.0 ^{o}F
NPS Pipe Size: 4
Wind Speed: 0.0 mph
Max Surface Temp: 140.0 ^{o}F

Insulation Layers
Add Button
Delete Button

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	850F Mineral Fiber PIPE, Type I, C547-07	Vary	
-	Jacket Material	0.9 All Service Jacket		

Slide 10: You can also determine what the calculation type you are interested in. Use the pull down menus for the options, which also change the input parameters slightly.

Slide 11: For our overview, select 'heat loss per year' in the pull down menu.

Calculation Type: Heat Loss per Year

Slide 12: Here, you can enter different parameters regarding your insulation thickness, including the type of system application

Item Description: *[blank]*
System Application: Pipe Horizontal
System Units: ASTM C585
Calculation Type: Heat Loss per Year
Process Temp: 350.0 ^{o}F
Ambient Temperature: 75.0 ^{o}F
NPS Pipe Size: 4
Wind Speed: 0.0 mph
Annual Operation: 8000 hrs/yr

Slide 13: (pipes or ductwork, horizontal or vertical) you're working with. ***[use the pull down menu]***

System Application: Pipe Horizontal

Slide 14: Process temperature is the temperature of the fluid in the insulated component; this is often obtained by process measurement indications or surface temperature measurement.

Other parameters to enter include ambient temperature, wind speed, annual hours of operation, and, the nominal diameter of the pipe.

Pipe diameter is described in NPS pipe size, which stands for Nominal Pipe Size. Look under 'System Units.' *ASTM C585* is a document that identifies the standard insulation dimensions for typical piping in accordance with U.S. dimensions.

In addition to the critical inputs for process and ambient temperatures, wind speed also affects the results significantly. Piping located indoors typically experiences 0 to 2 mile per hour wind speed, while piping located outdoors can be subject to much higher values. However, for most applications 20 miles per hour would be considered a very high wind speed. Select the average wind speed for your region, or select a conservative value closer to indoor conditions.

Slide 15: You can also add information about your insulation layers. Select what type of material each layer is made of, including the base metal (the piping), the insulation itself, and the jacket material. The base and jacket materials are essential inputs in the 'Insulation Layers' section, but you can change the materials by using the pull down menus.

Slide 19: You must have at least one insulation layer as an input. The default entry insulation material can be changed by using the pull down menus for other selections.

You can use the 'Add/Delete' buttons to create the insulation configuration (such as multiple layers) to evaluate.

Insulation Layers
Add Button
Delete Button

There are 36 insulations to choose from.

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
		Pull-Down Menu Options ▪ Steel ▪ Stainless Steel ▪ Copper ▪ PVC		
1	Insulation	850F Mineral Fiber PIPE, Type I, C547-07	Vary	
		Pull-Down Menu Options ▪ MF Insulating Cement, C195-07 ▪ Insul + Finish Cement, C449-07 ▪ Calcium Silicate BLK+PIPE, Type I, C533-07 ▪ Elastomeric SHT+TUBE, Gr 1, C534-07 ▪ 850F Mineral Fiber PIPE, Type I, C547-07 ▪ 1200F Mineral Fiber PIPE, Types II and III, C547-07 ▪ 1000F Mineral Fiber PIPE, Type IV, C547-07 ▪ Cellular Glass, Type I, BLOCK, C552-07 ▪ Cellular Glass, Type II, PIPE and Tube, C552-07 ▪ 450F MF BLANKET, Type II, C553-02 ▪ 850F MF BLANKET, Type IV, C553-02 ▪ 1000F MF BLANKET, Type V, C553-02 ▪ 1200F MF BLANKET, Type VII, C553-02 ▪ Polystyrene PIPE, Type XIII, C578-07 ▪ Polystyrene BOARD, Type IV, C578-07 ▪ PIR, Gr 1, Types I,and II, C591-07 ▪ PIR, Gr 2, Type IV, C591-07 ▪ MF Metal Mesh BLANKET, Type II, C592-04	**Toggle:** Vary or Fix	If Fix:1.5 or Enter your specific value

#	Type	Name	Lock Thickness	Thickness, Inches
		▪ Perlite BLOCK+PIPE, C610-07 ▪ 450F MF BOARD, Type IB, C612-04 ▪ 850F MF BOARD, Type II, C612-04 ▪ 1000F MF BOARD, Type III, C612-04 ▪ 1200F MF BOARD, Type IVB, C612-04 ▪ 1800F MF BOARD, Type V, C612-04 ▪ High Temp Fiber Blanket, Gr 6, C892-05 ▪ Glass Fiber Felt, C1086-96(2004) ▪ Phenolic Sheet+TUBE, Gr 1, Type II and III, C1126 ▪ 650F Min. Fiber Pipe and Tank, Type II, C1393-00a ▪ 850F Min. Fiber Pipe and Tank, Type IIB, C1393-00a ▪ 1000F Min. Fiber Pipe and Tank, Type IVB, C1393-00a ▪ Melamine PIPE+FLAT, C1410-05a ▪ Polyolefin SHT+TUBE, C1427-04 ▪ Polyimide, Type I, C1482-04 ▪ Duct Wrap, 0.75 pcf, C1290 ▪ Duct Wrap, 1.0 pcf, C1290 ▪ Duct Wrap, 1.5 pcf, C1290		
-	Jacket Material	0.9 All Service Jacket		
		Pull-Down Menu Options ▪ 0.04 Aluminum, new, bright ▪ Aluminum, oxidized, in service ▪ 0.13 Stainless Steel, new, cleaned ▪ Stainless Steel, dull, in service ▪ 0.8 Iron or Steel ▪ 0.6 Copper ▪ 0.8 Painted Metal ▪ Galvanized steel, new, bright ▪ 0.28 Galvanized steel, dipped or dull ▪ 0.9 All Service Jacket ▪ 0.5 Aluminum Paint ▪ 0.9 Canvas ▪ 0.9 Roofing felt and black mastics ▪ 0.9 Colored mastics ▪ 0.9 PVC Jacketing		

