Appendix 3

Results of EE&C Study in Pilot Implementation of Energy Management System

EE&C Audit Report of A Factory

February, 2010

JICA Study Team

Contents

1. Summary

1-1. Summary of EE&C (Energy Efficiency and Conservation) Audit results

A summary of EE&C Audit results are in the following Table-1-1.

Table-1-1 : Summary of EE&C Audit Results of [redacted]

No.	Item	Kind of Saved Utility	Reduction of Utility Consumption /year	Reduction of Utility Cost ₹/year	Investment ₹	Payback Period year	Remarks
1	Reduction of Evaporation Steam Pressure at Boiler	Fuel Oil	37 ton	13,900	None	0	1) In case of the pressure 10.5 →8 bar 2) In production area as well, the pressure should be lowered as low as possible.
2	Insulation on Non-Insulated Valves, etc.	Fuel Oil	51 ton	19,200	15,000	0.8	
3	Management of Steam Traps	Fuel Oil	67 ton	25,200	10,000	0.4	1st year
4	Steam Condensate Recovery	Fuel Oil	118 ton	44,400	100,000	2.3	
5	Installation of Economizer at 8t/h Boiler	Fuel Oil	55 ton	20,700	70,000	3.4	
6	Decrement of Compressed Air Pressure	Electricity	14,800 kWh	520	None	0	
7	Decrement of Leaking Compressed Air	Electricity	35,100 kWh	1,230	2,000	1.6	1st year
8	Changing the Operation Pattern of Atlas Copco and FIAC AIRBLOCK Air Compressor	Electricity	75,000 kWh	2,630	None	0	
9	Replacing Incandescent Lamps to CFLs (Compact Fluorescent Lamps)	Electricity	57,800 kWh	2,000	650	0.3	
10	Replacing Ballast of Fluorescent Lamps to Hf lamps	Electricity	22,600 kWh	800	4,000	5.0	
11	Adding Leading Phase Condenser (reactive power compensation unit) to the Power System	Electricity	1,717,000 kvarh	7,250	-	-	

2. EE&C Potential

As for the EE&C potential, the results of examination is in the following Table-1-2. Number 6 and 11 are excluded based on the discussion with [redacted] factory.

Table-1-2 : EE&C Potential of [redacted] Factory

Utility	Annual Utility Consumption ton or kWh	Quantity of Reduction ton or kWh	Factor of Intervene	Corrected Quantity of Reduction ton or kWh	Rate of Reduction %	Reduction of Utility Cost ₹	Investment ₹	Payback Period y	Remarks
Fuel Oil	2,229	328	0.9	295	13.2	123,400	195,000	1.6	Item-1,2,3,4,5
Electricity	5,403,000	167,900	-	167,900	3.1	5,860	2,650	0.5	Item-7,8,9
Total	116.515 GJ	14,887 GJ	-	13,398 GJ	11.5	129,260	197,650	1.5	NHV of Heavy Fuel Oil: 43.544 GJ/ton
	32,358 MWh	4,134 MWh		3,721 MWh					

2. Background and Outline of EE&C Audit

2-1. Background of This Project

The Republic of Serbia (Serbia) requested a study for introduction of Energy Management System (EMS) for Serbia to the Government of Japan (GOJ). The GOJ has dispatched the JICA Study Team to conduct the study since July 2009.

As a part of the study, the JICA Study Team proposed that a pilot implementation of temporary EMS in model sites (a factory and a building), in order to feedback the results and lessons learned to a scheme design of EMS.

The 6 candidate sites (3 factories and 3 buildings) were short-listed by the Steering Committee, and the JICA Study Team visited these 6 sites and made interviews to responsible persons in September.

As a result, the JICA Study Team together with the Steering Committee selected 2 sites including [redacted] as the factory considering EE&C potential, variety of energy consuming equipment and their strong willingness to achieve EE&C.

The pilot project consists of the following contents.

1) Component 1: Training Program (provided by the JICA Study Team)
   - Internal training program to raise awareness and skill of site staff (especially focusing on middle management class)
2) Component 2: EE&C Study (provided by the JICA Study Team)
   - Initial measurement and data analysis for energy consuming equipment
   - Study for EE&C potential and methods by 3 classes (O&M improvement, simple investment, large investment)
3) Component 3: Periodical Reports (Joint Activities by the JICA Study Team and the Site
   - Appointment of temporary Energy Manager within the site
   - Discussion of format of Periodical Reports consisting of energy consumption data/energy consuming equipment list, and EE&C plan
   - Collection of monthly data and making Periodical Reports by the temporary Energy Manager

2-2. Outline of the EE&C Audit

This EE&C Audit was carried out as one activity out of EE&C potential study of the Component-2 for the following purposes.

1) Grasping the present conditions of energy consuming equipment by questionnaire, interview, site survey and measurement
2) Picking up the promising items for EE&C improvement
3) Examining each item
4) Preparing and submitting an EE&C Audit Report

3. Outline of Company, Factory and Facilities

3-1. Outline of Company and Factory

1) Name of Company / Factory
2) Ownership
3) Address, Tel. and E-Mail

[redacted]

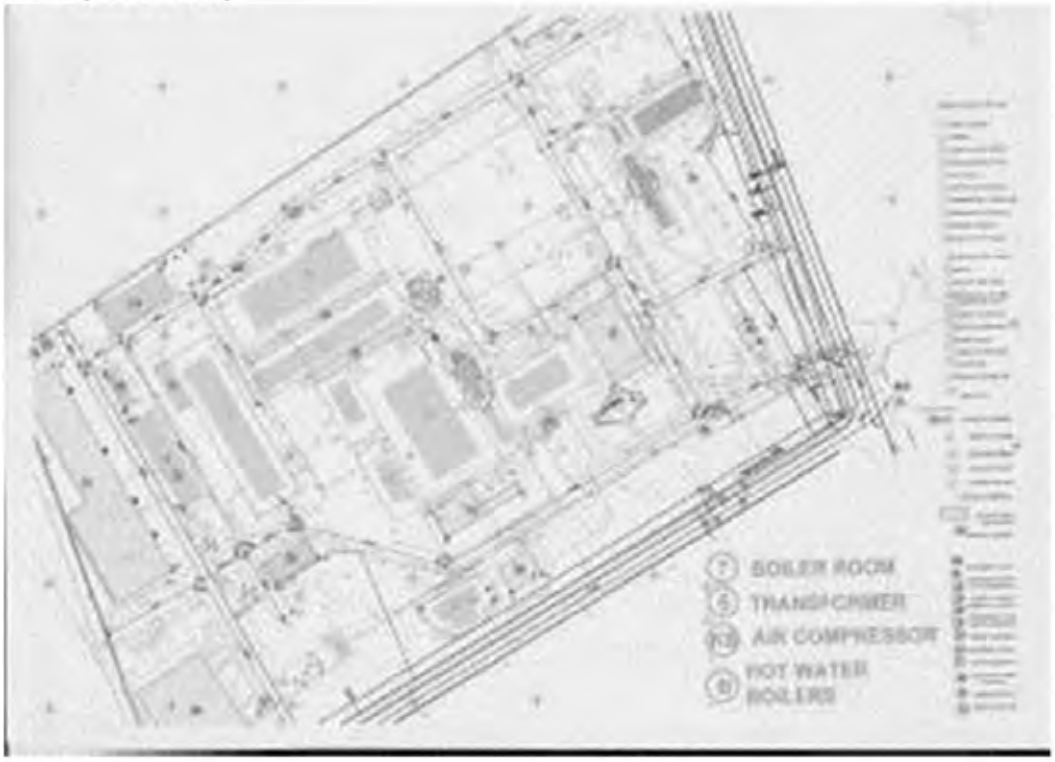
4) Sector — Industrial Sector

5) Main Products and Production in 2008

- Short Durability Milk	[redacted]	ton
- Cream Cheese Processing		
- Feta Processing and Soft Cheese		
- Uht Milk		
- Milk 0.1 % Feet		
- Sour Cream		
- Yogurt		
- Other(Butter, etc.)		
Total		ton
cf. Raw Milk		kL

6) Number of Employees — 450 persons
7) Operation Days per Year — 365 days
8) Operation Hours per Day — 24 hours
9) Energy Consumption
(1) Electricity — 5,403,000 kWh from Oct. 2008 to Sept. 2009
(2) Heavy Fuel Oil — 2,229 tons from Oct. 2008 to Sept. 2009

3-2. Layout of Factory



3-3. Outline of Utility Facilities

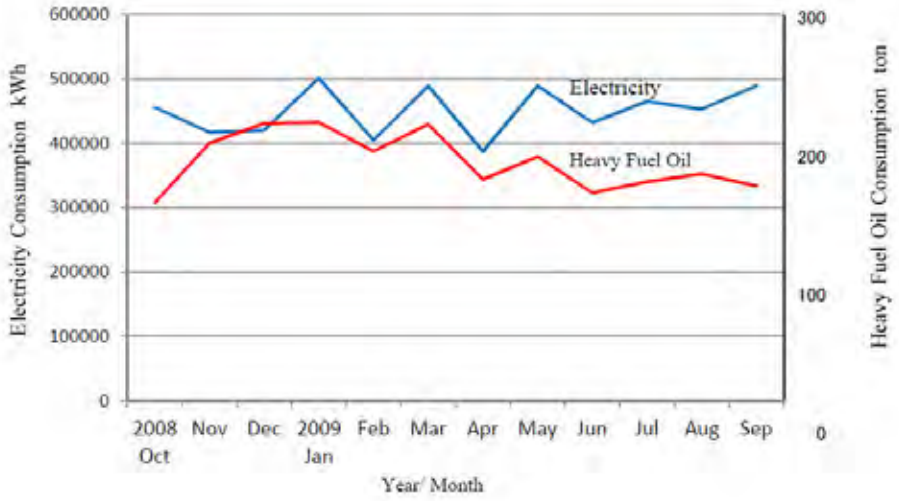
Utility Facilities	Steam Boiler		1	2	3			
	Evaporation (Rated)	t/h	3.50	8.00	3.50			
	Steam Press. (Rated)	bar	10.50	10.50	10.50			
	Kind of Fuel		Heavy Fuel Oil	Heavy Fuel Oil	Heavy Fuel Oil			
	Air Compressor		1	2				
	Type		FIAC AIR BLOK 100	ATLAS COPCO GA 75 PLUS				
	Air Volume (Rated)	Nm3/h	756.0	830.4				
	Discharge Press. (Rated)	MPaG	0.80	0.80				
	Input Power (Rated)	kW	82.0	75.0				
	Evaporation condenser		1	2				
	Type		VBO 655A GRAM	VBO 655A GRAM				
	Capacity (Rated)	MJ/h	1,512	1,512				
	Input Power (Rated)	kW						
	Receiving Power Transformer		1	2				
	Primary and Secondary Voltage		380	380				
	Capacity	kVA	1,000	1,000				
	Installed Year							
Air Conditioners	Heating							
	Heating Floor Area	m2	2,332					
	Heat Source		Steam 3 bar					
	Cooling							
	Cooling Floor Area	m2	2,332					
	Cooking Source		Chiller,TYPE SLC 1802 R407C BLN CG WESPER					
Lighting	Type of Lamps		Incandescent	Fluorescent ecs	Fluorescent (HF)	HID	Hg	Hg
	Number of Lamps	ecs	130,90	64,160,78	54	25, 40	130	20
	Ave. Consumed Power per each	W	60	18,36,58	2x9 =18	250, 400	125,250	400
Other Equipment Consuming a Large Quantity of Utilities(Pump, Blower, etc.), and the Specifications			Ammonia Reciprocating Compressors					
			GRAM TYPE HC-6-100-PCS					
			Cooling Capacity 174.5KW, Motor Power 75KW					

Unit Cost of Utilities

1) Electricity 0.035 €/kWh
2) Heavy Fuel Oil 0.376 €/kg

3-4. Consumption and Intensity of Energy

Year/Month		Energy Consumption				Production		Energy Intensity			
		Purchased Electricity		Heavy Fuel Oil (Mazut)	Potable Water	Processed Raw Milk	Sales Amount	Electricity		Fuel Oil	
		Peak in every month	Cumulative					Raw Milk Base	Sales Base	Raw Milk Base	Sales Base
		kW	kWh	ton	m3	kL	€	kWh/M-kL	kWh/1,000€	F-ton/M-kL	F-ton/1,000€
2008	Oct	810	456,000	153.660	38,220	6,152,286	3,450,092	74.1	132.2	0.0250	0.0445
2008	Nov	870	417,000	200.000	37,220	6,045,888	3,366,547	69.0	123.9	0.0331	0.0594
2008	Dec	855	420,000	215.380	38,620	6,039,944	3,439,366	69.5	122.1	0.0357	0.0626
2009	Jan	870	501,000	216.200	40,300	6,003,160	2,878,421	83.5	174.1	0.0360	0.0751
2009	Feb	915	405,000	193.780	36,400	5,139,748	3,117,933	78.8	129.9	0.0377	0.0622
2009	Mar	870	489,000	214.660	39,200	5,909,866	3,488,683	82.7	140.2	0.0363	0.0615
2009	Apr	810	387,000	171.820	38,950	5,738,708	3,472,814	67.4	111.4	0.0299	0.0495
2009	May	900	489,000	189.640	40,100	6,199,638	3,795,682	78.9	128.8	0.0306	0.0500
2009	Jun	915	432,000	161.340	39,000	5,909,424	3,814,924	73.1	113.2	0.0273	0.0423
2009	Jul	960	465,000	170.040	40,150	5,806,160	3,811,377	80.1	122.0	0.0293	0.0446
2009	Aug	960	453,000	176.020	40,070	5,708,252	3,726,599	79.4	121.6	0.0308	0.0472
2009	Sep	960	489,000	166.680	38,700	5,247,421	3,509,663	93.2	139.3	0.0318	0.0475
Total		-	5,403,000	2,229.220	466,930	69,900,495	41,872,101	-	-	-	-



4. Contents of EE&C Audit

4-1. General

1) Date 3/Nov. '09

2) Auditor Mr. Sadao Higaki (Responsible for Heat)
Mr. Susumu Takahashi (Responsible for Electricity)
Ms. Madoka Nakajima (Responsible for Building)

3) On 10/Nov, we additionally measured the motor ampere and compressed air pressure of which FIAC AIRBLOCK air compressor (Inverter) for about 3 hours.

4-2. Steam System

1) Measuring the exhaust gas at 8 t/h New Boiler
So as to confirm the operation conditions of 8t/h New Boiler, we measured the O2 and CO2 content and temperature of exhaust gas.

2) Checking the steam generation system and steam distribution system and preparing a flow sheet of the steam system

3) Checking the action of steam traps and leaking of the bypass valve

4) Checking the conditions of thermal insulation

4-3. Compressed Air System

1) Measuring the motor amp. of air compressors and compressed air pressure

2) Checking the compressed air generation system and distribution system and preparing a flow sheet of compressed air system

3) Checking the leakage of compressed air pipe lines

4-4. Cooling System for Storage Rooms

1) Checking the ammonia refrigeration chiller

2) Checking the thermal storage

3) Checking the fan coil unit (FCU) in storage rooms

4-5. Building

1) Air Handling Unit (AHU) and Fan Coil Unit (FCU)

2) Lighting System

4-6. Power System

1) Checking the power receiving facility

5. Results of EE&C Audit

5-1. Steam System

1) Making the flow sheet of steam system

So as to understand the whole steam system, we made the flow sheet excluding the process area based on the site survey. (refer to Attachement-1)

2) Measuring the exhaust gas at 8 t/h New Boiler

So as to confirm the operation conditions of 8t/h New Boiler, we measured the O2 and CO2 content and temperature of exhaust gas.

The measurement result is in the following Table-5-1.

Table-5-1 : Measurement Result of Exhaust Gas at 8t/h New Boiler

Date and Time	Temp. °C	O2 (Dry) %	CO2 (Dry) %
Nov./3 '09 10:31	264.5	5.2	12.4
10:32	271.1	4.6	12.6
10:33	288.9	3.4	13.4
10:34	297.3	3.0	13.7
10:35	289.0	3.6	13.2
10:36	257.3	5.3	11.9
10:37	248.2	5.7	11.6
10:38	251.3	5.0	12.2
Ave.	271.0	4.48	12.6

Operation Condition

- Evaporation 3.8 t/h
- Steam Press. 10.5 bar
- Steam Temp. 185.2 °C (Saturate)

2) Boiler efficiency of 8 t/h New Boiler

The exhaust gas loss (stack loss) % is calculated at 11.4% based on the measured data, and considering the radiation loss and blowdown loss the total efficiency would be about 85%.

- Exhaust Gas Los 11.4 %
- Radiation Loss: 2 % (assumed by ECCJ data)
- Blowdown Loss: 1.5 % (assumed by blow down ratio (5%))

Loss Total: 14.9 % → Boiler Efficiency : 85.1%

Properties of heavy fuel oil (Mazut) are as follows;

- Composition (wt%): C (85.73), H (12.16), O (0.30), N (0.30), S (1.03), H2O (0.48) Total (100)
- Net Heating Value: 43,544 kJ/kg
- Density: 0.92 g/cc at 15/4°C

3) Checking the condition of thermal insulation

The conditions of thermal insulation on equipment and pipe lines are as follows;

- The thermal insulation condition is relatively good.
- However, valves, flanges, small pipe lines and some parts of equipment are not insulated. (refer to Attachement-1)

4) Checking the steam Traps

We checked nine (9) steam traps and bypass valves about the correct action (leaking or not), and the results are in the following Table-5-2. (refer to Attachment-1)

Table-5-2 : Results of Steam Trap Checking

	Nos.	Correct Action	Leaking (Malfunction)	Malfunction Ratio %
Steam Trap	9	6	3	33
Bypass Valve	7	0	0	0

In case of the correct maintenance of steam traps, the malfunction ratio is 5 to 10%, therefore the malfunction ratio, 33%, is quite high.

We were informed that there were about forty (40) steam traps in the factory, the total malfunctioned steam traps would be about twelve (13).

In addition, at some radiators for heating, steam was consumed without steam traps.

The overall heat transfer rate of radiator tubes without steam traps is remarkably lower than that with steam traps. Therefore, the heating capacity of radiator is low, and live steam is exhausted as well.

Thus, in case of the usage without steam traps, the steam loss must/will be very large. Therefore, this situation would be better to be improved immediately.

Compressed Air System

1) Making the flow sheet of compressed air system

So as to understand the whole compressed air system, we made the flow sheet excluding the process area based on the site survey. (Attachement-2)

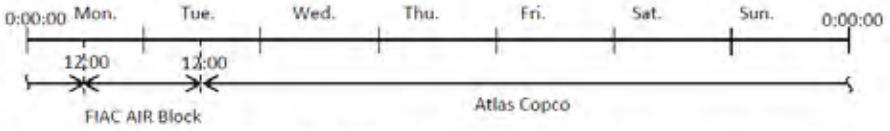
2) Confirming the operation conditions of air compressor

Mlekara Sabac dairy factory has two (2) air compressors, and these operation conditions are shown in Table 5-3.

Table-5-3 : Operation Condition of Air Compressor

Air Compressor	Capacity Nm3/h	Motor kW	Pressure Control	Remarks
Atlas Copco	830	82	Pressure Switch Control a. 7.0 bar : Unload to load or stop b. 7.8 bar : Load to unload c. Condition to be stop : - Low compressed air generation - Once per three (3) cycles	
FIAC AIRBLOCK	756	75	Inverter Control (Set Press. : 7.2 bar)	During the operation of Atlas Copco air compressor, automatically starting at compressed air press. 6.5 bar

Note : The fundamental operation pattern of each compressor is follows.



At Low compressed air generation the Atlas Copco air compressor repeats start and stop frequently (about every 8 minute), and this is not preferable for the life of bearings and motor of the compressor.

3) Measuring the motor ampere of air compressors and compressed air pressure

So as to analyze the operation condition of air compressor, we continuously measured the motor ampere of air compressors and compressed air pressure as follows.

- Nov.3 12:25 - Nov.5 11:46 (about 47 hours) : Atlas Copco operation
- Nov.10 9:41 - 12:50 (about 3 hours) : FIAC AIRBLOCK operation

Table- shows the two (2) hour data of Atlas Copco air compressor on 4/Nov. midnight, morning, afternoon and FIAC AIRBLOCK air compressor on 10/Nov. morning.

4) Present Operation Condition

The analyzed results of present operation conditions of air compressors based on the gathered data are shown in the following Table-5-4.

Table-5-4: Operation Ratio of Load/Unload/Stop, Motor Amp. and Air Pressure

Compressor	Date and Time	Operation Ratio %				Motor Amp.	Air Press.	Generated Air (Cf.)
		Load	Unload	Stop	Total	(Av.) A (kW)	(Av.) bar	Nm3/h
Atlas Copco	4/Nov. 1:00-300 Midnight	26.7	56.6	16.7	100	73.6 (43.3)	7.46	222
Atlas Copco	4/Nov. 10:00-1200 Morning	40.1	59.1	0.8	100	94.6 (55.7)	7.44	327
Atlas Copco	4/Nov. 14:00-16:00 Afternoon	42.8	60.2	0	100	96.9 (57.1)	7.42	345
FIAC AIRBLOCK	10/Nov. 10:00-1200 Morning	-	-	-	100	65.3 (42.9)	7.21	-

Note : a. Power Factor for calculating motor input kW

Atlas Copco 0.85 FIAC AIRBLOCK(Inverter) 0.95

b. The generated air of Atlas Copco air compressor was calculated assuming that the generated air at load operation was 830 Nm3/h (rated capacity).

Fig.-5-1 shows load / unload / stop operation ratio and assumed generated compressed air by the gathered data.

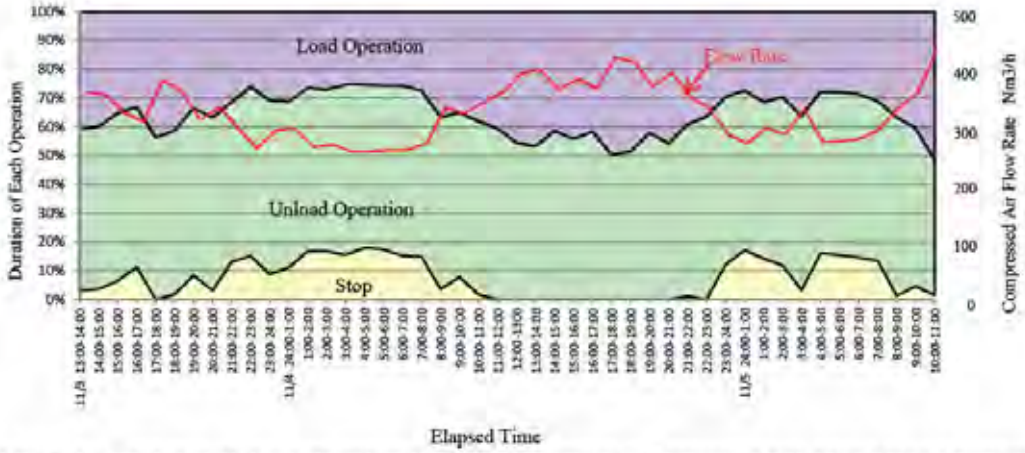


FIG.-5-1: Trend Data of Each Operation Ratio and Generated Compressed Air at Atlas Copco Operation

In addition, in order to confirm the performance of air compressor, generated air ratio was calcualted, shown in Table-5-5.

In general, the generated air ratio is 10 - 11 Nm3/kWh.

Table-5-5 : Calculation Results of Generated Air Ratio

Compressor	Date and Time	Motor Amp. at Load Operation A	Motor kW at Load Operation kW	Load Operation Ratio %	Air Press. (Av.) bar	Generated Air Nm3/h	Generated Air Ratio Nm3/kWh
Atlas Copco	4/Nov 10:00-12:00 Morning	142	79.4	40.1	7.44	327	10.3
FIAC AIRBLOCK	10/Nov 10:00-12:00 Morning	65.3	40.8	100	7.21	327	8.0

Note : a. The generated air of FIAC AIRBLOCK air compressor was assumed as the same of Atlas Copco because of the same time zone.

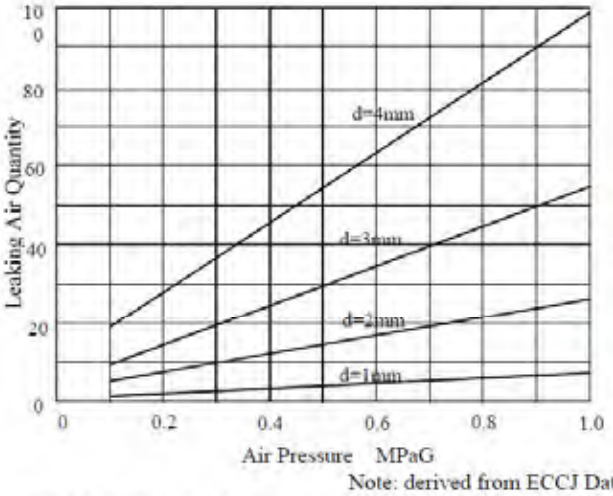
3) Checking the leakage of compressed air pipe lines

We surveyed leakage of compressed air in compressor room and around, and at some production area by using Ultrasonic Leak Detector, and found out the following leaking parts.

Table-5-5 shows the Estimated Equivalent Dia.1fole and Estimated Leaking Volume at every leaking part.

Table-5-6 : Leaking Parts and Leakage Volume of Compressed Air

No	Location	Estimated Equivalent Hole Dia Nm3/h	Estimated Leaking Volume Nm3/h	Remarks
1	Air Filter in Compressor Room-1	0.5	2.5	
2	Air Filter in Compressor Room-2	0.5	2.5	
3	Air Holder Drain Valve	1.5	12	
4	Air Filter in Production Area-1	1	6	Refer to Fig.-5-3
5	Air Filter in Production Area-2	1	6	
	Total	-	29	



Note: derived from ECCJ Data

Fig.-5-2 : Relation between Leaking Volume and Opening

Fig.-5-3 : An Example of Leaking Part

Cooling System for Storage Rooms

-1. Ammonia Refrigeration Chiller

1) There are 4 ammonia refrigeration chillers for cooling for storage rooms using ice thermal storage (80m3).
2) They are old and the capacity is short of necessity.
3) 4 pumps are operated in CWV control.
4) They are planned to be retrofit and some manufacturers, including Maekawa Seisakujo, have already provided proposals. Thus, it is not covered in this energy audit.

5-3-2. Thermal Storage

1) Ice thermal storage (80m3) is used.
2) The thickness of ice is 40mm.
3) The temperature is being checked on a monitor by an operator.
4) 5 pumps are used for circulation in the storage
5) Some heat loss form the storage seems to be recognized.

5-3-3. Fan Coil Unit (FCU) in Storage Rooms

1) FCU is used for cooling storage rooms
2) Refrigerant temperature to FCU is constant.
3) During operation, the doors of storage rooms were kept open.

-4. Building

5-4-1. Air Handling Unit (AHU) and Fan Coil Unit (FCU)

1) They are used for heating and cooling for production line rooms.
   The temperature data and specifications of AHU will be provided later.
2) It controls fresh-air intake according to the temperature of the return air.
   This means it has nothing to do with the necessary fresh-air intake volume.
   Fresh air volume seems to be used to control the supply air temperature and it can be zero.
3) No ventilation system exists other than the intake by AHU.
4) Heating period: 15 October – 15 April, Cooling period: 15 April – 15 October
5) Supply air duct is near the ceiling and return air duct is near the floor.
   The return air temperature in winter may not be appropriate, namely colder, for the control.
   Thus, it might be consuming more energy than necessary.

5-4-2. Lighting System

1) Some lamps are fluorescent type and incandescent type.
2) About half of them are turned off where unnecessary.

-5. Power System

1) The factory paid about 23,603,000 dinars for electricity in 2008.
2) About 7.3% of the above cost, 4,173,002 dinars, is paid for reactive power.
3) Average power factor, estimated roughly, is about 78%.
   In Japan, standard is 85% in terms of electricity tariff and 95% in case of EE&C Law.

6. EE&C Countermeasures

6-1. Steam System

6-1-1. Reduction of Evaporation Steam Pressure at Boiler

1) Present condition

The generated steam pressure at boiler is now 10.5 bar, and the steam is sent to production areas.

At every inlet of production area the steam is depressed by pressure reducing valves into 7, 6, 3.5, 3 bar respectively.

2) Countermeasures

Reducing the generated steam pressure as low as possible

3) Merit by reducing steam pressure

By lowering the steam pressure of boiler, the fuel consumption of boiler is able to be reduced due to the following four (4) reasons.

a. Decrement of heat input due to lowering generated steam enthalpy
b. Increment of boiler efficiency due to reduction of exhaust gas temperature
c. Reduction of radiation heat loss from steam pipe line (including valves, etc.) surface
d. Reduction of steam loss from steam traps

Table-6-1 and Fig.-6-1 show the fuel saving effect with three (3) cases (Press. 10.5 bar → 9 bar, 8 bar, 7 bar).

Table-6-1 : Fuel Saving Effect by Lowering Steam Pressure

Reduced Steam Press. bar	Decrement of heat input %	Increment of boiler efficiency %	Reduction of radiation heat loss %	Reduction of steam loss from steam traps %	Total fuel saving ratio %	Fuel saving quantity ton/y
10.5	Base	Base	Base	Base	Base	Base
9.0	0.25	0.38	0.20	0.10	0.93	21.3
8.0	0.50	0.61	0.34	0.17	1.62	37.1
7.0	1.00	0.86	0.49	0.24	2.59	59.3

Note: Annual fuel consumption : 2,290 kL/y

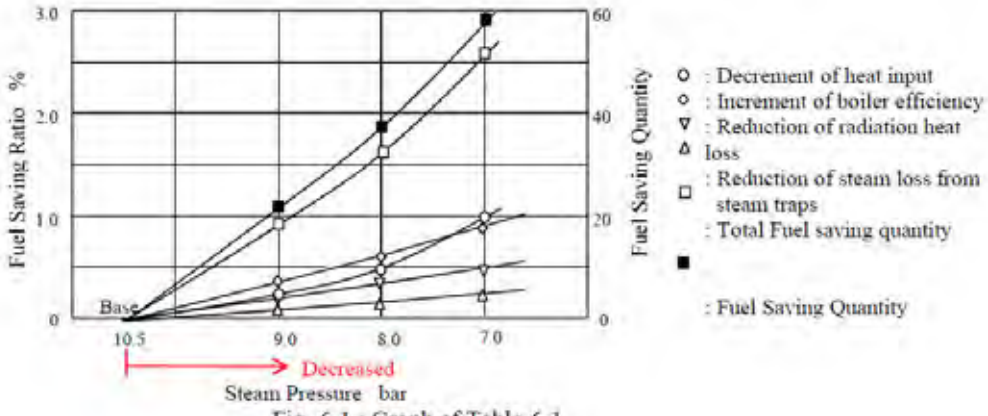


Fig.-6-1 : Graph of Table-6-1

In case to reduce the steam pressure to 8 bar, the calculation result is shown hereinbelow as an example.

(1) Decrement of heat input due to lowering generated steam enthalpy

a. Premises for calculation

- Boiler feed water enthalpy 436 kJ/kg
- Steam enthalpy at 10.5 bar 2,781 kJ/kg (185.2 °C)
- Steam enthalpy at 8.0 bar 2,771 kJ/kg (176.5 °C)
- Boiler efficiency 85 %

b. Calculation result of fuel saving ratio

(1-(2,771-436)/(2,781-436))/0.85*100= 0.50 %

(2) Increment of boiler efficiency due to reduction of exhaust gas temperature

a. Premises for calculation

- Boiler water temp. at 10.5 bar 185.2 °C
- Boiler water temp. at 8.0 bar 174.5 °C
- Exhaust gas temp. at 10.5 bar 271 °C
- Exhaust gas temp. at 8.0 bar 257.9 °C (calculated)

b. Calculated based on the following base

- Calculated by heat transfer equation Q=U*A*LMTD
  - Q : Transferred heat kJ/h
  - U : Overall heat transfer rate kJ/m2·h·deg.C (constant)
  - A : Heating surface m2 (constant)
  - LMTD Logarithmic Mean Temperature Difference °C
- Combustion gas temperature : 2.200 °C (calculated by specific heat of combustion gas)

c. Calculation result of decrement of exhaust gas loss and fuel saving ratio by software

Exhaust gas loss : 11.36 % → 10.75 % Fuel saving ratio : 0.61 %

(3) Reduction of heat loss from steam pipe line (including valves, etc.) surface

a. Premises for calculation

- Supposing the equivalent pipe line as follows
  - Insulated pipe line : 6"*400m
  - Non-Insulated pipe line : 6"*50m
- Radiation heat per 1m at 10.5 bar steam
  - Insulated : 490 kJ/h·m
  - Non-Insulated : 5,179 kJ/h·m
- Radiation heat per 1m at 8 bar steam
  - Insulated : 460 kJ/h·m
  - Non-Insulated : 4,709 kJ/h·m
- Steam enthalpy at 10.5 bar 2,781 kJ/kg (185.2 °C)
- Steam enthalpy at 8.0 bar 2,767 kJ/kg (176.5 °C)
- Boiler feed water enthalpy 436 kJ/kg
- Annual fuel consumption 2,229 ton/y
- NHV of heavy fuel oil 43,544 kJ/kg
- Boiler efficiency 85 %

b. Calculation result of reduced radiation loss

	10.5 bar	8 bar	
- Radiation heat from insulated pipe line	196,000	→ 184,000	kJ/h
- Radiation heat from non-insulated pipe line	258,950	→ 235,450	kJ/h
- Decrement of radiation heat			
(196,000-184,000)+(258,950-235,450) =		35,500	kJ/h

c. Calculation result of fuel saving

- 35,500/((3,800*(2,781-436))/85*100)*100 0.34 %

(4) Reduction of steam loss from steam traps

a. Premises for calculation

- Nos. of malfunctioned steam traps : 5 (assumed)
- Steam loss per each (ave.) : 10 kg/h
- Total Steam Loss : 50 kg/h

b. Calculation result of fuel saving

50-50*(8/10.5)^0.5 = 6.4 kg/h

c. Calculation result of fuel saving ratio

6.4/3,800*100 = 0.17 %

4) Saved amount, investment and payback period

(1) Saved amount

- Depressed press. 9 bar : 21.3*376 : 8,000 €/y
- Depressed press. 8 bar : 37.1*376 : 13,900 €/y
- Depressed press. 7 bar : 59.3*376 : 22,300 €/y

(2) Investment

None (unless the replacement of any pressure reducing valve)

(3) Payback period

None (unless the replacement of any pressure reducing valve)

5) Another comments

(1) Although the enthalpy of generated steam decreases, the steam consumption does not increase because the steam pressure is reduced by pressure reducing valves before users.

(2) Before the steam pressure reduction, it is required to confirm the capacity of each pressure reducing valve.

(3) At trying the steam pressure reduction, it should proceed step by step and gradually in cooperation with production side.
If it might affect to the operation of production facilities, it should be stopped and the pressure have to be increased up to the adequate pressure.

(4) The present steam transfer pipe lines have enough capacity for reducing the steam pressure.

(5) As for the production sites as well, it would be recommendable to reduce the steam pressure by lowering the set pressure of pressure reducing valve.
At production areas, the steam pipe lines (SUS) are not insulated due to sanitary reason. Therefore, reducing steam pressure would make the steam loss lower considerably.

6-1-2. Insulation on Non-Insulated Valves, etc.

1) Present conditions

Valves, flanges, small pipe lines and some parts of equipment are not insulated. (refer to Fig.-6-2)

Fig.-5- shows an example of non-insulated valves on the 8 t/h boiler steam header.

Fig.-6-2 : 8 t/h boiler steam header

2) Heat loss from non-insulated valves, etc.

The total heat radiation from non-insulated surfaces is 70,750 W/h excluding production area based on Table-6-2.

Table-6-2 : Heat Radiation from Non-Insulated Valves, etc. Surface

Globe Valves

Size	Rating	Press. bar	Temp. °C	Pipe Equivalent Length m	Heat Radiation per m W/m·h	Number of Valves	Total Heat Radiation W/h	
3/4"	PN16	10.5	185.2	1.20	283	20	6,792	
1-1/2"	PN16	10.5	185.2	1.20	470	2	1,127	
2"	PN16	10.5	185.2	1.30	569	4	2,960	
2"	PN16	2.8	141.1	1.30	363	3	1,414	
2"	PN16	0.02	104.0	1.30	223	1	290	
2"+Check	PN16	10.5	185.2	1.50	569	1	854	
3"	PN16	10.5	185.2	1.60	802	5	6,413	
3"	PN16	3.4	185.2	1.60	541	1	865	
4"	PN16	10.5	185.2	1.60	1,000	4	6,402	
5"	PN16	3.4	146.4	1.70	805	2	2,736	
6"	PN16	10.5	185.2	1.80	1,390	6	15,014	
6"+Check	PN16	10.5	185.2	1.90	1,390	1	2,641	Total
8"	PN16	10.5	185.2	1.90	1,187	1	2,255	49,764

Flanges

51

Size	Rating	Press. bar	Temp. °C	Pipe Equivalent Length m	Heat Radiation per m W/m·h	Number of Flanges	Total Heat Radiation W/h	
2"	PN16	10.5	181.2	0.50	569	2	569	
4"	PN16	10.5	181.2	0.50	1,000	1	500	
6"	PN16	10.5	181.2	0.60	1,390	3	2,502	Total
24"		0.2	105.0	0.40	1,178	1	471	3,572

Small size pipe lines

7

Size (Equivalent)	Press. bar	Temp. °C	Heat Radiation per m W/m·h	Pipe Length m	Total Heat Radiation W/h	
3/4"	10.5	181.2	283	50	14,150	Total
						14,150

Others

Location	Press bar	Temp. °C	Surface Area m2	Heat Radiation W/m·h	Total Heat Radiation W/h	
Old Deaerator	0.017	104.0	2.7	1,209	3,264	Total
						3,264
						Grand Total
						70,750

3) Countermeasures

(1) Insulation of upper-mentioned non-insulated valves, etc

(2) Fig.6-3 shows the insulation method by insulation jacket of indoor specification for reference.

