

**Client** : PT. Cheil Jedang – Pasuruan

**Location** : Jl Raya Arjosari, Desa Arjosari RT.04 RW.02 Kec. Rejosu Kab. Pasuruan  
Jawa Timur

**Type of audit** : Walkthrough Energy Audit

**Scope of Audit** : Boiler – Coal fired 120T/Hr

**Auditor** : Antonius Agung Pramudiyantoro  
Ramaiyer Ramachandran

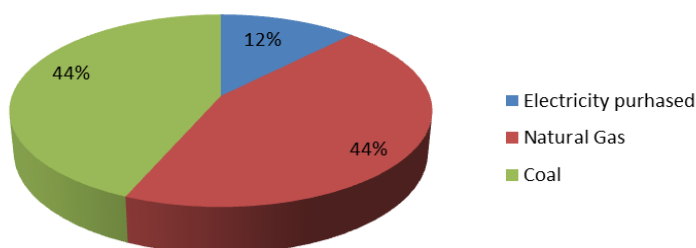
**Agenda** : 10.00 – 11.15 : Presentation for ISO 50001 certification  
11.15 – 12.00 : Presentation for Energy Audit  
12.00 – 13.15 : Break  
13.15 – 15.15 : Walkthrough audit to Boiler  
15.15 – 15.45 : Closing meeting

**Energy Review** : • Annual consumption of Energy Sources:

Energy Use	Unit	Consumption	Ton oil equivalent (toe)
Electricity purchased	kWh	25,500,000	2,193.01
Natural Gas	m3	7,700,000	7,964.83
Coal	Kg	13,400,000	7,852.36
Total consumption			<b>18,010.20</b>

Total Annual consumption of Energy Sources 18,010.20 toe

**Energy Consumption**



Largest energy consumption comes from the use of Natural Gas and Coal. Those area are very potential in energy saving.

- Preliminary data for Energy User

Equipment	Capacity	Qty	Running hours/day
Lighting system	1500 kW	-	-
Packaged ACs	41 PK/30.6 kW	-	2 h/m
Split AC	303 PK / 226 kW	-	8 h/d
Steam Boiler	175 T/h	5	5 h/d
	120 T/h	4	23 h/d
	120 T/h	4	20 h/d
Compressor	17,200 kW	18 (avg operation 11.6 unit/day)	24 h/d
Chiller	13,210 kW	19 (avg operation 11.4 unit/day)	24h/d

Based on energy sources data, annual electricity consumption is 25,500,00 kWh/year, and from table of Energy User, annual electricity consumption for Compressor is approx. 3,192,192 kWh/year (13% of total electricity purchased) and Chiller is approx. 2,282,688 kWh/year (9% of total electricity purchased)

Preliminary assumption for Significant Energy User is Compressor and Chiller.

- Observation Result** : Walkthrough audit to warehouse
- There is opportunity in saving lighting by replacing smoky sun roof

#### Walkthrough audit to boiler

- There is opportunity in saving compressed air consumption by replacing method in cleaning the spillage in the pulverising area. with vacuum suction method.  
(note : cleaning the ash using compressed air is not solving the problem, but only remove the ash to other place)
- Loss of steam in distribution:
  - o Several instances of steam leaks (in fitting and valves) observed.
  - o Also reported loss in distribution line between Co-gen plant and end user.
 Prevention of loss of steam is high potential for Energy performance Improvement
- Insulation Failures:
- Insulation failures lead to heat loss, possible condensation, and drop in steam quality in the supply to the end user. Insulation need replacement in many places. Observed both in
  - o Piping as well as Valves & Fittings ( perhaps left open after maintenance) Explore using removable insulation.
  - o Observed insulation damage to many instances where there is traffic of personnel and material crossing over piping.
- Steam pressure loss between Co-gen plant and end user is also reported. Steam leaks and insulation failures leading to excess condensation – possible cause. Needs more study to understand.
- Difficulties in maintaining steady steam temperature is also observed in operations.
- Incomplete combustion suspected , by observing emission from stack.
- One of the Boilers observed to be operating at 67.5 % efficiency ( from the control panel readings)