You can use the 'Add/Delete' buttons to create the insulation configuration (such as multiple layers) to evaluate.

Insulation Layers
Add Button ***[click the Add Button]***
Delete Button

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	850F Mineral Fiber PIPE, Type I, C547-07	Fix	1.5
2	Insulation	MF Insulating Cement, C195-07	Fix	1.5
3	Insulation	MF Insulating Cement, C195-07	Vary	
-	Jacket Material	0.9 All Service Jacket		

Insulation Layers
Add Button
Delete Button ***[click the Delete Button]***

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	850F Mineral Fiber PIPE, Type I, C547-07	Fix	1.5
-	Jacket Material	0.9 All Service Jacket		

You cannot remove the jacket material.

<u>Slide 27:</u> Let's look at an example for a run of bare piping. As you see in this picture, there is approximately 20 feet of bare 10 inch diameter piping, possibly removed for repairs and never replaced.

<u>Piping Photograph Visual Description</u>

A photograph of an industrial pipe bridge is shown. The piping is somewhat congested but fairly typical of an industrial plant. One of the pipes, prominently displayed in the picture, is a steam header that has a section with no insulation. The un-insulated section has horizontal and vertical runs. This run has four 90-degree elbows which allow the pipe to avoid an obstruction. The piping distribution runs from left to right, engages an elbow to allow the piping to be raised, then an elbow to allow the piping to run toward the viewer and over a structural member, engage another elbow to turn down to the original elevation, then another elbow to continue to advance to the right. The pipe at the left of the picture is observed to be insulated with a metal jacket covering the assembly. However, in a very short distance the insulation and covering are removed leaving the pipe un-insulated through the turns and straight sections. Insulation and jacketing are in-place on the pipe as it leaves the picture to the right.

Let's enter the data for this system. There are vertical and horizontal sections, but for simplicity let's use horizontal as the input.

System Application: Pipe Horizontal

The steam temperature is 550 degrees Fahrenheit, enter this for the process temperature.

Process Temperature: 550.0 F

Ambient Temperature: 70.0 ^{o}F

<u>Slide 31:</u> The nominal pipe size is 10 inches. ***[Use the pull-down menu to select "10"]***

NPS Pipe Size: 10

<u>33:</u> Although this looks to be an outdoor application, there appears to be many opportunities to block wind, so let's enter a conservative 3 miles per hour for wind speed.

Wind Speed: 3 mph

Slide 35: Let's use the default steel piping, and change the insulation to calcium silicate ***[Use the pull-down menu to select]*** as we plan to replace it to match the existing insulation and an aluminum jacket, oxidized as the existing is in service ***[Use the pull-down menu to select]***.

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	Calcium Silicate BLK+PIPE, Type I, C533-07	Fix	1.5
-	Jacket Material	0.1 Aluminum, oxidized in service		

Slide 43: Make sure the Lock Thickness toggle is set to 'vary'.

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	Calcium Silicate BLK+PIPE, Type I, C533-07	Vary	
-	Jacket Material	0.1 Aluminum, oxidized in service		

Slide 45: Select the annual operation hours. Our system operates year round, so we'll select 8,760 hours per year.

Annual Operation: 8760 hours per year

There are 8,760 hours in a 365-day year.

Slide 47: Click on 'Calculate' to see your results.

Energy Tab – Calculate Option

Energy Tab Results - Visual Description

Heat Loss Per Year Report

Item Description: *[blank]*
System Units: ASTM C585
Geometry Description: Steel Pipe - Horizontal
Bare Surface Emittance: 0.8
Nominal Pipe Size: 10 in.
Process Temperature: 550 °F
Ave. Ambient Temperature: 70 °F
Ave. Wind Speed: 3 mph
Relative Humidity: N/A
Dew Point: N/A
Condensation Control Thickness: N/A
Hours Per Year: 8760
Outer Jacket Material: Aluminum, oxidized, in service
Outer Surface Emittance: 0.1
Insulation Layer 1: Calcium Silicate BLK+PIPE, Type I
Thickness: Varied

Variable Insulation Thickness	Surface Temp (°F)	Heat Loss (BTU/ft/yr)	Efficiency (percent)
Bare	547.8	50950000	-
0.5	207.0	10400000	79.59
1.0	149.2	5920000	88.39
1.5	121.4	3970000	92.21
2.0	109.8	3200000	93.73
2.5	102.4	2700000	94.69
3.0	97.2	2360000	95.36
3.5	93.3	2110000	95.86
4.0	90.4	1920000	96.24
4.5	88.1	1760000	96.54
5.0	86.2	1640000	96.78
5.5	84.7	1530000	96.99
6.0	83.4	1450000	97.16
6.5	82.3	1370000	97.31
7.0	81.3	1310000	97.43
7.5	80.5	1250000	97.55
8.0	79.8	1200000	97.64
8.5	79.2	1160000	97.73
9.0	78.6	1120000	97.81
9.5	78.1	1080000	97.88
10.0	77.7	1050000	97.95

Slide 48: At the top, it reviews all of the information that you input. At the bottom, you see the results for each insulation thickness, based on the 'vary' Lock Thickness, from bare pipe to 10 inches of insulation. As we would likely replace the insulation with a similar 3 inch thick insulation, go to the 3 inch row and you can see the results for a like-for-like replacement, as well as other insulation thicknesses that you could choose.