FIG.-6-3 : An Example of Insulation Jacket on Valves

4) Saved heat Loss and fuel

(1) Premises

- Insulation Efficiency :	85 %
- Boiler Efficiency :	85 %
- Operation Hour :	8,760 h/y
- NHV of Fuel Oil	43,544 kJ/kg
- Annual Fuel Consumption:	2,229 ton/y

(2) Calculation

- Saved Heat Loss :	70,750*3.6*0.85 =	216,495 kJ/h
- Saved fuel :	216,495/43,544/0.85*8,760/1,000 =	51 ton/y
- Saved fuel consump. Ratio :	51/2,229*100 =	2.3 %

4) Saved amount, investment and payback period

(1) Saved amount	51*376 =	19,200 €/y
(2) Investment		15,000 €
(3) Payback period		0.8 y

6-1-3. Management of Steam Traps

1) Present condition

(1) Management of steam traps is not executed systematically.

(2) The malfunction ratio of steam traps would be around 30% based on the EE&C audit.

2) Countermeasures

(1) Periodical inspection of all steam traps and bypass valve on the action and leaking

(2) Required maintenance based on the inspection results

(3) As for how to proceed the periodical checking and maintenance, refer to Attachent-4.

3) Reduction of steam loss and effect by countermeasures

(1) Premises

- Number of Steam Traps :	40
- Malfunction Rate :	30 %
- Number of Malfunctioned Steam Tr	12
- Steam Loss per Steam Trap	10 kg/h
- Boiler Efficiency	85 %
- Enthalpy(A1) @ 10.5bar	2,781 kJ/kg
- Feed Water(B)	437 kJ/kg
- NHV of Fuel Oil	43,544 kJ/kg
- Annual Operation Hours	8,760 h/y
- Annual Fuel Consumption	2,229 ton/y

(2) Calculation

- Total Steam Loss : 12*10 = 120 kg/h
- Annual Steam Loss : 120*8,760/1,000 = 1,051 ton/y
- Annual Steam Generatio 43,544/(2,781-437)*2,229*1000*0.85/1,000 = 35,200 t/y
- Fuel Saving : 2,229*1,051/35,200 = 67 ton/y (▲3.0 %)

4) Saved amount, investment and payback period in the first year

(1) Saved amount 67*376 = 25,200 €/y
(2) Investment 10,000 € (1st year)
(3) Payback period 0.4 y

6-1-4. Steam Condensate Recovery

1) Present condition

(1) The most part of steam condensate is returned to Condensate Recovery Tank. However, due to the reason to prevent process fluids from entering into condensate side, the condensate is directly discharged to sewer system.
(2) Therefore, a lot of heat and potable water are not recovered.

2) Countermeasures

(1) Recovery of steam condensate with required countermeasures
(2) Fig.-6-4 is an example of countermeasure for steam condensate recovery.

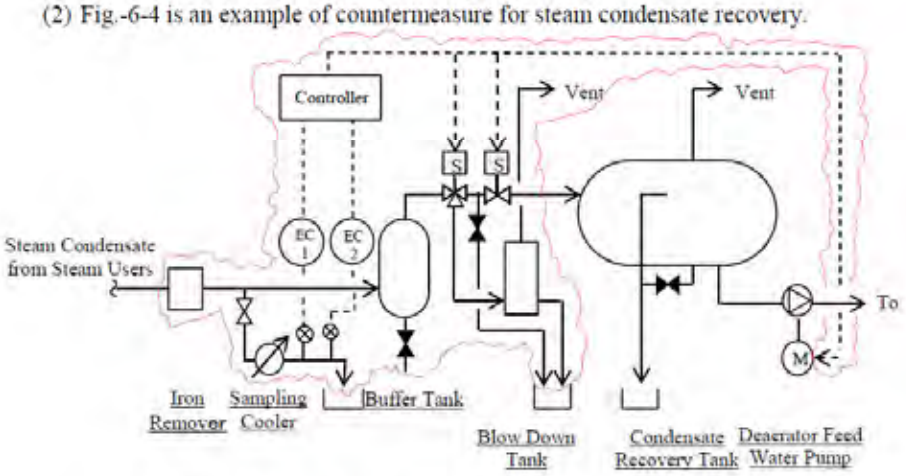


Fig.6-4 : An Example of Countermeasures for Steam Condensate Recovery

3) Effect of steam condensate recovery

(1) Premises

- Condensate Recovery Ratio : 50 %
- Condensate Recovery Temp. : 90 °C (Enthalpy : 376.8 kJ/kg)
- Fresh Feed Water Temp. : 20 °C (Enthalpy : 83.7 kJ/kg)
- Annual Steam Evaporation : 35,200 ton/y
- Annual Fuel Consumption 2,229 ton/y
- NHV of Fuel Oil 43,544 kJ/kg
- Annual Operation Hours 8,760 h/y

(2) Calculation

- Condensate Recovery Quantity : 35,200*0.5 = 17,600 ton/y
  2.01 ton/h
- Recovery Heat : (376.8-83.7)*2.01*1.000 = 589,000 kJ/h
- Fuel Saving : 589,000/43,544*8,760/1,000 = 118 ton/y (▲5.3%)

4) Saved amount, investment and payback period

(1) Saved amount 118*376 = 44,400 €/y

Note : Reduction of potable water consumption is not considered.

(2) Investment 100,000 €/y

(3) Payback period 2.3 y

6-1-5. Installation of Economizer at 8t/h Boiler

1) Present condition

(1) The 8t/h boiler is not equipped with economizer.

(2) The exhaust gas temperature at EE&C audit was 250 to 300 °C (Average: 271 °C), and it would be possible to recover the heat to feed water.

2) Countermeasures

Installing a economizer in exhaust gas duct at 8t/h Boiler

3) Calculation

(1) Premises

- Annual Fuel Consumption : 2,229 ton/y
- Boiler Feed Water Preheated Temp. 20 °C
- BFW Economizer Inlet Temp. : 104 °C (Deaerator Outlet)
- BFW Economizer Outlet Temp. : 124 °C (Boiler Feed)
- Annual Operation Hours of 8t/h Boi 7,450 h/y (85% Operation)

(2) Calculation

- Fuel Saving Ratio : 2.9 %
  (from Fig.6-5)
- Fuel Saving Quantity :
  2,229*0.029*0.85 = 55 ton/y

4) Saved amount, investment and payback period

(1) Saved amount 55*376 = 20,700 €/y

(2) Investment 70,000 €

(3) Payback period 50,000/21,200 = 3.4 y

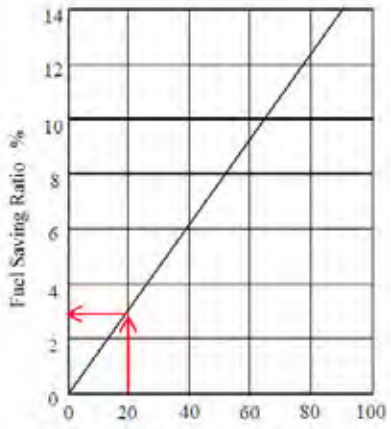


Fig.6-5 : Relation between Boiler Feed Water Preheated Temp. and Fuel Saving Ratio

Derived from ECCJ data

6-2. Compressed Air System

6-2-1. Decrement of Compressed Air Pressure

1) Present condition

(1) Operation pressure of compressed air

- Atlas Copco : 7.0 - 7.8 bar
- FIAC AIRBLOCK : 7.2 bar

(2) Input power at load operation

- Atlas Copco : 83.6 kW
- FIAC AIRBLOCK : 43.0 kW

(3) Operation term

- Atlas Copco : 6 days/week
- FIAC AIRBLOCK : 1 day/week

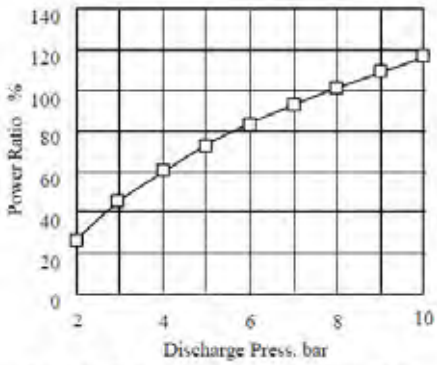


Fig.6-6 : Relation between Discharge Press. and Power Ratio at Air Compressor

Derived from ECCJ data

2) Countermeasures

Changing the set pressures of each air compressor

3) Calculation

(1) Premises

- Decrement of pressure : 0.5 bar
- Decrement of power ratio is 4% based on Fig.-6-6.

(2) Calculation

- Reduction of electric power

Atlas Copco :	83.6*0.04*8,760*6/7*0.5 =	12,600 kWh
FIAC AIRBLOCK :	43.0*0.04*8,760*1/7 =	2,200 kWh
	Total	14,800 kWh

4) Saved amount, investment and payback period

(1) Saved amount	14,800*0.035 =	520 €/y
(2) Investment		None
(3) Payback period		None

6-2-2. Decrement of Leaking Compressed Air

1) Present condition

Some leaking parts of compressed air were found out at the EE&C audit, and the total leaking volume would be about 50 Nm3/h including production area.

2) Countermeasures

Inspection of leaking parts of compressed air and repairing the leaking parts

3) Calculation

(1) Premises

- Leaking air volume : 50 Nm3/h
- Generated air ratio

Atlas Copco air compressor :	10.3 Nm3/h/kW
FIAC AIRBLOCK air compressor	8.0 Nm3/h/kW

(2) Calculation

- Generated Air Ratio : 10.3*6/7+8.0*1/7 = 9.97 Nm3/h/kW
- Reduction of electric power : 50*8,760/9.97 = 35,100 kWh

4) Saved amount, investment and payback period

(1) Saved amount 35,100*0.035 = 1,230 €/y
(2) Investment 2,000 €
(3) Payback period 1.6 y

6-2-3. Changing the Operation Pattern of Atlas Copco and FIAC AIRBLOCK Air Compressor

1) Present condition

(1) Operation days of each air compressor

- Atlas Copco air compressor : 6 days/week operation
- FIAC AIRBLOCK air compressor : 1 day/week operation

(2) Average motor ampere

- Atlas Copco air compressor : 94.6 A (at 4/Sept. 10:00-12:00)
- FIAC AIRBLOCK air compressor : 65.3 A (at 10/Sept. 10:00-12:00)

2) Countermeasures

Changing the operation days of each air compressor as follows

- Atlas Copco air compressor : 1 day/week operation
- FIAC AIRBLOCK air compressor : 6 days/week operation

3) Calculation

(1) Premises

- Motor power factor

Atlas Copco air compressor : 0.85
FIAC AIRBLOCK air compressor 0.95

(2) Calculation

- Motor input power
  - Atlas Copco air compressor : 94.6*0.38*3^0.5*0.85 = 52.9 kW
  - FIAC AIRBLOCK air compressor 65.3*0.38*3^0.5*0.95 = 40.8 kW
- Annual electric power (present)

52.9*8,760*6/7+40.8*8,760*1/7 = 448,000 kWh

- Annual electric power (improved)

52.9*8,760*1/7+40.8*8,760*6/7 = 373,000 kWh

- Difference of electric power 75,000 kWh

4) Saved amount, investment and payback period

(1) Saved amount 75,000*0.035 = 2,630 €/y
(2) Investment None
(3) Payback period None

6-3. Building

6-3-1. Replacing Incandescent Lamps to CFLs (Compact Fluorescent Lamps)

1) Present condition

(1) 220 incandescent lamps are equipped in the factory.

(2) About half of them are turned off where unnecessary.

2) Countermeasures

Replacing incandescent lamps to CFLs (Compact Fluorescent Lamps)

3) Calculation

(1) Premises

- Number of incandescent lamps: 220 (130+90)
- Average capacity of incandescent lamps: 60 W
- Operation hours/year: 24*365*0.75 (half of them were turned off for half)
- Power saving rate: 2/3 = 0.67
- Cost of bulb: Incandescent lamp: € 0.29, CFL: € 2.87

(2) Calculation

Power saving amount:

220*60*24*365*0.75*2/3/1,000 = 57,800 kWh/y

4) Saved amount, investment and payback period

(1) Saved amount 57,800*0.035 = 2,000 €/y

(2) Investment 650 €

(3) Payback period 0.3 y

6-3-2. Replacing Ballast of Fluorescent Lamps to Hf lamps

1) Present condition

(1) 302 fluorescent lamps are equipped in the factory.

(2) About half of them are turned off where unnecessary.

2) Countermeasures

Replacing ballasts of fluorescent lamps to Hf lamps

3) Calculation

(1) Premises

- Number of fluorescent lamps: 64 (18W), 160 (36W), 78 (58W) (Total: 302)
- Average capacity of fluorescent lamps: 38W
- Operation hours/year: 24*365*0.75 (half of them were turned off for half)
- Energy saving ratio : 30%

(2) Calculation

Power saving amount:

302*38*24*365*0.75*0.3/1,000 = 22,600 kWh/y

4) Saved amount, investment and payback period

(1) Saved amount 22,600*0.035 = 800 €/y

(2) Investment 4,000 €

(3) Payback period 5.0 y

6-4. Power System

6-4-1. Adding Leading Phase Condenser (reactive power compensation unit) to the Power System

1) Present condition

(1) The factory paid about 23,603,000 dinars for electricity in 2008, and about 7.3% of the above cost, 4,173,002 dinars, is paid for reactive power.

(2) Average power factor, estimated roughly, is about 78%.

2) Countermeasures

Adding leading phase condenser to the power system

3) Calculation

(1) Premises

There are no measured data on power factor. Thus, the calculation here is based on the available data, summation of monthly reactive power. The result can be only effective for a reference.

- Power factor: before: 78.2 % to after: 95%
- Demand capacity: 850kW (average)
- Capacity of condenser: 850 * 0.474 = 402.9 kvar
- Tariff: 0.28 – 0.57 din/kvarh, 0.41 din/kvarh (average of 2008)

(2) Calculation

Reduced amount of reactive power; is calculated by the following equation by each month.

0.95 = P/ sqrt (P*P +Q*Q); P: effective power (kW), Q: reactive power (kvar)

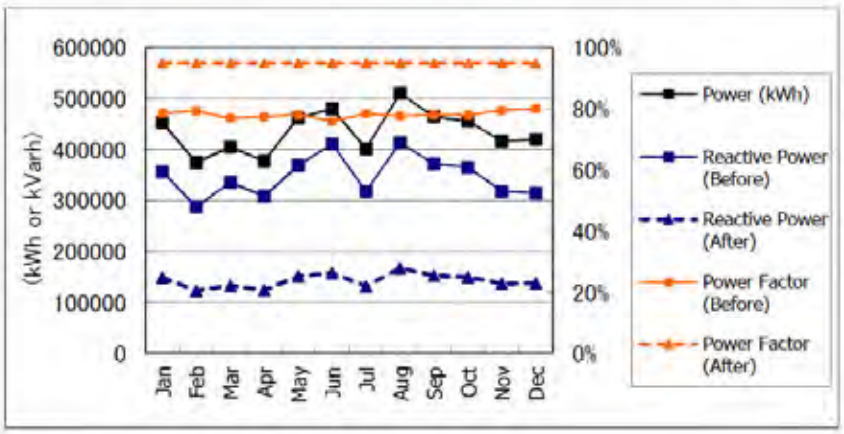
1,717,000 kvarh/year

4) Saved amount, investment and payback period

(1) Saved amount	1,717,000*0.41 =	704,000	din/y	(7,250 €/y)
(2) Investment		-	din	
(3) Payback period		-	y	

5) Note

- This calculation is based on the monthly data of reactive power (kvarh). Thus, the value shows just an average. It is necessary to measure power factor even for a short period.
- This method is to reduce reactive power, power wasted without noticing in the unit of kWh. However, it reduces waste as a society or power grid and also reduce cost of consumers.



7. Conclusion

1) The EE&C audit result is shown in Fig.-1-1, and there are some effective countermeasures of short pay back period for the EE&C in your factory.
2) We would be very happy if our EE&C audit result would be some of your help for your further activity towards EE&C.

EE&C Audit Report of B Hospital

February, 2010

JICA Study Team

Contents

1. Summary

1-1. EE&C Audit Results

The summary of EE&C Audit results are in the following Table-1-1.

Table-1-1 : Summary of EE&C Audit Results of [redacted]

No.	Item	Saved Utility	Reduction of Utility Consumption /year	Reduction of Utility Cost RSD/year	Investment RSD	Payback Period year	Remarks
1	Improvement of Steam Boiler Efficiency Case-1 : Replacement of burner Case-2 : Replacement of boiler	Natural Gas	11,600 Sm3	348,000	Case-1: 1,480,000 Case-2: 4,000,000	Case-1: 4.3 Case-2: 11.5	1) Changing to continuous combustion from intermittent combustion 2) Considering the worn-out of steam boiler (installed in 1982), it would be better to replace with new one.
2	Insulation on Non-Insulated Valves, etc. at Steam System	Natural Gas	13,000 Sm3	390,000	700,000	1.8	
3	Management of Steam Traps	Natural Gas	9,000 Sm3	270,000	200,000	0.7	1st year
4	Improvement of Hot Water Boiler Efficiency	Natural Gas	7,340 Sm3	220,000	200,000	0.9	
5	Installation of Thermostatic Valves for Radiators and VWV system	Electricity	65,700 kWh	295,700	3,500,000	12	
6	Replacement of incandescent lamps to CFLs	Electricity	219,000 kWh	985,500	280,000	0.3	
7	Replace ballasts of fluorescent lamps to Hf lamps	Electricity	1,500 kWh		-	5 - 10	

1-2. EE&C Potential

As for the EE&C potential the result of examination is in the following Table-1-2.

Table-1-2 : EE&C Potential of [redacted]

Utility	Annual Utility Consumption Sm3 or kWh	Quantity of Reduction Sm3 or kWh	Factor of Intervention	Corrected Quantity of Reduction Sm3 or kWh	Rate of Reduction %	Reduction of Utility Cost din	Investment	din	Payback Period y	Remarks
Natural Gas	463,413	40,940	0.9	40,940	8.8	1,228,000	(1-Case-1) (1-Case-2)	2,580,000 5,100,000	2.1 4.2	Item-1,2,3,4
Electricity	3,165,778	219,000	-	219,000	6.9	985,500		280,000	0.3	Item-6
Total	27,163 GJ 7,544 MWh	2,183 GJ 606 MWh	-	2,183 MW 606 MWh	8.0	2,213,500	(1-Case-1) (1-Case-2)	2,860,000 5,380,000	1.3 2.4	NHV of NG: 34.038 MJ/Sm3

2. Background of this Project and Outline of EE&C Audit

2-1. Background of This Project

The Republic of Serbia (Serbia) requested a study for introduction of Energy Management System (EMS) for Serbia to the Government of Japan (GOJ). The GOJ has dispatched the JICA Study Team to conduct the study since July 2009.

As a part of the study, the JICA Study Team proposed that a pilot implementation of temporary EMS in model sites (a factory and a building), in order to feedback the results and lessons learned to a scheme design of EMS.

The 6 candidate sites (3 factories and 3 buildings) were short-listed by the Steering Committee, and The JICA Study Team visited these 6 sites and made interviews to responsible persons in September.

As a result, the JICA Study Team together with the Steering Committee selected 2 sites including [redacted] as the factory considering EE&C potential, variety of energy consuming equipment and their strong willingness to achieve EE&C.

The pilot project consists of the following contents.

1) Component 1: Training Program (provided by the JICA Study Team)
   - Internal training program to raise awareness and skill of site staff (especially focusing on middle management class)
2) Component 2: EE&C Study (provided by the JICA Study Team)
   - Initial measurement and data analysis for energy consuming equipment
   - Study for EE&C potential and methods by 3 classes (O&M improvement, simple investment, large investment)
3) Component 3: Periodical Reports (Joint Activities by the JICA Study Team and the Site
   - Appointment of temporary Energy Manager within the site
   - Discussion of format of Periodical Reports consisting of energy consumption data/energy consuming equipment list, and EE&C plan
   - Collection of monthly data and making Periodical Reports by the temporary Energy Manager

2-2. Outline of the EE&C Audit

This EE&C Audit was carried out as one activity out of EE&C potential study of the Component-2 for the following purposes.

1) Grasping the present conditions of energy consuming equipment by questionnaire, interview, site survey and measurement
2) Picking up the promising items for EE&C improvement
3) Examining each item
4) Preparing and submitting a EE&C Audit Report

3. Outline of [redacted] Hospital

3-1. Outline of [redacted] Hospital

1) Name and Kind of Institution	[redacted]
2) Ownership	
3) Address, Tel. and E-Mail	
4) Number of Employees	907 persons
5) Operation Days per Year	365 days
6) Operation Hours per Day	24 hours
7) Energy Consumption	
(1) Electricity	3,165,778 kWh in 2008
(2) Natural Gas	463,413 Sm3 in 2008
(3) Heavy Fuel Oil	0 (Emergency Use)

3-3. Outline of Utility Facilities

Utility Facilities	Steam Boiler		1	2			
	Evaporation (Rated)	t/h	2.08	1.116			
	Steam Press. (Rated)	MPaG	1.05	1.05			
	Kind of Fuel		Natural Gas	Heavy Fuel Oil			
	Hot Water Boiler		1	2			
	Capacity (Rated)	MW	2.9	2.9			
	Kind of Fuel		Natural Gas	Heavy Fuel Oil			
	Air Compressor						
	Type						
	Air Volume	Nm3/h					
	Discharge Press. (Rated)	MPaG	10 Bar				
	Input Power (Rated)						
	Receiving Power Transformer		1	2			
	Primary and Secondary Voltage		/ 380	/ 380			
	Capacity	kVA	600kW	400kW			
	Installed Year		1970	1992			
	Independent Generator		1				
	Type / Kind of Fuel		/				
	Generated Power (Rated)	kVA	200kW				
	Normal Use or Emergency Use		Emergency Use				
Air Conditioners	Heating						
	Heating Floor Area	m2	about 31,500m2 (total floor area).				
	Heat Source		Hot Water Boiler				
	Cooling						
	Cooling Floor Area	m2					
	Cooking Source						
Lighting	Type of Lamps		Incandescent	Fluorescent	Fluorescent (HF)	HID	Hg
	Number of Lamps						
	Ave. Consumed Power per eac	W	75W	30W			
Other Equipment Consuming a Large Quantity of Utilities(Pump, Blower, etc.), and the Specifications			Sterilization, Washing, Laundry, Cooking				

3-4. Unit Price of Utilities

1) Electricity 4.5 din/kWh
2) Natural Gas 30 din/Sm3

3-5. Energy Consumption

The energy consumption in 2008 is in the following Table-3-1 and Fig.-3-1.

Table.-3-1 : Energy Consumption at [redacted] Hospital

Year/Month	Energy Consumption					Water	
	Purchased Electricity		Natural Gas	Heavy Fuel Oil (Mazut)		Potable Water	Well or River Water
	Peak in every mouth kW	Cumulative kWh	Sm3	ton		m3	m3
2008 Jan		364,411	109,766	0		2,000	18,000
2008 Feb		298,800	67,980	0		2,000	18,000
2008 Mar		310,000	57,990	0		2,000	18,000
2008 Apr		241,400	23,148	0		2,000	18,000
2008 May		221,512	6,182	0		2,000	18,000
2008 Jun		206,800	5,875	0		2,000	18,000
2008 Jul		232,000	5,865	0		2,000	18,000
2008 Aug		209,800	5,989	0		2,000	18,000
2008 Sep		234,000	7,055	0		2,000	18,000
2008 Oct		252,200	27,426	0		2,000	18,000
2008 Nov		256,255	56,306	0		2,000	18,000
2008 Dec		338,600	89,831	0		2,000	18,000
Total	-	3,165,778	463,413	0		24,000	216,000

Because there is no flow meter of natural gas for the steam boiler and hot water boiler respectively, the natural gas consumption at each boiler is not appreciated precisely.

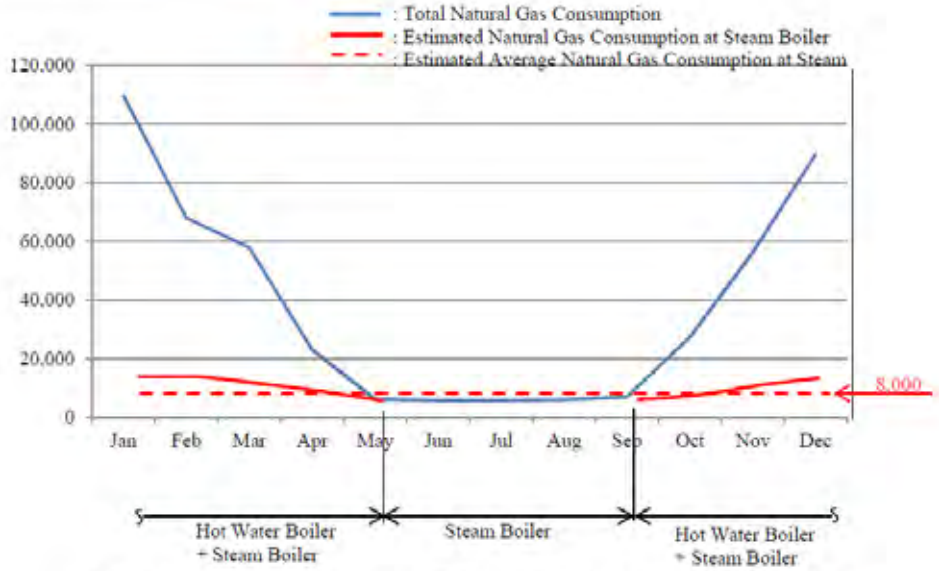


Fig.-3-1 : Natural Gas Consumption at the Steam Boiler and Hot Water Boiler

In consideration of the steam boiler operation from middle of May to middle of Sept., the natural gas consumption at the steam boiler would be around 96,000Sm3/y (8,000 x 12 months) based on the Fig.-3-1 .

Therefore the yearly natural gas consumption at steam boiler and hot water boiler are as follows.

- Steam Boiler 96,000 Sm3/y
- Hot Water Boiler 367,400 Sm3/y
- Total 463,400 Sm3/h

4. Contents of EE&C Audit

4-1. General

1) Date 2/Nov. '09

2) Auditor Mr. Sadao Higaki (Responsible for Heat)
Mr. Susumu Takahashi (Responsible for Electricity)
Ms. Madoka Nakajima (Responsible for Building)

4-2. Steam System

1) Measuring the exhaust gas at natural gas burn steam boiler
So as to confirm the operation conditions of natural gas burn steam boiler, we measured the O2 and CO2 content and temperature of exhaust gas.
2) Checking the steam generation system, steam distribution system and seam users
3) Making a flow sheet of the steam system
4) Checking the action of steam traps and leaking of the bypass valve
5) Checking the conditions of thermal insulation

4-2. Hot Water System

1) Measuring the exhaust gas at natural gas burn hot water boiler
2) Checking the steam generation system and steam distribution system
3) Making a flow sheet of the hot water system

4-3. Building

1) Checking the thermal insulation properties of buildings
2) Checking the heating systems
3) Checking the lighting facilities

5. Result of EE&C Audit

5-1. Steam System

1) Making the flow sheet of steam system

So as to understand the whole steam system, we made the flow sheet based on the site survey. (refer to Attachement-1)

2) Measuring the exhaust gas at the natural gas burning steam boiler

So as to confirm the operation conditions of the natural gas burning steam boiler, we measured the O2 and CO2 content and temperature of exhaust gas.

The measurement result is in the following Table-5-1 and Fig.-5-1.

Table-5-1 : Measurement Result of Exhaust Gas at Natural Gas Burning Steam Boiler

Time	Elapsed Time min.	Exhaust Gas Temp. °C	Exhaust Gas O2 %	Exhaust Gas CO2 %	Steam Press. bar	Remarks
15: 26 00	0	105	20.9		0.38	Pre-purge(50 sec.) start
26: 50	1	105	20.9		0.35	Burning start
28: 00	2	217	5.9	9.5		
29: 00	3	224	5.7	9.5	Increasing	
30: 00	4	224	5.8	9.5	↓	1 cycle : 8min.
30: 30	4.5	224	5.8	9.5	0.5	
31: 00	5	152	15.5			
31: 30	5.5	117	19.3		Decreasing	
32: 00	6	109	20.2			
32: 30	6.5	105	20.9		↓	
34: 00	7	105	20.9		0.38	Pre-purge(50sec.) start
34: 50	8	105	20.9		0.35	Burning start
Average in Burning		222	5.8	9.5		

The steam boiler is operated by intermittent natural gas burning, and the cycle is about eight (8) minutes. The set steam pressures to start pre-purge and stop burning are 0.38 bar and 0.5 bar respectively. Before starting burning the pressure goes down up to 0.35 bar due to pre-purge.

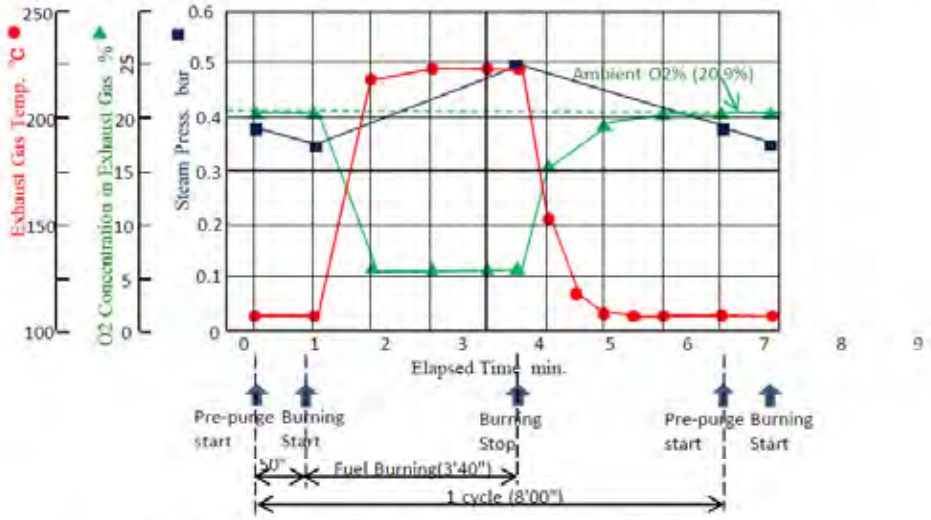


Fig.-5-1 : Trend Graph of Operation Conditions at the Steam

2) Calculation of boiler efficiency of the steam boiler

(1) Calculation of Pre-Purge Loss

Operation Hours	12	h/d	
	3,754	h/y	313d/y
Fuel Consumption	8,000	Sm3/month	
	96,000	Sm3/y	
	91,000	Nm3/y	
Ave. Fuel Consumption	25.6	Sm3/h	
Burning Ratio	45.8	%	
Average Burning NG Flow	55.8	Sm3/h	
Average Combustion Air Flow	745	Nm3/h	
Air Flow at Pre-Purge	3,726	Nm3/h	

Note: Because of the following reasons, the air flow of pre-purge is supposed as five (5) time on the average combustion air flow.

- Increment of air flow at pre-purge
- Ingress of ambient air to boiler inside during the stop of combustion
- Reheat of internals of the boiler at the start of combustion
- Heat radiation during the stop of combustion

Av. Steam Press.	0.42	bar
Av. Steam Temp.	109.2	°C
Seam Condensate Enthalpy	457.6	kJ/kg
Steam Enthalpy	2,690	kJ/kg
Air Cp	1.30	kJ/Nm3·deg
NG NHV	35,929	kJ/Nm3
	34,058	kJ/Sm3
Feed Water Enthalpy	293	kJ/kg (70°C)
Energy Loss by Pre-purge	44,936	kJ/h
NG Loss by Pre-Purge	1.32	Sm3/h
	4,953	Sm3/y
	5.2	%

(2) Calculation of Boiler Efficiency

Stack Loss at Burning	11.7 %	at average temperature and O2%
Pre-Purge Loss	5.2 %	
Heat Radiation Loss	5 %	
Blow Down Loss	5 %	
Total	27 %	
Boiler Efficiency	73 %	

3) Checking the condition of thermal insulation

The conditions of thermal insulation on equipment and pipe lines are as follows.

- Valves, flanges, small pipe lines on steam pipe lines are not insulated. (refer to Attachement-1)
- Condensate recovery pipe lines, condensate recovery tank and boiler feed water tank (70 °C) are not insulated.
- The insulation on steam header in boiler house is damaged. (refer to Attachement-1)

3) Checking the steam Traps

We checked six (6) steam traps about the action (leaking or not). and the results are in the following Table-5-2. (refer to Attachment-1)

Table-5-2 : Results of Steam Trap Checking

Checked Number	Correct Action	Leaking (Malfunction)	Malfunction Ratio %
6	3	3	50

In case of the correct maintenance of steam traps, the malfunction ratio is 5 to 10%. Therefore the malfunction ratio of 50% is quite high.

About ten (10) steam traps are continuously used, so about five (5) steam traps would be malfunctioned.

4) Calculation of boiler steam generation

Based on the information of boiler operation, the boiler steam generation was calculated. As a result of calculation, the average of hourly steam generation is 0.27 t/h (270 kg/h).

(1) Premises

- Boiler Efficiency 73 %
- Fuel Consumption 91,000 Nm3/y
- NG NHV 35,929 kJ/Nm3
- Steam Enthalpy 2,690 kJ/kg
- Feed Water Enthalpy 293 kJ/kg (70°C)
- Operation Hours 3,754 h/y

(2) Calculation

- Yearly steam generation
  91,000*35,929*0.73/(2,690-292)/1000 = 995 ton/y
- Average of hourly steam generation
  995/3,754 = 0.27 ton/h

5) Another Comments

(1) So as to prevent boiler water from concentrating hardness components, it is very important to manage the blow down of boiler water.
Without adequate blow down management, fouling troubles in boiler water side and damage of boiler tubes would be brought about due to accumulation of hardness components on the metal surface.

-2. Hot Water System

1) Making the flow sheet of hot water system

So as to understand the hot water system, we made the flow sheet based on the site survey. (refer to Attachement-2)

2) Measuring the exhaust gas at the natural gas burning hot water boiler

So as to confirm the operation conditions of natural gas burning hot water boiler, we measured the O2 and CO2 content and temperature of exhaust gas.

The measurement result is in the following Table-5-3.

Table-5-3 : Measurement Result of Exhaust Gas at Natural Gas Burning Hot Water Boiler

High Load Operation

Time	Temp. °C	O2 %
3/Nov. 12:50	212	1.3
12:51	220	0.9
12:52	221	0.9
12:53	222	0.9
Ave.	219	1.0

(Cf.) Exhaust gas heat loss : 9.4%

Low Load Operation

Time	Temp. °C	O2 %
3/Nov. 13:00	108	10.0
13:01	109	9.9
13:02	107	10.0
13:03	110	9.8
Ave.	109	9.9

(Cf.) Exhaust gas heat loss : 4.2%

. Building

-3-1. Thermal Insulation Properties of the Buildings

Obesrvation results on the thermal insulation conditions of buildings are as follows.

- Air-tightness of window frame
- No insulation of walls
- No insulation of roofs

-3-2. Heating Systems

1) Heating Radiator

It has nothing to control the output according to the room temperature or demand.

Room temperatures of some rooms are higher than necessary resulting in making people to open windows and those of others are lower than necessary. (interview based information)

2) Pipe System

They are so old that some leakage and heat loss might be assumed.

In addition, considering temperature variety in the rooms/buildings, there must be some rooms for revision on the heat allocation, namely pipe system with consideration on each room temperature.

3) Benchmark evaluation on Heating Energy

Energy consumption by hot water boiler is about 113 kWh/ m2.

That of average in Serbia is about 205. (Mr. Alexandar's presentation at a workshop of 4 Nov. 2009).

Other samples of a project shows 248 – 272 kWh/m2 (WB report part IV).

Another data shows 108 kWh/m2 for smaller hospitals (which is calculated based on the data of projects on SEEA's website.) In case of UK is 263 kWh/m2 and Germany is 225 kWh/m2. (Alexandar's presentation)

Having evaluated with those data above, energy consumption for heating at Cupria is rather low.

It may derive from that some buildings might not satisfy the necessary temperature.

-3-3. Lighting Systems

- There are incandescent lamps and fluorescent lamps.
- Some of them, approximately half of them, are turned off or broken down. As a result, it contributes to energy conservation.
- The data provided by Cupria Hospital is that average consumed power per each is 75W for incandescent, and 30W for fluorescent lamps.