## Steam System analysis using Steam System Scoping Tool :

During the audit, a quick analysis of the Boiler System, Operating practices and the, distribution system data was collected from the Energy Manager, and the Boiler Manager. This data was input to a software “ Steam System Scoping Tool” approved by Dept Of energy , USA. So that Cheil Jedang practices are compared to ‘Best Practices’ in the Industry. Results of the comparison is tabulated below, followed by an analysis to arrive at recommendation for improvement .

The data collection was limited to 120T/Hr boiler.

STEAM SYSTEM SCOPING TOOL, Version 1.0d

2/10/2014

### STEAM SYSTEM BASIC DATA

#### BASIC DATA ABOUT YOUR SYSTEM

**What To Do** Document some of the basic operating information about your steam system.

**Why Important** Documenting basic steam system data is important to help you to identify the current conditions of your steam

**ANSWERS TO BASIC DATA**

Chemicals for Food industry

- a** Briefly describe the type of production that your plant does in the column to the right. If you know the Standard Industrial Code (SIC) for your industry, please include that in your

**IF YOU CONSUME STEAM BUT DO NOT GENERATE ANY OF YOUR OWN,**

**PLEASE**

**ANSWERS TO BASIC DATA**

- b** What Is Your Total Annual Steam Production?

NA

Million lbs/year

- c** How Many Hours Per Year Is Your System In Operation?

8,520

hours/year

- d** What Is Your Total Steam Generation Capacity?

120

T/hr

- e** What Is Your Average Steam Generation Rate?

102

T/hr

- f** What Is The % Distribution (On A Btu Basis) Of Your Fuel Sources For Steam Generation?

Coal  
Fuel Oil (#6)  
No. 2 Fuel Oil  
Natural Gas  
Process Waste Heat  
Biomass  
Solid Wastes  
Other

TOTAL (Should add up to 100%)

100.0

%

%

%

%

%

%

%

%

100.0

%

STEAM SYSTEM SCOPING TOOL, Version 1.0d

2/10/2014

Total Capacity

kW

Combustion Gas Turbines With HRSGs

Total Capacity

kW

Other (specify type)

Total Capacity

kW

- h** How Much Steam Do You Buy Annually From Others?

Million lbs/year

- i** How Many Steam Traps Do You Have In Your Steam System?

362

- j** What is Your Average Boiler Blowdown Rate?