Variable Insulation Thickness	Surface Temp (°F)	Heat Loss (BTU/ft/yr)	Efficiency (percent)
Bare	547.8	50950000	-
3.0	97.2	2360000	95.36

The results include 'Surface temperature,' ***[the outer surface of the insulation jacket (the surface that is exposed to the ambient)],*** 'Heat loss' in BTU's per year per linear foot, and efficiency ***[the portion of bare pipe heat loss that has been eliminated as a result of the proposed insulation installation]***,

You can see for bare pipe, {{the heat loss is 50,905,000 BTU per linear foot per year. For 3 inches of insulation, the heat loss is 2,300,000 BTU per linear foot per year. The difference between these values is the energy savings associated with installing the insulation. For the 20 foot length the savings is 973,000,000 BTU per year, or 111,000 BTU per hour.

Energy Savings – ((Energy Loss)$_{Bare}$ – (Energy Loss)$_{insul}$)) (Uninsulated Length)

Energy Savings = (50,950,000Btu per foot - year – 2,300,000 Btu per foot - year) (20 feet)

Energy Savings = (48,650,000 Btu per foot - year) (20 feet)

Energy Savings = (973,000,000 Btu per year) (1 year per 8,760 hours) = 111,000 Btu per

Click 'Back' to go back to the first screen, or select the menu tab ENERGY at the top of the screen.

Energy Tab Inputs

Slide 49: You can also specify the thickness of each insulation layer by selecting the toggle 'fixed' under Lock Thickness and entering the appropriate inches of the respective insulation material. For this example, put your cursor over the 'vary' Lock Thickness, and it will automatically turn to 'fixed' and '1.5' will appear under Thickness, Inches for this layer indicating 1.5 inches of calcium silicate.

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
			Pull-Down Menu:	
			Fix	1.5
1	Insulation	Calcium Silicate BLK+PIPE, Type I, C533-07	Vary	
-	Jacket Material	0.1 Aluminum, oxidized in service		

Slide 50: You can change the default insulation thickness by manually changing the 1.5 to the desired thickness. For our example, let's change it to 3 inches.

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	Calcium Silicate BLK+PIPE, Type I, C533-07	Fix	3
-	Jacket Material	0.1 Aluminum, oxidized in service		

Slide 53: Click on 'Calculate' ***[top of screen]*** to view the results.

Energy Tab – Calculate Option

Energy Tab Results - Visual Description

Heat Loss Per Year Report

Item Description: *[blank]*
Geometry Description: Steel Pipe - Horizontal
System Units: ASTM C585
Bare Surface Emittance: 0.8
Nominal Pipe Size: 10 in.
Process Temperature: 550 °F
Ave. Ambient Temperature: 70 °F
Ave. Wind Speed: 3 mph
Relative Humidity: N/A
Dew Point: N/A
Condensation Control Thickness: N/A
Hours Per Year: 8760
Outer Jacket Material: Aluminum, oxidized, in service
Outer Surface Emittance: 0.1
Insulation Layer 1: Calcium Silicate BLK+PIPE, Type I
Thickness: 3.085 in.

Variable Insulation Thickness	Surface Temp (°F)	Heat Loss (BTU/ft/yr)	Efficiency (percent)
Bare	547.8	50950000	
Layer 1	97.2	2360000	95.36

Slide 54: You will only see the results for this particular configuration, compared to the base case of bare pipe.

Slide 55: Click 'Back' to go back to the first screen, or select the menu tab energy at the top of the screen.

Energy Tab Inputs

Slide 56: Return the Lock Thickness to 'vary' to return to the default parameters.

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	Calcium Silicate BLK+PIPE, Type I, C533-07	Vary	
-	Jacket Material	0.1 Aluminum, oxidized in service		

Slide 57: On the left-hand side of the screen, click on 'Cost of Energy' in order to estimate cost and savings of different insulation thicknesses.

Energy Tab – Cost of Energy Option

Cost of Energy Option Inputs - Visual Description

Insulation Thickness (Data Entry Screen)

Item Description: *[blank]*
System Application: Pipe Horizontal
System Units: ASTM C585
Fuel Type: Natural Gas
Heat Content – 1026 BTU/cubic foot
Fuel Cost – 10.00 $/Mcf
Efficiency: 75 %
Process Temperature – 550.0 ^{o}F
Ambient Temperature – 70.0 ^{o}F
NPS Pipe Size – 10
Wind Speed – 3 mph
Annual Operation – 8760 hours per year

Insulation Layers
Add Button
Delete Button

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	Calcium Silicate BLK+PIPE, Type I, C533-07	Vary	
-	Jacket Material	0.1 Aluminum, oxidized in service		

Efficiency – a comparison of fuel energy input into the system required to produce the thermal energy loss at the point of investigation.