6. Recommendation for EE&C based on the EE&C Audit

6-1. Steam System

6-1-1. Changing the present burning system into continuous burning one

1) Present condition

The steam boiler is operated by intermittent natural gas burning, and it makes the boiler efficiency lower due to the following two (2) reasons.

(1) Heat loss by pre-purge and ingress of fresh air to boiler inside during stopping burning

(2) Exhaust gas heat loss during burning due to the high load burning

2) Countermeasures

It would be recommendable to change the present burning system into continuous burning one, and as the countermeasures the following two (2) cases would be considered.

Case-1 : Replacement of burner with continuous burning type

Case-2 : Replacement of boiler with continuous burning type

3) Saved natural gas consumption

(1) Present boiler efficiency

- Exhaust gas loss	11.7 %	(Exhaust gas temp.: 222 °C, O2% : 5.8 %)
- Pre-Purge loss	5.2 %	
- Heat Radiation Loss	5 %	
- Blow Down Loss	5 %	
Total	26.9 %	
Boiler Efficiency	73 %	

(2) Improved boiler efficiency by countermeasure

- Exhaust gas loss	6.9 %	(Exhaust gas temp.: 150 °C, O2% : 4 %)
- Heat Radiation Loss	5 %	
- Blow Down Loss	5 %	
Total	16.9 %	
Boiler Efficiency	83 %	

(3) Saved natural gas consumption

a. Premises for calculation

- Present natural gas consumptio	96,000 Sm3/y
- Present boiler efficiency	73 %
- Improved boiler efficiency	83 %

b. Calculation of saved natural gas

96.000-96.000*0.73/0.83 = 11.600 Sm3/y

4) Saved amount, investment and payback period

(1) Saved amount

11.600*30 = 348.000 din/y

(2) Investment

Case-1 : 1.480.000 din

Case-2 : 4.000.000 din

(3) Payback period

Case-1 : 4.3 y

Case-2 : 11.5 y

6-1-2. Insulation on Non-Insulated Valves, etc.

1) Present conditions

Valves, flanges, and some vessels are not insulated. Fig.-6-1 shows an example of non-insulated valves on the steam header.

Fig.-6-1 : Steam header

2) Heat loss from non-insulated valves, vessels, etc.

The total heat radiation from non-insulated surfaces is 38,700 W/h from the following Table-6-1.

Table-6-1 : Heat Radiation from Non-Insulated Valves, Vessels, etc. Surface

Globe Valves

Size	Rating	Press. bar	Temp. ℃	Heat Radiation W/m·h	Pipe Equivalent Length m	Number of Valves	Total Heat Radiation W/h
1"	PN16	0.42	109.2	164	1.2	2	395
1-1/2"	PN16	0.42	109.2	223	1.2	8	2,137
2"	PN16	0.42	109.2	268	1.3	7	2,442
3"	PN16	0.42	109.2	374	1.6	4	2,392
4"	PN16	0.42	109.2	463	1.6	2	1,483
6"	PN16	0.42	109.2	637	1.8	2	2,295
8"	PN16	0.42	109.2	806	1.9	2	3,064
Total						27	14,206

Flange

Size	Rating	Press. bar	Temp. ℃	Heat Radiation per m W/m·h	Pipe Equivalent Length m	Number of Flange	Total Heat Radiation W/h
6"	PN16	0.45	109.2	637	0.6	1	382
Total							382

Damaged Pipe Insulation

Location	Size	Press. bar	Temp. ℃	Heat Radiation W/m·h	Pipe Length m	Insulation Efficiency %	Total Heat Radiation W/h
Steam Header	8"	0.42	109.2	637	2.5	50	797
Total							797

Non-Insulated Equipment

Location	Size	Surface Area m2	Press. bar	Temp. ℃	Heat Radiation W/m2·h	Total Heat Radiation W/h
Boiler Feed Water Tank	1,600ODx3,300TL	18.8	Atmos.	70	616	11,573
Condensate Rec. Tank	2,200Lx1,000Wx1,600H	12.4	Atmos.	90	943	11,697
Total						23,270

Total heat loss :	38,700 W/h

3) Calculation of steam loss

(1) Premises

- Total heat loss :	38,700	W/h
- Steam Enthalpy :	2,690	kJ/kg
- Condensate Enthalpy :	458	kJ/kg
- Insulation Efficiency	85	%
- Boiler Efficiency	73	%
- NHV of Natural Gas	34,058	kJ/Sm3
- Operation hours	3,745	h/y

(2) Calculation

- Saved Steam Loss :	38,700*0.85*3,600/1,000/(2,690-458) =	53 kg/h
- Saved Natural Gas :	38,700*0.85*3,600/1,000/34,058*3,745 =	13,000 Sm3/h

3) Countermeasures

(1) Insulation of upper-mentioned non-insulated valves, vessels, etc.

(2) Fig.-6-2 shows the insulation method by insulation jacket of indoor specification for reference.

FIG.-6-2 : An Example of Insulation Jacket on Valve

4) Saved amount, investment and payback period

(1) Saved amount

13,000*30 = 390,000 din/y

(2) Investment 700,000 din

(3) Payback Period 1.8 y

6-2-3. Management of Steam Traps

1) Present conditions

(1) Management of steam traps is not executed systematically.

(2) The malfunction ratio of steam traps would be around 50% based on the EE&C audit.

2) Countermeasures

(1) Periodical inspection of all steam traps and bypass valve on the action and leaking

(2) Required maintenance based on the inspection results

(3) As for how to proceed the periodical checking and maintenance, refer to Attachent-4.

3) Reduction of steam loss by countermeasures

(1) Premises

- Number of Steam Traps	10
- Malfunction Rate	50 %
- Number of Malfunctioned Steam Trap :	5
- Steam Loss per Steam Trap	5 kg/h
- Boiler Efficiency	73 %
- NHV of Natural Gas	34,058 kJ/Sm3
- Operation hours	3,745 h/y

- Steam Enthalpy 2,690 kJ/kg
- Feed Water Enthalpy 293 kJ/kg (70 °C)

(2) Calculation
- Total steam loss 5*5 = 25 kg/h
- Saved natural gas
  25*(2,690-293)/0.73/34,058*3,745 = 9,000 Sm3/h

4) Saved amount, investment and payback period in 1st year
(1) Saved amount
9,000*30 = 270,000 din/y

(2) Investment (1st year) 200,000 din

(3) Payback Period 0.7 y

6-2. Hot Water System

6-2-1. Improvement of Hot Water Boiler Operation

1) Present conditions
(1) The Hot Water Boiler of natural gas burning is operated from the middle of October to the middle of May.
(2) The hot water is supplied to each building with the temperature about 60 °C.
(3) Depending on the operation condition the boiler is operated by the following operations.
- Burning stop
- High load burning
- Low load burning
(4) The boiler efficiencies at high load burning and low load burning are in the following Table-6-2.

Table-6-2 : Present Boiler Efficiency of Hot Water Boiler

Operation	Exhaust Gas O2 %	Exhaust Gas Temp. °C	Exhaust Gas Loss %	Radiation Loss %	Total Loss %	Boiler Eff. %
High Load	1.0	218	9.4	2.0	11.4	88.6
Low Load	9.9	109	6.7	2.0	8.7	91.3

2) Countermeasures
(1) High load burning
- Reducing natural gas burning capacity
- Adjusting O2% (1 % → 2 %)
  Note: The O2 % of 1 % is too low.
(2) Low load burning
- Adjusting O2% (9.9 % → 4 %)

3) Reduction of natural gas consumption by countermeasures

(1) Increment of boiler efficiency by the upper-mentioned countermeasures

Table-6-3 : Comparison of Boiler Efficiency between Present and Improved Operation

High load burning

Operation	Exhaust Gas O2 %	Exhaust Gas Temp. °C	Exhaust Gas Loss %	Radiation Loss %	Total Loss %	Boiler Eff. %
Present	1.0	218	9.4	2.0	11.4	88.6
Improved	2.0	170	7.4	2.0	9.4	90.6

Low load burning

Operation	Exhaust Gas O2 %	Exhaust Gas Temp. °C	Exhaust Gas Loss %	Radiation Loss %	Total Loss %	Boiler Eff. %
Present	9.9	109	6.7	2.0	8.7	91.3
Improved	4.0	109	4.7	2.0	6.7	93.3

(2) Premises

- Natural gas consumption 367,400 Sm3/y
- Total improved efficiency 2 % (conservative)

(3) Calculation

- Saved natural gas consumption

367,000*0.02 = 7,340 Sm3/y

4) Saved amount, investment and payback period in the 1st year

(1) Saved amount

7,340*30 = 220,000 din/y

(2) Investment 200,000 din

(3) Payback Period 0.9 y

6-3. Building

6-3-1. Installing Thermostatic Valves for Radiators and VWV system at Hot Water System

1) Present conditions

(1) Thermostatic valves for radiators are not installed.

(2) The most of adjusting valves of radiators are not available by removing the valve wheels.

2) Countermeasures

Replacing radiators or installing thermostatic valves will keep the room at constant temperature by adjusting hot water volume. As a result, it will reduce heat loss which occurs when people open windows when it is hotter than necessary. It also reduces energy consumption to produce hot water and power consumption of pumps.

Just for a reference, in the WB project mentioned in 6-2-1, all the sites adopted this measure to reduce energy consumption. One site adopts only this measure and its payback period is about 8 years, rather long for investment, although it should be noted that results would vary depending on different conditions.

However, retrofit of pipe system and revision on heat allocation should be considered before this measure. Thus, the below is for reference for the future needs.

The mechanism of this measure is described as follows.

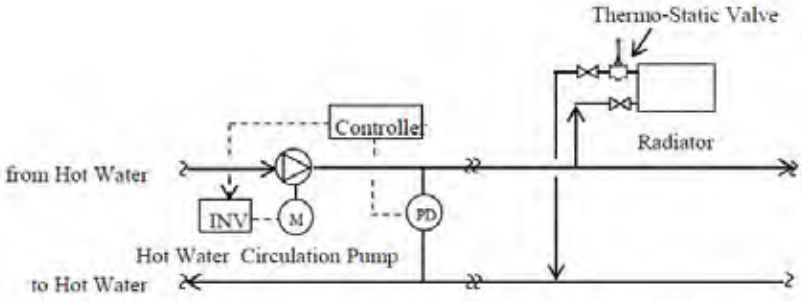


FIG.-6-3 : Concept of Installing Thermostatic Valves for Radiators and VWV system at Hot Water System

3) Reduction of electric power at Hot Water Circulation Pump

(1) Premises

- Effect (percent): approximately about 30% to 70% of power consumption of pumps (This number is just for reference, a Japanese case.)
- Pumps: 15 kW * 2 units (2 pumps: run, 1 pump: standing-by)
- Operation hours: 24 (hours)*6/12 (month) * 365 (day)
- Saving percentage: 0.5 (50%: assumed)

(3) Calculation

- Reduction of electric power

15*2*0.5*24*6/12*365 = 65,700 kWh/y

4) Saved amount, investment and payback period in 1st year

(1) Saved amount

65,700*4.5 = 295,700 din/y

(2) Investment 3,500,000 din

(3) Payback Period 12 y

6-3-2. Replacing incandescent lamps to compact fluorescent lamps (CFL)

1) Present conditions

(1) There are incandescent lamps and fluorescent lamps.

(2) Some of them, approximately half of them, are turned off or broken down. Eventually, it contributes to energy conservation.

(3) The data provided by Cupria Hospital is that average consumed power per each is 75W forincandescent, and 30W for fluorescent lamps.

2) Countermeasures

Replace incandescent lamps to compact fluorescent lamps (CFL)

By replacing incandescent lamps to compact fluorescent lamps gives about two thirds of reduction in power with providing same amount of luminance.

FIG.-6-4 : An Example of CFL

3) Effect by Improvement

(1) Premises

- The number of incandescent lamps was not acquired.
  From the observation of No. 15 building, 1 unit/50m2
  is temporarily assumed and total floor area is 50,000 m2.
  (Total units : 1,000)
- Power saving effect of each: about 2/3
- Lighting hours per year: 50% (=365*24*0.3 = 4,380 hrs/y)
- Average Capacity: 75W

(2) Calculation

Power saving per year: 75W * 1,000 unit * 2/3 * 4,380 hrs = 219,000 kWh/y

4) Saved amount, investment and payback period in 1st year

(1) Saved amount

219,000*4.5 = 985,500 din/y (average tariff: 4.5 din/kWh)

(2) Investment 280,000 din (incandescent: 28 din, CFL: 280 din)

(3) Payback Period 0.3 y

Note: - This measure can be applied to part of the lumps, so that it is not necessary to replace all the lamps. Payback period depends of lighting hours in a year. The longer the lighting hours, the shorter the payback period becomes.
- The lifetime of lamps becomes about 6 to 10 times of those of incandescent lamps.

5-3-3. Replace ballasts of fluorescent lamps to Hf lamps

By replacing FLR to Hf lamps with ballasts, it would reduce power consumption about 25%. Unfortunately, the number of fluorescent lamps is not available. Thus, calculation here is based on an assumption.

3) Calculation

(1) Premises

- Number of fluorescent lamps: 500 unit
- Average capacity of fluorescent lamps: 38W
- Operation hours/year: 24*365*0.3
- Energy saving ratio : 30%

(2) Calculation

Power saving amount:

302*38*24*365*0.3*0.3/1,000 = 15,000 kWh/y

4) Saved amount, investment and payback period

(1) Saved amount : 15,000*4.5 = 67,500 din/y
(2) Investment : 648,000 din
(3) Payback period : 9.6 y

6-3-4. Improvement of Thermal Insulation Properties

1) Present conditions

(1) Low air-tightness of window frame
(2) No insulation of walls
(3) No insulation of roofs

2) Countermeasures

(1) Replace wooden window frame to PCV (Polyvinylchloride)
(2) Insulation of walls
(3) Insulation of roofs

3) Effect of countermeasures

These measures are quite effective to reduce heat loss from the building envelope, leading to reduce energy consumption without sacrificing the comfort. It even contributes to ameliorate the inside environment. However, it requires investment in rather big amount.

In addition, it is difficult to evaluate the energy savings potential in numeric term this time only with a brief walk through investigation. Thus, the below is just to describe the possibility and characteristics of these measures.

There has been a WB project with a period of 2005-2012. It intends to promote energy efficiency in schools and hospitals. 16 schools and 11 hospitals were selected. The total project budget is US$ 55 million.

In this project, majority, 8 out of 11 sites, adopted replacement of window and door frames.

Investment on this measure consists of about 63% of the total investment on hospitals.

Simple payback period is about 5 to 10 years.

4 out of 11 sites adopted outside wall and roof thermal insulation. It saves about 30 to 40% of thermal demand compared to that of without insulation and its **simple payback period is about 5** to 10 years.

Investment on this measure comprises about 23.7% of the total investment.

7. Conclusion

1) The EE&C audit result is shown in Fig.-1-1, and there are some effective countermeasures of short pay back period for the EE&C in your hospital.
2) The natural gas burning steam boiler was installed in 1982 and the efficiency is very low due to the intermittent combustion system.
   Furthermore it would have the fouling and corrosion problem due to the poor boiler water blow down system.
   In cosideration of the deterioration and low efficiency it would be better to consider the replacement with a new high efficiency boiler.
   In such a case the specification should be decided based on the precise conditions of required and fluctuation of steam demand by detailed examination.
3) We would be very happy if our EE&C audit result would be some of your help for your further activitiy towards EE&C.

Appendix 4

Evaluation Criteria (Draft)

Evaluation Criteria

Category	Management and Control	Measurement & Recording	Maintenance & Inspection	Measure to be taken for the new installation of equipment
1 **Fuel combustion**	a) Control of combustion air ratio depends on combustion equipment and type of fuel "Management Standards" b) Rationalization of combustion air ratio for combustion equipment based on attachment table-A(1)**Standards-A** c) For multi combustion systems, improve overall energy efficiency by heat load adjustment "Management Standards" d) Control of fuel properties (Granularity, Moisture, Viscosity etc) for the improvement of combustion efficiency *e) Primary fuel used in power generation system(with cogeneration or without) can be mixture of main fuel and additional fuel (coal + heavy oil, light oil and gas +heavy oil)*	(2) Metering and recording of fuel combustion Metering and recording of amount of oxygen extant in exhaust gas, amount of fuel supply, and exhaust gas temperature etc→ "Management Standards"	(3) Maintenance / Inspection of combustion equipment Carrying out of scheduled maintenance to keep combustion equipment in good condition→ "Management Standards"	(4) Measure to be taken for the new installation of equipment a) For combustion equipment, with control system of amount of fuel and combustion air ratio b) For combustion equipment, with ventilator arrangement for ventilation volume and combustion chamber pressure regulation
2 **Heat transfer, Heating and cooling**	(1) Control of heat transfer, heating and cooling a) Heat medium temperature, pressure and volume control for avoiding excessive heat loss. "Management Standards" b) For industrial furnace, improve heat pattern to enhancement heat efficiency. "Management Standards" c) Control volume and location of heating and cooling target items in a furnace for avoidance of excessive loading/under loading" Control standards" d) Load adjustment to increase total efficiency when several systems are in use. "Management Standards" e) Shortening of latency times between repeated processes. "Management Standards" f) Consolidation of operation for intermittent operations. "Management Standards" g) Water quality control for boiler water supply h) Closing of shutoff valve for steam equipment when no required. i) Keeping appropriate dryness quality for steam equipment. j) For other heating process etc, control volume, temperature and pressure of items using heat medium and heating target items. "Management Standards"	(2) Measurement and recording for heating etc. Measurement and recording of heat medium temperature, pressure and flow volume for target heating and cooling items and steam etc to improve.→ "Management Standards"	(3) Maintenance and inspection on systems providing heating etc. Maintenance and spot check of heat transfer parts for boiler / heat exchange equipment, periodic removal of soot and scale, and prevention of decline in heat transfer performance. "Management Standards"	(4) Measure to be taken for the new installation of equipment a) Use materials with high rate of heat transfer for heat exchange parts. b) Optimize arrangement of heat exchange equipment to improve overall thermal exchange *c) Use multi stage boilers where load varied 20-100%*
	(1) A/C system control a) Management of A/C system includes limiting partitioning, control of blinds for load reductions, as well as control system operation times, room temperature, air exchange rates and humidity etc according to usage conditions. "Management Standards" Observe national regulations for cooling and heating temperatures. "Management Standards" b) Control of A/C heat source equipment to improve system's overall efficiency for seasonal changes in outdoor air conditions. "Management Standards" c) Control the number of operating units and selection of equipment in response to outdoor air conditions to improve combined energy saving where the A/C heating source equipment is composed of more than 1 heat source unit. "Management Standards" d) Control the number of operating units and selection of equipment in response to load conditions to improve combined energy saving where A/C equipment is composed of more than one A/C unit in the same zone. "Management Standards" *e) Avoid running chilled and heating system at the same time where 4 pipes system is installed.* *f) Check regulating valves on A/C system for leaks.* (2) Domestic hot water system control a) Control of hot water temperature and pressure to improve efficiency and restriction of supply areas in response to seasons and nature of work. "Management Standards" b) Control of heat source for the domestic hot water supply system in response to changes in load, and control to improve combined efficiency of auxiliaries such as heat source unit and pump. "Management Standards" c) The domestic hot water supply system composed of several heat source units set up to improve combined energy efficiency by the adjusting the number of operating units in response to load conditions. "Management Standards"	(2) Measurement and recording for A/C system and domestic hot water supply a) Measurement and recording of temperature &humidity in each zone. "Management Standards" b) Measurement & recording for improvement of efficiency of individual units and combined efficiency. "Management Standards" c) Measurement and recording of necessary items for improvement of domestic hot water supply such as volume and temperature. "Management Standards"	(3) A/C system, domestic hot water system maintenance& inspection a) Maintenance & inspection for improvements inefficiency of individual A/C units and in combined efficiency→ "Management Standards" b) Maintenance and inspection for improvements inefficiency of domestic hot water system→ "Management Standards" c) Maintenance and inspection of automatic controls for the A/C system→ "Management Standards	(4) Measures prior to new installation of A/C systems and domestic hot water systems a) Efficient energy usage to be implemented when new A/C systems are installed 1) Separate control of respective zones in response to changes in temperature requirements 2) Adoption of highly efficient heat sources such as heat pumps 3) Adoption of highly efficient operation system, such as unit control. 4) Adoption of variable air volume / variable flow system, such as speed control. 5) The necessary meters shall be installed for improvement of efficiency in respective zones,adoption of BEMS and appropriate A/C control b) Where new domestic hot water systems are installed, measures to efficiently target energy in response to changes in load, such as localization for low consumption locations. c) Where the following equipment is newly installed, Consider the adoption of top runner equipment 1)Air-conditioners 2) Stove heaters 3) Gas heating units 4) Oil heating units 5) Gas cooking appliances
3 **Waste heat collection**	(1) Standards for usage of waste heat collection a) Control of waste gas temperature from the exhaust gas discharge equipment and waste heat collection rate. "Management Standards" b) Waste gas temperature and a waste heat collection rate are controlled based on attached. Table-B (1). **Standards-B** c) Control of steam drain temperature, volume and characteristics. "Management Standards" d) Control of collection ranges for collection usage of heating unit / flow sensible heat / latent heat/ pressure / combustible component. "Management Standards" e) Usage of waste heat	Measurement and recording of waste heat Measurement & recording of temperature, calorific values, composition etc. to ascertain waste heat conditions and promote usage.→ "Management Standards"	Maintenance & inspection of waste heat collection Equipment Maintenance & inspection of waste heat collection equipment to prevent leakage of heat transfer medium etc. and removal of dirt from the heat transfer surfaces.→ "Management Standards"	Measures prior to new installation of heat collection system a) Measures for maintenance of waste heat temperature for waste heat collection system flues and pipes. b) Measures to increase the area of, and improve the characteristics and shape of the heat transfer surface, to increase heat collection rate.
4 **Conversion of the thermal power for power generation systems, etc...**	Control of power generation systems a) Operational control of power generation systems to maintain high efficiency.→ "Management Standards" Furthermore, parallel operation requires appropriate distribution in line with increases & decreases in the load to improve overall efficiency.→ "Management Standards" b) If pressure reduction is available when the steam turbine of the thermal power plant is at partial load, it can be optimized.	Measurement & recording for generation facilities Thermal efficiency related periodic measurement and recording for the generation facilities.→ "Management Standards"	Maintenance and inspection of generation facilities. Maintenance and inspection to maintain high thermal efficiency of generation facilities.→ "Management Standards"	Measures prior to new installation of generation facilities a) Sufficient study of actual power demand and future trends shall be carried out so that power generation facilities are of the appropriate scale and capacity. b) Average efficiency of new installation of generation facilities should not be remarkably lower than that of domestic thermal power generation facilities.

	Control of cogeneration facilities a) Improve overall efficiency of operation of multiple boilers for cogeneration facility in accordance with increases and decreases in load.→ "Management Standards" b) Where bleed / back pressure turbine is used for cogeneration facility, control the permitted maximum value of the bleed pressure /back pressure.→ "Management Standards"	Measurement & recording for cogeneration facilities a) Measurement & recording of thermal efficiency→ "Management Standards" b) When the turbine is operating at maximum pressure measure and record inlet / outlet pressure, bleed pressure, back pressure etc ‘’Management Standards"	Maintenance and inspection of cogeneration facilities to maintain high thermal efficiency→ "Management Standards"	Measures prior to new installation of cogeneration facilities Sufficient study of actual power demand and future trends shall be carried out so that cogeneration generation facilities are of the appropriate scale and capacity.
5 Prevention of energy loss by radiation, Conduction, Resistance, etc…	Insulation standards a) Heat insulation work on heat and *cooling* utilizing systems shall be based on regulations such as the Serbian Industrial Standards b) Heat insulation measures shall be implemented on newly installed industrial furnaces using the attached table-C (1) which details furnace wall outer surface temperatures. **Standards-C** c) Where possible the same heat insulation measures shall be implemented on existing furnaces.	For all measurement and recording devices related to heat loss, furnace wall outer surface temperature, temperatures of heated materials, exhaust gas temperatures etc. readings will be taken and recorded and the results of analysis shall be recorded.→ "Management Standards"	Inspection & maintenance of heat utilizing equipment a) Maintenance and inspection of heat loss prevention measures such as heat insulation on heat utilizing equipment→ "Management Standards" b) Inspection and maintenance to prevent steam leakage from steam trap→ "Management Standards"	Measures prior to new installation of heat utilizing equipment a) Where any new heat utilizing equipment is installed, there shall be sufficient fire resistant performance to improve adiabatic. b) Closure and reduction of openings in equipment to prevent radiation heat loss. c) Limiting of routes of heat transfer pipes to reduce the radiating area.
	Substation & distribution system control a) Maintain appropriate demand factor for transformer & UPS installation→ "Management Standards" b) Appropriate arrangement of Substation, limiting of distribution line, appropriate voltage→ "Management Standards" c) The receiving end power factor shall be above *95*%, improve by using the leading power factor transformer by installation of leading power factor capacitor as per the attached table-D as **Standard-D** d) Control the leading power factor capacitor to start/stop in line with installed systems→ "Management Standards" e) Control to prevent voltage imbalance where single phase load is connected to 3-phase.→ "Management Standards" f) Balance electricity usage to reduce maximum current for operation of electrically powered systems→ "Management Standards" g) Reduce power loss for other substation & distribution systems etc.→ "Management Standards"	Measurement & recording for substation &distribution systems Measurement & recording of voltage and current etc. for amount of power, substation & distribution systems.→ "Management Standards"	Maintenance a& inspection of substation &distribution systems Substation & distribution systems shall be inspected &maintained to keep them in good condition→ "Management Standards"	Measures prior to new installation of Substation & distribution systems a) Sufficiently study actual demand and future trends for Substation & distribution systems and determine substation arrangement, distribution voltage & system capacity. b) When new transformers are installed, the adoption of items (top runner) beyond standard energy consumption efficiency prescribed in “criteria for manufacturing business to improve transformer performance” should be considered.
6 Conversion of electrical power for power generation system, heat, etc…	Mechanically powered systems, electrical heating systems a) Consider the relationship between electrically powered systems and initial energy, and shutdown in order to reduce power loss due to idling.→ "Management Standards" b) Where several motors are used, adjustment number of running units and carry out appropriate load distribution to maintain the appropriate demand rate.→ "Management Standards" c) For the fluid machinery, appropriately adjust the delivery amount/voltage by controlling speed through checks on the application terminal voltage and the discharge voltage, and reduce the electric motor load.→ "Management Standards" d) Improve thermal efficiency of induction furnaces, arc furnaces, resistance furnaces by insulation & waste heat collection, removal of no-load operation and improvements in charging of heat receiving equipment→ "Management Standards" e) Improve electrolytic efficiency of electrolytic equipment by controlling the distance between electrodes and the concentration of electrolytic solution.→ "Management Standards" f) Reduce electrical power loss by controlling the current and voltage for all electrical equipment → "Management Standards" *g) Control of compressed air installation for leaks and compressor operation.*	Mechanically powered equipment, electric heating equipment etc. related measurement and recording . Record voltage and current for mechanically powered equipment & electric heating equipment→ "Management Standards"	Maintenance and inspection of Mechanically powered equipment & electric heating equipment a) Inspection & maintenance to reduce mechanical loss of load equipment, transmission parts and electric motors→ "Management Standards" b) Inspection and maintenance of fluid machinery to reduce pipe resistance and prevent leakages→ "Management Standards" c) Inspection and maintenance of Electrical heating equipment to reduce resistance loss for junctions and switch contacts etc.→ "Management Standards"	Measures prior to new installation of mechanically powered systems When usage of mechanically powered systems presumes large changes in load, system configuration should be easily adjustable in response to such load changes. *New high efficiency electrical motors to use.*
	Control of lighting equipment, elevators, office appliances a) Lighting shall be controlled according to location as prescribed in the Srbian Industrial Standards*(Serbian standard for lighting efficiency to be set)*→ "Management Standards" b) Control number of elevators in operation c) Power for office appliance shall be switched off when not in use and put in low power mode.	Measurement and recording for lighting systems Measure and record lighting levels→ "Management Standards"	Inspection and maintenance of lighting systems, elevators and office appliances a) Lighting system cleaning and replacement→ "Management Standards" b) Inspection and maintenance of elevators to reduce power loss→ "Management Standards" c) Schedules inspection and maintenance of office appliances	Measures prior to new installation of lighting, office equipment and other end-user appliances. a) Where new lighting systems are installed, efficient usage of energy is implemented with understanding of items relating to lighting systems in the building criteria, and with reference to the following: 1) Adoption of efficient energy lighting systems 2) Highly efficient lamps such as HID. 3) Consideration of maintenance, cleaning. 4) Consideration of total lighting efficiency comprising lighting circuits, fixtures etc. 5) Separate circuit for areas utilizing daylight b) Consider adoption of top runner equipment where the following equipment is to be newly installed 1) Fluorescent only light fixtures 2) Photocopiers 3) Computer equipment 4) hard disks 5) Television receivers 6) Video recorders 7) Electric refrigerators 8) Electric freezers 9) Electric toilet seats 10) Vending machines *11) Use of photo cells and motion detectors for new lighting installation where applicable* *12) Use window micro switch to control AC in the room* .

	ИНОВАЦИОНИ ЦЕНТАР МАШИНСКОГ ФАКУЛТЕТА У БЕОГРАДУ ДОО, БЕОГРАД	INNOVATIVE CENTER FACULTY OF MECHANICAL ENGINEERING UNIVERSITY OF BELGRADE	http://www.inovacionicentar.rs
	МРЕЖА ЗА ЕНЕРГЕТСКУ ЕФИКАСНОСТ У ИНДУСТРИЈИ СРБИЈЕ МЕЕИС	SERBIAN INDUSTRIAL ENERGY EFFICIENCY NETWORK SIEEN	

Check-list for Energy Efficiency Improvements in Industrial Energy Systems (Draft)

1. Industrial Boilers

1.1. Stack temperature should be as low as possible; application of feed water preheating using economizer and/or combustion air preheating

1.2. Application of regular excess air control; use automatic air-to-fuel controller with O2 sensor and/or temporary adjustment of burner air-to-fuel ratio

1.3. Radiation and convection heat loss minimization by repairing or improvement of boiler insulation

1.4. Introduction of automatic blow down control

1.5. Reduction of scaling and soot losses

1.6. Reduction of boiler steam pressure

1.7. Application of variable speed control for fans, blowers and pumps

1.8. Operation of boiler on loading which corresponds to maximum efficiency, if more boilers are in use application of proper boiler scheduling.

1.9. Boiler replacement in case of old and inefficient, or over or under-sized for present requirements

1.10. Examination of all implications of long-term fuel availability

1.11. Improvement of water treatment system

2. Steam Systems

2.1. Proper steam and condense pipe sizing and design

2.2. Utilizing steam at the lowest acceptable pressure for the process

2.3. Proper drainage and layout of steam lines

2.4. Providing dry steam for process

2.5. Proper utilization of directly injected steam

2.6. Avoiding of steam pipe redundancy

2.7. Proper air venting

2.8. Good drainage of condensate from process equipment; for that is essential:

2.8.1. Determination of proper condensate drainage point at the vessel,

2.8.2. Proper selection, operation and maintenance of steam traps

2.9.3. Monitoring of steam traps

2.9. Avoiding steam leakages on valves, flanges, or holes in the steam system

2.10. Minimizing heat transfer barriers

2.11. Maximum condensate recovery; only contaminated condensate after cooling can be drained out of the system

2.12. Flash steam recovery; loss of flash steam in condensate return system must be avoided

2.13. Proper insulation of steam pipelines and hot process equipments

2.14. Reducing the work to be done by steam :

2.14.1. Reduction in operating hours

2.14.2. Reduction in steam quantity required per hour

2.14.3. Use of more efficient technology

2.14.4. Minimizing wastage.

3. Insulation of pipes, valves and vessels

3.1. For minimization of heat losses, it is important to notice that outer surface temperature of pipes, valves and vessels is close or almost equal to the heating fluid temperature

3.2.Insulate all uninsulated hot surfaces and/or repair damaged or old insulation

3.3. It is important to calculate optimal (economicaly) thickness of insulation

3.4. Avoid wind on pipe lines if possible; heat losses rise significantly with wind velocity

3.5. Check temporary the insulation thickness: if the price of fuel rised, it is probably profitable to rise the thickness of the insulation

3.6. Check and avoid empty space between insulation and hot surface; it causes air circulation and rise of the heat transfer

3.7. Cover open surfaces of tanks which contain hot liquids by lids or layers of plastic balls

3.8. Measure outer surface of hot pipes, valves and vessels regularely; it has to be lower than 60^{o}C.

4. General Fuel Economy Measures in Furnaces

4.1. Complete combustion with minimum excess air

4.2. Correct heat distribution

4.3. Operate at the desired temperature

4.4. Reduce heat losses from furnace openings

4.5. Maintain correct amount of furnace draught

4.6. Apply waste heat recovery from the flue gases (recuperation and utilization)

4.7. Apply waste heat recovery from cooling water and products

4.8. Minimize refractory losses

4.9. Use ceramic coatings

4.10. Chose furnace operation at optimum capacity

4.11. Reduce unsteady state operation conditions

5. Electricity

5.1. Optimize the tariff structure with utility supplier

5.2. Schedule your operations to maintain a high load factor

5.3. Shift loads to off-peak times if possible.

5.4. Minimize maximum demand by tripping loads through a demand controller

5.5.Stagger start-up times for equipment with large starting currents to minimize load peaking.

5.6. Use standby electric generation equipment for on-peak high load periods.

5.7. Correct power factor to at least 0.90 under rated load conditions.

5.8. Relocate transformers close to main loads.

5.9. Set transformer taps to optimum settings.

5.10. Disconnect primary power to transformers that do not serve any active loads

5.11. Consider on-site electric generation or cogeneration.

5.12. Export power to grid if you have any surplus in your captive generation

5.13. Check utility electric meter with your own meter.

5.14. Shut off unnecessary computers, printers, and copiers at night.

6. Motors

6.1. Properly size to the load for optimum efficiency.

(High efficiency motors offer of 4 - 5% higher efficiency than standard motors*)*

6.2 Use energy-efficient motors where economical.

6.3. Use synchronous motors to improve power factor.

6.4. Check alignment.

6.5. Provide proper ventilation

(For every 10^{o}C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)

6.6. Check for under-voltage and over-voltage conditions.

6.7. Balance the three-phase power supply.

(An Imbalanced voltage can reduce 3 - 5% in motor input power)

6.8. Demand efficiency restoration after motor rewinding.

(If rewinding is not done properly, the efficiency can be reduced by 5 - 8%)

7. Drives

7.1. Use variable-speed drives for large variable loads.

7.2. Use high-efficiency gear sets.

7.3. Use precision alignment.

7.4. Check belt tension regularly.

7.5. Eliminate variable-pitch pulleys.

7.6. Use flat belts as alternatives to v-belts.

7.7. Use synthetic lubricants for large gearboxes.

7.8. Eliminate eddy current couplings.

7.9. Shut them off when not needed.

8.Fans

8.1 Use smooth, well-rounded air inlet cones for fan air intakes.

8.2. Avoid poor flow distribution at the fan inlet.

8.3. Minimize fan inlet and outlet obstructions.

8.4 Clean screens, filters, and fan blades regularly.

8.5. Use aerofoil-shaped fan blades.

8.6. Minimize fan speed.

8.7. Use low-slip or flat belts.

8.8. Check belt tension regularly.

8.9. Eliminate variable pitch pulleys.

8.10. Use variable speed drives for large variable fan loads.

8.11. Use energy-efficient motors for continuous or near-continuous operation

8.12. Eliminate leaks in ductwork.

8.13. Minimize bends in ductwork

8.14. Turn fans off when not needed.

9. Blowers

9.1. Use smooth, well-rounded air inlet ducts or cones for air intakes.

9.2. Minimize blower inlet and outlet obstructions.

9.3 Clean screens and filters regularly.

9.4. Minimize blower speed.

9.5. Use low-slip or no-slip belts.

9.6. Check belt tension regularly.

9.7. Eliminate variable pitch pulleys.

9.8. Use variable speed drives for large variable blower loads.

9.9 Use energy-efficient motors for continuous or near-continuous operation.

9.10. Eliminate ductwork leaks.

9.11. Turn blowers off when they are not needed.

10. Pumps

10.1. Operate pumping near best efficiency point.

10.2. Modify pumping to minimize throttling.

10.3. Adapt to wide load variation with variable speed drives or sequenced control of smaller units.

10.4. Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.

10.5 Use booster pumps for small loads requiring higher pressures.
10.6. Increase fluid temperature differentials to reduce pumping rates.
10.7. Repair seals and packing to minimize water waste.
10.8. Balance the system to minimize flows and reduce pump power requirements.
10.9. Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

11. Compressors

11.1. Consider variable speed drive for variable load on positive displacement compressors.
11.2 Use a synthetic lubricant if the compressor manufacturer permits it.
11.3. Be sure lubricating oil temperature is not too high (oil degradation and lowered viscosity) and not too low (condensation contamination).
11.4. Change the oil filter regularly.
11.5. Periodically inspect compressor intercoolers for proper functioning.
11.6. Use waste heat from a very large compressor to power an absorption chiller or preheat process or utility feeds.
11.7. Establish a compressor efficiency-maintenance program. Start with an energyaudit and follow-up, then make a compressor efficiency-maintenance program a part of your continuous energy management program.

