

BEYOND
SMART CITIES
3 June 2008

Distribution marketing participation in the securities market.

Category	Value
TVG division	20%
FST division	15%
Other	65%

Revenue growth divisions.

Category	Value
TVG division	20%
FST division	15%
Other	65%

**MAINTENANCE AND COMMISSIONING - CEM
REFRESHER TRAINING COURSE**

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
CEM REFRESHER TRAINING COURSE

3 August 2008
5 September 2008

ENERGY MANAGEMENT SPECIALIST
BEYOND SMART CITIES

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**MAINTENANCE
FOR ENERGY PROFESSIONALS**

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
ENERGY SPECIALIST CURRICULUM COURSE

ENERGY MANAGEMENT SPECIALIST
BEYOND SMART CITIES

WHAT SHOULD YOU LEARN

Useful Maintenance Technologies

Basic Terminology and Common Maintenance Strategies

Estimating Savings from Maintenance Activities (Compressed Air and Steam Leaks, Uninsulated Steam Lines, Group Relamping)

Maintenance ECMs

Vibration Analysis

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IMPORTANCE OF MAINTENANCE PROGRAMS

✓ Good maintenance saves energy costs Major problems in maintenance

- Lack of adequate management attention
- Lack of adequate maintenance training
- Poor reporting of problems
- Lack of work order systems
- Poor analysis of problems
- Poor preventive maintenance efforts
- Poor control of maintenance activities



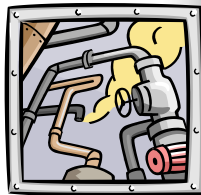
SUCCESSFUL MAINTENANCE PROGRAMS

- ✓ Require adequate funding and training
- ✓ Do not defer maintenance
- ✓ Use new Maintenance Management Systems

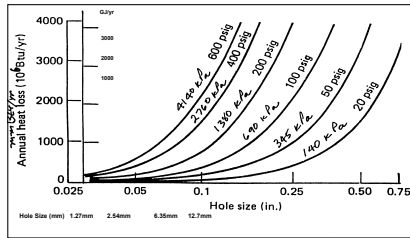


COSTS OF POOR MAINTENANCE

- ✓ Steam leaks
- ✓ Steam trap failures
- ✓ Compressed air leaks
- ✓ Uninsulated pipes
- ✓ Boiler scale



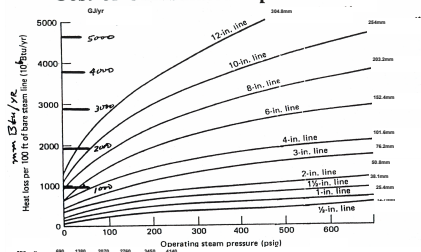
COST OF STEAM LEAK CHART 8760 HOURS/YEAR OPERATION



COSTS OF COMPRESSED AIR LEAKS 8760 HOURS/HR OPERATION

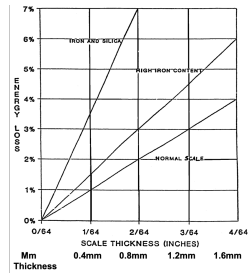
Hole Diameter (mm)	Energy Loss at Pressure (kWh/yr)		
	760 kPa	690 kPa	620 kPa
9.525	226,100	208,100	190,000
6.35	100,500	92,500	86,300
3.175	25,100	23,100	21,100
1.588	6,300	5,800	5,300
0.794	1,600	1,400	1,300

Cost of Uninsulated Pipes Chart *



* 8760 hours/yr operation and per 30 metres of pipe

ENERGY LOSS FROM SCALE DEPOSITS



MAINTENANCE COST EXAMPLE - 1

Five bucket steam traps are stuck open in your facility. They all exhaust to the drain. If LPG gas for the boiler costs \$1.25/kg and your steam system is 78% efficient, what is the cost of these malfunctioning steam traps per year? Each trap has a 2.5 mm orifice. The steam line pressure is 690 kPa.



SOLUTION TO MAINTENANCE EXAMPLE 1 STEAM LEAK – ONE TRAP

- ✓ The stuck open steam trap is like a 2.5 mm leak in a 690 kPa steam system.
- ✓ From the chart, the annual heat loss for 8760 hours of operation per year is about 400 GJ/yr.

$$\begin{aligned} \frac{\$}{\text{yr}} &= \frac{400 \text{ GJ}}{\text{yr}} \times \frac{\$1.25}{\text{kg}} \times \frac{1 \text{ kg}}{45,605 \text{ kJ}} \times \frac{1}{0.78} \\ &= \$14,070 / \text{yr} \end{aligned}$$



SOLUTION (CONTINUED)

In problem 1, what else should you examine?

- ☒ "They all exhaust to the drain"
- ☒ When you lose condensate you lose:
 - Heat
 - Water C
 - Chemicals
 - The cost of sewer disposal
- ☒ Adding condensate return piping is generally quite cheap and cost effective.



MAINTENANCE COST EXAMPLE - 2

You run a compressed air check in your facility and find the following leaks – one 6.35 mm and one 3.2 mm. What is the annual cost to your facility if your system has 690 kPa air and you are paying \$0.10 per kWh for electricity?



SOLUTION TO MAINTENANCE EXAMPLE 2 AIR LEAK – ONE LEAK

- ☒ From the table on page 37, the kWh of electrical energy needed by the compressor to feed one 6.5 mm leak at 690 kPa for 8760 hours is: 92,500 kWh/yr.
- ☒ The cost of this leak is:

$$\begin{array}{l} \frac{\$}{\text{yr}} = \frac{92,500 \text{ kWh}}{\text{yr}} \left| \frac{\$0.10}{\text{kWh}} \right. \\ \quad = \$9250 / \text{yr} \end{array}$$