Slide 58: The information that you input is basically the same, actually carried over if you entered ENERGY data, except now you have the ability to select the type of fuel, cost of the fuel, and efficiency of the heating system. You can also enter the heat content, but for now we are just accepting the default.

Slide 59: As an example of this efficiency, assume 100,000 BTU's per hour of thermal energy is lost from a section of uninsulated pipe. More than 100,000 BTU's per hour of fuel energy had to be placed in the boiler to support the insulation loss. A large portion of the inefficiency resides in the inefficiency of the boiler. If boiler efficiency is 80 percent then at least 125, 000 BTU's per hour of fuel energy had to be provided to the boiler to accommodate the 100,000 BTU's per hour thermal loss.

Boiler Fuel Input Energy = Insulation Thermal Energy Loss / Boiler Efficiency

Boiler Fuel Input Energy = 100,000 Btu per hour / 0.80

Boiler Fuel Input Energy = 125,000 Btu per hour

Additional losses exist; such as, condensate losses that will make the total system energy loss increase further. Therefore, the efficiency value in 3EPlus is an expression of the comparison of thermal energy loss to fuel input energy. The efficiency will be less than boiler efficiency but boiler efficiency is a good approximation. It should be noted that the only calculations that rely on system efficiency are those related to fuel consumption. The primary calculation is the economic impact (fuel consumption) of adding insulation (*cost* and *savings*).

The units for the fuel's heat content and cost will change to reflect the typical units of measure for the fuel selected. Default values for the heat content, fuel cost, efficiency, and annual hours of operation **[keep in mind there are 8.760 hours in a 365-day year]** will be shown, but you can enter your specific values manually to reflect your site conditions.

Fuel Name	Cost Units	BTU
Natural Gas	$/Mcf	1026
Oil	$/gal	138700
LPG	$/gal	86310
Coal	$/ton	12500
Electricity	$/kWh	3415.3

For our example, enter natural gas for the fuel. The default values for natural gas heat content and cost of the fuel are shown. We will accept these values, but you can enter specific values for your application. For this example enter 80 percent for the boiler efficiency.

Efficiency: 80 %

Slide 61: "Click 'Calculate.'

Energy Tab – Cost of Energy – Calculate Option

Energy Tab Results - Visual Description

Cost of Energy Report

Item Description: *[Blank]*
Geometry Description: Steel Pipe - Horizontal
System Units: ASTM C585
Bare Surface Emittance: 0.8
Nominal Pipe Size: 10 in.
Process Temperature: 550 °F
Ave. Ambient Temperature: 70 °F
Ave. Wind Speed: 3 mph
Fuel Name: Natural Gas
Heat Content: 1026 BTU/cuft
Fuel Cost: 10.00 $/Mcf
Efficiency: 80 %
Hours Per Year: 8760
Outer Jacket Material: Aluminum, oxidized, in service
Outer Surface Emittance: 0.1
Insulation Layer 1: Calcium Silicate BLK+PIPE, Type I
Thickness: Varied

Variable Insulation Thickness	Cost ($/ft/yr)	Heat Loss (BTU/ft/yr)	Savings ($/ft/yr)
Bare	620.7	50950000	
0.5	126.7	10400000	494
1	72.07	5920000	548.6
1.5	48.38	3970000	572.3
2	38.95	3200000	581.7
2.5	32.94	2700000	587.8
3	28.78	2360000	591.9
3.5	25.71	2110000	595
4	23.35	1920000	597.4
4.5	21.48	1760000	599.2
5	19.96	1640000	600.7
5.5	18.7	1530000	602
6	17.63	1450000	603.1
6.5	16.72	1370000	604
7	15.93	1310000	604.8
7.5	15.24	1250000	605.5
8	14.62	1200000	606.1
8.5	14.08	1160000	606.6
9	13.59	1120000	607.1
9.5	13.15	1080000	607.5
10	12.75	1050000	608

Slide 62: Again, the top shows the information you input. The bottom table can be a bit confusing, but shows the results for different insulation thicknesses, including the cost of heat loss in dollars per foot per year **[The fuel-related operating costs associated with a 1-foot long section of pipe with the indicated insulation thickness]**. Also, heat loss in BTU per foot per year, **[even insulated pipe experiences some heat loss]** and savings in dollars per foot per year as compared to bare pipe are shown. It should also be noted that the *cost* and *savings* calculations associated with 3EPlus are based on the assumption that all thermal energy carries the same worth.

And as before, if you had left the Lock Thickness as 'fixed',
you would have only seen the results for one configuration,
3-inches of calcium silicate, compared to the bare insulation.

Slide 63: Using the table, you will see the energy cost due to heat loss for bare pipe is 620.70 dollars per linear foot per year-12,400 dollars per year for the 20 foot section.

Heat Loss Cost of Bare Pipe = Cost $_{bare}$ (Uninsulated Length)

Heat Loss Cost of Bare Pipe = $620.07 per linear foot – year) (20 feet) = $12,414 per year

For our example, by adding the 3 inches of calcium silicate and the aluminum jacket the cost of the heat loss is calculated at 27.97 dollars per linear foot per year. So for the 20 foot length of piping, the estimated cost of heat loss of this configuration is 560 dollars a year.