12. Compressed air

12.1. Install a control system to coordinate multiple air compressors.
12.2. Study part-load characteristics and cycling costs to determine the most-efficient mode for operating multiple air compressors.
12.3. Avoid over sizing - match the connected load.
12.4. Load up modulation-controlled air compressors. (They use almost as much power at partial load as at full load.)
12.5. Turn off the back-up air compressor until it is needed.
12.6. Reduce air compressor discharge pressure to the lowest acceptable setting.
(Reduction of 1 bar air pressure would result in 5-7% input power savings; this will also reduce compressed air leakage rates by 10%)
12.7. Use the highest reasonable dryer dew point settings.
12.8. Turn off refrigerated and heated air dryers when the air compressors are off.
12.9. Use a control system to minimize heatless desiccant dryer purging.
12.10.Minimize purges, leaks, excessive pressure drops, and condensation accumulation.
(Compressed air leak from 1 mm hole size at 7 bar pressure would mean power loss equivalent to 0.25 kW)
12.11.Use drain controls instead of continuous air bleeds through the drains.
12.12.Replace standard v-belts with high-efficiency flat belts as the old v-belts wear out.
12.13.Use a small air compressor when major production load is off.
12.14.Take air compressor intake air from the coolest (but not air conditioned) location.

(Every 5^{0}C reduction in intake air temperature would result in 1% reduction in compressor power consumption)

12.15.Use an air-cooled after cooler to heat building makeup air in winter.

12.16.Be sure that heat exchangers are not fouled (e.g. -- with oil).

12.17.Be sure that air/oil separators are not fouled.

12.18.Monitor pressure drops across suction and discharge filters and clean or replace filters promptly upon alarm.

(0.2 bar pressure drop at the filter, if air pressure is 7 bar and flow250 l/s, would result in 1kW of compressor power consumption)

12.19. Use a properly sized compressed air storage receiver. Minimize disposal costs by using lubricant that is fully demulsible and an effective oil-water separator.

12.20.Consider alternatives to compressed air such as blowers for cooling, hydraulic rather than air cylinders, electric rather than air actuators, and electronic rather than pneumatic controls.

12.21.Use nozzles or venture-type devices rather than blowing with open compressed air lines.

12.22.Check for leaking drain valves on compressed air filter/regulator sets. Certain rubber-type valves may leak continuously after they age and crack.

12.23. In dusty environments, control packaging lines with high-intensity photocell units instead of standard units with continuous air purging of lenses and reflectors.

12.24. Establish a compressed air efficiency-maintenance program. Start with an energy audit and follow-up, then make a compressed air efficiency-maintenance program a part of your continuous energy management program.

13. Chillers

13.1. Increase the chilled water temperature set point if possible.

13.2. Use the lowest temperature condenser water available that the chiller can handle.

(Reducing condensing temperature by 5.5^{0}C, results in a 20 - 25% decrease in compressor power consumption)

13.3.Increase the evaporator temperature

(5.5^{0}C increase in evaporator temperature reduces compressor power consumption by 20 - 25%)

13.4.Clean heat exchangers when fouled.

(1 mm scale build-up on condenser tubes can increase energy consumption by 40%)

13.5.Optimize condenser water flow rate and refrigerated water flow rate.

13.6.Replace old chillers or compressors with new higher-efficiency models.

13.7.Use water-cooled rather than air-cooled chiller condensers.

13.8.Use energy-efficient motors for continuous or near-continuous operation.

13.9.Specify appropriate fouling factors for condensers.

13.10.Do not overcharge oil.

13.11.Install a control system to coordinate multiple chillers.

13.12.Study part-load characteristics and cycling costs to determine the most-efficient mode for

operating multiple chillers.

13.13. Run the chillers with the lowest operating costs to serve base load.

13.14. Avoid over sizing -- match the connected load.

13.15. Isolate off-line chillers and cooling towers.

13.16. Establish a chiller efficiency-maintenance program. Start with an energy audit and follow-up, then make a chiller efficiency-maintenance program a part of your continuous energy management program.

14. HVAC (Heating / Ventilation / Air Conditioning)

14.1. Tune up the HVAC control system.

14.2. Consider installing a building automation system (BAS) or energy management system (EMS) or restoring an out-of-service one.

14.3. Balance the system to minimize flows and reduce blower/fan/pump power requirements.

14.4. Eliminate or reduce reheat whenever possible.

14.5. Use appropriate HVAC thermostat setback.

14.6. Use morning pre-cooling in summer and pre-heating in winter (i.e. -- before electrical peak hours).

14.7. Use building thermal lag to minimize HVAC equipment operating time.

14.8. In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.

14.9. In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.

14.10. Improve control and utilization of outside air.

14.11. Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.

14.12. Reduce HVAC system operating hours (e.g. -- night, weekend).

14.13. Optimize ventilation.

14.14. Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).

14.15. Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.

14.16. Use evaporative cooling in dry climates.

14.17. Reduce humidification or dehumidification during unoccupied periods.

14.18. Use atomization rather than steam for humidification where possible.

14.19. Clean HVAC unit coils periodically and comb mashed fins.

14.20. Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.

14.21. Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.

14.22. Check pneumatic controls air compressors for proper operation, cycling, and maintenance.

14.23. Isolate air conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.

14.24. Install ceiling fans to minimize thermal stratification in high-bay areas.

14.25.Relocate air diffusers to optimum heights in areas with high ceilings.
14.26.Consider reducing ceiling heights.
14.27.Eliminate obstructions in front of radiators, baseboard heaters, etc.
14.28.Check reflectors on infrared heaters for cleanliness and proper beam direction.
14.29.Use professionally-designed industrial ventilation hoods for dust and vapor control.
14.30.Use local infrared heat for personnel rather than heating the entire area.
14.31.Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
14.32.Purchase only high-efficiency models for HVAC window units.
14.33.Put HVAC window units on timer control.
14.34.Don't oversize cooling units. (Oversized units will "short cycle" which results in poor humidity control.)
14.35.Install multi-fueling capability and run with the cheapest fuel available at the time.
14.36.Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
14.37.Minimize HVAC fan speeds.
14.38.Consider ground source heat pumps.
14.39.Seal leaky HVAC ductwork.
14.40.Seal all leaks around coils.
14.41.Repair loose or damaged flexible connections (including those under air handling units).
14.42.Eliminate simultaneous heating and cooling during seasonal transition periods.
14.43.Zone HVAC air and water systems to minimize energy use.
14.44.Inspect, clean, lubricate, and adjust damper blades and linkages.
14.45.Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.

15. Refrigeration

15.1.Use water-cooled condensers rather than air-cooled condensers.
15.2.Challenge the need for refrigeration, particularly for old batch processes.
15.3.Avoid over sizing -- match the connected load.
15.4.Consider gas-powered refrigeration equipment to minimize electrical demand charges.
15.5.Use "free cooling" to allow chiller shutdown in cold weather.
15.6.Use refrigerated water loads in series if possible.
15.7.Convert firewater or other tanks to thermal storage.
15.8.Don't assume that the old way is still the best -- particularly for energy-intensive low temperature systems.
15.9.Correct inappropriate brine or glycol concentration that adversely affects heat transfer and/or pumping energy. If it sweats, insulate it, but if it is corroding, replace it first.
15.10.Make adjustments to minimize hot gas bypass operation.
15.11.Inspect moisture/liquid indicators.

15.12.Consider change of refrigerant type if it will improve efficiency.

15.13.Check for correct refrigerant charge level.

15.14.Inspect the purge for air and water leaks.

15.15.Establish a refrigeration efficiency-maintenance program. Start with an energy audit and follow-up, then make a refrigeration efficiency-maintenance program a part of your continuous energy management program.

16. Cooling towers

16.1.Control cooling tower fans based on leaving water temperatures.

16.2.Control to the optimum water temperature as determined from cooling tower and chiller performance data.

16.3.Use two-speed or variable-speed drives for cooling tower fan control if the fans are few. Stage the cooling tower fans with on-off control if there are many.

16.4.Turn off unnecessary cooling tower fans when loads are reduced.

16.5.Cover hot water basins (to minimize algae growth that contributes to fouling).

16.6.Balance flow to cooling tower hot water basins.

16.7.Periodically clean plugged cooling tower water distribution nozzles.

16.8.Install new nozzles to obtain a more-uniform water pattern.

16.9.Replace splash bars with self-extinguishing PVC cellular-film fill.

16.10.On old counter flow cooling towers, replace old spray-type nozzles with new square-spray ABS practically-non-clogging nozzles.

16.11.Replace slat-type drift eliminators with high-efficiency, low-pressure-drop, self-extinguishing, PVC cellular units.

16.12.If possible, follow manufacturer's recommended clearances around cooling towers and relocate or modify structures, signs, fences, dumpsters, etc. that interfere with air intake or exhaust.

16.13.Optimize cooling tower fan blade angle on a seasonal and/or load basis.

16.14.Correct excessive and/or uneven fan blade tip clearance and poor fan balance.

16.15.Use a velocity pressure recovery fan ring.

16.16.Divert clean air-conditioned building exhaust to the cooling tower during hot weather.

16.17.Re-line leaking cooling tower cold water basins.

16.18.Check water overflow pipes for proper operating level.

16.19.Optimize chemical use.

16.20.Consider side stream water treatment.

16.21.Restrict flows through large loads to design values.

16.22.Shut off loads that are not in service.

16.23.Take blow down water from the return water header.

16.24.Optimize blow down flow rate.

16.25.Automate blow down to minimize it.

16.26.Send blow down to other uses (Remember, the blow down does not have to be removed at the cooling tower. It can be removed anywhere in the piping system.)

16.27.Implement a cooling tower winterization plan to minimize ice build-up.

16.28.Install interlocks to prevent fan operation when there is no water flow.

16.29.Establish a cooling tower efficiency-maintenance program. Start with an energy audit and follow-up, then make a cooling tower efficiency-maintenance program a part of your continuous energy management program.

17. Lighting

17.1.Reduce excessive illumination levels to standard levels using switching, delamping, etc. (Know the electrical effects before doing delamping.)

17.2.Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.

17.3.Install efficient alternatives to incandescent lighting, mercury vapor lighting, etc. Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high pressure sodium, metal halide, fluorescent, mercury vapor, incandescent.

17.4.Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.

17.5.Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts

17.6.Consider lowering the fixtures to enable using less of them.

17.7.Consider day lighting, skylights, etc.

17.8.Consider painting the walls a lighter color and using less lighting fixtures or lower wattages.

17.9.Use task lighting and reduce background illumination.

17.10.Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.

17.11.Change exit signs from incandescent to LED.

18. Buildings

18.1.Seal exterior cracks/openings/gaps with caulk, gasketing, weather-stripping, etc.

18.2.Consider new thermal doors, thermal windows, roofing insulation, etc.

18.3.Install windbreaks near exterior doors.

18.4.Replace single-pane glass with insulating glass.

18.5.Consider covering some window and skylight areas with insulated wall panels inside the building.

18.6.If visibility is not required but light is required, consider replacing exterior windows with insulated glass block.

18.7.Consider tinted glass, reflective glass, coatings, awnings, overhangs, draperies, blinds, and shades for sunlit exterior windows.

18.8.Use landscaping to advantage.

18.9.Add vestibules or revolving doors to primary exterior personnel doors.

18.10.Consider automatic doors, air curtains, strip doors, etc. at high-traffic passages between conditioned and non-conditioned spaces. Use self-closing doors if possible.

18.11.Use intermediate doors in stairways and vertical passages to minimize building stack effect.

18.12.Use dock seals at shipping and receiving doors.

18.13.Bring cleaning personnel in during the working day or as soon after as possible to minimize lighting and HVAC costs.

19. Water & Wastewater

19.1.Recycle water, particularly for uses with less-critical quality requirements.

19.2.Recycle water, especially if sewer costs are based on water consumption.

19.3.Balance closed systems to minimize flows and reduce pump power requirements.

19.4.Eliminate once-through cooling with water.

19.5.Use the least expensive type of water that will satisfy the requirement.

19.6.Fix water leaks.

19.7.Test for underground water leaks. (It's easy to do over a holiday shutdown.)

19.8.Check water overflow pipes for proper operating level.

19.9.Automate blow down to minimize it.

19.10.Provide proper tools for wash down -- especially self-closing nozzles.

19.11.Install efficient irrigation.

19.12.Reduce flows at water sampling stations.

19.13.Eliminate continuous overflow at water tanks.

19.14.Promptly repair leaking toilets and faucets.

19.15.Use water restrictors on faucets, showers, etc.

19.16.Use self-closing type faucets in restrooms.

19.17.Use the lowest possible hot water temperature.

19.18.Do not use a heating system hot water boiler to provide service hot water during the cooling season -- install a smaller, more-efficient system for the cooling season service hot water.

19.19.If water must be heated electrically, consider accumulation in a large insulated storage tank to minimize heating at on-peak electric rates.

19.20.Use multiple, distributed, small water heaters to minimize thermal losses in large piping systems.

19.21.Use freeze protection valves rather than manual bleeding of lines.

19.22.Consider leased and mobile water treatment systems, especially for deionized water.

19.23.Seal sumps to prevent seepage inward from necessitating extra sump pump operation.

19.24.Install pretreatment to reduce TOC and BOD surcharges.

19.25.Verify the water meter readings. (You'd be amazed how long a meter reading can be estimated after the meter breaks or the meter pit fills with water!)

19.26.Verify the sewer flows if the sewer bills are based on them

.

20. Miscellaneous

20.1.Meter any unmetered utilities. Know what is normal efficient use. Track down causes of deviations.

20.2.Shut down spare, idling, or unneeded equipment.

20.3.Make sure that all of the utilities to redundant areas are turned off -- including utilities like compressed air and cooling water.

20.4.Install automatic control to efficiently coordinate multiple air compressors, chillers, cooling tower cells, boilers, etc.

20.5.Renegotiate utilities contracts to reflect current loads and variations.

20.6.Consider buying utilities from neighbors, particularly to handle peaks.

20.7.Leased space often has low-bid inefficient equipment. Consider upgrades if your lease will continue for several more years.

20.8.Adjust fluid temperatures within acceptable limits to minimize undesirable heat transfer in long pipelines.

20.9.Minimize use of flow bypasses and minimize bypass flow rates.

20.10.Provide restriction orifices in purges (nitrogen, steam, etc.).

20.11.Eliminate unnecessary flow measurement orifices.

20.12.Consider alternatives to high pressure drops across valves.

20.13.Turn off winter heat tracing in summer.

Prepared by: Prof Goran Jankes Belgrade, November, 2010

References:

1.Manual for Energy Efficiency Improvements and Energy Conservation in Industry, SIEEN, ICMFBgd, Belgrade, 2009.

2. Bureau of Energy Efficiency of India, Documents for certification of energy managers and energy auditors

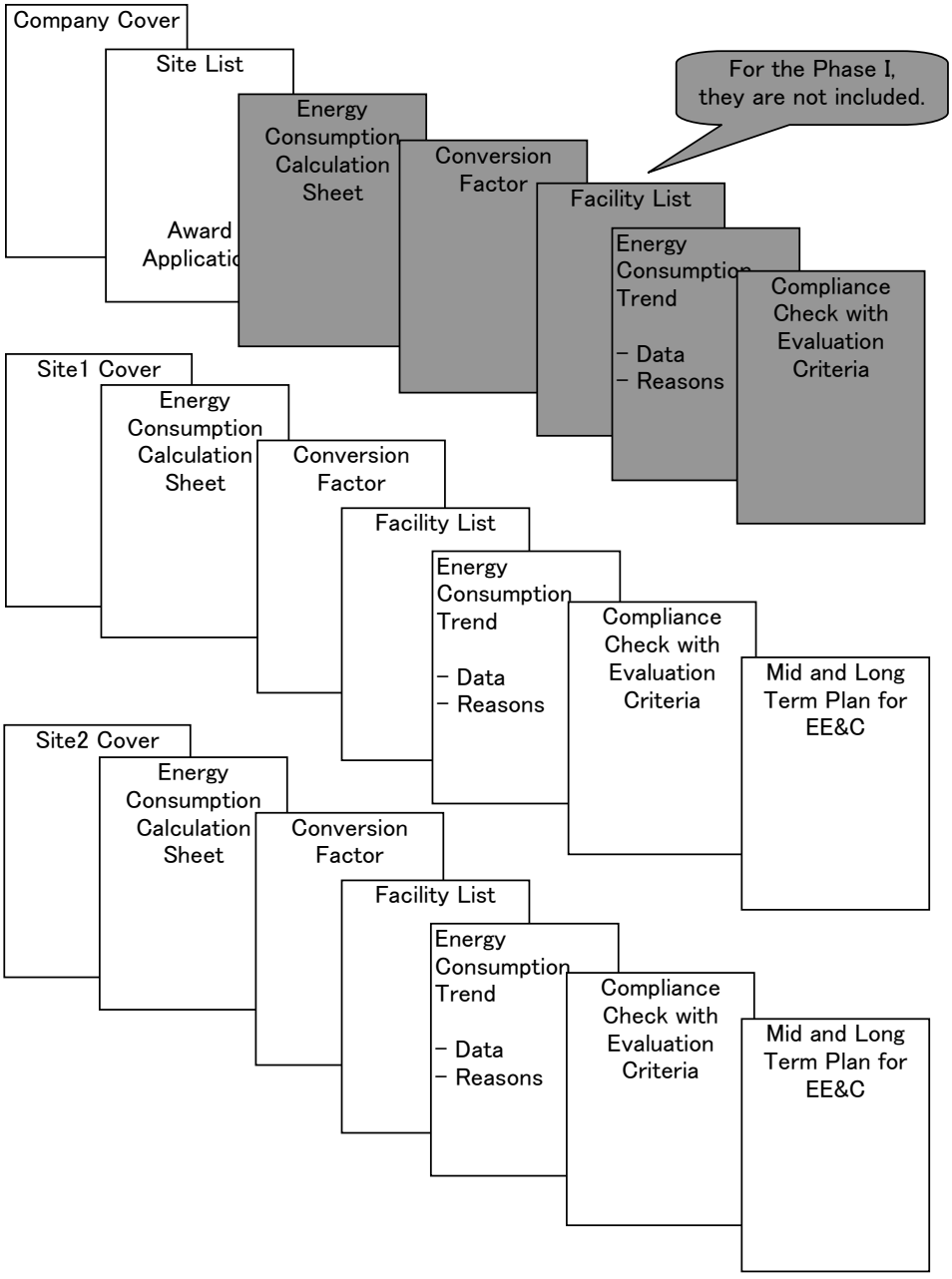
Appendix 5

Formats of Periodical Report

Draft Format of Periodical Report for Phase I

Structure of Periodical Report for Phase I

- This format is for the beginning phase, Phase I
- Only Sites are designated
- But reports shall be submitted through Organization



List of Contents

※Date received	
※Date processed	

Periodecal Report

To: Ministry of Mining and Energy

Day Month Year

Blue parts are to be filled.

Pink letters are for examples.

Address:

Name: CEO's Name

Signed/Stamped

Registered number of designated organization								
Name of organizaiton								
Address of main office of organization								
	Phone: (— —)							
	FAX: (— —)							
Resposible document creator (registered EM)	(Name) (Title/department) (Address) (Phone&Fax)							
Registered license number of Registered Energy Manager (including outsourced one)								
Name and position of Energy Officer of organization, when assigned								
Date of previsous energy audit by an accredited energy auditor, if any								
Date of previsous inspection by an inspector on an organization								

Has Name or Address of company changed since the previous report? Yes or No

If yes,

previous Name of company:

previous Address of company:

Table C-1: List of designated sites (Factory/Building)

Category of designation (Factory/Building)	Registered Number of Designated Site (Factory/Building)	Name of Site (Factory/Building)	Address of Site (Factory/Building)	Energy Consumption (toe) (primary energy)	Business category No.	Name of business category
Factory	#####	#####	####	**3,270**	####	**Food**
Total Energy Consumption (toe)				0		

Table C-2: Award scheme application

Would you like to apply for the Award Scheme?	Yes ☐	No ☐

Table C-3-S: Energy consumption trend only for special sectors

This table is only for the special sectors which are defined in the law to submit energy consumption/intensity in particular categories.

	FY2006	FY2007	FY2008	FY2009	FY2010	Remarks/Notes
Category unit %	%	%	%	%	%	
Plant toe %	%	%	%	%	%	
Transmission & Distribution toe %	%	%	%	%	%	
Building toe %	%	%	%	%	%	
Total %	%	%	%	%	%	

Blue parts are to be filled.

Even if company = site, this sheet shall not be skipped.

Registered Number of Designated Site (Factory/Building)							

Name of Site (Factory/Building)		
Address of Site (factory/building)		
	Phone: (— —)	
	FAX: (— —)	
Business type of factory		(Number)
Responsible document creator (Registered EM)	(Name) (Title/department)	

Registered License number of Registered Energy Manager, including outsourced EM	
Name and position of Energy Officer of site, when assigned	
Date of previsous energy audit by an accredited energy auditor, if any	
Date of previsous inspection by an inspector on an organization	

Table S-1-1: Quantity of annual energy consumption

	Unit	(FY 2010)					
		Input energy A	Excluded energy (sold etc.) B	Net Total A-B	Final Energy (toe)	Primary Energy (toe)	Carbon Dioxide (tCO2)
Lignite raw	t				0	0	0
Lignite dried	t					0	0
Brown Coal	t					0	0
Hard Coal	t					0	0
Heating oil	m3			0	0	0	0
Heavy fuel oil	t	2,229	0	2,229	2,108	2,108	1
Kerosene	m3			0	0	0	0
Propane-Butane	m3			0	0	0	0
Natural gas	m3			0	0	0	0
Biogas	m3			0	0	0	0
Coke	t			0	0	0	0
Wood	m3			0	0	0	0
Wood waste	t			0	0	0	0
Biomass	t			0	0	0	0
				0	0	0	0
Steam	kWh			0	0	0	0
Hot water	kWh			0	0	0	0
Technical steam	kWh			0	0	0	0
Geothermal water	kWh			0	0	0	0
EPS	kWh	5,403,000		5,403,000	465	1,161	4,322
Solar (PV)	kWh			0	0	0	0
Wind Power	kWh			0	0	0	0
Others	kWh			0	0	0	0
Total					2,573	3,270	4,323

Kinds of fuels will be the same as national energy statistics.
Currently they are of Municipality EMS.

Table S-1-2: Re-calculation of renewable energy (for reference)

Re-calculation	Final Energy (toe)	Primary Energy (toe)	
Renewable Energy*	0	0	

*: Definition of renewable energy in the Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 is as follows;
'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases;

Table S-1-3: Quantity of water usage (for reference)

	unit	Quantity
Drinking water/well water etc.	m3	
Industrial water	m3	
Any water	m3	
Total	m3	0

This page is a sample of coversion factors.

M−EMS Version

Convertor for Table 1 8.5985E−05

	Unit	to Final Energy (toe)	to Primary Energy (toe)	to Carbon Dioxide (kgCO2 to tCO2)	to Final Energy (kWh)	to Primary Energy (kWh)	to Carbon Dioxide (kWh to kgCO2)
Lignite raw	t	0.3095442	0.3095442	0.00035	3,600	3,600	0.35
Lignite dried	t	0.38693025	0.38693025	0.00035	4,500	4,500	0.35
Brown Coal	t	0.4299225	0.4299225	0.00035	5,000	5,000	0.35
Hard Coal	t	0.515907	0.515907	0.00035	6,000	6,000	0.35
Heating oil	m3	0.979363455	0.979363455	0.00025	11,390	11,390	0.25
Heavy fuel oil	t	0.9458295	0.9458295	0.00028	11,000	11,000	0.28
Kerocine	m3	0.9458295	0.9458295	0.00025	11,000	11,000	0.25
Propane-Butane	m3	0.9458295	0.9458295	0.00024	11,000	11,000	0.24
Natural gas	m3	0.000796216	0.000796216	0.0002	9.26	9	0.20
Biogas	m3	0.000773861	0.000773861	0.0002	9.00	9	0.20
Coke	t	0.6018915	0.6018915	0.00035	7,000	7,000	0.35
Wood	m3	0.14445396	0.14445396	0.0003	1,680	1,680	0.30
Wood waste	t	0.38693025	0.38693025	0.0003	4,500	4,500	0.30
Biomass	t	0.30094575	0.30094575	0.0003	3,500	3,500	0.30
Steam	kWh	8.59845E-05	0.000107481	0.40	1.00	1.25	0.40
Hot water	kWh	8.59845E-05	0.000107481	0.40	1.00	1.25	0.40
Technical steam	kWh	8.59845E-05	0.000107481	0.40	1.00	1.25	0.40
Geothermal water	kWh	8.59845E-05	8.59845E-05	0.00	1.00	1.00	0.00
EPS	kWh	8.59845E-05	0.000214961	0.0008	1.00	2.50	0.80
Solar energy	kWh	8.59845E-05	8.59845E-05	0.000	1.00	1.00	0.00
Wind Energy	kWh	8.59845E-05	8.59845E-05	0.000	1.00	1.00	0.00

Current values are from M−EMS. They were written in kWh/jm

As examples, efficiency as 80% are put here.

Efficiency defined in EU Directive is 40%.

Reference Data 1: The data of conversion factors used in M-EMS, municipality energy management project are shown below.

	Energy sourceDenomination1	JM	kWh/jm	Emission kg/kWh
0	Not used		0.0000	0.00
1	Steam	kWh	1.0000	0.40
2	Hot water	kWh	1.0000	0.40
3	Lignite raw	t	3,600.0000	0.35
4	lignite dried	t	4,500.0000	0.35
5	Brown coal	t	5,000.0000	0.35
6	Hard coal	t	6,000.0000	0.35
7	Wood	m3	1,680.0000	0.30
8	Wood waste	t	4,500.0000	0.30
9	Biomass	t	3,500.0000	0.30
10	Heating oil	m3	11,390.0000	0.25
11	Heavy fuel oil	t	11,000.0000	0.28
12	Kerozin	m3	11,000.0000	0.25
13	Propane-Butane	m3	11,000.0000	0.24
14	natural gas	m3	9.2600	0.20
15	Biogas	m3	9.0000	0.20
16	Electricity	kWh	1.0000	0.80
17	Solar energy	kWh	1.0000	0.00
18	Technical steam	kWh	1.0000	0.40
19	Geothermal water	kWh	1.0000	0.00
25	Wind energy	kWh	1.0000	0.00
30	Coke	t	7,000.0000	0.35

Source: M-EMS buildingsVer21FINAL.xls

Table S-2: List of facilities which can contribute to EE&C and other major facilities consuming energy. The list should cover more than **80%** of total energy consumptin and describe situations of operation

	Name of facilities	Outline of facilities	Operationnal status	New installation, remodeling or removal
Facilities related to EE&C				
Major facilities comsuming energy other than the above				

Table S-3: Energy consumption trend (in primary energy)

	FY2006	FY2007	FY2008	FY2009	FY2010	Average reduction of 5 years
Energy consmption (primary energy in toe)	(to be filled by designated site)	(to be filled by designated site)	**2,650**	**2,600**	2,573	
Comparison to previous fiscal year (%)		(a) #VALUE!	(b) #VALUE!	(c) 98.1%	(d) 99.0%	#VALUE!

Table S-4: Reasons for **(A)** a case where energy consumption **for the past five years** did not decrease by 1%* or more **on average**,
or **(B)** a case where energy consumption **to the previous fiscal year** did not decrease by 1%* or

Reasons for (A) above
Reasons for (B) above

*: Target number, here 1%, shall be defined in the law or regulations

Table S-5: Compliance check with evaluation criteria

Target items (facilities)	Status of establishing management standards	Status of observing mesurement/record	Status of observing maintenance/inspection	Status of measures to betaken on new installation
Rationalization of fuel combustion (Combustion facility)	Status of establishing management standards for air ratio and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of combustion facilities ☐ Done ☐ Not done ☐ Not applicable
Rationalization of heating, cooling and heart transfer (Heat consumption facility)	Status of establishing management standards for heating equipment and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of heating equipment and others ☐ Done ☐ Not done ☐ Not applicable
	Status of establishing management standards for air conditioning and hot water supply facility ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of air conditioning facility and others ☐ Done ☐ Not done ☐ Not applicable
Waste heat recovery (Waste heat recovery facility)	Status of establishing management standards for waste heat recovery facility ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of waste heat recovery facility ☐ Done ☐ Not done ☐ Not applicable
Rationalization of converting heat to power and others (Power generation facility and cogeneration facility)	Status of establishing management standards for gas turbine of power generation facility and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of power generation facility ☐ Done ☐ Not done ☐ Not applicable

	Status of establishing management standards for boiler of cogeneration facility and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of cogeneration facility ☐ Done ☐ Not done ☐ Not applicable
Prevention of energy loss by radiation, conduction, resistance and others (Heat consumption facility, power receiving & transforming facility and distribution facility)	Status of establishing management standards for heat loss ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of heat consumption facility ☐ Done ☐ Not done ☐ Not applicable
	Status of establishing management standards for electricity loss ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of power receiving & transforming facility and distribution facility ☐ Done ☐ Not done ☐ Not applicable
Rationalization of converting electricity to power and heat and others (Electricity utilizing facility)	Status of establishing management standards for electricity utilizing facility of applied electric power facility, electric heating facility, electrolysis facility ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of applied electric power facility and others ☐ Done ☐ Not done ☐ Not applicable
	Status of establishing management standards for lighting facility and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of lighting facility and others ☐ Done ☐ Not done ☐ Not applicable

Table S-6: Other measures taken for EE&C

Outline of measures

Table S-7: Middle and Long Term Plan for EE&C

I Planning Period

FY - FY

Middle and Long term means within 5 years

II Plan for EE&C and Expected Effects

"Hard" Measures

Process/Facility	Plan	Expected Effects of EE&C (toe) in primary energy
pumps of hot/cold water system	ex. Add inverters for pumps	
	This plan shoud describe mainly the ″hard″ measures ″with investment″ related to facility, system, technology etc., namely which can expect effects with certain confidence.	

"Soft" Measures

Process/Facility	Plan	Expected Effects of EE&C (toe) in primary energy
	″Soft″ measures, ″without investment″, such as promoting switching off lights by employees, should be limited to the ones which can expect effects with certain confidence.	

III Comparison or Change to Plan of Previous Fiscal Year

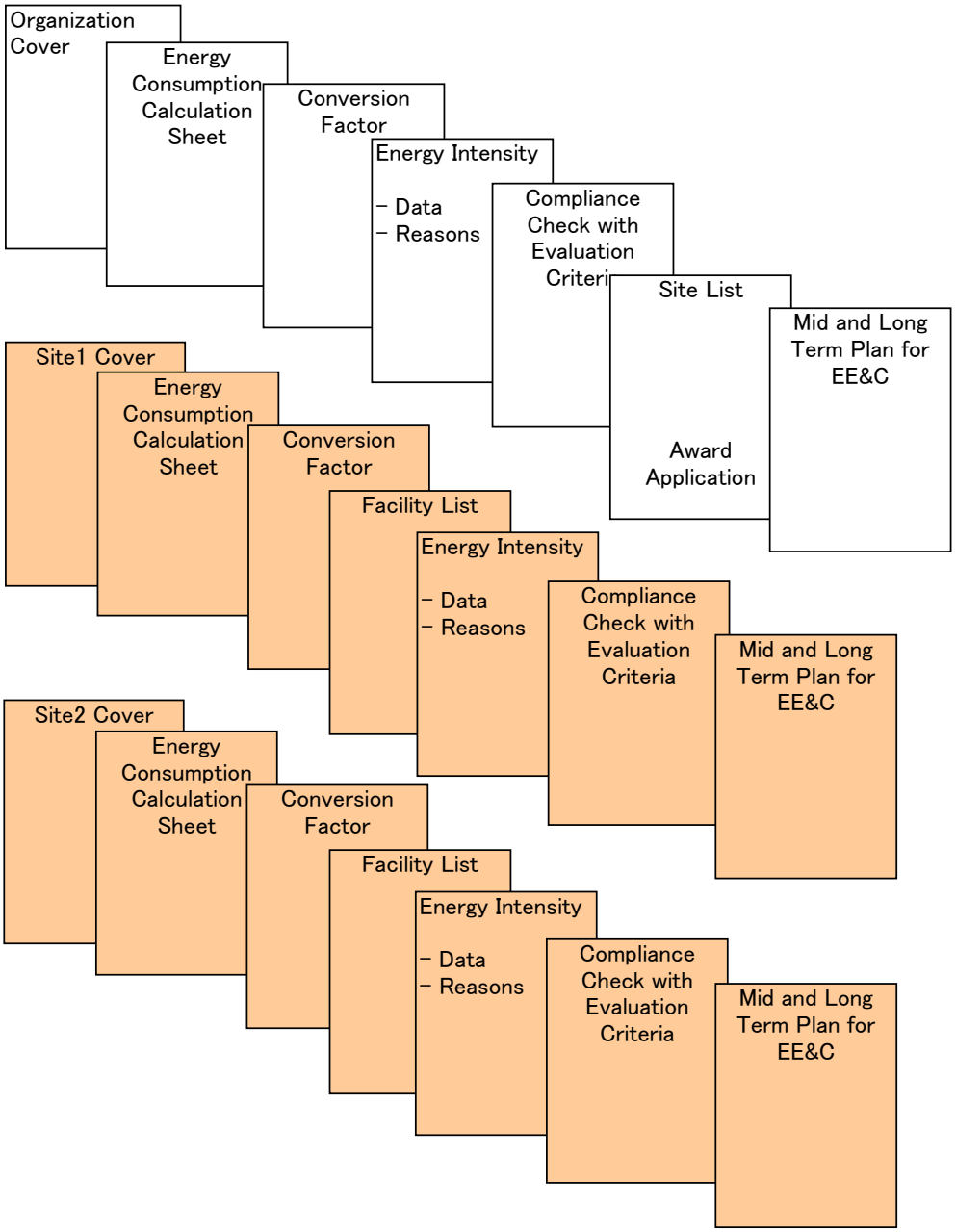
Process	Deleted Contents of Measures	Reasons
Process	Added Contents of Measures	Reasons

IV Other Issues on Planning

Draft Format of Periodical Report for Phase II

Structure of Periodical Report for Phase II

- This format is for the routine phase, Phase II
- When there are no desiganated sites of the organization, orange sheets are not necessary.



List of Contents

Organization	Cover	Basic Information
		- Address & Name of Company with Signature/Stamp
		- Registered number of designated organization
		- Name of organization
		- Address of main office of organization
		- Name of responsible document creator
		- Registered licence number of registered energy manager
		- Date of previous energy audit by accredited energy auditor
		- Date of previous inspection by an inspector on an organization
		- Change in address
	Table C-1-1	Quantity of annual energy consumption of whole organization
		- input data: input energy, excluded energy
		- output data: final energy (toe), primary energy (toe), CO2 (tCO2)
	Table C-1-2	Re-calculation of renewable energy (for reference)
		- automatical calculation
	Table C-1-3	Quantity of water usage
		- input data: clean water, industrial water, any water
		- output data: total volume
	Table C-2	Energy intensity as a whole company and by each business category
		- input energy (toe) and denominator of intensity
	Table C-3	Energy intensity for the past 5 years
		- past data and this year
	Table C-3-S	Energy intensity for special sectors for the past 5 years
		- additional data to be reported
	Table C-4	Reasons for not achidving the target
		- (a) for past 5 years
		- (b) to the previous year
	Table C-5	Compliance check with evaluation criteria
		- self checking for compliance
	Table C-6	Other measure or activities
	Table C-7	List of Designated Sites
		- Category of designation (factory/building)
		- Registered number of the sites
		- Name&Address of the sites
		- No. and Name of business category
		- Energy consumption amount of the sites (toe)
	Table C-8	Award Scheme
		- Apply or not?
	Table C-9	Middle and Long Term Plan for EE&C
		- Hard measures
		- Soft measures
		- Comparison to previous Plan
		- Other issues

Site	Cover	Basic Information
		- Registered number of designated site (factory/building)
		- Name and Address of site
		- Business type of factory/building
		- Responsible document creator
		- Registered licence number of registerd energy manager
	Table S-1-1	Quantity of Energy Consumption
		- input data: input energy, excluded energy
		- output data: final energy (toe), primary energy (toe), CO2 (tCO2)
	Table S-1-2	Re-calculation of renewable energy (for reference)
		- automatical calculation
	Table S-1-2	Quantity of Water Use
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		- output data: total volume
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		- Name, outline, operation status, conditions
	Table S-3	Values closely related to energy consumption
		- input data: denominator
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	Table S-4	Energy intensity trend
		- past data and this year
	Table S-5	Reasons for not achidving the target
		- (a) for past 5 years
		- (b) to the previous year
	Table S-6	Compliance Check with Evaluation Criteria
		- self checking for compliance
	Table S-7	Other measures taken for EE&C
	Table S-8	Middle and Long Term Plan for EE&C
		- Plan for EE&C and expected effects
		- Comparison of the plan to premious fiscal year

※Date received	
※Date processed	

Periodecal Report

To: Ministry of Mining and Energy

Day Month Year

Blue parts are to be filled.