3

% of  
average  
feedwater  
flow rate

STEAM SCOPING TOOL, Version 1.0d\_Metric

10/1/2014

## SUMMARY RESULTS

SCOPING TOOL QUESTIONS	POSSIBLE SCORE	YOUR SCORE
<b>1. STEAM SYSTEM PROFILING</b>		
<b>STEAM COSTS</b>		
SC1: Measure Fuel Cost To Generate Steam	10	10
SC2: Trend Fuel Cost To Generate Steam	10	10
<b>STEAM/PRODUCT BENCHMARKS</b>		
BM1: Measure Steam/Product Benchmarks	10	10
BM2: Trend Steam/Product Benchmarks	10	10
<b>STEAM SYSTEM MEASUREMENTS</b>		
MS1: Measure/Record Steam System Critical Energy Parameters	30	26
MS2: Intensity Of Measuring Steam Flows	20	16
<b>STEAM SYSTEM PROFILING SCORE</b>	<b>90</b>	<b>82</b>
<b>2. STEAM SYSTEM OPERATING PRACTICES</b>		
<b>STEAM TRAP MAINTENANCE</b>		
ST1: Steam Trap Maintenance Practices	40	40
<b>WATER TREATMENT PROGRAM</b>		
WT1: Water Treatment - Ensuring Function	10	10
WT2: Cleaning Boiler Fireside/Waterside Deposits	10	10
WT3: Measuring Boiler TDS, Top/Bottom Blowdown Rates	10	5
<b>SYSTEM INSULATION</b>		
IN1: Insulation - Boiler Plant	10	6
IN2: Insulation - Distribution/End Use/Recovery	20	0
<b>STEAM LEAKS</b>		
LK1: Steam Leaks - Severity	10	0
<b>WATER HAMMER</b>		
WH1: Water Hammer - How Often	10	10
<b>MAINTAINING EFFECTIVE STEAM SYSTEM OPERATIONS</b>		
MN1: Inspecting Important Steam Plant Equipment	20	20
<b>STEAM SYSTEM OPERATING PRACTICES SCORE</b>	<b>140</b>	<b>101</b>
<b>3. BOILER PLANT OPERATING PRACTICES</b>		
<b>BOILER EFFICIENCY</b>		
BE1: Measuring Boiler Efficiency - How Often	10	0
BE2: Flue Gas Temperature, O2, CO Measurement	15	10
BE3: Controlling Boiler Excess Air	10	10
<b>HEAT RECOVERY EQUIPMENT</b>		
HR1: Boiler Heat Recovery Equipment	15	5
<b>GENERATING DRY STEAM</b>		
DS1: Checking Boiler Steam Quality	10	0
<b>GENERAL BOILER OPERATION</b>		
GB1: Automatic Boiler Blowdown Control	5	5
GB2: Frequency Of Boiler High/Low Level Alarms	10	10
GB3: Frequency Of Boiler Steam Pressure Fluctuations	5	0
<b>BOILER PLANT OPERATING PRACTICES SCORE</b>	<b>80</b>	<b>40</b>

STEAM SCOPING TOOL, Version 1.0d\_Metric

12/14/2010

## SUMMARY RESULTS (page 2)

<b>4. STEAM DISTRIBUTION, END USE, RECOVERY OPERATING PRACTICES</b>		
<b>MINIMIZE STEAM FLOW THROUGH PRVs</b>		
PR1: Options For Reducing Steam Pressure	10	10

<b>RECOVER AND UTILIZE AVAILABLE CONDENSATE</b>		
CR1: Recovering And Utilizing Available Condensate	10	0
<b>USE HIGH-PRESSURE CONDENSATE TO MAKE LOW-PRESSURE STEAM</b>		
FS1: Recovering And Utilizing Available Flash Steam	10	3
<b>DISTRIBUTION, END USE, RECOVERY OP. PRACTICES SCORE</b>	30	13

### SUMMARY OF STEAM SCOPING TOOL RESULTS

	POSSIBLE SCORE	YOUR SCORE
STEAM SYSTEM PROFILING	90	82
STEAM SYSTEM OPERATING PRACTICES	140	101
BOILER PLANT OPERATING PRACTICES	80	40
DISTRIBUTION, END USE, RECOVERY OP. PRACTICES	30	13
<b>TOTAL SCOPING TOOL QUESTIONNAIRE SCORE</b>	<b>340</b>	<b>236</b>
<b>TOTAL SCOPING TOOL QUESTIONNAIRE SCORE (%)</b>		<b>69.4%</b>

Date That You Completed This Questionnaire

12/14/2010

### SUMMARY OF STEAM SCOPING TOOL RESULTS

	POSSIBLE SCORE	YOUR SCORE
STEAM SYSTEM PROFILING	90	82
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<b>TOTAL SCOPING TOOL QUESTIONNAIRE SCORE (%)</b>		<b>69.4%</b>

**Observation Results** : From the table above it is observed that when bench marked with best practices in boiler operations, a high scope for improvement exist in the areas.

Steam Operating practices through

- Improvement in Insulation repair and maintenance
- Arresting and Preventing steam leaks,
- And controlling hammering by maintaining steam pressure. Recommend to monitor, control and maintain steam purity.