Heat Loss Cost of Insulated Pipe = Cost $_{Insul}$ (Uninsulated Length)

Heat Loss Cost of Insulated Pipe = $27.97 per linear foot – year) (20 feet) = $559 per year

The Savings column indicates 592.70 dollars per year per linear foot, which is the difference of bare pipe at 620.70 dollars and 3 inches of insulation at 27.92 dollars, for the resulting savings of 592.73 dollars per foot per year. Therefore, to insulate 20 feet of bare piping, the total savings from this project are estimated at 11,854 dollars per year (about 11,000 dollars per year).

Savings = (Cost $_{bare}$ - Cost $_{Insul}$) (Uninsulated Length)

Savings = ($620.07 per linear foot – year - $27.97 per linear foot – year) (20 feet)

Savings = ($592.73 per linear foot – year) (20 feet) = $12,414 per year

Savings = $11,852 per year

<u>Slide 64:</u> 'Environment' is a model of the fuel based environmental emissions associated with reducing the thermal loss of a facility. Most of the information is carried over from the ENERGY/Cost of Energy configuration. You can change any information as you wish.

Environment is a model of the fuel-based environmental emissions associated with reducing the thermal loss of a facility.

Environment Tab

Environment Tab Inputs - Visual Description

Insulation Thickness (Data Entry Screen)

Item Description: *[blank]*
System Application: Pipe Horizontal
System Units: ASTM C585
Fuel Type: Natural Gas
Heat Content – 1026 Btu/cubic foot
Efficiency: 80 %
Process Temperature – 550.0 F
Ambient Temperature – 70.0 F
NPS Pipe Size – 10
Wind Speed – 3 mph
Annual Operation – 8760 hours per year

Insulation Layers
Add Button
Delete Button

#	Type	Name	Lock Thickness	Thickness, Inches
-	Base Metal	Steel		
1	Insulation	Calcium Silicate BLK+PIPE, Type I, C533-07	Vary	
-	Jacket Material	0.1 Aluminum, oxidized in service		

Click on 'Calculate' for your results.

Environment Tab – Calculate Option

Environment Tab Results - Visual Description

Pollutant Reduction Report

Item Description: *[blank]*
Geometry Description: Steel Pipe - Horizontal
System Units: ASTM C585
Bare Surface Emittance: 0.8
Nominal Pipe Size: 10 in.
Process Temperature: 550 °F
Ave. Ambient Temperature: 70 °F
Ave. Wind Speed: 3 mph
Fuel Name: Natural Gas
Heat Content: 1026Btu/cuft
Fuel Cost: 10.00 $/Mcf
Efficiency: 80%
Hours Per Year: 8760
Outer Jacket Material: Aluminum, oxidized, in service
Outer Surface Emittance: 0.1
Insulation Layer 1: Calcium Silicate BLK+PIPE, Type I
Thickness: Varied

Variable Insulation Thickness	CO2 (lb/ft/yr)	NOx (lb/ft/yr)	CE (lb/ft/yr)
Bare	7421	14.89	2022
0.5	1515	3.038	412.7
1	861.7	1.728	234.8
1.5	578.4	1.16	157.6
2	465.7	0.934	126.9
2.5	393.9	0.79	107.3
3	344	0.69	93.74
3.5	307.3	0.616	83.75
4	279.2	0.56	76.07
4.5	256.8	0.515	69.98
5	238.7	0.479	65.03
5.5	223.6	0.448	60.92
6	210.8	0.423	57.44
6.5	199.9	0.401	54.47
7	190.4	0.382	51.89
7.5	182.2	0.365	49.63
8	174.8	0.351	47.64
8.5	168.3	0.338	45.86
9	162.5	0.326	44.27
9.5	157.2	0.315	42.83
10	152.4	0.306	41.52

Slide 65: Here, we see the emissions for each gas: carbon dioxide (CO_2), nitrogen oxides (NOx), and carbon equivalent (CE), in pounds per foot per year. These amounts decrease as the insulation thickness increases.

Click on 'Economics' for a worksheet that calculates cost and thickness of different sizes of insulation.

Begin Economics Tab

Environment Tab Inputs – Job Information - Visual Description

Job Information (Data Input Screen)

Job Name: New Job
Project Name:
Project Number: 1
System:
Date: 03/10/2009
Location:
Engineer:
Contact:
Phone Number:
Will this analysis be for a hot surface, or a cold surface?
Radio buttons
[Selected] Hot
Cold
Is this a new application or a retrofit?
Radio buttons
[Selected] New
Retrofit
System Units: ASTM C585

Back Button
Next Button
Calculate Button

Slide 66: The first page asks for general information about this insulation job. You must enter a project number and date (which is provided) as a minimum to move forward. Enter '1' for project number; the current date is provided. Click the "next box" to forward to the next page

Slide 67: The next page asks for fuel information, including fuel type, cost, and heating system efficiency. Enter 80 percent for your system efficiency.