Pink letters are for examples.

Address:

Name: **CEO's Name** Signed/Stamped

Registered number of designated organization								
Name of organizaiton								
Address of main office of organization								
	Phone: (		—		—		)	
	FAX: (		—		—		)	
Resposible document creator (registered EM)	(Name) (Title/department) (Address) (Phone&Fax)							

Registered license number of Registered Energy Manager (including outsourced one)	
Name and position of Energy Officer of organization, when assigned	
Date of previsous energy audit by an accredited energy auditor, if any	
Date of previsous inspection by an inspector on an organization	

Has Name or Address of company changed since the previous report? Yes or No
If yes,
previous Name of company:
previous Address of company:

Table C-1-1: Quantity of annual energy consumption of whole organiztion

	Unit	(FY 2010)					
		Input energy A	Excluded energy (sold etc.) B	Net Total A-B	Final Energy (toe)	Primary Energy (toe)	Carbon Dioxide (tCO2)
Lignite raw	t			0	0	0	0
Lignite dried	t			0	0	0	0
Brown Coal	t			0	0	0	0
Hard Coal	t			0	0	0	0
Heating oil	m3			0	0	0	0
Heavy fuel oil	t			9	2,108	2,108	1
Kerosene	m3			0	0	0	0
Propane-Butane	m3			0	0	0	0
Natural gas	m3			0	0	0	0
Biogas	m3			0	0	0	0
Coke	t			0	0	0	0
Wood	m3			0	0	0	0
Wood waste	t			0	0	0	0
Biomass	t			0	0	0	0
				0	0	0	0
Steam	kWh			0	0	0	0
Hot water	kWh			0	0	0	0
Technical steam	kWh			0	0	0	0
Geothermal water	kWh			0	0	0	0
					0	0	0
EPS	kWh	5,403,000		5,403,000	465	1,161	4,322
					0	0	0
Solar (PV)	kWh			0	0	0	0
Wind Power	kWh			0	0	0	0
Others	kWh			0	0	0	0
Total					2,573	3,270	4,323

Kinds of fuels will be the same as national energy statistics.
Currently they are of Municipality EMS, since data of IEA are not sufficient for this table.

Table C-1-2: Re-calculation of renewable energy consumption (for reference)

Re-calculation	Final Energy (toe)	Primary Energy (toe)	
Renewable Energy*	0	0	

*: Definition of renewable energy in the Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 is as follows;
'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases;

Table C-1-3: Quantity of water usage (for reference)

	unit	Quantity
Drinking water/well water etc.	m3	
Industrial water	m3	
Any water	m3	
Total	m3	0

This page is a sample of coversion factors.

M−EMS Version

Convertor for Table 1 8.5985E−05

	Unit	to Final Energy (toe)	to Primary Energy (toe)	to Carbon Dioxide (kgCO2 to tCO2)	to Final Energy (kWh)	to Primary Energy (kWh)	to Carbon Dioxide (kWh to kgCO2)
Lignite raw	t	0.3095442	0.3095442	0.00035	3,600	3,600	0.35
Lignite dried	t	0.38693025	0.38693025	0.00035	4,500	4,500	0.35
Brown Coal	t	0.4299225	0.4299225	0.00035	5,000	5,000	0.35
Hard Coal	t	0.515907	0.515907	0.00035	6,000	6,000	0.35
Heating oil	m3	0.979363455	0.979363455	0.00025	11,390	11,390	0.25
Heavy fuel oil	t	0.9458295	0.9458295	0.00028	11,000	11,000	0.28
Kerocine	m3	0.9458295	0.9458295	0.00025	11,000	11,000	0.25
Propane-Butane	m3	0.9458295	0.9458295	0.00024	11,000	11,000	0.24
Natural gas	m3	0.000796216	0.000796216	0.0002	9.26	9	0.20
Biogas	m3	0.000773861	0.000773861	0.0002	9.00	9	0.20
Coke	t	0.6018915	0.6018915	0.00035	7,000	7,000	0.35
Wood	m3	0.14445396	0.14445396	0.0003	1,680	1,680	0.30
Wood waste	t	0.38693025	0.38693025	0.0003	4,500	4,500	0.30
Biomass	t	0.30094575	0.30094575	0.0003	3,500	3,500	0.30
Steam	kWh	8.59845E-05	0.000107481	0.40	1.00	1.25	0.40
Hot water	kWh	8.59845E-05	0.000107481	0.40	1.00	1.25	0.40
Technical steam	kWh	8.59845E-05	0.000107481	0.40	1.00	1.25	0.40
Geothermal water	kWh	8.59845E-05	8.59845E-05	0.00	1.00	1.00	0.00
EPS	kWh	8.59845E-05	0.000214961	0.0008	1.00	2.50	0.80
Solar energy	kWh	8.59845E-05	8.59845E-05	0.000	1.00	1.00	0.00
Wind Energy	kWh	8.59845E-05	8.59845E-05	0.000	1.00	1.00	0.00

Current values are from M−EMS. They were written in kWh/jm

As examples, efficiency as 80% are put here.

Efficiency defined in EU Directive is 40%.

Reference Data 1: The data of conversion factors used in M-EMS, municipality energy management project are shown below.

	Energy sourceDenomination1	JM	kWh/jm	Emission kg/kWh
0	Not used		0.0000	0.00
1	Steam	kWh	1.0000	0.40
2	Hot water	kWh	1.0000	0.40
3	Lignite raw	t	3,600.0000	0.35
4	lignite dried	t	4,500.0000	0.35
5	Brown coal	t	5,000.0000	0.35
6	Hard coal	t	6,000.0000	0.35
7	Wood	m3	1,680.0000	0.30
8	Wood waste	t	4,500.0000	0.30
9	Biomass	t	3,500.0000	0.30
10	Heating oil	m3	11,390.0000	0.25
11	Heavy fuel oil	t	11,000.0000	0.28
12	Kerozin	m3	11,000.0000	0.25
13	Propane-Butane	m3	11,000.0000	0.24
14	natural gas	m3	9.2600	0.20
15	Biogas	m3	9.0000	0.20
16	Electricity	kWh	1.0000	0.80
17	Solar energy	kWh	1.0000	0.00
18	Technical steam	kWh	1.0000	0.40
19	Geothermal water	kWh	1.0000	0.00
25	Wind energy	kWh	1.0000	0.00
30	Coke	t	7,000.0000	0.35

Source: M-EMS buildingsVer21FINAL.xls

Table C-2: Energy intensity as a whole company and by each business category

Number		Calcuration of energy intensity for each business category								
		Input energy (toe)	Excluded energy (toe)		Propotion of each C	Values closely related to energy consumption	Energy intensity	Energy intensity of previous fiscal year	Comparison to previous fiscal year in 5	Proportion of D to previous year
		A	B	C=A-B	D=C/U*100	E	F	G	H=F/G	I=D*H
1	business category Factories category No.	100	50	50	11%	10 (unit) ton	5	11	45%	(1) 5.1%
2	business category Buildings category No.	200	0	200	44%	20 (unit) m2	10	8	125%	(2) 55.6%
3	business category Shops category No.	200	0	200	44%	10 (unit) ton	20	5	400%	(3) #####
4	business category category No.			0	0%	(unit)	#####		#####	(4) #####
		S (sum) 500	T (sum) 50	U (sum) 450	100%	V (unit)	W	X	Y=W/X*100	Z=(1)+(2)+(3)+(4)+ #DIV/0!

Note: When it is difficult to set common denominator for a whole organization, G, H, I and Z should be filled and V, W, X and Y are not necessary to be filled.

Table C-3: Energy intensity of the previous five years

	FY2006	FY2007	FY2008	FY2009	FY2010	Average change of energy intensity of 5 years
Energy intensity	(to be filled by designated org.)	(to be filled by designated org.)	1.0	2.0	#DIV/0!	
Comparison to previous fiscal year (%)		J #VALUE!	K #VALUE!	L 200%	M #DIV/0!	#VALUE!

Table C-3-S: Energy intensity for special sectors of the previous five years
This table is only for the special sectors which are defined in the law to submit energy consumption/intensity in particular categories.

	FY2006	FY2007	FY2008	FY2009	FY2010	Remarks/Notes
Category unit %	%	%	%	%	%	
Plant toe/kWh %	%	%	%	%	%	
Transmission & Distribution toe/kWh %	%	%	%	%	%	
Building toe/m2 %	%	%	%	%	%	
Total %	%	%	%	%	%	

Table C-4: Reasons for **(A)** a case where **energy intensity for the past five years** did not improve by 1 %* or more **on average**, or **(B)** a case where **energy intensity to the previous fiscal year** did not improve by 1%* or more.

Reasons for (A) above
Reasons for (B) above

*: Target number, here 1%, shall be defined in the law or regulations

Table C-5: Compliance Check with Evaluation Criteria

A. Has management system for rational use of energy is established or not?	☐ Yes ☐ not yet. (planned to be established in FY ##)
B. Has an responsible person for rational use of energy been appointed?	☐ Yes ☐ No
C. Has a policy towards rational use of energy been established?	☐ Yes ☐ No (planned to be established in FY ##)
D. Have you been monitoring and evaluating whether the business units in your company observe the policy towards rational use of energy?	☐ Yes ☐ partly Yes ☐ No
E. Have you been revising the way of monitoring and evaluating (described in D)?	☐ Yes ☐ No
F. Do you organize, revise and store the documents on the business units of your company?	☐ Yes ☐ partly Yes ☐ No (planned to be implemented in FY ##)

Table C-6: Other measures or activities

Outline of measures/activities

Table C-7: List of designated sites (Factory/Building)

Category of designation (Factory/Building)	Registered Number of Designated Site (Factory/Building)	Name of Site (Factory/Building)	Address of Site (Factory/Building)	Energy Consumption (toe) (primary energy)	Business category No.	Name of business category
Factory		**ABC**		**3,000**		
Factory		**DEF**		**3,500**		
Total Energy Consumption (toe)				6,500		

Table C-8: Award scheme application

Would you like to apply for the Award Scheme?	Yes	☐	No	☐

Table C-9: Middle and Long Term Plan for EE&C

I Planning Period

FY - FY

Middle and Long term means within 5 years.

II Plan for EE&C and Expected Effects

"Hard" Measures

Process/Facility	Plan	Expected Effects of EE&C (toe) in primary energy
pumps of hot/cold water system	ex. Add inverters for pumps	
	This plan shoud describe mainly the ″hard″ measures ″with investment″ related to facility, system, technology etc., namely which can expect effects with certain confidence.	

"Soft" Measures

Process/Facility	Plan	Expected Effects of EE&C (toe) in primary energy
	″Soft″ measures, ″without investment″, such as promoting switching off lights by employees, should be limited to the ones which can expect effects with certain confidence.	

III Comparison or Change to Plan of Previous Fiscal Year

Process	Deleted Contents of Measures	Reasons
Process	Added Contents of Measures	Reasons

IV Other Issues on Planning

Blue parts are to be filled.

Even if company = site, this sheet shall not be skipped.

Registered Number of Designated Site (Factory/Building)							
Name of Site (Factory/Building)							
Address of Site (Factory/Building)							
	Phone: (		—		—		)
	FAX: (		—		—		)
Business type of factory						(Number)	
Responsible document creator (Registered EM)	(Name)			(Title/department)			

Registered License number of Registered Energy Manager, including outsourced EM	
Name and position of Energy Officer of site, when assigned	
Date of previsous energy audit by an accredited energy auditor, if any	
Date of previsous inspection by an inspector on an organization	

Table S-1-1: Quantity of annual energy consumption

	Unit	(FY 2010)					
		Input energy A	Excluded energy (sold etc.) B	Net Total A-B	Final Energy (toe)	Primary Energy (toe)	Carbon Dioxide (tCO2)
Lignite raw	t				0	0	0
Lignite dried	t				0	0	0
Brown Coal	t				0	0	0
Hard Coal	t				0	0	0
Heating oil	m3			0	0	0	0
Heavy fuel oil	t	2,229	0	2,229	2,108	2,108	1
Kerosene	m3			0	0	0	0
Propane-Butane	m3			0	0	0	0
Natural gas	m3			0	0	0	0
Biogas	m3			0	0	0	0
Coke	t			0	0	0	0
Wood	m3			0	0	0	0
Wood waste	t			0	0	0	0
Biomass	t			0	0	0	0
				0	0	0	0
Steam	kWh			0	0	0	0
Hot water	kWh			0	0	0	0
Technical steam	kWh			0	0	0	0
Geothermal water	kWh			0	0	0	0
EPS	kWh	5,403,000		5,403,000	465	1,161	4,322
Solar (PV)	kWh			0	0	0	0
Wind Power	kWh			0	0	0	0
Others	kWh			0	0	0	0
Total					2,573	3,270	4,323

Kinds of fuels will be the same as national energy statistics.
Currently they are of Municipality EMS.

Table S-1-2: Re-calculation of renewable energy (for reference)

Re-calculation	Final Energy (toe)	Primary Energy (toe)	
Renewable Energy*	0	0	

*: Definition of renewable energy in the Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 is as follows;
'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases;

Table S-1-3: Quantity of water usage (for reference)

	unit	Quantity
Drinking water/well water etc.	m3	
Industrial water	m3	
Any water	m3	
Total	m3	0

Table S-2: List of facilities which can contribute to EE&C and other major facilities consuming energy. The list should cover more than **80%** of total energy consumptin and describe situations of operation

	Name of facilities	Outline of facilities	Operationnal status	New installation, remodeling or removal
Facilities related to EE&C				
Major facilities comsuming energy other than the above				

Table S-3: Values closely related to energy consumption (= a denominator of energy intensity)

Fiscal Year			FY2010	Comparison to previous fiscal year (%)
Values closely related to energy consumption such as production quantity, (ex.gross floor space or production amount etc.)	ex. Total floor area Production Amount	m2 ton	73,000	0

Table S-4: Energy intensity trend (in primary energy)

	FY2006	FY2007	FY2008	FY2009	FY2010	Average reduction of 5 years
Energy consmption (primary energy in toe)	(to be filled by designated site)	(to be filled by designated site)	2,650	2,600	2,573	
Comparison to previous fiscal year (%)		(a) #VALUE!	(b) #VALUE!	(c) 98.1%	(d) 99.0%	#VALUE!

Table S-5: Reasons for **(A)** a case where energy consumption **for the past five years** did not decrease by 1%* or more **on average**,
or **(B)** a case where energy consumption **to the previous fiscal year** did not decrease by 1%* or

Reasons for (A) above
Reasons for (B) above

*: Target number, here 1%, shall be defined in the law or regulations

Table S-6: Compliance check with evaluation criteria

Target items (facilities)	Status of establishing management standards	Status of observing mesurement/record	Status of observing maintenance/inspection	Status of measures to betaken on new installation
Rationalization of fuel combustion (Combustion facility)	Status of establishing management standards for air ratio and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of combustion facilities ☐ Done ☐ Not done ☐ Not applicable
Rationalization of heating, cooling and heart transfer (Heat consumption facility)	Status of establishing management standards for heating equipment and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of heating equipment and others ☐ Done ☐ Not done ☐ Not applicable
	Status of establishing management standards for air conditioning and hot water supply facility ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of air conditioning facility and others ☐ Done ☐ Not done ☐ Not applicable
Waste heat recovery (Waste heat recovery facility)	Status of establishing management standards for waste heat recovery facility ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of waste heat recovery facility ☐ Done ☐ Not done ☐ Not applicable
Rationalization of converting heat to power and others (Power generation facility and cogeneration facility)	Status of establishing management standards for gas turbine of power generation facility and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of power generation facility ☐ Done ☐ Not done ☐ Not applicable

	Status of establishing management standards for boiler of cogeneration facility and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of cogeneration facility ☐ Done ☐ Not done ☐ Not applicable
Prevention of energy loss by radiation, conduction, resistance and others (Heat consumption facility, power receiving & transforming facility and distribution facility)	Status of establishing management standards for heat loss ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of heat consumption facility ☐ Done ☐ Not done ☐ Not applicable
	Status of establishing management standards for electricity loss ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of power receiving & transforming facility and distribution facility ☐ Done ☐ Not done ☐ Not applicable
Rationalization of converting electricity to power and heat and others (Electricity utilizing facility)	Status of establishing management standards for electricity utilizing facility of applied electric power facility, electric heating facility, electrolysis facility and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of applied electric power facility and others ☐ Done ☐ Not done ☐ Not applicable
	Status of establishing management standards for lighting facility and others ☐ Already established ☐ Being established (%) ☐ To be established	Status of mesurement/record defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of maintenance/inspection defined in management standards ☐ Regularly done ☐ Done as needed ☐ Not done	Status of measures to be taken on new installation of lighting facility and others ☐ Done ☐ Not done ☐ Not applicable

Table S-7: Other measures taken for EE&C

Outline of measures

Table S-8: Middle and Long Term Plan for EE&C

I Planning Period

FY - FY

Middle and Long term means within 5 years.

II Plan for EE&C and Expected Effects

"Hard" Measures

Process/Facility	Plan	Expected Effects of EE&C (toe) in primary energy
pumps of hot/cold water system	ex. Add inverters for pumps	
	This plan shoud describe mainly the ″hard″ measures ″with investment″ related to facility, system, technology etc., namely which can expect effects with certain confidence.	

"Soft" Measures

Process/Facility	Plan	Expected Effects of EE&C (toe) in primary energy
	″Soft″ measures, ″without investment″, such as promoting switching off lights by employees, should be limited to the ones which can expect effects with certain confidence.	

III Comparison or Change to Plan of Previous Fiscal Year

Process	Deleted Contents of Measures	Reasons
Process	Added Contents of Measures	Reasons

IV Other Issues on Planning

Appendix 6

Guidebook for
Energy Management System

Outline of the Energy Management System on Law on Rational Use of Energy

Table of Contents

1. What is the Law on Rational Use of Energy?

The Law on Rational Use of Energy was started in 20XX, which introduces mandatory energy management system for large consumers. The law requires activities such as monitoring, checking and reporting on energy consumption and continuous implementation of activities for rational use of energy.

2. What does Energy mean in the Law on Rational Use of Energy?

The term "Energy " as defined in the law refers to all types of energy available commercially, including natural gas (liquid natural gas and liquid oil gas), all heating and cooling fuels (including district heating and cooling), coal, transport fuels (with the exception of fuels meant for air and sea transport) and renewable energy sources.

Fuel	**Natural gas (including liquefied natural gas), Liquefied petroleum gas, any fuel for heating and cooling (including district heating and cooling), Coal and Lignite, Peat, Transport Fuels (excluding aviation and maritime bunker fuels and Biomass**
Heat	**Heat generated from above mentioned fuel (Steam, Hot Water, Cold Water, etc)**
Electricity	**Electricity generated by all kind of resource including renewable energy resources**

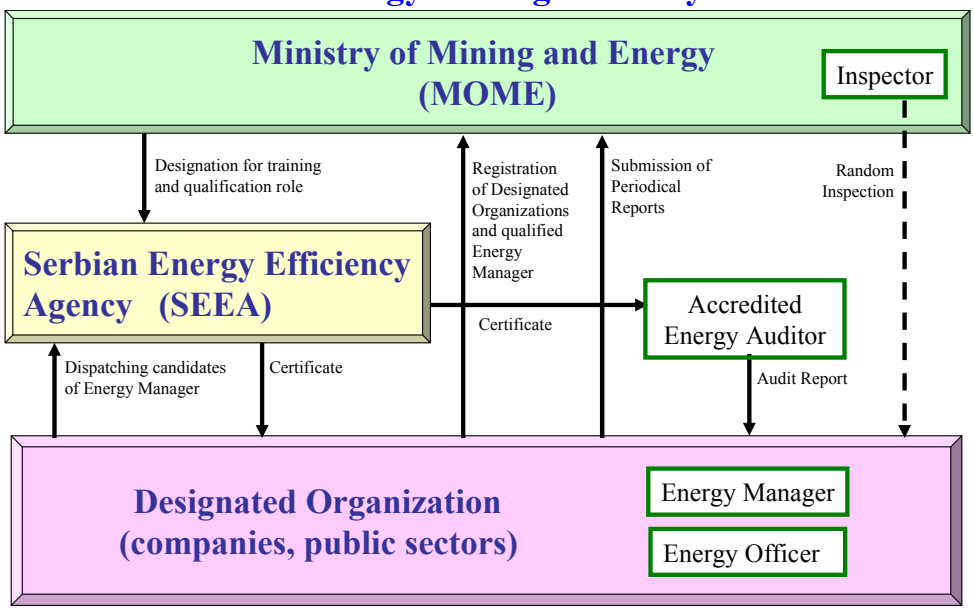
3. What business fields are regulated by the Law on Rational Use of Energy?

The law covers rational use of enegy in factories, commercial buildings, government, transportations, residential households, and other fields listed below.
This guidebook mainly explains about regulation for factories and commercial buildings.

(1) Fields and Business enetities to be regulated by the Energy Management System

Fields	Business entities to be regulated
Industry Commercial& Services Government Buildings Municipality	Companies and other organizations in possession of Large Energy Consuming Factories and Buildings are required to meet mandatory EE&C information measures. Government Buildings and Municipality Facilities are also regulated.

(2) Players related in the Energy Management System



(3) Fields and Business enetities to be also regulated by the law

Fields	Business entities to be regulated
Building Construction	All the new and reconstructed buildings with functional area exceeding 500 m² are required to meet minimum energy efficiency standards
Transportations	New Cars are required to meet new EE standards
Households	To be updated
District Heating (Measurement)	Public utility companies and other companies delivering heat energy are obligated to provide technical conditions for the regulation and measurement of heat energy consumption in premises
Others	To be updated

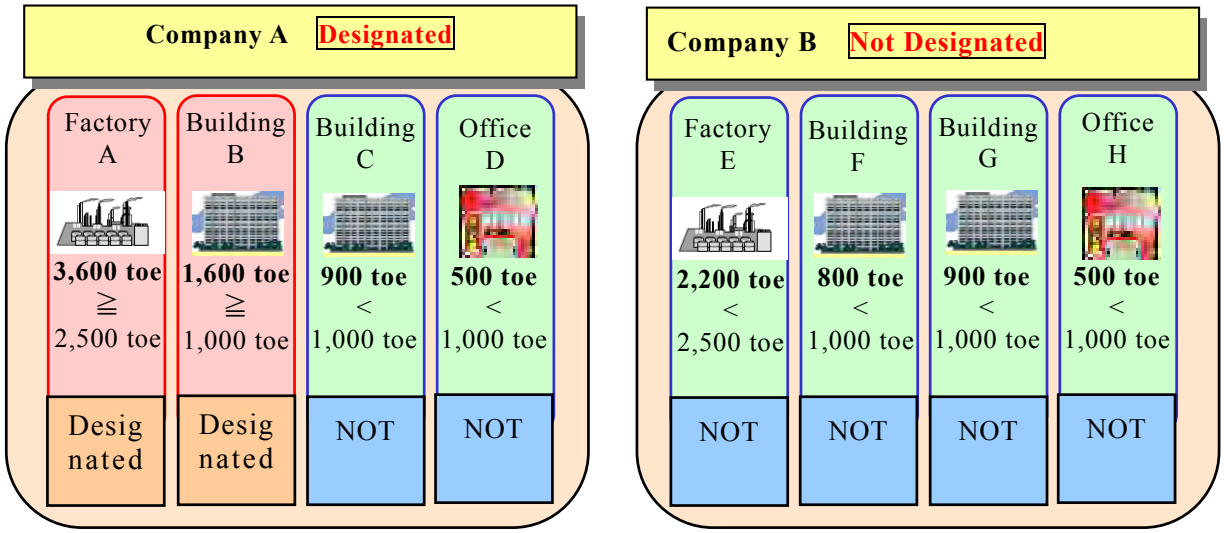
4. What companies or organizations (owners) are to be regulated?

Companies or other organizations whose factory and/or building consume at least a certain amount of energy at the entire business operation level would be designated as designated company or organization. Also, each factory or building of such level would be designated.

Energy consumption amount for designation (primary energy):

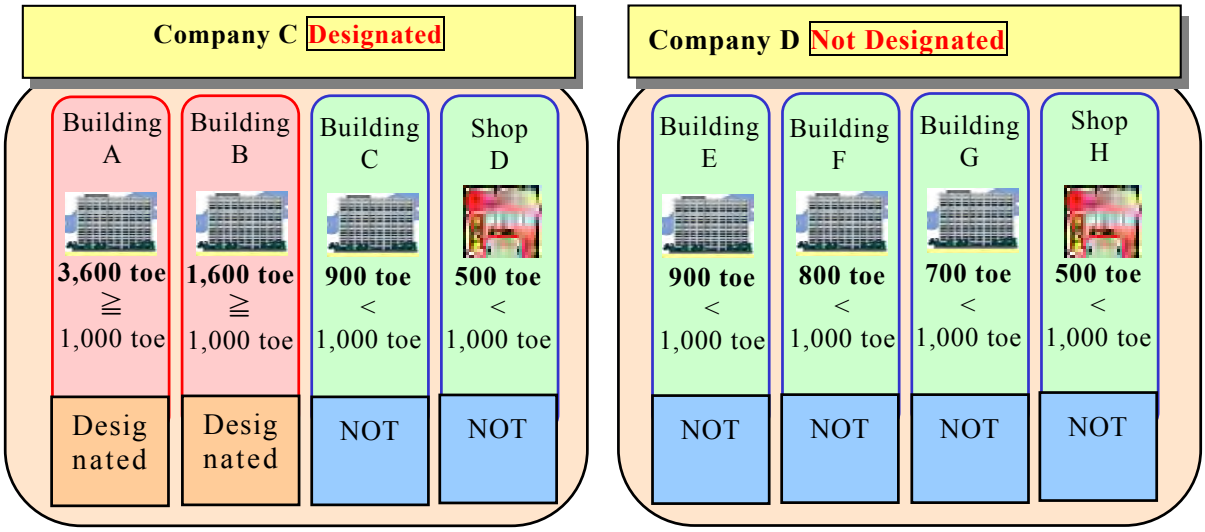
Factory	**(for each)**	**: 2,500 toe / year**
Building	**(for each)**	**: 1,000 toe / year**

(1) Examples for Industrial Sector



Companies of industrial sector who has and run 1) factory with energy consumption of 2,500 toe/y or more or 2) buildings with energy consumption of 1,000 toe/y or more are to

(2) Examples for Commercial & Services Sector



Companies of Commercial & Service sector who has and run buildings with energy consumption of 1,000 toe/y or more are to be designated.

5. What should each company or organization do?

(1) Identification of the energy use amount of whole company level

Please identify the energy use amount (crude oil equivalent) of whole company, indivisual factory and building in the previous fiscal year.

(2) Submission of the "Notification of Energy Use Status"

In the case where an individual factory and/or building consumed energy of 1,500 toe (for factory) or 1,000 toe (for building) or more per year at the business place level, please submit the result in the form of the "Notification of Energy Use Status (see P.XX)" to XXX by (*date of deadline*), with a breakdown of the energy use amount of the entire designated company.

Please identify the energy use amount (toe) of each factory and/or building in the previous fiscal year.

(3) Designation of designated companies, factories, and buildings

When a company submits a "Notification of Energy Use Status," the national government will designate the company as "Designated Company".

Also, the national government designates a factory which uses energy of 2,500 toe or more per year as "Designated Factory", and a building which uses energy of 1,000 toe or more per year as "Designated Building".

(4) Appointment of Energy Manager or Energy Officer

A Designated Company is requested to appoint one "Energy Manager" respectively, and to submit "Notification of Appointment of Energy Manager" to MOME.

Companies having "Designated Factory"or "Designated Building" is requested to appoint "Energy Manager" (for buildings, "Energy Manager" or "Energy Officer") each of the applicable factories/buildings and to submit "Notification of Appointment of Energy Manager/Energy Officer" to MOME

Energy Manager must pass a qualification exam (to be an Energy Manager) required by regulation.

(5) Implementation of energy management at the company level

The Designated Companies are requested to comply with the judgment criteria for the entire company (setting of management standard, implementation of energy conservation actions, etc.), and make efforts to reduce specific energy consumption by 1% (in primary energy) or more per year in average from the medium and long term standpoint.

(6) Submission of medium and long-term plan and periodical report

A Designated Company is requested to submit "Medium and Long-Term Plan" and "Periodical Report" by XXX*(deadline)* in every fiscal year to XXX. It is also requested to add the energy use amount, etc. in the applicable factory/building in the periodical report as the breakdown of the periodic report of the company.

The Periodical Report must include energy efficiency plan with a reduction target of # % per year in primary energy.

Items included in the reports by companies or organization

(1)Basic Information of the company or organization
(2) List of Designated Sites
- Category of designation (factory/building)
- Registered number of the sites
- Name & Address of the sites
- No. and Name of business category
- Energy consumption amount of the sites

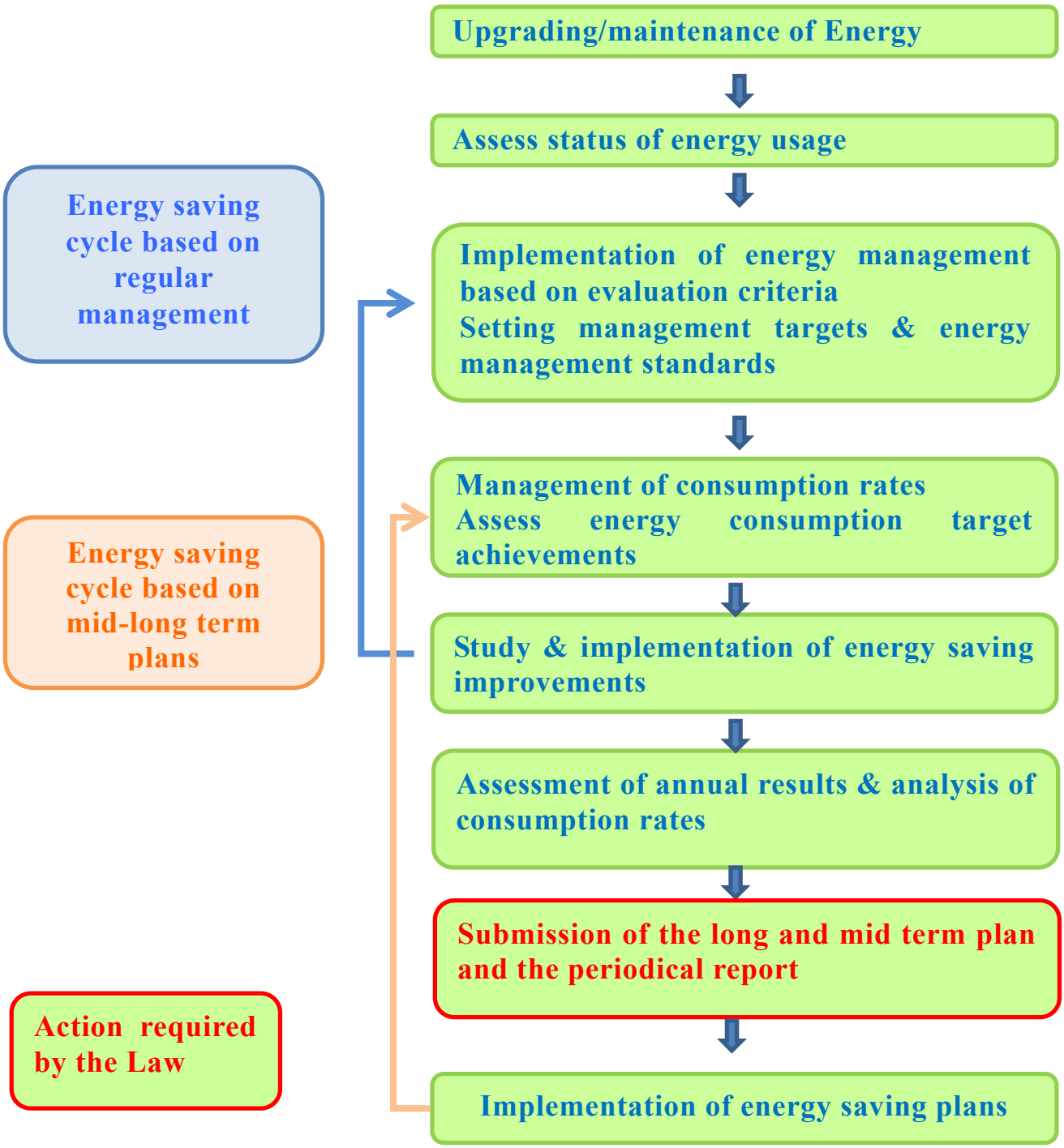
(3) Award scheme
(4) Energy consumption trend for special sectors for the past 5 years
- Energy consumption according to determined categories

Items included in the reports by designated factories or buildings

(1) Basic Information
(2) Quantity of Energy Consumption
(3) Re-calculation of renewable energy (for reference)
(4) Quantity of Water Use
(5) List of Facilities
(6) Energy Consumption Trend
(7) Reasons for not achieving the target
(8) Compliance Check with Evaluation Criteria
(9) Other measures taken for EE&C
(10) Middle and Long Term Plan for EE&C

5-a. Flow of energy management activities

It is important for Designated Companies to organize their in-house energy management system for effective and continuous activity for rational use of energy.



5-b. Method for converting the energy use amount to the basic unit (toe)

(1) Identification of the energy use amount of each fuel, electricity, in the previous fiscal year by energy category
(2) Convertion of energy use amount of each category to "toe"
(3) Calculation of a total figure of (2)

Table S-1-1: Quantity of annual energy consumption

	Unit	(FY 2010)					
		Input energy A	Excluded energy (sold etc.) B	Net Total A-B	Final Energy (toe)	Primary Energy (toe)	Carbon Dioxide (tCO2)
Lignite raw	t			0	0	0	0
Lignite dried	t			0	0	0	0
Brown Coal	t			0	0	0	0
Hard Coal	t			0	0	0	0
Heating oil	m3			0	0	0	0
Heavy fuel oil	t	2,229	0	2,229	2,108	2,108	1
Kerosene	m3			0	0	0	0
Propane-Butane	m3			0	0	0	0
Natural gas	m3			0	0	0	0
Biogas	m3			0	0	0	0
Coke	t			0	0	0	0
Wood	m3			0	0	0	0
Wood waste	t			0	0	0	0
Biomass	t			0	0	0	0
				0	0	0	0
Steam	kWh			0	0	0	0
Hot water	kWh			0	0	0	0
Technical steam	kWh			0	0	0	0
Geothermal water	kWh			0	0	0	0
EPS	kWh	5,403,000		5,403,000	465	1,161	4,322
Solar (PV)	kWh			0	0	0	0
Wind Power	kWh			0	0	0	0
Others	kWh			0	0	0	0
Total					2,573	3,270	4,323

Table S-1-2: Re-calculation of renewable energy (for reference)

Re-calculation	Final Energy (toe)	Primary Energy (toe)	
Renewable Energy*	0	0	

*: Definition of renewable energy in the Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 is as follows;
'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases;

Table S-1-3: Quantity of water usage (for reference)

	unit	Quantity
Drinking water/well water etc.	m3	
Industrial water	m3	
Any water	m3	
Total	m3	0

5-c. Detail of the obligations of Designated Companies

(1) Companies of Industrial Sector

	Whole Company	Each Factory	Each Building	Others
Annual Energy Use Amount (toe)	Having factories or buildings with annual energy use over designation	2,500 toe Or more per year	1,000 toe or more per year	---
Category	Designated Company	Designated Factory	Designated Building	---
Personnel to be appointed	Energy Manager in Head Quarter	Energy Manager on site	Energy Manager or Energy Officer On site	---
Report to be submitted	Periodical Report Mid-and Long Term Plan	Attachement to the company's report	Attachement to the company's report	---
Numerical Target	Avarage 1% of Annual Energy Use Amount in primary energy			---
Energy Management Activity	Compliance with Evaluation Criteria by -Setting of management standard -Implementation of energy conservation actions,			---
Checking system	Random Check by Energy Inspector would be conducted			Voluntary Energy Audit Systems are prepared

(2) Companies of Commercial & Services Sector

	Whole Company	Each Building	Others
Annual Energy Use Amount (toe)	Having buildings with annual energy use amount over designation	1,000 toe or more per year	---
Category	Designated Company	Designated Building	---
Personnel to be appointed	Energy Manager in Head Quarter	Energy Manager on site Energy Manager or Energy Officer on site	---
Report to be submitted	Periodical Report Mid-and Long Term Plan	Attachement to the company's report	---
Numerical Target	Avarage 1% of Annual Energy Use Amount in primary energy		---
Energy Management Activity	Compliance with Evaluation Criteria by -Setting of management standard -Implementation of energy conservation actions,		---
Checking system	Random Check by Energy Inspector would be conducted		Voluntary Energy Audit Systems are prepared

NOTE: Accredited Auditors are licenced by MOME and designated companies or organizations can voluntarily engage qualified energy auditors to conduct energy audits. Inspection by an official Energy Inspector of MOME would be conducted for a companies or organization if their energy management is judged as insufficient level.