Boiler Plant Operating practices through

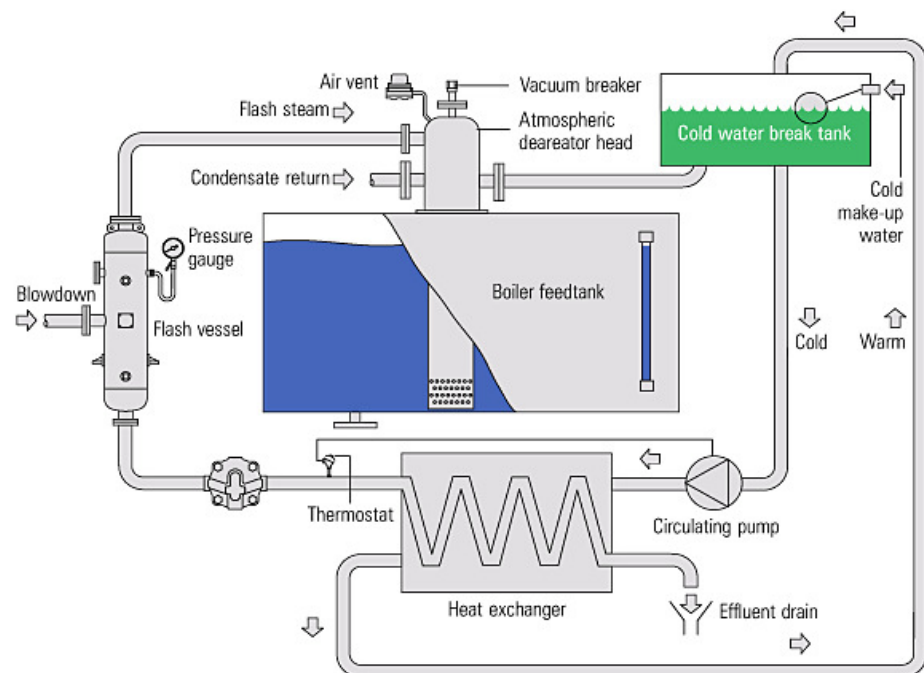
- Measuring Boiler efficiency Periodically
- Monitoring CO content in Flue gas,
- Blow down heat recovery,

Distribution, End use & Recovery through

- Improved condensate recovery
- Improving flash steam recovery.

## Recommendation for Improvement :

- Replacing smoky sun roof, by fresh transparent roofing in the warehouse.
- Use vacuum suction method to clean the spillage in the pulverising area. More effective, Saves compressed air consumption, possibly recyclable after check.
- Stop OR at least reduce the steam leaks in distribution lines, Valves and Fittings in particular , by attending to them as early as possible.
  - A system to constantly look for tiny(potential) leaks and arresting them before they become detectable visually is better.
  - Recommend, minor investment to detect tiny leakage in monitoring equipment, ( Thermal Imager, Ultrasonic detector).
  - Implement a preventive maintenance program for continuous monitoring for steam leaks .
- Replace failed insulation ASAP (use the simple software provided to calculate the approximate ‘ cost and savings’)
  - Avoid accidental damage to insulation by protecting the piping by providing (simple) cross-over bridge to go across the piping.
  - Explore the use of removable insulation for valves and fittings, progressively increasing the numbers to cover all the fittings. over a period of time. ( refer to ‘Tip Sheet’ provided)
- Recommend to arrange for a special study, to investigate the reasons for loss of pressure between co-gen and end user. This will result in improving the steam quality, improve the boiler efficiency, steam purity which are all might be inter-related.
- Continuous blow down is practiced, which is good. However recovering heat from the blow down is not effective.  
Recommend to consider installing a simple standard system. to recover the heat/condensed water. Example :



**Fig. 3.13.4**  
**Heating make-up water in a cold break tank**  
(level controls have not been shown on the feedtank)