Environment Tab Inputs –Fuel Information - Visual Description

Fuel Information (Data Input Screen)

Fuel Type: Natural Gas
First Year Cost (Dollars/Mcf): 10.00; Question Box
Heating Value (BTU/cubic foot): 1,026
Efficiency (%): 75
Annual Fuel Inflation Rate (%): 3; Question Box

Back Button
Next Button
Calculate Button

[Enter '80' for efficiency]

Efficiency (%): 80

Slide 69: Defaults for these values are provided for the particular fuel type selected, as well as the heating value, all can be manually entered. The question mark beside the First Year Cost provides guidance to help you to calculate your fuel cost per the default unit. The Annual Fuel Inflation Rate default can be adjusted based on your particular economic analysis to perform. ……. Click the "next box" to forward to the next page.

Slide 70: 'Economic information' is where you will input discount rate, income tax rate, depreciation period in years, etc…again, according to the economic analysis you wish to review or accept the defaults.

Environment Tab Inputs – Economic Information - Visual Description

Economic Information (Data Input Screen)

Discount Rate (%): 8; Question Box
Effective Income Tax Rate (%): 35; Question Box
Physical Plant Depreciation Period (years): 7; Question Box
New Insulation Depreciation Period (years): 7; Question Box
Incremental Cost of Plant Capacity ($/MM BTU/hour): 3.47; Question Box
Percent of New Insulation Cost for Annual Insulation Maintenance: 2
Percent of Annual Fuel Bill for Physical Plant Maintenance: 1; Question Box
Annual Hours of Operation: 8320
Average Annual Ambient Temperature (F): 75
Average Annual Wind Speed (mph): 0
Reference Thickness for Payback Calculations: 0; Question Box

Back Button
Next Button
Calculate Button

To continue with this example, enter the data from the ENERGY tab inputs: 8,760 hours of operation, ………

Slide 72: 70 degrees ambient temperature, ……

Slide 73: wind speed of 3 miles per hour …….

Slide 75: and 0 inches of insulation thickness.

Environment Tab Inputs – Economic Information Entered - Visual Description

Annual Hours of Operation: 8760
Average Annual Ambient Temperature (F): 70
Average Annual Wind Speed (mph): 3
Reference Thickness for Payback Calculations: 0

[Click the "next box" to forward to the next page.]

Slide 76: 'Reporting Options ' is where you decide whether you want a report on all surfaces, or each surface individually, and whether you want a detailed engineering report, or a tabled report.

Environment Tab Inputs – Reporting Options - Visual Description

Reporting Options (Data Input Screen)

Select the number of Surfaces to Report On

Radio-buttons

Report on all surfaces, NPS or Tubing Sizes, and Top/Vertical/Bottom Flat Surfaces

[Selected] Select each surface individually

Select the Report Type

Radio-buttons

Detailed Engineering Report

[Selected] Tables Style Report

Cost Information Source

Radio-buttons

[Selected] Estimated Installation Cost by FEA Method

Cost Data from Previous Reports

User-supplied Thickness and Installed Cost Information for Each Surface

Starting Temperature: 100

Temperature Increment: 100

Back Button
Next Button
Calculate Button

We want to report on all surfaces.

[Select Radio Button]: Report on all surfaces, NPS or Tubing Sizes, and Top/Vertical/Bottom Flat Surfaces

[Click the "next button" to forward to the next page.]

Slide 78: In 'Insulation System,' specify the insulation to be installed, so select 'calcium silicate' and 'aluminum jacket oxidized in service' to continue with our example.

Environment Tab Inputs – Insulation System - Visual Description

Insulation System (Data Input Screen)

Insulation Material for Job: 1000F Min. Fiber Pipe and Tank, Type IVB, C1393-00a
Installation Complexity: Average
External Jacket Material: Aluminum, oxidized, in service
Material Price, dollar per foot for 2 by 2 pipe insulation, including jacket: 4.97; Question Box
Material Price, dollar per square foot for 2-inch thick board or block, including jacket: 1.71; Question Box
Labor Rate, dollar an hour. Including overhead: 38.25; Question Box
Regional Productivity Factor: Alabama; Question Box

Back Button
Next Button
Calculate Button

Insulation material – calcium silicate
Jacket – aluminum, oxidized, in service

Again, for an 'apples to apples' comparison

Slide 80: ***[Use the pull-down menu to select "Calcium Silicate BLK+PIPE, Type I, C533-07']***

Slide 82: You can also specify the price for the specific material selected, the cost of labor, and the location by state where the job is being done. Default costs should be adjusted for the specific insulation and labor. The baseline material cost adjustments should be based on the cost of 2 inch thickness of insulation covering pipe with a 2 inch nominal diameter. The program will ratio the cost for the various sizes of pipe or surfaces. The Question Marks can be checked to help you with the inputs. Click the "next box" to forward to the next page.

Slide 83: On the next page, you will see the 'Cost and Thickness Data' screen to estimate the cost (in dollars) for different insulation thicknesses.

Environment Tab Inputs – Cost and Thickness Data - Visual Description

Cost and Thickness Data (Results Screen)

Surface number: 1
Pipe Size: 0.5

Thicknesses are noted with units of inches.

Costs are noted with units of dollars per square foot for a flat surface.

Single Layer

Thick	Cost
1	7.24
1.5	8.19
2	9.84
2.5	11.05
3	12.35
4	17.64

Double Layer

Thick	Cost
3	15.57
4	21.32
5	26.96
6	32.75
0	0.00
0	0.00

Triple Layer

Thick	Cost
6	0.00
7	0.00
8	0.00
9	0.00
10	0.00
0	0.00

Back Button
Next Button
Calculate Button

Each pipe size is noted as a unique Surface Number with the corresponding Pipe Size.   You will see options for single, double, and triple layers of insulation. You can scroll through every pipe size by clicking 'next' or 'back'.