5-d. Appointment of Energy Manager and Energy Officer

(1) Energy Manager or Energy Officer to be appointed

	Industrial Sector				Commercial & Services Sector			
	Head Quarters	Each Factory	Each Building		Head Quarters		Each Building	
Energy Manager								
Outsourced Energy Manager & Energy Officer				 		 		 

When a Energy Manager is outsourced, Energy Officer has to be stationed in the site.

(2) Qualification of Energy Managers, Energy Officers, and Accredited Energy Auditors

	Energy Manager	Energy Officer	Accredited Energy Auditor
Role	Promotion of Energy Management of company and site	Support Energy Manager on Energy Management Activities	Conducting voluntary energy audit to companies or organizations upon request
Minimum Requirement for application for Certificate	None	Energy management experience in site at least 3 years	Certificate of Energy Manager Number of experience of Energy Audit Master of science
Qualification Method for Certificate	National Examination (1 day) or Official Training Program & Certificate Exam (8 days)	Official Training Program (1 day)	Official Training Program with Certificate Exam (4 days)
Minimum Requirement for application for Licence	Certificate of Energy Manager Energy management experience in site at least 3 years, Bachelor of science	Certificate of Energy Officer Energy management experience in site at least 3 years	Certificate of Accredited Energy Auditor
Qualification Method for Licence	Documentary check for the above application requirement	Documentary check for the above application requirement	Documentary check for the above application requirement
Executing Agency	Certificate: SEEA License: MOME	Certificate: SEEA License: MOME	Certificate: SEEA License: MOME
Frequency of Qualification	Once a year	Once a year	Once a year

6. What are the Evaluation Criteria to be complied with Designated Companies?

6-a. Evaluation Criteria

The "Evaluation Criteria" is a guideline what EE&C activities are to be conducted within an organization and can also determine whether or not such activities are actually being carried out. The Evaluation Criteria instructs on fields and methods to be managed, management standards, standard values and target improvement values.

6 Fields to be Managed

1. Rationalization of combustion of fuels
2. Rationalization of heating and cooling as well as heat transfer
3. Recovery and utilization of waste heat
4. Rationalization of conversion of heat into power, etc.
5. Prevention of Energy loss due to emission, conduction, resistance, etc.
6. Rationalization of conversion of electricity into power, heat, etc.

4 Methods to be Managed

1. Management Methods
2. Measurement and Record
3. O&M and Inspection
4. Treatment when New Installation

Making Management Standards

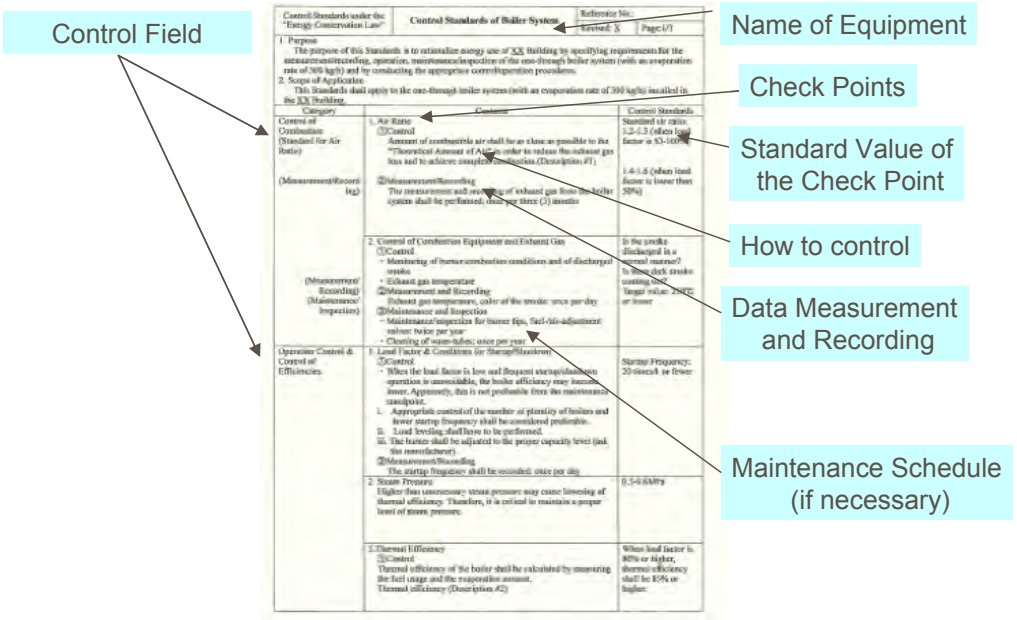
Standard Value to be Complied

1. Standard of Air Ratio
2. Standard of Exhaust Gas Temp.
3. Standard of Heat Recovery Rate
4. Standard of Outside Surface Temp. of Incinerator
5. Standard of Power Factor at Receiving

Target: Average # % per year improvement of energy intensity in the past 5 years

6-b. Management Standards

The Management Standards are standards to be set up and to be managed by each facility based on the guidelines of the Evaluation Criteria. The Management Standards includes four methods such as management methods, measurement and records, O&M and inspections, and treatments during new installation.



(1)Management Method

- Establishment and properly management of the in-house EE&C System
- Preparation and maintenance of EE&C Management Standards
- Middle and Long Term Plans
- PDCA Management cycle

(2)Energy Measurement and Recording

- Regular measurement and recording

(3)Maintenance and inspection of equipment

- Maintenance and inspection of equipment
- Checking each system performance

(4)EE&C Investment

- Installation of new facilities

7-b. Key Equipment for factories

(1) Air Conditioning and Refrigeration Equipment
(2) Pumps, Fans, and Compressors
(3) Boilers, Industrial Furnaces, Steam System, Heat Exchanger
(4) Electric Power Equipment

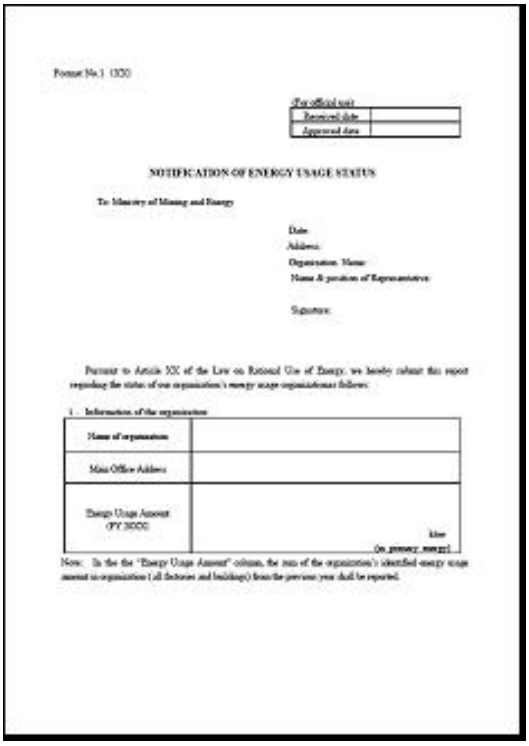
Please also see the “Check-list for Energy Efficiency Improvements in Industrial Energy Systems” attached as reference.

7-c. Key Equipment for buildings

(1) Heat source and heat conveying equipment
(2) Air conditioning and ventilation equipment
(3) Hot-water supply, feed-water and drainage, freezing and refrigeration Heat Exchanger
(4) Elevating machines and buildings
(5) Electric Power Equipment

8. Sample of the reports

(1) Notification of Energy Use Status



Format No.1 (XX)

(For official use)

Received date	
Approved date	

NOTIFICATION OF ENERGY USAGE STATUS

To: Ministry of Mining and Energy

Date:
Address:
Organization Name:
Name & position of Representative:

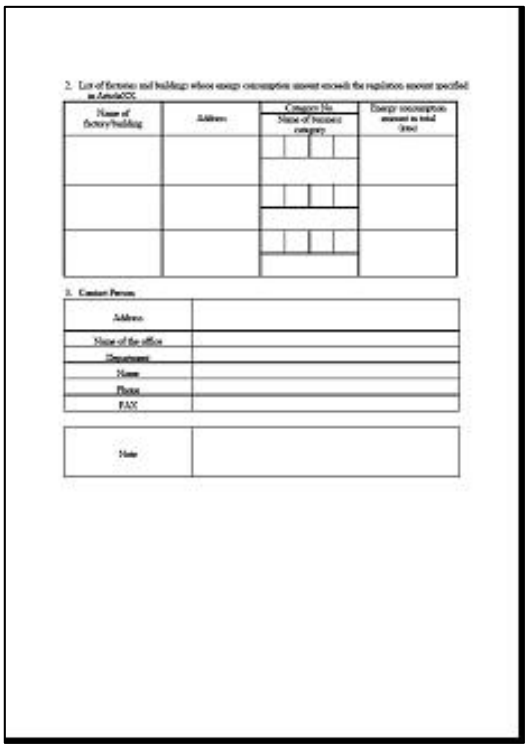
Signature:

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby submit this report regarding the status of our organization's energy usage organizations as follows:

1. Information of the organization

Name of organization	
Main Office Address	
Energy Usage Amount (FY XXXX)	kl/yr (in primary energy)

Note: In the the "Energy Usage Amount" column, the sum of the organization's identified energy usage amount in organization (all factories and buildings) from the previous year shall be reported.



2. List of factories and buildings whose energy consumption amount exceeds the regulation amount specified in Article XXX

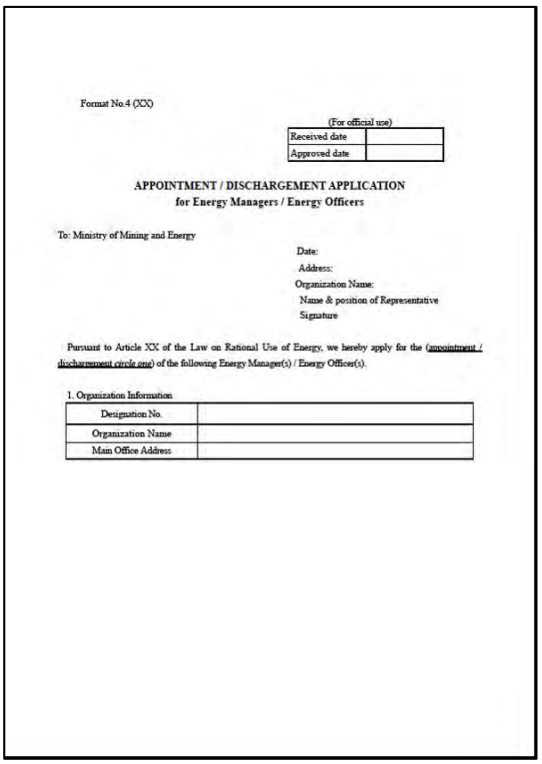
Name of factory/building	Address	Category No. Name of business category	Energy consumption amount in total (kl)

3. Contact Person

Address	
Name of the office	
Department	
Name	
Phone	
FAX	

Note	

(2) Notification of Appointment of Energy Manager or Energy Officer



Format No.4 (XX)

(For official use)

Received date	
Approved date	

APPOINTMENT / DISCHARGEMENT APPLICATION
for Energy Managers / Energy Officers

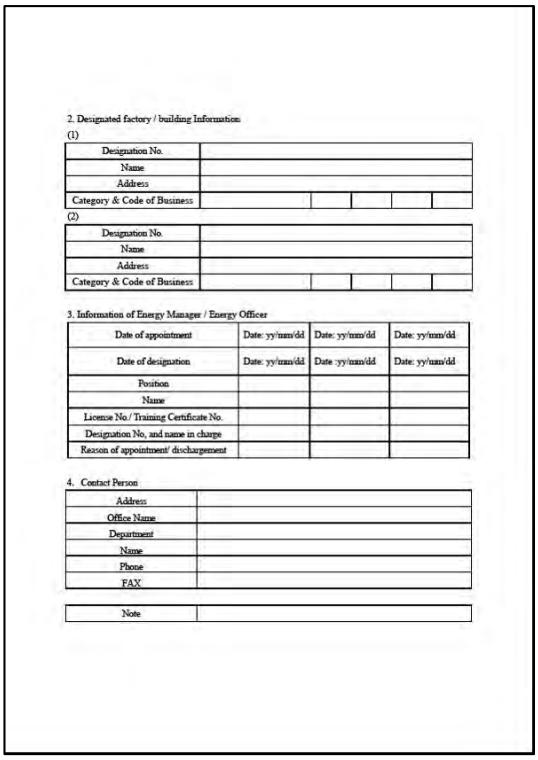
To: Ministry of Mining and Energy

Date:
Address:
Organization Name:
Name & position of Representative
Signature

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby apply for the (appointment / dischargement circle one) of the following Energy Manager(s) / Energy Officer(s).

1. Organization Information

Designation No.	
Organization Name	
Main Office Address	



2. Designated factory / building Information

(1)

Designation No.	
Name	
Address	
Category & Code of Business	

(2)

Designation No.	
Name	
Address	
Category & Code of Business	

3. Information of Energy Manager / Energy Officer

Date of appointment	Date: yy/mm/dd	Date: yy/mm/dd	Date: yy/mm/dd
Date of designation	Date: yy/mm/dd	Date: yy/mm/dd	Date: yy/mm/dd
Position			
Name			
License No./ Training Certificate No.			
Designation No. and name in charge			
Reason of appointment/ dischargement			

4. Contact Person

Address	
Office Name	
Department	
Name	
Phone	
FAX	

Note	

(3) Declaration of Revocation for designated organizations

Format No.3 (XX)

(For official use)

Received date	
Approved date	

DECLARATION OF REVOCATION
for Designated Organization

To: Ministry of Mining and Energy

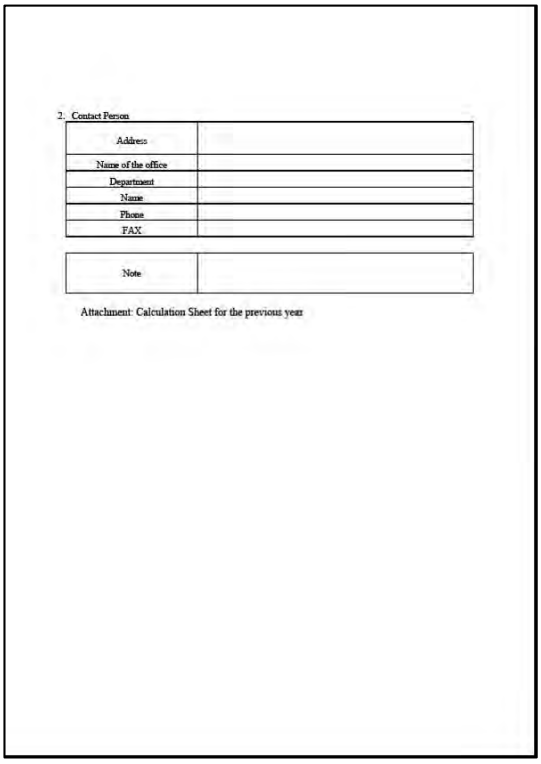
Date:
Address:
Organization Name:
Name & position of Representative
Signature

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby apply to have our status as a designated organization revoked.

1. Information of the organization

General information	Designation No.	
	Name of organization	
	Address of the main office	
	Energy Usage Amount (FY 20XX)	ktoe (in primary energy)
Reason		
Note		

Note: 1. In the "Energy Usage Amount" column, the sum of the organization's identified energy usage amount in organization (all factories and buildings) from the previous year shall be reported.
2.In the "Reason" column, the applicant should articulate the circumstances leading to the submission of this application. If the applicant is closing its business, please put "closing business" etc., and if the applicant expects an energy amount reduction to a level less than the designated amount, please fill in the year and next year's projected amount of conserved energy together with the reasons (calculations etc.) substantiating these projections.



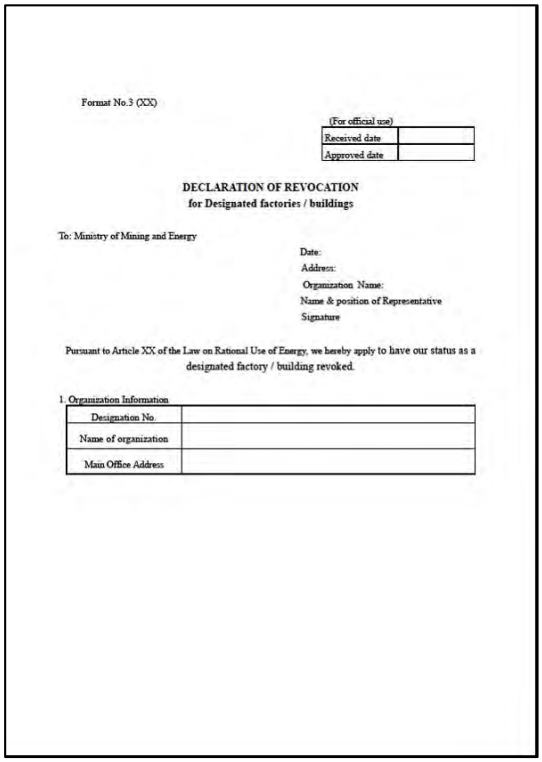
2. Contact Person

Address	
Name of the office	
Department	
Name	
Phone	
FAX	

Note	

Attachment: Calculation Sheet for the previous year

(4) Declaration of Revocation for designated factories/ buildings



Format No.3 (XX)

(For official use)

Received date	
Approved date	

DECLARATION OF REVOCATION
for Designated factories / buildings

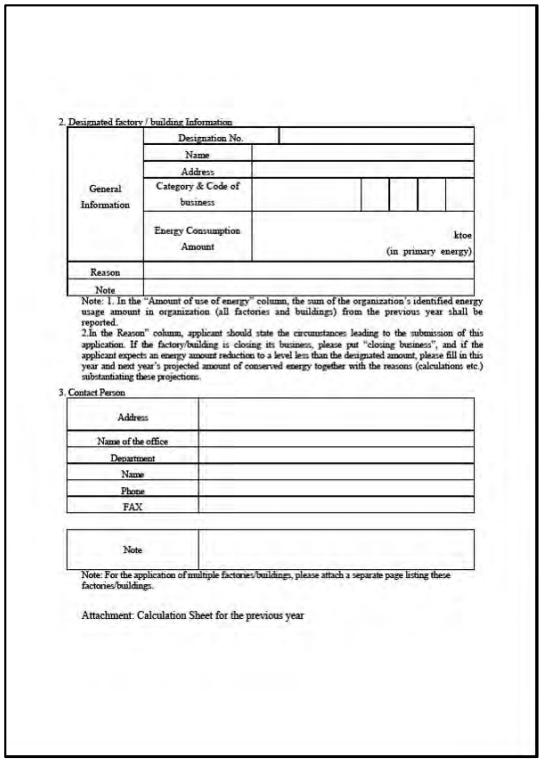
To: Ministry of Mining and Energy

Date:
Address:
Organization Name:
Name & position of Representative
Signature

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby apply to have our status as a designated factory / building revoked.

1. Organization Information

Designation No.	
Name of organization	
Main Office Address	



2. Designated factory / building Information

General Information	Designation No.	
	Name	
	Address	
	Category & Code of business	
	Energy Consumption Amount	ktoe (in primary energy)
Reason		
Note		

Note: 1. In the "Amount of use of energy" column, the sum of the organization's identified energy usage amount in organization (all factories and buildings) from the previous year shall be reported.
2.In the Reason" column, applicant should state the circumstances leading to the submission of this application. If the factory/building is closing its business, please put "closing business", and if the applicant expects an energy amount reduction to a level less than the designated amount, please fill in this year and next year's projected amount of conserved energy together with the reasons (calculations etc.) substantiating these projections.

3. Contact Person

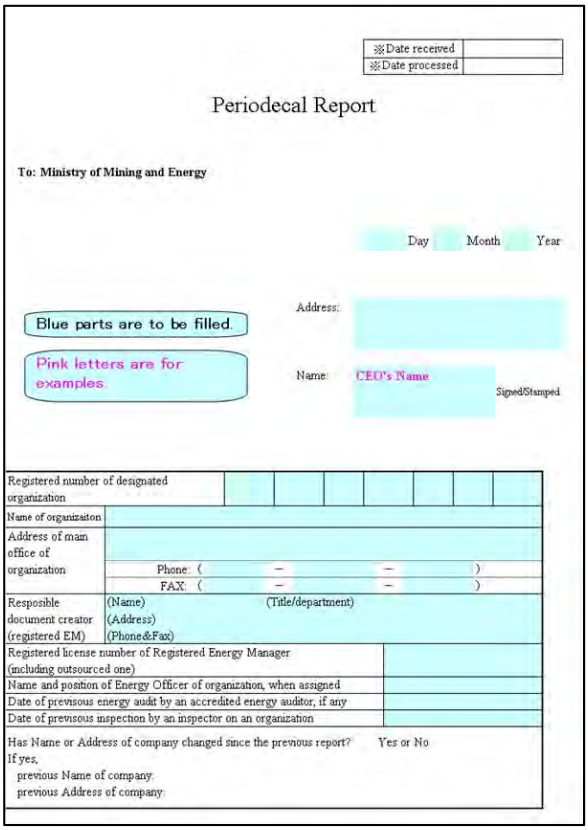
Address	
Name of the office	
Department	
Name	
Phone	
FAX	

Note	

Note: For the application of multiple factories/buildings, please attach a separate page listing these factories/buildings.

Attachment: Calculation Sheet for the previous year

(5) Periodical Report, Middle and Long Term Plan



※Date received	
※Date processed	

Periodecal Report

To: Ministry of Mining and Energy

Day Month Year

Blue parts are to be filled.

Pink letters are for examples.

Address:

Name: CEO's Name

Signed/Stamped

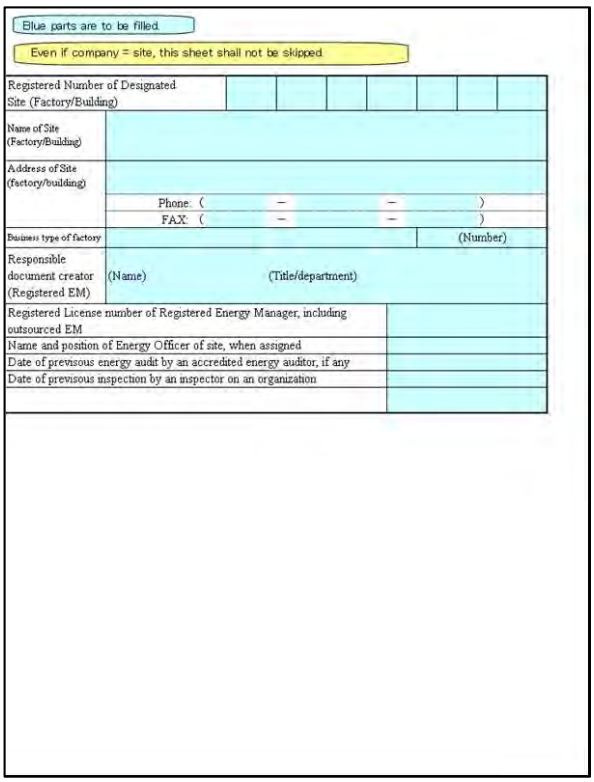
Registered number of designated organization	
Name of organizaton	
Address of main office of organization	Phone: (– –)
	FAX: (– –)
Resposible document creator (registered EM)	(Name) (Title/department)
	(Address)
	(Phone&Fax)
Registered license number of Registered Energy Manager (including outsourced one)	
Name and position of Energy Officer of organization, when assigned	
Date of previsous energy audit by an accredited energy auditor, if any	
Date of previsous inspection by an inspector on an organization	
Has Name or Address of company changed since the previous report? Yes or No If yes, previous Name of company: previous Address of company:	

Table C-1: List of designated sites (Factory/Building)

Category of designation (Factory/Building)	Registered Number of Designated Site (Factory/Building)	Name of Site (Factory/Building)	Address of Site (Factory/Building)	Energy Consumption (toe) (primary energy)	Business category No.	Name of business category
Factory	#####	Mekars Sabar	Sabar,	3,270	####	Food
Total Energy Consumption (toe)				0		

Table C-2: Award scheme application

Would you like to apply for the Award Scheme?	Yes ☐ No ☐



Blue parts are to be filled.

Even if company = site, this sheet shall not be skipped.

Registered Number of Designated Site (Factory/Building)	
Name of Site (Factory/Building)	
Address of Site (factory/building)	Phone: (– –)
	FAX: (– –)
Business type of factory	(Number)
Responsible document creator (Registered EM)	(Name) (Title/department)
Registered License number of Registered Energy Manager, including outsourced EM	
Name and position of Energy Officer of site, when assigned	
Date of previsous energy audit by an accredited energy auditor, if any	
Date of previsous inspection by an inspector on an organization	

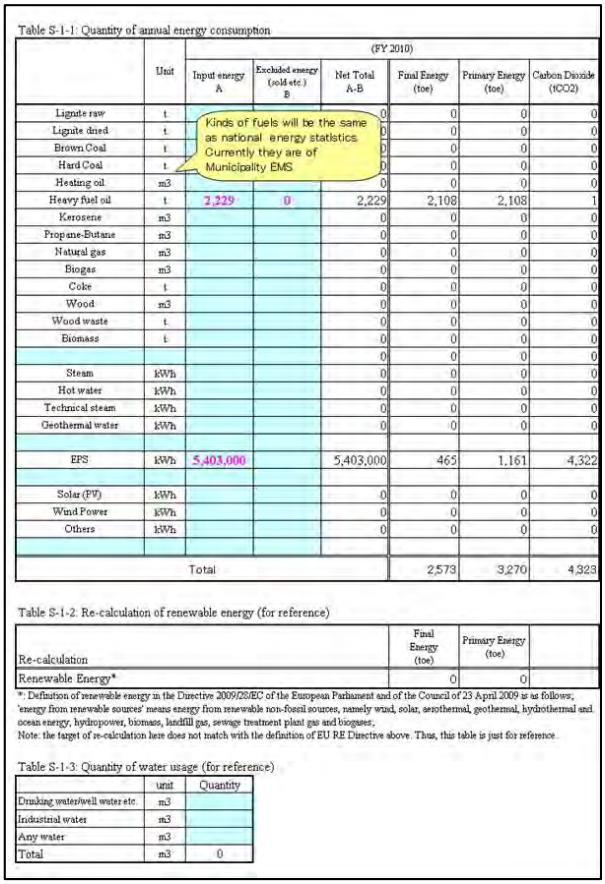


Table S-1-1: Quantity of annual energy consumption

	Unit	(FY 2010) Input energy A	Excluded energy (sold etc.) B	Net Total A-B	Final Energy (toe)	Primary Energy (toe)	Carbon Dioxide (tCO2)
Lignite raw	t			0	0	0	0
Lignite dried	t			0	0	0	0
Brown Coal	t			0	0	0	0
Hard Coal	t			0	0	0	0
Heating oil	m3			0	0	0	0
Heavy fuel oil	t	2,229	0	2,229	2,108	2,108	1
Kerosene	m3			0	0	0	0
Propane-Butane	m3			0	0	0	0
Natural gas	m3			0	0	0	0
Biogas	m3			0	0	0	0
Coke	t			0	0	0	0
Wood	m3			0	0	0	0
Wood waste	t			0	0	0	0
Biomass	t			0	0	0	0
				0	0	0	0
Steam	kWh			0	0	0	0
Hot water	kWh			0	0	0	0
Technical steam	kWh			0	0	0	0
Geothermal water	kWh			0	0	0	0
EPS	kWh	5,403,000		5,403,000	465	1,161	4,322
Solar (PV)	kWh			0	0	0	0
Wind Power	kWh			0	0	0	0
Others	kWh			0	0	0	0
Total					2,573	3,270	4,323

Kinds of fuels will be the same as national energy statistics. Currently they are of Municipality EMS.

Table S-1-2: Re-calculation of renewable energy (for reference)

Re-calculation	Final Energy (toe)	Primary Energy (toe)	
Renewable Energy*	0	0	

*: Definition of renewable energy in the Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 is as follows;
'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases;
Note: the target of re-calculation here does not match with the definition of EU RE Directive above. Thus, this table is just for reference.

Table S-1-3: Quantity of water usage (for reference)

	unit	Quantity
Drinking water/well water etc.	m3	
Industrial water	m3	
Any water	m3	
Total	m3	0

Table S-2: List of facilities which can contribute to EE&C and other major facilities consuming energy. The list should cover more than **80%** of total energy consumptin and describe situations of operation including new

	Name of facilities	Outline of facilities	Operationnal status	New installation, remodeling or removal
Facilities related to EE&C				
Major facilities consuming energy other than the above				

Table S-3: Energy consumption trend (in primary energy)

	FY2006	FY2007	FY2008	FY2009	FY2010	Average reduction of 5 years
Energy consumption (primary energy in toe)	(to be filled by designated site)	(to be filled by designated site)	2,650	2,600	2,573	
Comparison to previous fiscal year (%)		(a) #VALUE!	(b) #VALUE!	(c) 98.1%	(d) 99.0%	#VALUE!

Table S-4: Reasons for **(A)** a case where energy consumption **for the past five years** did not decrease by 1%* or more **on average**,
or **(B)** a case where energy consumption **to the previous fiscal year** did not decrease by 1%* or more.

Reasons for (A) above
Reasons for (B) above

*: Target number, here 1%, shall be defined in the law or regulations

Table S-5: Compliance check with evaluation criteria

Target items (Facilities)	Status of establishing management standards	Status of observing management standards	Status of observing establishment schedule(s)	Status of measures to be taken on new installation
Rationalization of fuel, combustion (Combustion facility)	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
Rationalization of heating, cooling and hot water (Heat consumption facility)	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
Waste heat recovery (Waste heat recovery facility)	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
Rationalization of converting fuel to power and others (Power generation facility and cogeneration facility)	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
Prevention of energy loss by radiation, conduction and others (Heat consumption facility, power converting & transforming facility and distribution facility)	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
Rationalization of motive power and others (Electricity utilizing facility)	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable
	☐ Already established ☐ Being established (to be) ☐ To be established	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Regularly done ☐ Done as needed ☐ Not done	☐ Done ☐ Not done ☐ Not applicable

Table S-6: Other measures taken for EE&C

Outline of measures

Table S-7: Middle and Long Term Plan for EE&C

I Planning Period

FY . FY

Middle and Long term means within 5 years

II Plan for EE&C and Expected Effects

"Hard" Measures

Process/Facility	Plan	Expected Effects of EE&C (toe) in primary energy
pumps of hot/cold water system	ex. Add inverters for pumps	
	This plan shoud describe mainly the "hard" measures "with investment" related to facility, system, technology etc., namely which can expect effects with certain confidence.	

"Soft" Measures

Process/Facility	Plan	Expected Effects of EE&C (toe) in primary energy
	"Soft" measures, "without investment", such as promoting switching off lights by employees, should be limited to the ones which can expect effects with certain confidence.	

III Comparison or Change to Plan of Previous Fiscal Year

Process	Deleted Contents of Measures	Reasons
Process	Added Contents of Measures	Reasons

IV Other Issues on Planning

9. Introduction of supporting measures

Financial preferential treatment systems are available for EE&C activities and investments.

To be updated

(1) Energy Efficiency Fund

- Loans: to be updated
- Grants: to be updated

(2) Tax Incentives

- VAT reduction: for energy efficient equipment, materials, appliances and technologies
- Corporate income tax reduction : for the amount invested in energy efficient equipment, materials, appliances and technologies, as well as energy efficiency projects

10. Other Information

Item to be explained in this section:
Contact address of MOME, SEEA and other related institution
Internet Links of information related to energy management

To be updated

11. References:

Check-list for Energy Efficiency Improvements in Industrial Energy Systems

(1) Industrial Boilers

1.1. Stack temperature should be as low as possible; application of feed water preheating using economizer and/or combustion air preheating
1.2. Application of regular excess air control; use automatic air-to-fuel controller with O2 sensor and/or temporary adjustment of burner air-to-fuel ratio
1.3. Radiation and convection heat loss minimization by repairing or improvement of boiler insulation
1.4. Introduction of automatic blow down control
1.5. Reduction of scaling and soot losses
1.6. Reduction of boiler steam pressure
1.7. Application of variable speed control for fans, blowers and pumps
1.8. Operation of boiler on loading which corresponds to maximum efficiency, if more boilers are in use application of proper boiler scheduling.
1.9. Boiler replacement in case of old and inefficient, or over or under-sized for present requirements
1.10. Examination of all implications of long-term fuel availability
1.11. Improvement of water treatment system

(2) Steam Systems

2.1. Proper steam and condense pipe sizing and design
2.2. Utilizing steam at the lowest acceptable pressure for the process
2.3. Proper drainage and layout of steam lines
2.4. Providing dry steam for process
2.5. Proper utilization of directly injected steam
2.6. Avoiding of steam pipe redundancy
2.7. Proper air venting
2.8. Good drainage of condensate from process equipment; for that is essential:
  2.8.1. Determination of proper condensate drainage point at the vessel,
  2.8.2. Proper selection, operation and maintenance of steam traps
  2.8.3. Monitoring of steam traps
2.9. Avoiding steam leakages on valves, flanges, or holes in the steam system
2.10. Minimizing heat transfer barriers
2.11. Maximum condensate recovery; only contaminated condensate after cooling can be drained out of the system
2.12. Flash steam recovery; loss of flash steam in condensate return system must be avoided
2.13. Proper insulation of steam pipelines and hot process equipments
2.14. Reducing the work to be done by steam:
  2.14.1 Reduction in operating hours
  2.14.2. Reduction in steam quantity required per hour
  2.14.3. Use of more efficient technology
  2.14.4. Minimizing wastage.

(3) Insulation of pipes, valves and vessels

3.1. For minimization of heat losses, it is important to notice that outer surface temperature of pipes, valves and vessels is close or almost equal to the heating fluid temperature
3.2. Insulate all uninsulated hot surfaces and/or repair damaged or old insulation
3.3. It is important to calculate optimal (economically) thickness of insulation
3.4. Avoid wind on pipe lines if possible; heat losses rise significantly with wind velocity
3.5. Check temporary the insulation thickness: if the price of fuel raised, it is probably profitable to rise the thickness of the insulation
3.6. Check and avoid empty space between insulation and hot surface; it causes air circulation and rise of the heat transfer
3.7. Cover open surfaces of tanks which contain hot liquids by lids or layers of plastic balls
3.8. Measure outer surface of hot pipes, valves and vessels regularly; it has to be lower than 60^{o}C.

(4) General Fuel Economy Measures in Furnaces

4.1. Complete combustion with minimum excess air
4.2. Correct heat distribution
4.3. Operate at the desired temperature
4.4. Reduce heat losses from furnace openings
4.5. Maintain correct amount of furnace draught
4.6. Apply waste heat recovery from the flue gases (recuperation and utilization)
4.7. Apply waste heat recovery from cooling water and products
4.8. Minimize refractory losses
4.9. Use ceramic coatings
4.10. Chose furnace operation at optimum capacity
4.11. Reduce unsteady state operation conditions

(5) Electricity

5.1. Optimize the tariff structure with utility supplier
5.2. Schedule your operations to maintain a high load factor
5.3. Shift loads to off-peak times if possible.
5.4. Minimize maximum demand by tripping loads through a demand controller
5.5. Stagger start-up times for equipment with large starting currents to minimize load peaking.
5.6. Use standby electric generation equipment for on-peak high load periods.
5.7. Correct power factor to at least 0.90 under rated load conditions.
5.8. Relocate transformers close to main loads.
5.9. Set transformer taps to optimum settings.
5.10. Disconnect primary power to transformers that do not serve any active loads
5.11. Consider on-site electric generation or cogeneration.
5.12. Export power to grid if you have any surplus in your captive generation
5.13. Check utility electric meter with your own meter.
5.14. Shut off unnecessary computers, printers, and copiers at night.

(6) Motors

6.1. Properly size to the load for optimum efficiency.
(High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
6.2. Use energy-efficient motors where economical.
6.3. Use synchronous motors to improve power factor.
6.4. Check alignment.
6.5. Provide proper ventilation
(For every 10^{o}C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)
6.6. Check for under-voltage and over-voltage conditions.

6.7. Balance the three-phase power supply.
(An Imbalanced voltage can reduce 3 - 5% in motor input power)
6.8. Demand efficiency restoration after motor rewinding.
(If rewinding is not done properly, the efficiency can be reduced by 5 - 8%)

(7) Drives

7.1. Use variable-speed drives for large variable loads.
7.2. Use high-efficiency gear sets.
7.3. Use precision alignment.
7.4. Check belt tension regularly.
7.5. Eliminate variable-pitch pulleys.
7.6. Use flat belts as alternatives to v-belts.
7.7. Use synthetic lubricants for large gearboxes.
7.8. Eliminate eddy current couplings.
7.9. Shut them off when not needed.

(8) Fans

8.1. Use smooth, well-rounded air inlet cones for fan air intakes.
8.2. Avoid poor flow distribution at the fan inlet.
8.3. Minimize fan inlet and outlet obstructions.
8.4. Clean screens, filters, and fan blades regularly.
8.5. Use aerofoil-shaped fan blades.
8.6. Minimize fan speed.
8.7. Use low-slip or flat belts.
8.8. Check belt tension regularly.
8.9. Eliminate variable pitch pulleys.
8.10. Use variable speed drives for large variable fan loads.
8.11. Use energy-efficient motors for continuous or near-continuous operation
8.12. Eliminate leaks in ductwork.
8.13. Minimize bends in ductwork
8.14. Turn fans off when not needed.

(9) Blowers

9.1. Use smooth, well-rounded air inlet ducts or cones for air intakes.
9.2. Minimize blower inlet and outlet obstructions.
9.3. Clean screens and filters regularly.
9.4. Minimize blower speed.
9.5. Use low-slip or no-slip belts.
9.6. Check belt tension regularly.
9.7. Eliminate variable pitch pulleys.
9.8. Use variable speed drives for large variable blower loads.
9.9. Use energy-efficient motors for continuous or near-continuous operation.
9.10. Eliminate ductwork leaks.
9.11. Turn blowers off when they are not needed.

(10) Pumps

10.1. Operate pumping near best efficiency point.
10.2. Modify pumping to minimize throttling.
10.3. Adapt to wide load variation with variable speed drives or sequenced control of smaller units.
10.4. Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
10.5. Use booster pumps for small loads requiring higher pressures.
10.6. Increase fluid temperature differentials to reduce pumping rates.
10.7. Repair seals and packing to minimize water waste.

10.8. Balance the system to minimize flows and reduce pump power requirements.
10.9. Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

(11) Compressors

11.1. Consider variable speed drive for variable load on positive displacement compressors.
11.2. Use a synthetic lubricant if the compressor manufacturer permits it.
11.3. Be sure lubricating oil temperature is not too high (oil degradation and lowered viscosity) and not too low (condensation contamination).
11.4. Change the oil filter regularly.
11.5. Periodically inspect compressor intercoolers for proper functioning.
11.6. Use waste heat from a very large compressor to power an absorption chiller or preheat process or utility feeds.
11.7. Establish a compressor efficiency-maintenance program. Start with an energy audit and follow-up, then make a compressor efficiency-maintenance program a part of your continuous energy management program.

(12) Compressed air

12.1. Install a control system to coordinate multiple air compressors.
12.2. Study part-load characteristics and cycling costs to determine the most-efficient mode for operating multiple air compressors.
12.3. Avoid over sizing - match the connected load.
12.4. Load up modulation-controlled air compressors. (They use almost as much power at partial load as at full load.)
12.5. Turn off the back-up air compressor until it is needed.
12.6. Reduce air compressor discharge pressure to the lowest acceptable setting.
(Reduction of 1 bar air pressure would result in 5-7% input power savings; this will also reduce compressed air leakage rates by 10%)
12.7. Use the highest reasonable dryer dew point settings.
12.8. Turn off refrigerated and heated air dryers when the air compressors are off.
12.9. Use a control system to minimize heatless desiccant dryer purging.
12.10. Minimize purges, leaks, excessive pressure drops, and condensation accumulation.
(Compressed air leak from 1 mm hole size at 7 bar pressure would mean power loss equivalent to 0.25 kW)
12.11. Use drain controls instead of continuous air bleeds through the drains.
12.12. Replace standard v-belts with high-efficiency flat belts as the old v-belts wear out.
12.13. Use a small air compressor when major production load is off.
12.14. Take air compressor intake air from the coolest (but not air conditioned) location. (Every 50^{o}C reduction in intake air temperature would result in 1% reduction in compressor power consumption)
12.15. Use an air-cooled after cooler to heat building makeup air in winter.
12.16. Be sure that heat exchangers are not fouled (e.g. -- with oil).
12.17. Be sure that air/oil separators are not fouled.
12.18. Monitor pressure drops across suction and discharge filters and clean or replace filters promptly upon alarm.
(0.2 bar pressure drop at the filter, if air pressure is 7 bar and flow 250 l/s, would result in 1 kW of compressor power consumption)
12.19. Use a properly sized compressed air storage receiver. Minimize disposal costs by using lubricant that is fully demulsible and an effective oil-water separator.
12.20. Consider alternatives to compressed air such as blowers for cooling, hydraulic rather than air cylinders, electric rather than air actuators, and electronic rather than pneumatic controls.
12.21. Use nozzles or venture-type devices rather than blowing with open compressed air lines.
12.22. Check for leaking drain valves on compressed air filter/regulator sets. Certain rubber-type valves may leak continuously after they age and crack.
12.23. In dusty environments, control packaging lines with high-intensity photocell units instead

of standard units with continuous air purging of lenses and reflectors.

12.24. Establish a compressed air efficiency-maintenance program. Start with an energy audit and follow-up, then make a compressed air efficiency-maintenance program a part of your continuous energy management program.

(13) Chillers

13.1. Increase the chilled water temperature set point if possible.

13.2. Use the lowest temperature condenser water available that the chiller can handle.(Reducing condensing temperature by 5.50°C, results in a 20 - 25% decrease in compressor power consumption)

13.3. Increase the evaporator temperature
(5.50°C increase in evaporator temperature reduces compressor power consumption by 20 - 25%)

13.4. Clean heat exchangers when fouled.
(1 mm scale build-up on condenser tubes can increase energy consumption by 40%)

13.5. Optimize condenser water flow rate and refrigerated water flow rate.

13.6. Replace old chillers or compressors with new higher-efficiency models.

13.7. Use water-cooled rather than air-cooled chiller condensers.

13.8. Use energy-efficient motors for continuous or near-continuous operation.

13.9. Specify appropriate fouling factors for condensers.

13.10. Do not overcharge oil.

13.11. Install a control system to coordinate multiple chillers.

13.12. Study part-load characteristics and cycling costs to determine the most-efficient mode for operating multiple chillers.

13.13. Run the chillers with the lowest operating costs to serve base load.

13.14. Avoid over sizing -- match the connected load.

13.15. Isolate off-line chillers and cooling towers.

13.16. Establish a chiller efficiency-maintenance program. Start with an energy audit and follow-up, then make a chiller efficiency-maintenance program a part of your continuous energy management program.

(14) HVAC (Heating / Ventilation / Air Conditioning)

14.1. Tune up the HVAC control system.

14.2. Consider installing a building automation system (BAS) or energy management system (EMS) or restoring an out-of-service one.

14.3. Balance the system to minimize flows and reduce blower/fan/pump power requirements.

14.4. Eliminate or reduce reheat whenever possible.

14.5. Use appropriate HVAC thermostat setback.

14.6. Use morning pre-cooling in summer and pre-heating in winter (i.e. -- before electrical peak hours).

14.7. Use building thermal lag to minimize HVAC equipment operating time.

14.8. In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.

14.9. In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.

14.10. Improve control and utilization of outside air.

14.11. Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.

14.12. Reduce HVAC system operating hours (e.g. -- night, weekend).

14.13. Optimize ventilation.

14.14. Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).

14.15. Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.

14.16. Use evaporative cooling in dry climates.

14.17. Reduce humidification or dehumidification during unoccupied periods.
14.18. Use atomization rather than steam for humidification where possible.
14.19. Clean HVAC unit coils periodically and comb mashed fins.
14.20. Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
14.21. Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.
14.22. Check pneumatic controls air compressors for proper operation, cycling, and maintenance.
14.23. Isolate air conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
14.24. Install ceiling fans to minimize thermal stratification in high-bay areas.
14.25. Relocate air diffusers to optimum heights in areas with high ceilings.
14.26. Consider reducing ceiling heights.
14.27. Eliminate obstructions in front of radiators, baseboard heaters, etc.
14.28. Check reflectors on infrared heaters for cleanliness and proper beam direction.
14.29. Use professionally-designed industrial ventilation hoods for dust and vapor control.
14.30. Use local infrared heat for personnel rather than heating the entire area.
14.31. Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
14.32. Purchase only high-efficiency models for HVAC window units.
14.33. Put HVAC window units on timer control.
14.34. Don't oversize cooling units. (Oversized units will "short cycle" which results in poor humidity control.)
14.35. Install multi-fueling capability and run with the cheapest fuel available at the time.
14.36. Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
14.37. Minimize HVAC fan speeds.
14.38. Consider ground source heat pumps.
14.39. Seal leaky HVAC ductwork.
14.40. Seal all leaks around coils.
14.41. Repair loose or damaged flexible connections (including those under air handling units).
14.42. Eliminate simultaneous heating and cooling during seasonal transition periods.
14.43. Zone HVAC air and water systems to minimize energy use.
14.44. Inspect, clean, lubricate, and adjust damper blades and linkages.
14.45. Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.

(15) Refrigeration

15.1. Use water-cooled condensers rather than air-cooled condensers.
15.2. Challenge the need for refrigeration, particularly for old batch processes.
15.3. Avoid over sizing -- match the connected load.
15.4. Consider gas-powered refrigeration equipment to minimize electrical demand charges.
15.5. Use "free cooling" to allow chiller shutdown in cold weather.
15.6. Use refrigerated water loads in series if possible.
15.7. Convert firewater or other tanks to thermal storage.
15.8. Don't assume that the old way is still the best -- particularly for energy-intensive low temperature systems.
15.9. Correct inappropriate brine or glycol concentration that adversely affects heat transfer and/or pumping energy. If it sweats, insulate it, but if it is corroding, replace it first.
15.10. Make adjustments to minimize hot gas bypass operation.
15.11. Inspect moisture/liquid indicators.
15.12. Consider change of refrigerant type if it will improve efficiency.
15.13. Check for correct refrigerant charge level.
15.14. Inspect the purge for air and water leaks.
15.15. Establish a refrigeration efficiency-maintenance program. Start with an energy audit and follow-up, then make a refrigeration efficiency-maintenance program a part of your

continuous energy management program.

(16) Cooling towers

16.1. Control cooling tower fans based on leaving water temperatures.
16.2. Control to the optimum water temperature as determined from cooling tower and chiller performance data.
16.3. Use two-speed or variable-speed drives for cooling tower fan control if the fans are few. Stage the cooling tower fans with on-off control if there are many.
16.4. Turn off unnecessary cooling tower fans when loads are reduced.
16.5. Cover hot water basins (to minimize algae growth that contributes to fouling).
16.6. Balance flow to cooling tower hot water basins.
16.7. Periodically clean plugged cooling tower water distribution nozzles.
16.8. Install new nozzles to obtain a more-uniform water pattern.
16.9. Replace splash bars with self-extinguishing PVC cellular-film fill.
16.10. On old counter flow cooling towers, replace old spray-type nozzles with new square-spray ABS practically-non-clogging nozzles.
16.11. Replace slat-type drift eliminators with high-efficiency, low-pressure-drop, self-extinguishing, PVC cellular units.
16.12. If possible, follow manufacturer's recommended clearances around cooling towers and relocate or modify structures, signs, fences, dumpsters, etc. that interfere with air intake or exhaust.
16.13. Optimize cooling tower fan blade angle on a seasonal and/or load basis.
16.14. Correct excessive and/or uneven fan blade tip clearance and poor fan balance.
16.15. Use a velocity pressure recovery fan ring.
16.16. Divert clean air-conditioned building exhaust to the cooling tower during hot weather.
16.17. Re-line leaking cooling tower cold water basins.
16.18. Check water overflow pipes for proper operating level.
16.19. Optimize chemical use.
16.20. Consider side stream water treatment.
16.21. Restrict flows through large loads to design values.
16.22. Shut off loads that are not in service.
16.23. Take blow down water from the return water header.
16.24. Optimize blow down flow rate.
16.25. Automate blow down to minimize it.
16.26. Send blow down to other uses (Remember, the blow down does not have to be removed at the cooling tower. It can be removed anywhere in the piping system.)
16.27. Implement a cooling tower winterization plan to minimize ice build-up.
16.28. Install interlocks to prevent fan operation when there is no water flow.
16.29. Establish a cooling tower efficiency-maintenance program. Start with an energy audit and follow-up, then make a cooling tower efficiency-maintenance program a part of your continuous energy management program.

(17) Lighting

17.1. Reduce excessive illumination levels to standard levels using switching, delamping, etc. (Know the electrical effects before doing delamping.)
17.2. Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
17.3. Install efficient alternatives to incandescent lighting, mercury vapor lighting, etc. Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high pressure sodium, metal halide, fluorescent, mercury vapor, incandescent.
17.4. Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.
17.5. Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts
17.6. Consider lowering the fixtures to enable using less of them.

17.7. Consider day lighting, skylights, etc.
17.8. Consider painting the walls a lighter color and using less lighting fixtures or lower wattages.
17.9. Use task lighting and reduce background illumination.
17.10. Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.
17.11. Change exit signs from incandescent to LED.

(18) Buildings

18.1. Seal exterior cracks/openings/gaps with caulk, gasketing, weather-stripping, etc.
18.2. Consider new thermal doors, thermal windows, roofing insulation, etc.
18.3. Install windbreaks near exterior doors.
18.4 Replace single-pane glass with insulating glass.
18.5. Consider covering some window and skylight areas with insulated wall panels inside the building.
18.6. If visibility is not required but light is required, consider replacing exterior windows with insulated glass block.
18.7. Consider tinted glass, reflective glass, coatings, awnings, overhangs, draperies, blinds, and shades for sunlit exterior windows.
18.8. Use landscaping to advantage.
18.9. Add vestibules or revolving doors to primary exterior personnel doors.
18.10. Consider automatic doors, air curtains, strip doors, etc. at high-traffic passages between conditioned and non-conditioned spaces. Use self-closing doors if possible.
18.11. Use intermediate doors in stairways and vertical passages to minimize building stack effect.
18.12. Use dock seals at shipping and receiving doors.
18.13. Bring cleaning personnel in during the working day or as soon after as possible to minimize lighting and HVAC costs.

(19) Water & Wastewater

19.1. Recycle water, particularly for uses with less-critical quality requirements.
19.2. Recycle water, especially if sewer costs are based on water consumption.
19.3. Balance closed systems to minimize flows and reduce pump power requirements.
19.4. Eliminate once-through cooling with water.
19.5. Use the least expensive type of water that will satisfy the requirement.
19.6. Fix water leaks.
19.7. Test for underground water leaks. (It's easy to do over a holiday shutdown.)
19.8. Check water overflow pipes for proper operating level.
19.9. Automate blow down to minimize it.
19.10. Provide proper tools for wash down -- especially self-closing nozzles.
19.11. Install efficient irrigation.
19.12. Reduce flows at water sampling stations.
19.13. Eliminate continuous overflow at water tanks.
19.14. Promptly repair leaking toilets and faucets.
19.15. Use water restrictors on faucets, showers, etc.
19.16. Use self-closing type faucets in restrooms.
19.17. Use the lowest possible hot water temperature.
19.18. Do not use a heating system hot water boiler to provide service hot water during the cooling season -- install a smaller, more-efficient system for the cooling season service hot water.
19.19. If water must be heated electrically, consider accumulation in a large insulated storage tank to minimize heating at on-peak electric rates.
19.20. Use multiple, distributed, small water heaters to minimize thermal losses in large piping systems.
19.21. Use freeze protection valves rather than manual bleeding of lines.
19.22. Consider leased and mobile water treatment systems, especially for deionized water.

19.23. Seal sumps to prevent seepage inward from necessitating extra sump pump operation.
19.24. Install pretreatment to reduce TOC and BOD surcharges.
19.25. Verify the water meter readings. (You'd be amazed how long a meter reading can be estimated after the meter breaks or the meter pit fills with water!)
19.26. Verify the sewer flows if the sewer bills are based on them

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(20) Others

20.1. Meter any unmetered utilities. Know what is normal efficient use. Track down causes of deviations.
20.2. Shut down spare, idling, or unneeded equipment.
20.3. Make sure that all of the utilities to redundant areas are turned off -- including utilities like compressed air and cooling water.
20.4. Install automatic control to efficiently coordinate multiple air compressors, chillers, cooling tower cells, boilers, etc.
20.5. Renegotiate utilities contracts to reflect current loads and variations.
20.6. Consider buying utilities from neighbors, particularly to handle peaks.
20.7. Leased space often has low-bid inefficient equipment. Consider upgrades if your lease will continue for several more years.
20.8. Adjust fluid temperatures within acceptable limits to minimize undesirable heat transfer in long pipelines.
20.9. Minimize use of flow bypasses and minimize bypass flow rates.
20.10. Provide restriction orifices in purges (nitrogen, steam, etc.).
20.11. Eliminate unnecessary flow measurement orifices.
20.12. Consider alternatives to high pressure drops across valves.
20.13. Turn off winter heat tracing in summer.

<These lists are prepared by SIEEN (Prof. Goran Jankes) in Nov,2010>

11. References: Word List

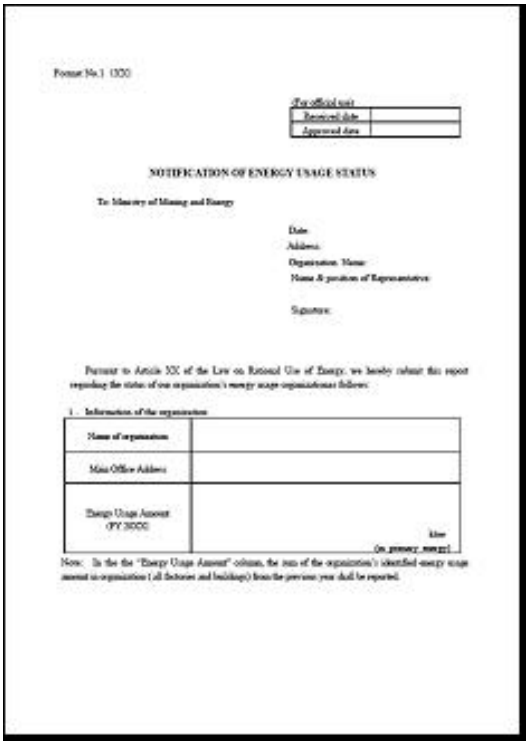
Word	Definition
Energy	All types of energy available commercially, including natural gas (liquid natural gas and liquid oil gas), all heating and cooling fuels (including district heating and cooling), coal, transport fuels (with the exception of fuels meant for air and sea transport) and renewable energy sources
Energy Efficiency	The ratio between the results achieved in services, goods or energy and energy consumption
Increase in Energy Efficiency	The increase in the efficiency of production, transmission, distribution, i.e. final energy consumption, as a result of change in behaviors, work organization, i.e. installed technology and devices. It manifests itself either in energy consumption reduction for the same scale and quality of activities and services or in the increased scale and quality of activities and services with the same energy consumption
Primary Energy	Energy that exists in a naturally occurring form, such as coal, before being converted into an end-use form
Final Energy	Energy forms and fuels as sold to or as used by final consumers
Energy Savings	Volume of energy saved. It is determined by measurement, i.e. assessment of consumption before and after the implementation of one or several measures for the increase in energy efficiency
Energy Efficiency Services	service, technology, management system, device, or other goods implemented in any part of the energy use process which is offered based on the contract and which, under normal circumstances, leads to proven, measurable or appraisable increase in energy efficiency, i.e. to energy savings
ESCO (Energy Service Company)	natural or legal person providing services in the field of energy efficiency increase in customer's premises, facilities, i.e. plants and which bears the whole or partial financial risk for the realization of planned increase in energy efficiency through provided services and measures, i.e. this company collects the funds for implemented services and measures either partially or as a whole from the savings arising from the increase in energy efficiency in the customer's premises, facilities, i.e. plants
Energy Management	the most extensive set of regulatory, organizational, incentive and technical measures and activities of energy consumption supervision, which are determined and implemented by the state administration bodies, local administration bodies and energy consumers, within their competence, aiming at increased energy efficiency. Energy Management includes all the activities realized during organized energy consumption supervision, comparison of realized consumption with planned consumption, analyses of energy consumption and energy efficiency measures implementation based on this
toe	A unit of energy (ton of oil equivalent), the amount of energy released by burning one ton of crude oil. 1 toe equals to approximately 42 GJ
Management Standard	A standard to be set up and to be managed by each facility based on the guidelines of the Evaluation Criteria. The Management Standards includes four methods such as management methods,

	measurement and records, O&M and inspections, and treatments during new installation
Evaluation Criteria	The "Evaluation Criteria" is a guideline what EE&C activities are to be conducted within an organization and can also determine whether or not such activities are actually being carried out. The Evaluation Criteria instructs on fields and methods to be managed, management standards, standard values and target improvement values
Energy Manager	A person authorized by designated consumer to propose and implement the measures for the increase in energy efficiency and to perform other activities proscribed by the Law
Energy Officer	A person who supports outsourcing Energy Managers that can be assigned for designated buildings
Accredited Energy Auditor	A person who conducts voluntary energy audit to companies or organizations upon request
Energy Audit	Systematic procedure for the collection of necessary data and information on the existing level and the way energy is consumed in a building or a set of buildings, industrial plant, i.e. the facilities within a company or public service. These data are used so as to determine and quantify the possibilities for the increase in energy efficiency, i.e. energy savings in an economically justifiable way. The data are presented in the report on energy audit results.

Appendix 7

Application Formats
regarding Energy Management System

(1) (for Users) Notification of Energy Use Status



Format No.1 (XX)

(For official use)	
Received date	
Approved date	

NOTIFICATION OF ENERGY USAGE STATUS

To: Ministry of Mining and Energy

Date:
Address:
Organization Name:
Name & position of Representative:

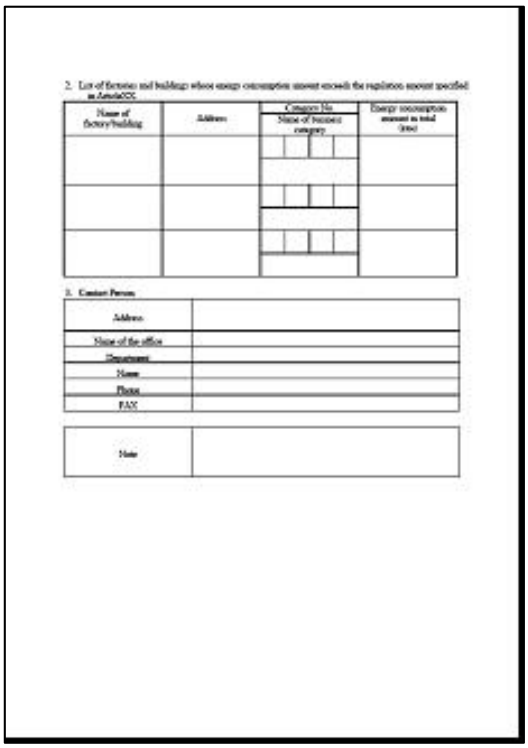
Signature:

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby submit this report regarding the status of our organization's energy usage organizations follows:

1. Information of the organization

Name of organization	
Main Office Address	
Energy Usage Amount (FY 20XX)	toe (in primary energy)

Note: In the the "Energy Usage Amount" column, the sum of the organization's identified energy usage amount in organization (all factories and buildings) from the previous year shall be reported.



2. List of factories and buildings whose energy consumption amount exceeds the regulation amount specified in Article(XX)

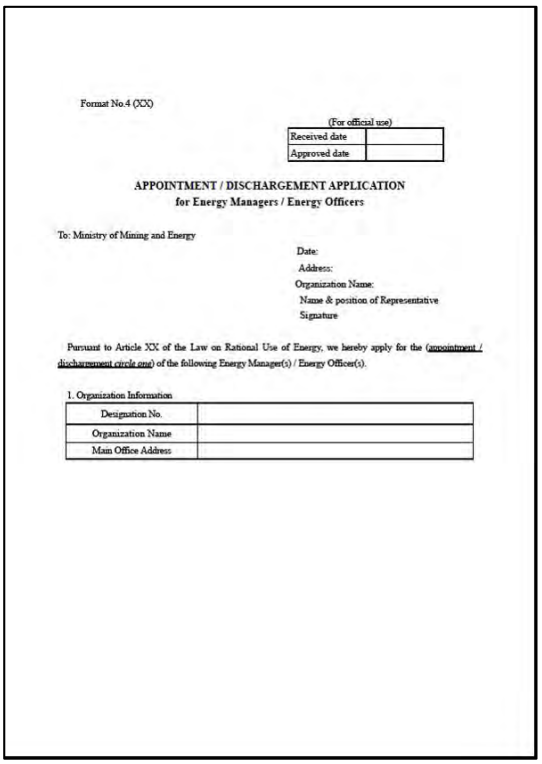
Name of factory/building	Address	Category No. Name of business category	Energy consumption amount on total (toe)

3. Contact Person

Address	
Name of the office	
Department	
Name	
Phone	
FAX	

Note	

(2) (for Users) Notification of Appointment of Energy Manager or Energy Officer



Format No.4 (XX)

(For official use)	
Received date	
Approved date	

APPOINTMENT / DISCHARGEMENT APPLICATION
for Energy Managers / Energy Officers

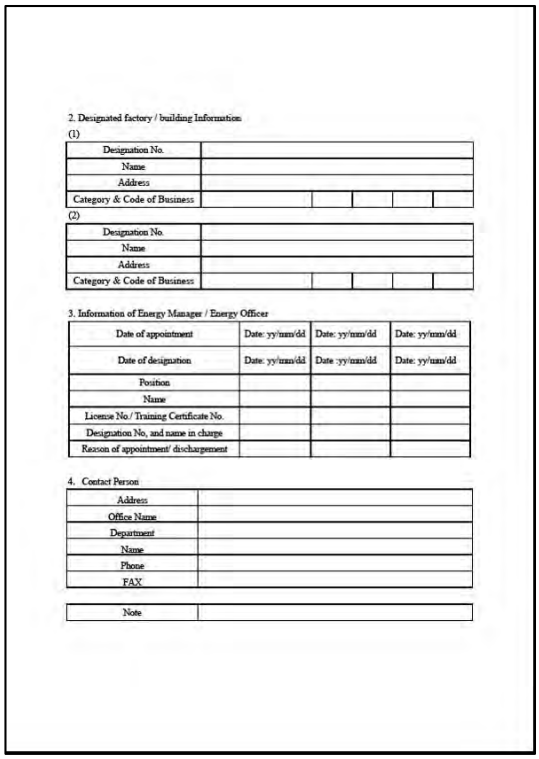
To: Ministry of Mining and Energy

Date:
Address:
Organization Name:
Name & position of Representative
Signature

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby apply for the (appointment / dischargement circle one) of the following Energy Manager(s) / Energy Officer(s).

1. Organization Information

Designation No.	
Organization Name	
Main Office Address	



2. Designated factory / building Information

(1)

Designation No.	
Name	
Address	
Category & Code of Business	

(2)

Designation No.	
Name	
Address	
Category & Code of Business	

3. Information of Energy Manager / Energy Officer

Date of appointment	Date: yy/mm/dd	Date: yy/mm/dd	Date: yy/mm/dd
Date of designation	Date: yy/mm/dd	Date :yy/mm/dd	Date: yy/mm/dd
Position			
Name			
License No./ Training Certificate No.			
Designation No. and name in charge			
Reason of appointment/ dischargement			

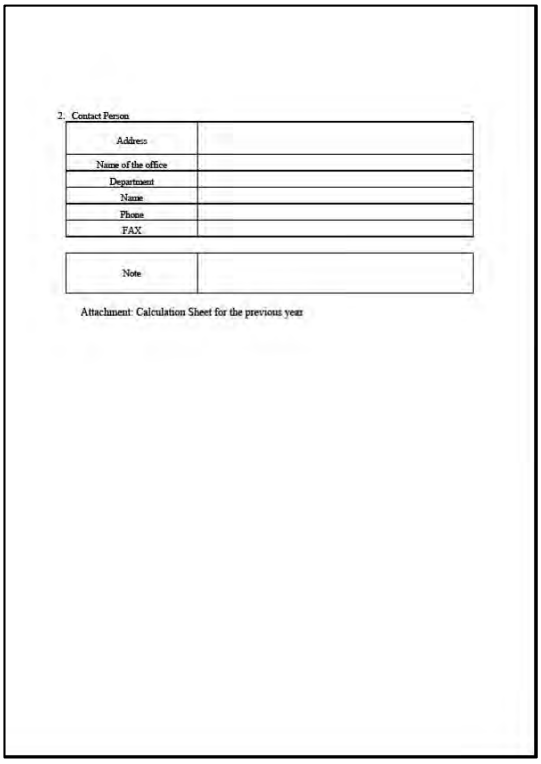
4. Contact Person

Address	
Office Name	
Department	
Name	
Phone	
FAX	

Note	

(3) (for Users) Declaration of Revocation for designated organizations

DECLARATION OF REVOCATION
for Designated Organization



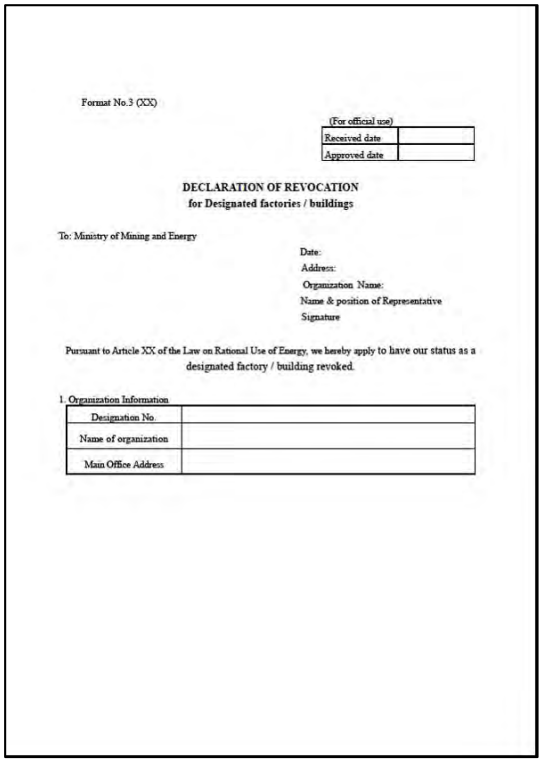
2. Contact Person

Address	
Name of the office	
Department	
Name	
Phone	
FAX	

Note	

Attachment: Calculation Sheet for the previous year

(4) (for Users) Declaration of Revocation for designated factories/ buildings



Format No.3 (XX)

(For official use)

Received date	
Approved date	

DECLARATION OF REVOCATION
for Designated factories / buildings

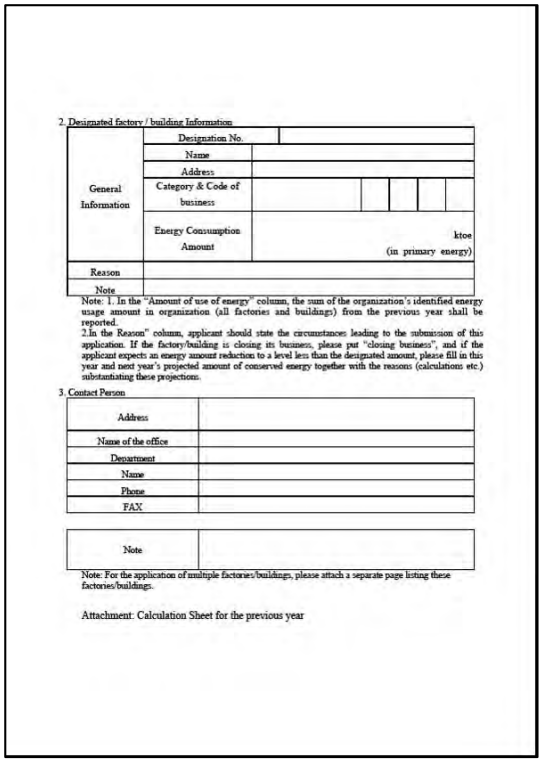
To: Ministry of Mining and Energy

Date:
Address:
Organization Name:
Name & position of Representative
Signature

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby apply to have our status as a designated factory / building revoked.

1. Organization Information

Designation No.	
Name of organization	
Main Office Address	



2. Designated factory / building Information

General Information	Designation No.	
	Name	
	Address	
	Category & Code of business	
	Energy Consumption Amount	ktoe (in primary energy)
Reason		
Note		

Note: 1. In the "Amount of use of energy" column, the sum of the organization's identified energy usage amount in organization (all factories and buildings) from the previous year shall be reported.
2.In the Reason" column, applicant should state the circumstances leading to the submission of this application. If the factory/building is closing its business, please put "closing business", and if the applicant expects an energy amount reduction to a level less than the designated amount, please fill in this year and next year's projected amount of conserved energy together with the reasons (calculations etc.) substantiating these projections.

3. Contact Person

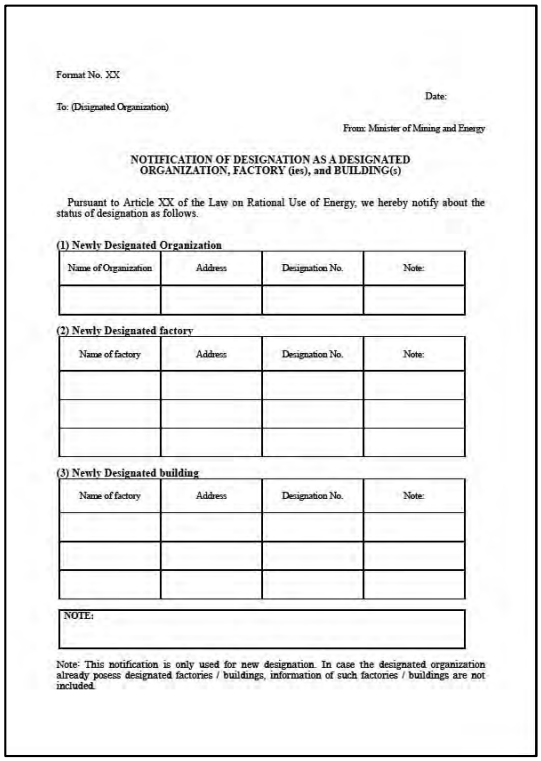
Address	
Name of the office	
Department	
Name	
Phone	
FAX	

Note	

Note: For the application of multiple factories/buildings, please attach a separate page listing these factories/buildings.

Attachment: Calculation Sheet for the previous year

(5) (for MOME) Notification of Designation as a Designated Organization, factory(ies), and Building(s)



Format No. XX

Date:

To: (Designated Organization)

From: Minister of Mining and Energy

NOTIFICATION OF DESIGNATION AS A DESIGNATED ORGANIZATION, FACTORY (ies), and BUILDING(s)

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby notify about the status of designation as follows.

(1) Newly Designated Organization

Name of Organization	Address	Designation No.	Note:

(2) Newly Designated factory

Name of factory	Address	Designation No.	Note:

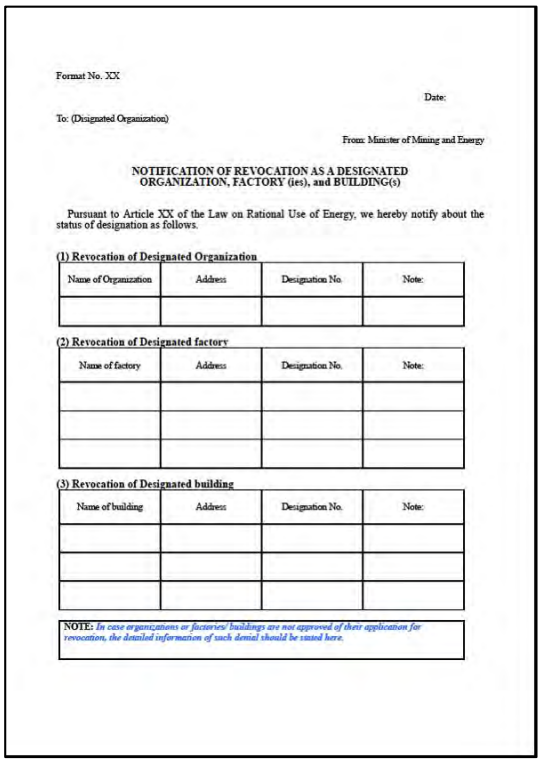
(3) Newly Designated building

Name of factory	Address	Designation No.	Note:

NOTE:

Note: This notification is only used for new designation. In case the designated organization already posess designated factories / buildings, information of such factories / buildings are not included.

(6) (for MOME) Notification of Revocation as a Designated Organization, factory(ies), and Building(s)



Format No. XX

Date:

To: (Designated Organization)

From: Minister of Mining and Energy

NOTIFICATION OF REVOCATION AS A DESIGNATED ORGANIZATION, FACTORY (ies), and BUILDING(s)

Pursuant to Article XX of the Law on Rational Use of Energy, we hereby notify about the status of designation as follows.

(1) Revocation of Designated Organization

Name of Organization	Address	Designation No.	Note:

(2) Revocation of Designated factory

Name of factory	Address	Designation No.	Note:

(3) Revocation of Designated building

Name of building	Address	Designation No.	Note:

NOTE: *In case organizations or factories/ buildings are not approved of their application for revocation, the detailed information of such denial should be stated here.*

Appendix 8

Audit Standards
for Accredited Energy Auditors

Audit Standards for Factory

Contents

Reference: “Check Sheet of Energy Audit”

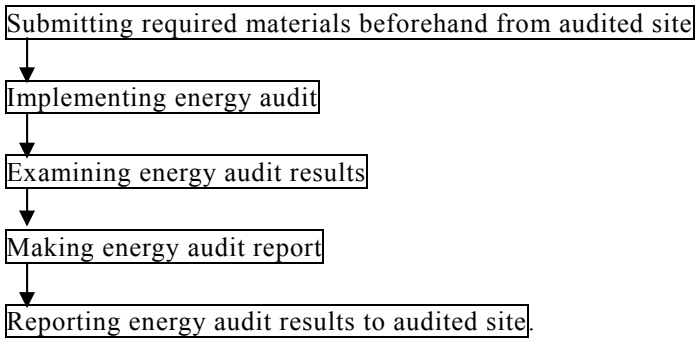
1. Objective of the Standards

This standards is a sample for advisory energy audit by accredit auditor in Serbia in connection with introduction of energy management system.