Slide 87: As you scroll through, you will see that the cost per thickness of insulation increases with pipe size. Also, the cost increases with each layer; single, double, and triple.

For our example, we will select the pipe size "10."

As you scroll through, you will find Surface Number 17

Slide 88: which is for 10 inch diameter piping.

Environment Tab Inputs – Cost and Thickness Data Example - Visual Description

Cost and Thickness Data (Results Screen)

Surface number: 17
Pipe Size: 10

Single Layer

Thick	Cost
1	0.00
1.5	19.01
2	23.25
2.5	26.74
3	29.99
4	37.23

Double Layer

Thick	Cost
3	33.86
4	43.70
5	53.69
6	63.72
0	0.00
0	0.00

Triple Layer

Thick	Cost
6	72.24
7	84.39
8	96.51
9	103.70
10	119.84
0	0.00

You can see that a single layer of 3 inches of calcium silicate insulation and jacketing on a 10 inch diameter pipe for the default location Alabama and its default rates is 29.99 dollars per linear foot.

Single Layer

Thick	Cost
3	29.99

For 20 feet of piping, the estimated insulation costs, based on the economic inputs, is approximately 600 dollars.

Cost of Installing Insulation = (Cost $_{\text{Install}}$) (Uninsulated Length)

Cost of Installing Insulation = ($29.99 per linear foot) (20 feet) = $599.80

Our Costs of Energy calculation indicated an annual savings of approximately 11,000 dollars. The simple payback for insulating this 20 feet section is about 1 month, well worth the investment!

Simple Payback = Cost of Installing Insulation / Energy Savings

Simple Payback = $600 / $11,000 per year = 0.05 year = 1 month

Slide 89: Click on 'Calculate' to view the full report.

Pop Up Report– Visual Description

North American Insulation Mfg. Assoc.
NAIMA 3E Plus 4.0
Company Name
Address
City, State Zip
Phone Number

Project Name =
Project Number = 1
System =
Location =
Date = 03/10/2009
Engineer =
Contact =
Phone =

Slide 92: When you are ready to print a report, click on 'File.'

Slide 94: to print the report…… or save it as a rich text file.

Slide 96: If you choose to save it, type a filename, and click 'Save.'

Slide 98: To find the file in the future, the filename will be whatever name you chose, followed by Dot RTF.

[Click the "Options" at the top of the screen.]

Options Tab

Options Tab Inputs – General Options (Program Defaults) - Visual Description

User Information (Data Input Screen)

User Name: User Name
Company Name: Company Name
Address: Address
City, State, Zip: City, State, Zip
Phone Number: Phone Number

Save button

Slide 100: Under 'Options,' you can type general user information, add, delete,

Slide 101: or edit information about different insulation material……..

Options Tab Inputs – Insulation Material (Maintenance) - Visual Description

Insulation Material (Data Input Screen)

Add button
Edit button
Delete button
Activate button

ID	Material Name	Active	Created By	Type	Max Temp.
1	MF Insulating Cement, C195-07	TRUE	System	5	1900
2	Insul + Finish Cement, C449-07	TRUE	System	5	1200
3	Calcium Silicate BLK+PIPE, Type I, C533-07	TRUE	System	3	1200
4	Elastomeric SHT+TUBE, Gr 1, C534-07	TRUE	System	5	220
5	850F Mineral Fiber PIPE, Type I, C547-07	TRUE	System	1	850
6	1200F Mineral Fiber PIPE, Types II and III, C547-07	TRUE	System	2	1200

ID	Material Name	Active	Created By	Type	Max Temp.
7	1000F Mineral Fiber PIPE, Type IV, C547-07	TRUE	System	2	1000
8	Cellular Glass,Type I,BLOCK, C552-07	TRUE	System	4	800
9	Cellular Glass,Type II,PIPE and Tube, C552-07	TRUE	System	4	800
10	450F MF BLANKET, Type II, C553-02	TRUE	System	1	450
11	850F MF BLANKET, Type IV, C553-02	TRUE	System	1	850
12	1000F MF BLANKET, Type V, C553-02	TRUE	System	2	1000
13	1200F MF BLANKET, Type VII, C553-02	TRUE	System	2	1200
14	Polystyrene PIPE,Type XIII, C578-07	TRUE	System	5	165
15	Polystyrene BOARD, Type IV, C578-07	TRUE	System	5	165
16	PIR, Gr 1, Types I,and II, C591-07	TRUE	System	5	300
17	PIR, Gr 2, Type IV, C591-07	TRUE	System	5	300
18	MF Metal Mesh BLANKET, Type II, C592-04	TRUE	System	2	1200
19	Perlite BLOCK+PIPE, C610-07	TRUE	System	3	1200
20	450F MF BOARD, Type IB, C612-04	TRUE	System	1	450
21	850F MF BOARD, Type II, C612-04	TRUE	System	1	850
22	1000F MF BOARD, Type III, C612-04	TRUE	System	1	1000
23	1200F MF BOARD, Type IVB, C612-04	TRUE	System	2	1200
24	1800F MF BOARD, Type V, C612-04	TRUE	System	2	1800
25	High Temp Fiber Blanket, Gr 6, C892-05	TRUE	System	1	3000
26	Glass Fiber Felt, C1086-96(2004)	TRUE	System	1	1200
27	Phenolic Sheet+TUBE, Gr 1, Type II and III, C1126	TRUE	System	5	257
28	650F Min. Fiber Pipe and Tank, Type II, C1393-00a	TRUE	System	1	650
29	850F Min. Fiber Pipe and Tank, Type IIB, C1393-00a	TRUE	System	1	850
30	1000F Min. Fiber Pipe and Tank, Type IVB, C1393-00a	TRUE	System	2	1000
31	Melamine PIPE+FLAT, C1410-05a	TRUE	System	5	350
32	Polyolefin SHT+TUBE, C1427-04	TRUE	System	5	200
33	Polyimide, Type I, C1482-04	TRUE	System	5	400

ID	Material Name	Active	Created By	Type	Max Temp.
34	Duct Wrap, 0.75 pcf, C1290	TRUE	System	1	250
35	Duct Wrap, 1.0 pcf, C1290	TRUE	System		250
36	Duct Wrap, 1.5 pcf, C1290	TRUE	System		250

Temperature Points (Data Input Screen)

Row	Temperature	Conductivity
1	-200	0.124
2	-150	0.152
3	-100	0.181
4	-50	0.203
5	-25	0.212
6	0	0.221
7	25	0.234
8	50	0.246
9	75	0.259
10	100	0.272

Slide 102: different types of fuel,

Options Tab Inputs – Fuel Types - Visual Description

Fuel Types (Data Input Screen)

Add button
Edit button
Delete button
Activate button

ID	Fuel Name	Active	Created By	Cost	Cost Units	BTU
1	Natural Gas	TRUE	System	10.00	$/Mcf	1026
2	Oil	TRUE	System	1.50	$/gal	138700
3	LPG	TRUE	System	0.90	$/gal	86310
4	Coal	TRUE	System	70.00	$/ton	12500
5	Electricity	TRUE	System	0.10	$/kWh	3415.3

Pollutants (Data Input Screen)

ID	Name	Lbs/10^6 BTU
1	CO2	425.5
2	NOx	0.9497
3	CE	116

Slide 103: jacket material,

Options Tab Inputs – Jacket Material - Visual Description

Jacket Material (Data Input Screen)

Add button
Edit button
Delete button
Activate button

ID	Material Name	Active	Created By	Emittance
1	Aluminum, new, bright	TRUE	System	0.04
2	Aluminum, oxidized, in service	TRUE	System	0.1
3	Stainless Steel, new, cleaned	TRUE	System	0.13
4	Stainless Steel, dull, in service	TRUE	System	0.3
5	Iron or Steel	TRUE	System	0.8
6	Copper	TRUE	System	0.6
7	Painted Metal	TRUE	System	0.8
8	Galvanized steel, new, bright	TRUE	System	0.1
9	Galvanized steel, dipped or dull	TRUE	System	0.28
10	All Service Jacket	TRUE	System	0.9
11	Aluminum Paint	TRUE	System	0.5
12	Canvas	TRUE	System	0.9
13	Roofing felt and black mastics	TRUE	System	0.9
14	Colored mastics	TRUE	System	0.9
15	PVC Jacketing	TRUE	System	0.9

Slide 104: or base metals.

Options Tab Inputs – Base Metals- Visual Description

Base Metals (Data Input Screen)

Add button
Edit button
Delete button
Activate button

ID	Material Name	Active	Created By	Emittance
1	Steel	TRUE	System	0.8
2	Stainless Steel	TRUE	System	0.3
3	Copper	TRUE	System	0.6
4	PVC	TRUE	System	0.9

Under 'Edit,' ***[at the top of the screen]***

Slide 106: click on 'Save as Default' in order to save this information as the default that will display whenever you open 3E Plus. If you change any information while using 3E Plus, click on "Load Defaults' to restore everything back to the default.

Slide 107: To cover the remaining menus, go to the File menu,

Slide 109: and click 'Save job" in order to save all of your information as a 3E Plus File.

Slide 114: Click on 'Open Job' to open a 3E Plus File you had previously saved. You can also print the report, or export it, which converts it into a rich text file."

Under 'Units,' you can select whether you want measurements to display in English or SI units.

Slide 115: ***[Conclusion]*** The 3EPlus Insulation Tool has many useful features to evaluate insulation projects by assisting the user in selection of appropriate types ***[insulation materials]*** and thicknesses through parametric runs, and by calculating the energy and cost savings, implementation costs, and emission reductions ***[savings]***.

<u>Slide 116:</u> We now know the potential projects and their energy and economic impacts ***[energy and cost savings]*** from using 3EPlus.

You can also return to the Steam System Scoping Tool (SSST) to revise your scorecard results for insulation to determine a projected new score pre-implementation or for a final score post-installation of the projects.

We can use this information for stand-alone projects as well as incorporate the data into the ***[Next Steps]***Steam System Assessment Tool (SSAT) for modeling the current configuration, in order to better determine system-wide benefits ***[system interactions]*** from implementing these insulation improvement projects***[resulting in a Final Projects List with estimates of energy and cost savings]***.