In this manual the objectives of facilities are limited to utilities facilities as the common facilities in factories, and if possible the facilities for production might be audited as well.

2. Process Scheme of External Energy Audit

The process of external energy audit is implemented in accordance with the follows;



3. Materials to be Submitted beforehand from Audited Site

The following materials and documents are submitted previously from audited site as many as possible in consideration of executing the audit effectively and securing the precision of audit results.

(1) Basic Information (Table-1)
(2) Organization chart of company/factory and EE&C
(3) Equipment List (Table-2)
(4) Annual Energy Consumption (Table-3)
(5) Monthly Energy Consumption of the Latest One Year (Table-4)
(6) Typical Properties of Fuels (Table-5)
(7) Unit Prices of Fuels, Heat and Water (Table-6)
(8) Contract of Electricity (Table-7)
(9) Tariff of Electricity (Table-8)
(10) Other Materials (if possible)
  1) Layout drawing of factory
  2) Flow diagram of utility equipment (Steam system, Hot water system, Compressed air system, Chilled water system, etc.)
  3) One line diagram of electricity
  4) Design data of utility equipment (Steam boiler, Hot water boiler, Air compressor, chiller, etc.)
  5) Others

Table-1 Basic Information

Company/Factory Name			
Ownership	Public Private Privatized (in)		
Address			
Capital			
Person in Charge	Name : Position : Tel : E-Mail Address :		
Outline of Factory	Kind of Industry	1. Food and Beverage 2.Cigarette and Feed 3.Textile 4. Wood and Wooden furniture 5. Pulp and Paper 6. Printing 7. Chemical 8. Petroleum and Coal 8. Plastic 9. Rubber 10. Leather 11. Ceramic 12. Cement 13. Steel 14. Nonferrous Metal 15. Metal Products 16. Machinery 17. Electrical and Electronic Appliance 18. Automobile and the Parts 19. Others ( )	
	Main Product and annual Production		
	Annual Amount of Production		
	Number of Employees		
	Annual Operation Day		
	Operation Hours per Day		

Table-2 Equipment List

Utility Facilities	Steam Boiler	No.1	No.2	No.3	No.4		
	- Evaporation (Rated) t/h						
	- Steam Press. (Rated) MPaG						
	- Steam Temp. (Rated) ℃						
	- Kind of Fuel						
	Hot Water Boiler	No.1	No.2	No.3	No.4		
	- Capacity GJ/h						
	- Kind of Fuel						
	Air Compressor	No.1	No.2	No.3	No.4		
	- Type						
	- Air Volume (Rated) Nm3/h						
	- Discharge Press. (Rated) MPaG						
	- Input Power (Rated) kW						
	Chiller	No.1	No.2	No.3	No.4		
	- Type						
	- Capacity (Rated) RT						
	- Input Power (Rated) kW						
	Receiving Power Transformer	No.1	No.2	No.3	No.4		
	- Voltage of Inlet/Outlet V	/	/	/	/		
	- Capacity KVA						
	- Installed Year						
	Independent Generator	No.1	No.2	No.3	No.4		
	- Type						
	- Generated Power (Rated) kW						
	- Kind of Fuel						
	- Normal or Emergency Use						
Air-Conditioner	Heating						
	- Heating Floor Area M2						
	- Heat Source						
	Cooling						
	- Cooling Floor Area M2						
	- Cooling Source						
Lighting	Type of Lamps	Incandescent	Fluorescent	Fluorescent (HF)	Fluorescent (CFL)	HID	
	Number of Lumps						
	Average Power Consumption W						
Others							

Table-3 Annual Energy Consumption

Kind of Energy	Unit	Consumed Amount	Remarks
1. Electricity	kWh/y		
2. Natural Gas	Sm3(or Nm3)/y		
3. LPG	kg(or ton)/y		
4. Fuel Oil	kg(or kL)/y		
5. Steam from Outside	GJ/y		
6. Hot Water from Outside	GJ/y		
7. Others	-		

Table-4 Monthly Energy Consumption of the Latest One Year

Year	Month	Purchased Electricity		Generated Power	Natural Gas	LPG	Heavy Fuel Oil	Coal		Water		Production	
		Peak in Every Month	Cumulative							Potable Water	Well or River Water	Shipment amount	Sales Amount
		kW	kWh	kWh	Sm3	kg	kL or ton	ton		m3	m3	Ton, Number, etc.	RSD
Total													

Table-5 Typical Properties of Fuels

Natural Gas	Net Heating Value: KJ/Sm3
LPG	Net Heating Value: KJ/kg
Heavy Fuel Oil	Net Heating Value: KJ/kg Density: kg/L@15/4℃ Sulfur Content: wt%
Coal	Net Heating Value: KJ/kg

Table-6 Unit Prices of Fuels, Heat and Water

Natural Gas	RSD/Sm3
LPG	RSD/kg
Heavy Fuel Oil	RSD/kg
Coal	RSD/kg
Hot Water from Outside	RSD/GJ

Table-7 Contract of Electricity

Kind of Contract	High Voltage		Low Voltage		Others ( )			
Power Company			Contract Demand	kW	Receiving Power Voltage	V	Actual Power Factor	%
Another Contract	Yes	No	Classification					

Table-8 Tariff of Electricity

Demand Charge	RSD/kW
Energy Charge	RSD/kWh
Others ( )	

4. Implementing External Energy Audit

4-1. Schedule

An example of energy audit schedule is shown as follows;

9:30 - 11:00: Inception meeting and confirmation of EE&C conditions
11:00 - 15:30: Site survey
15:30 - 16:30: Wrap up meeting
Note: including lunch time and coffee break

This schedule would be modified according to the conditions of each audited site.

4-2. Inception Meeting

At inception meeting the following contents are confirmed;

(1) Schedule of energy audit
(2) Contents of information obtained previously from audited site
(3) Conditions of energy management in audited site
- Organization for energy management
- Conditions of energy management (recording, maintenance, manual, etc.)
- Awareness on energy management and conservation of managers and workers
- Countermeasures for energy conservation if any (past, present, planning)

(4) Others

4-3. Site Survey

Site survey should be carried out considering the following items;

(1) As for the facilities to be surveyed and the check points, refer to Reference “Check Sheet of Energy Audit”.
(2) At site survey it should be required that the person in charge of factory accompanies with auditors.
(3) At site survey auditors must not give any harmful influence against operating facility.
(4) If possible, it would be preferable to use the following instruments and apparatus so as to gather the precise data.

Table-9 Examples of Instruments for Energy Audit

Objectives of Facilities	Checked Items	Instruments and Apparatus
Steam and Hot Water Boiler	Exhaust gas O2%	Portable O2 analyze
	Exhaust gas temperature	Portable thermo-meter (thermocouple)
Hot Piping and Boiler	Condition of thermal insulation and refractory	Portable thermo-meter (infrared or thermo-couple) or Thermo camera
Steam Trap	Action of steam trap Internal leakage of bypass valve	Acoustic rod or Steam trap checker
Air Compressor	Operation condition of air compressor	Multi-channel recorder with ampere sensor for motor and pressure sensor for air pressure
Compressed Air Pipe Line	Leakage from compressed air pipe line	Ultra-sonic leak detector
Air Conditioner	Indoor condition	Potable thermo-meter (bi-metal) and Hygrometer
Lighting	Indoor illumination	Lux-meter

4-4. Wrap-up Meeting

At wrap meeting the following contents are confirmed;

(1) Additional questionnaires based on site survey
(2) Schedule of submitting energy audit report
(3) Others

5. Examining Energy Audit Results

Based on the energy audit results, considering the following contents;

(1) Based on energy audit, examining energy conservation items which have possibilities to be improved
(2) Evaluating (calculating) each recommended energy conservation item as quantitatively as possible
(3) Estimating investment and calculating payback period for each item

6. Making Energy Audit Report

After energy audit, the energy audit report is made based on the site survey results considering the following items;

(1) Summary of Energy Audit Result
  - Summary Table of Energy Audit Result (Table-10)
  - Potential of Energy Conservation in Audited Factory (Table-11)
(2) Materials and Data from Audited Site
  - Basic Information (Table-1)
  - Organization chart of company/factory and EE&C
  - Equipment List (Table-2)
  - Annual Energy Consumption (Table-3)
  - Monthly Energy Consumption of the Latest One Year (Table-4)
  - Typical Properties of Fuels (Table-5)
  - Unit Prices of Fuels, Heat and Water (Table-6)
  - Contract of Electricity (Table-7)

- Tariff of Electricity (Table-8)
- Other Materials

(3) Contents of Energy Audit
- Audit date and auditor
- Objective facilities and contents of audit
- Others

(4) Results of Energy Audit
- As for the general items and energy consuming facilities in APPENDIX (Check Sheet of Energy Audit), the applicable columns are filled out based on energy audit results.
- For every item are evaluated by ranking according to the level of three levels as a reference for audited site..

(5) Recommended Countermeasures for Energy Conservation
- As for the recommendable countermeasures for energy conservation in APPENDIX, describing the contents and calculation results in detail
- For each recommendable item, the following contents are fundamentally described:
  a. Present conditions
  b. Countermeasures
  c. Premises of calculation
  d. Calculation of energy saving and cost saving
  e. Investment
  f. Payback period

(6) Conclusion
- General comment by auditor
- Others

(7) Another Attachment
If required

Table-10 Summary Table of Energy Audit Result

No.	Item	Kind of Saved Energy	Reduction of Energy Consumption /year	Reduction of Energy Cost RDS/year	Investment RDS	Payback Period year	Remark
1	Insulation on non-insulated steam valves, etc.	Fuel Oil	51 ton	19,200	15,000	0.8	(Example)

Table-11 Potential of Energy Conservation in Audited Factory

Kind of Energy		Annual Energy Consumption Sm3, ton or kWh	Quantity of Reduction Sm3, ton or kWh	Rate of Reduction %	Reduction of Energy Cost RDS/year	Investment RDS	Payback Period year	Remark
Natural Gas		Sm3	Sm3					
Heavy Fuel Oil		ton	ton					
Electricity		kWh	kWh					
Total	Heat	GJ	GJ			-	-	
	Electricity	MWh	MWh			-	-	

7. Reporting Energy Audit Results

(1) It is better to visit the audited site and explain about the audit results, because the visit for reporting would make possible to confirm misunderstandings by hearing with persons in charge of site and re-check of site.

If any misunderstanding, the audit report should be revised and re-submitted.

(2) Energy audit report should be submitted as soon as possible. (such as “within one month”)

Reference: Check Sheet of Energy Audit

1. General Items

	Check Points	Evaluation	Present Conditions and the Points	Recommendations for Energy Conservation
General Items	(1) EE&C Management system - Establishment of EE&C management organization - Functioning of EE&C management organization - Human resources development for all employees			
	(2) EE&C Management standard - Preparation and maintenance of required EE&C standards - Maintenance of EE&C standards - Periodical measurement and recording according to EE&C standards (daily report, monthly report, yearly report, etc.) - Scheduled maintenance of equipment according to EE&C standards			
	(3) EE&C target management - Medium and long term plan for EE&C - Management of energy intensity			
	(4) Implementation of EE&C measures - EE&C activity - Investment for EE&C - Incentive system for EE&C			

Rankings of evaluation A : Good
B : Normal
C : Need efforts

2. Management of Energy Consuming Equipment

(1) Steam Boiler / Steam System, Hot Water Boiler / Hot Water System, Waste Heat / Waste Water

	Check Point and Contents	Present Conditions And the Points for Energy Conservation	Recommendations on countermeasures for Energy Conservation	Annual Estimated Effect
Steam Boiler	(1) Management of combustion control - Control of excess air ratio and exhaust gas temperature - Burner and draft system - Combustion control system			
	(2) Management of operation and efficiency - Load factor - Condition of start and stop - Operation system in case of multi-boiler system - Boiler efficiency and heat balance - Water quality control - Blow-down water control			
	(3) Refractory and insulation - Outside surface temperature on boiler shell - Insulation of steam and hot water pipe line - Sealing of opening and inside draft			
	(4) Exhaust gas temperature and heat recovery - Exhaust gas temperature - Heat recovery (Economizer, Air pre-heater)			
Steam System	(1) Management of steam system operation - Steam pressure - Boiler evaporation and steam quantity to steam users			
	(2) Leakage of steam - Leakage from steam pipe lines			
	(3) Insulation on steam pipe line - Insulation method (specification of insulation) - Surface temperature on surface of insulation - Insulation on valves, fittings, etc.			
	(4) Steam piping system - Pipe lines route - Pipe lines size - Existence of unused steam pipe line - Possibility to integrate plural pipe lines			
	(5) Management of steam traps - Periodical checking of steam traps action - Maintenance of malfunctioned steam traps			
	(6) Boiler load-leveling - Possibility of installing steam accumulator - Possibility of countermeasures at steam			

	(7) Condensate recovery - Recovery rate of steam condensate - Recovery system of steam condensate			
	(8) Flash steam recovery - Steam quantity and conditions of recovered steam - Recovery system of flash steam			
Hot Water Boiler	(1) Management of combustion control - Control of excess air ratio and exhaust gas temperature - Burner and draft system - Combustion control system			
	(2) Management of operation and efficiency - Load factor - Condition of start and stop - Operation system in case of multi-boiler system - Boiler efficiency and heat balance			
	(3) Refractory and insulation - Outside surface temp. on boiler shell - Insulation of steam and hot water pipe line - Sealing of opening and inside draft			
	(4) Exhaust gas temperature and heat recovery - Exhaust gas temperature - Possibility of heat recovery (Air pre-heater)			
Hot Water System	(1) Management of steam system operation - Steam pressure - Boiler evaporation and steam quantity to steam users			
	(2) Leakage of hot water - Leakage from hot water pipe lines			
	(7) Insulation on steam pipe line - Insulation method (specification of insulation) - Surface temperature on surface of insulation - Insulation on valves, fittings, etc.			
	(8) Steam piping system - Pipe lines route - Pipe lines size			
	(11) Condensate recovery - Recovery rate of steam condensate - Recovery system of steam condensate			
Others	(1) Others			

Rankings of evaluation (A, B, C)	
Management of energy consuming facility	
Improvement of energy consuming facility	

(2) Compressed Air System and Rotating Machines (Pump, Blower, Fan)

	Check Point and Contents	Present Conditions and the Points	Recommendations for Energy Conservation	Annual Estimated Effect
Compressor Air System	(2) Management of operation control and maintenance of equipments - Type of air compressor - Matching between capacity and type - Installation or reinforcement of air holder - Separation of high pressure and low pressure system - Reduction of compressed air press. at compressor outlet and end of pipe line - Pipe line route, size and length - Ventilation system and ambient temperature in compressor room - Operation system in case of multi-compressor system - Introduction of rotating speed control			
Pump, Blower, Fan	(1) Management of operation control and maintenance of equipments - Fluid and operation pressure - Rated power input and operation power input - Condition of valve opening - Pipe line route, size and length - Design margin against actual condition - Introduction of rotating speed control			
Others	(3) Others			

Rankings of evaluation (A, B, C)	
Management of energy rotating machines	
Improvement of energy consuming facility	

(3) Air Conditioner and Refrigeration Facility

	Check Point and Contents	Present Conditions and the Points	Recommendations for Energy Conservation	Annual Estimated Effect
Air Conditioner and Refrigeration Facility	(1) Operation management of air conditioner - Reviewing of set temperature - Reducing intake air volume - Reviewing of operation numbers of heat source machines - Scheduled operation - outside-air cooling - Prevention of outside-air inhalation			
	(2) Countermeasures for EE&C of air conditioner - Reinforcement of refractory outside building - Shut-out of high temperature equipment - Stratification air conditioning - Reduction of air conditioning space - Introduction of rotating speed control for pump and blower - Introduction of high efficiency air conditioner (such as heat pump) - Installation of total heat exchanger - Utilization of waste heat			
	(3) Operation management of chiller - Inlet and outlet temperature of refrigerant - Inlet and outlet temperature of cooling water - Management of water quality (electric conductivity) - Operation management of pump			
	(4) Facility management of chiller - Introduction of rotating speed control			
	(5) Operation management of refrigeration facility - Management of access - Management of insulation - Replacement with high performance facility - Another countermeasures (air curtain, cover for showcase)			
Others	(5) Others			

Rankings of evaluation (A, B, C)	
Management of energy consuming facility	
Improvement of energy consuming facility	

(4) Receiving Power Facility, Motor, Lighting, Electric Heater, etc.

	Check Point and Contents	Present Conditions and the Points	Recommendations for Energy Conservation	Annual Estimated Effect
Receiving Power Facility	(1) Management of receiving power - Management of power demand、load factor and power factor - Management of power consumption (hourly, daily, monthly, yearly)			
	(2) Management of receiving power facility - Number of transformers - Capacity and voltage of transformers - Load rejection of unused transformer - Integration of transformers			
Motor	(3) Management of motor - Voltage, Capacity, Number - Introduction of rotating speed control			
Lighting	(4) Management of lighting - Establishing standard of illumination - Introduction of high efficiency lighting - Introduction of automatic on/off facility - Introduction of local lighting and dividing circuit - Management of lighting time such as cut-off at lunch time - Maintenance of lighting equipment			
Electric Heater	(4) Management of electric heater - Voltage and capacity - Improvement of power factor - Heat loss at incoming and outgoing of product - Preheat of product - Heating control - Refractory condition - Improvement of load factor - Continuous operation - Utilizing of exhaust heat			
Other	(5) Other			

Rankings of evaluation (A, B, C)	
Management of electricity consuming facility	
Improvement of electricity consuming facility	

Audit Standards for Building

Contents

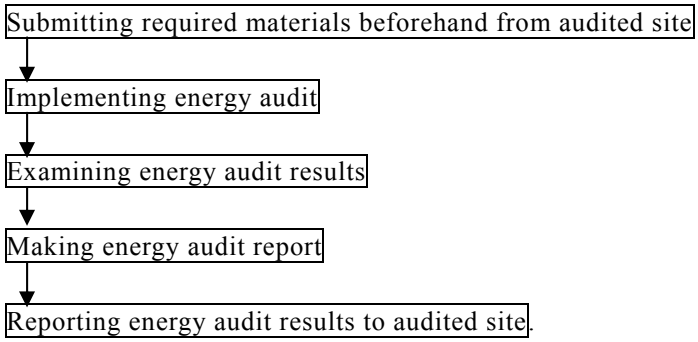
Reference "Check Sheet of Energy Audit"

1. Objective of the Standards

This standards is for advisory energy audit by consultant, etc. in Serbia in connection with introduction of energy management system.

2. Process Scheme of External Energy Audit

The process of external energy audit is implemented in accordance with the follows;



3. Materials to be Submitted beforehand from Audited Site

The following materials and documents are submitted previously from audited site as many as possible in consideration of executing the audit effectively and securing the precision of audit results.

(1) Basic Information (Table-1)
(2) Hot Water Supply from District Heating Company (Table-2)
(3) Outline of Building (Table-3)
(4) Outline of Building (Table-4)
(5) Equipment List (Table-5)
(6) Annual Energy Consumption (Table-6)
(7) Monthly Energy Consumption of the Latest One Year (Table-7)
(8) Typical Properties of Fuels (Table-8)
(9) Unit Prices of Fuels, Heat and Water (Table-9)
(10) Contract of electricity (Table-10)
(11) Tariff of Electricity (Table-11)

Table-1 Basic Information

Company or Organization / Building Name		
Ownership	Public Private Privatized (in)	
Address		
Person in Charge	Name : Position : Tel : E-Mail Address :	
Outline of Building	Kind of Building	
	Main Product and annual Production	
	Annual Amount of Production	
	Number of Employees	
	Annual Operation Day	
	Operation Hours per Day	

Table-2 Hot Water Supply from District Heating Company

No					
Yes		Name of DHC		Period of Receiving	~

Table-3 Business Hour of Building and Operation Hour of Equipment

Annual Business Days	days in XXXX			
Business Hour	~		Lunch Time	~
Equipment Operation hour	~			

Table-4 Outline of Building

Construction Year							
Name of Constructor							
Structure of Building	SRC	RC	S	Others	No. of Floors	Above Ground	
						Underground	
Total Floor Area	m2						
Special Remarks							
Air Conditioning	Cooling				Heating		
	Period	~			Period	~	
	Set Temperature	℃			Set Temperature	℃	

Table-5 Equipment List

Utility Facilities	Steam Boiler		No.1		No.2	No.3		No.4
	- Evaporation (Rated)	t/h						
	- Steam Press. (Rated)	MPaG						
	- Steam Temp. (Rated)	℃						
	- Kind of Fuel							
	Hot Water Boiler		No.1		No.2	No.3		No.4
	- Capacity	GJ/h						
	- Kind of Fuel							
	Air Compressor		No.1		No.2	No.3		No.4
	- Type							
	- Air Volume (Rated)	Nm3/h						
	- Discharge Press. (Rated)	MPaG						
	- Input Power (Rated)	kW						
	Chiller		No.1		No.2	No.3		No.4
	- Type							
	- Capacity (Rated)	RT						
	- Input Power (Rated)	kW						
	Receiving Power Transformer		No.1		No.2	No.3		No.4
	- Voltage of Inlet/Outlet	V	/		/	/		/
	- Capacity	KVA						
	- Installed Year							
	Independent Generator		No.1		No.2	No.3		No.4
	- Type							
	- Generated Power (Rated)	kW						
	- Kind of Fuel							
	- Normal or Emergency Use							
Air-Conditioner	Heating							
	- Heating Floor Area	M2						
	- Heat Source							
	Cooling							
	- Cooling Floor Area	M2						
	- Cooling Source							
Lighting	Type of Lamps		Incandescent	Fluorescent	Fluorescent (HF)	Fluorescent (CFL)	HID	
	Number of Lumps							
	Average Power Consumption	W						
Others								

Table-6 Annual Energy Consumption

Kind of Energy	Unit	Consumed Amount	Remarks
1. Electricity	kWh/y		
2. Natural Gas	Sm3(or Nm3)/y		
3. LPG	kg(or ton)/y		
4. Fuel Oil	kg(or kL)/y		
5. Steam from Outside	GJ/y		
6. Hot Water from Outside	GJ/y		
7. Others	-		

Table-7 Monthly Energy Consumption of the Latest One Year

Year	Month	Purchased Electricity		Generated Power	Natural Gas	LPG	Heavy Fuel Oil	Coal		Water		Production	
		Peak in Every Month	Cumulative							Potable Water	Well or River Water	Shipment amount	Sales Amount
		kW	kWh	kWh	Sm3	kg	kL or ton	ton		m3	m3	Ton, Number, etc.	RSD
Total													

Table-8 Typical Properties of Fuels

Natural Gas	Net Heating Value: KJ/Sm3
LPG	Net Heating Value: KJ/kg
Heavy Fuel Oil	Net Heating Value: KJ/kg Density: kg/L@15/4℃ Sulfur Content: wt%
Coal	Net Heating Value: KJ/kg

Table-9 Unit Prices of Fuels, Heat and Water

Natural Gas	RSD/Sm3
LPG	RSD/kg
Heavy Fuel Oil	RSD/kg
Coal	RSD/kg
Hot Water from Outside	RSD/GJ

Table-10 Contract of Electricity

Kind of Contract	High Voltage		Low Voltage		Others ( )		
Power Company			Contract Demand	kW	Receiving Power Voltage	V	Actual Power Factor	%
Another Contract	Yes	No	Classification				

Table-11 Tariff of Electricity

Demand Charge	RSD/kW
Energy Charge	RSD/kWh
Others ( )	

4. Implementing the External Energy Audit

4-1. Schedule

An example of advisory energy audit schedule is shown as follow;

9:30 - 11:00: Inception meeting.
11:00 - 15:30: Site survey
15:30 - 16:30: Wrap up meeting
Note: including lunch time and coffee break

This schedule would be modified according to the conditions of each audited site.

4-2. Inception Meeting

At the inception meeting the following contents are confirmed;

(1) Schedule of the advisory energy audit
(2) Contents of information obtained previously from audited site
(3) Conditions of energy management in audited site
- Organization for energy management
- Conditions of energy management (recording, maintenance, manual, etc.)
- Awareness on energy management and conservation of managers and workers
- Countermeasures for energy conservation if any (past, present, planning)

(4) Others

4-3. Site Survey

Site survey should be carried out considering the following items;

(1) As for the facilities to be surveyed and the check points, refer to Reference “Check Sheet of Energy Audit”.
(2) At site survey it should be required that the person in charge of building accompanies with auditors.
(3) At site survey energy auditors must not give any harmful influence against operating facility.
(4) If possible, it would be preferable to use the following instruments and apparatus so as to gather the precise data.

Table-12 Examples of Instruments for Energy Audit

Objectives of Facilities	Checked Items	Instruments and Apparatus
Steam and Hot Water Boiler	Exhaust gas O2%	Portable O2 analyze
	Exhaust gas temperature	Portable thermo-meter (thermocouple)
Hot Piping and Boiler	Condition of thermal insulation and refractory	Portable thermo-meter (infrared or thermo-couple) or Thermo camera
Steam Trap	Action of steam trap Internal leakage of bypass valve	Acoustic rod or Steam trap checker
Air Compressor	Operation condition of air compressor	Multi-channel recorder with ampere sensor for motor and pressure sensor for air pressure
Compressed Air Pipe Line	Leakage from compressed air pipe line	Ultra-sonic leak detector
Air Conditioner	Indoor condition	Potable thermo-meter (bi-metal) and Hygrometer
Lighting	Indoor illumination	Lux-meter

4-4. Wrap-up Meeting

At wrap meeting the following contents are confirmed;

(1) Additional questionnaires based on site survey
(2) Schedule of submitting energy audit report
(3) Others

5. Examining Energy Audit Results

Based on the energy audit results, considering the following contents;

(1) Based on energy audit results, examining energy conservation items which have possibilities to be improved
(2) Evaluating (calculating) each recommended energy conservation item as quantitatively as possible
(3) Estimating investment and calculating payback period for each item

6. Making Energy Audit Report

After energy audit, the energy audit report is made based on the site survey results considering the following items;

(1) Summary of Energy Audit Result
- Summary Table of Energy Audit Result (Table-13)
- Potential of Energy Conservation in Audited Site (Table-14)

(2) Document and Data from Audited Site
- Basic Information (Table-1)
- Hot Water Supply from District Heating Company (Table-2)
- Business Hour of Building and Operation Hour of Equipment (Table-3)
- Outline of Building (Table-4)
- Equipment List (Table-5)
- Annual Energy Consumption (Table-6)
- Monthly Energy Consumption of the Latest One year (Table-7)
- Typical Properties of Fuel (Table-8)
- Unit Prices of Fuel, Heat and Water (Table-9)
- Contract of Electricity (Table-10)
- Tariff of Electricity (Table-11)

(3) Contents of Energy Audit
- Audit date and auditor
- Objective facilities and contents of audit
- Others

(4) Results of Energy Audit
- As for the general items and energy consuming facilities in APPENDIX (Check Sheet of Advisory Energy Audit), the applicable columns are filled out based on energy audit results as a reference for audited site.
- Each item in APPENDIX is evaluated by ranking of three levels.

(5) Recommended Countermeasures for Energy Conservation
- As for the recommendable countermeasures for energy conservation in APPENDIX, describing the contents and calculation results in detail
- For each recommendable item, the following contents are fundamentally described:

a. Present conditions
b. Countermeasures
c. Premises of calculation
d. Calculation of energy saving and cost saving
e. Investment
f. Payback period

(6) Conclusion
- General comment by auditor
- Others

(7) Another attachment
If required

Table-13 Summary Table of Advisory Energy Audit Result

No.	Item	Kind of Saved Energy	Reduction of Energy Consumption /year	Reduction of Energy Cost RDS/year	Investment RDS	Payback Period year	Remark
1	Insulation on non-insulated steam valves, etc.	Fuel Oil	51 ton	19,200	15,000	0.8	(Example)

Table-14 Potential of Energy Conservation in Audited Site

Kind of Energy		Annual Energy Consumption Sm3, ton or kWh	Quantity of Reduction Sm3, ton or kWh	Rate of Reduction %	Reduction of Energy Cost RDS/year	Investment RDS	Payback Period year	Remark
Natural Gas		Sm3	Sm3					
Heavy Fuel Oil		ton	ton					
Electricity		kWh	kWh					
Total	Heat	GJ	GJ			-	-	
	Electricity	MWh	MWh			-	-	

7. Reporting energy audit results

(1) It is better to visit the audited site and explain about the audit results, because the visit for reporting would make possible to confirm misunderstandings by hearing with persons in charge of site and re-check of site.
If any misunderstanding, the audit report should be revised and re-submitted.

(2) Energy audit report should be submitted as soon as possible. (such as “within one month”)

Reference: Check Sheet of Energy Audit

1. General Items

	Check Point and Contents	Evaluation	Present Conditions and the Points	Recommendations for Energy Conservation
General Items	(1) EE&C Management system - Establishment of EE&C management organization - Functioning of EE&C management organization - Human resources development for all employees			
	(2) EE&C Management standard - Preparation and maintenance of required EE&C standards - Maintenance of EE&C standards - Periodical measurement and recording according to EE&C standards (daily report, monthly report, yearly report, etc.) - Scheduled maintenance of equipment according to EE&C standards			
	(3) EE&C target management - Medium and long term plan for EE&C - Management of energy intensity			
	(4) Implementation of EE&C measures - EE&C activity - Investment for EE&C - Incentive system for EE&C			

Rankings of evaluation A : Good
B : Normal
C : Need efforts

2. Management of Energy Consuming Equipment

(1) Facilities of Heat Source and Heat Transfer

	Check Point and Contents	Present Conditions and the Points	Recommendations for Energy Conservation	Annual Estimated Effect
Heat Source Facility	(1) Management of combustion facility - Control of excess air ratio and exhaust gas temperature - Burner and draft system - Combustion control system			
	(2) Management of chiller - Coefficient of performance (COP) - Inlet and outlet temperature of chilled water - Inlet and outlet temperature of cooling water - Management of performance in heat exchanger (thermal efficiency, etc.) - Control by operated units number			
	(3) Management of operation and efficiency - Load factor - Condition of start and stop - Thermal efficiency and heat balance - Water quality control - Blow-down water control			
	(4) Management of cooling tower - Operation condition of cooling tower - Water quality control (electric conductivity) and blow-down water control - Operation control of circulation water flow rate and supply pressure, etc. - Improvement of pipe line route			
Heat Transfer Facility	(5) Management of operation - Control by operated units number and rotating speed control - Improvement of pipe line route - Control of temperature difference between supply and return - Condition of valve opening (automatic valve, header bypass valve, etc.)			
	(6) Exhaust gas temperature and exhaust heat recovery - Management of exhaust gas temperature - Condensate recovery - Heat recovery (heat pump, CGS, etc.)			

	(7) Leakage of steam - Leakage from steam pipe lines			
	(8) Management of insulation - Insulation method (specification of insulation) - Surface temperature on surface of insulation - Insulation on valves, fittings, etc.			
	(9) Management of steam traps - Periodical checking of steam traps action - Maintenance of malfunctioned steam traps			
	(10) Management of hot water reservoir - Thermal storage efficiency - Thermal storage and dissipation time - Improvement of heat transfer route			
Others	(11) Others			

Rankings of evaluation (A, B, C)	
Management of energy rotating machines	
Improvement of energy consuming facility	

(2) Air Conditioner and Ventilation Facility

	Check Point and Contents	Present Conditions and the Points	Recommendations for Energy Conservation	Annual Estimated Effect
Air Conditioner and Ventilating Facility	(1) Operation management of air conditioner - Setting of temperature and humidity - Propriety of humidified zone and method - Propriety of reheat - Temperature distribution - Control of intake fresh air - Propriety of operation hour - Air conditioning for unused room - Rejection of ingress of fresh air - Management of environment in room (CO_2, etc.)			
	(2) Management of air conditioning efficiency - Limitation of air conditioned area - Utilization of fresh air (fresh air cooling) - Dew point control - Prevention of mixing loss - Night purge - Accuracy of automatic control			
	(3) Introduction of control system - Introduction of VAV and VWV - CO_2 control system - Fresh air cooling system (fresh air enthalpy control) - Installation of total heat exchanger - Local cooling and local air-exhaust			
	(4) Ventilation facility - Appropriate times of ventilation - Revision of operation hour - Operation temperature control (electric room, machine room, CVCF room, etc.) - Stop of ventilation in unused room - Local ventilation - CO_2 control in indoor parking lot - Inverter control of ventilation fan (VAV, VWV)			
	(5) Others			

Rankings of evaluation (A, B, C)	
Management of energy rotating machines	
Improvement of energy consuming facility	

(3) Hot-Water Supply System, Supply and Waste Water System, Kitchen Facilities

	Check Point and Contents	Present Conditions and thePoints	Recommendations for Energy Conservation
Hot-Water Supply System, Supply and Waste Water System, Kitchen Facility	(1) Management of hot-water supply system - Hot-water supply temperature - Improvement of hot-water system efficiency - Stop of - Schedule control in night, holiday, etc. - Utilization of waste heat - Utilization of solar heat		
	(2) Management of supply and wastewater System - Utilization of reclaimed water (rain water, well water, etc.) - Measures for water conservation - Control of supply water flow rate and pressure - Utilization of wastewater		
	(3) Management of kitchen facilities - Management of insulation - Management of opening and closing doors - Improvement in thermal efficiency of facilities - Management of defrost of refrigerator - Management of kitchen facilities (cooker, dishwasher, etc.)		

Rankings of evaluation (A, B, C)	
Management of energy rotating machines	
Improvement of energy consuming facility	

(4) Receiving Power Facility, Motor, Lighting, etc.

	Check Point and Contents	Present Conditions and the Points	Recommendations for Energy Conservation	Annual Estimated Effect
Receiving Power Facility	(1) Management of receiving power Facility - Management of power demand、load factor and power factor - Management of power consumption (hourly, daily, monthly, yearly) - Supervisory control of power demand - Stop of unused transformer			
	(2) Introduction of high efficient facility - Facility for improving power factor - Supervisory control system for power demand - High efficiency transformer - Integration of transformers			
Motor	(3) Management of motor - Voltage, Capacity, Number - Introduction of rotating speed control			
Lighting	(4) Management of lighting - Establishing standard of illumination - Introduction of high efficiency lighting - Introduction of automatic on/off facility - Introduction of local lighting and dividing circuit - Management of lighting time such as cut-off at lunch time - Maintenance of lighting equipment			
Others	(5) Other			

Rankings of evaluation (A, B, C)	
Management of energy rotating machines	
Improvement of energy consuming facility	

Appendix 9

Inspection Standards

1. Questionnaire Sheet (before Site Visit)

Questionnaire for EE&C Inspection (Industrial Sector)

Date					
Company/Factory Name					
Address					
Person in charge	Name		Position		
	Tel		E-mail		
Outline of company/Factory					
Industrial sub-sector	Energy Supplier, Steel and metal products, Food and cigarette, Ceramic Chemical, Textile, Fertilizer, Pulp & paper, Machinery, Electric & Electronics Automobile and parts, Others( )				
Main Product					
Number of emploees					
Operation days per year					
Operation days per week					
Daily operation hours					

Annual production and energy consumption			2010	2011	2012	Remarks
Product	Product A					
	Product B					
	Product C					
Energy	Electricity	kWh				
	Heat	MJ				
	Natural Gas	m3				
	Mazut	ton				
	Coal	ton				
	Others					
	Total	MJ				
Energy intensity						
Schematic process flow sheet of main products						
	Please attach					
Schematic flow sheet of energy consumption						
	Please attach					
Remarks						

Questionnaire for EE&C Inspection (Commercial Sector)

Date				
Company Name				
Address				
Person in charge	Name		Position	
	Tel		E-mail	
Outline of company				
Commercial sub-sector	Retail, Hotel, Financial, Mass communication Others( )			
Building area				
Annual sales revenue				
Number of emploees				
Operation days per year				
Operation days per week				
Daily operation hours				

Annual sales and energy consumption			2010	2011	2012	Remarks
Sales	Business					
Building area		m^2				
Energy	Electricity	kWh				
	Heat	MJ				
	Natural Gas	m^3				
	Mazut	ton				
	Coal	ton				
	Others					
	Total	MJ				
Energy intensity		MJ/m^2				

Building ground plan	
Please attach	
Schematic flow sheet of energy consumption	
Please attach	
Remarks	

Questionnaire for EE&C Inspection (Municipality)

Date				
Municipality Name				
Address				
Person in charge	Name		Position	
	Tel		E-mail	
Outline of municipality				
Population		Land area	km^2	
District Heatig				
Building information				
Main office	m^2			
School 1	m^2			
School 2	m^2			
School 3	m^2			
School 4	m^2			
School 5	m^2			
Hospital	m^2			

Annual and energy consumption			2010	2011	2012	Remarks
Energy	Electricity	kWh				
	Heat	MJ				
	Natural Gas	m^3				
	Mazut	ton				
	Coal	ton				
	Others					
	Total	MJ				
Energy intensity		MJ/m^2				
Building ground plan						
	Please attach					
Schematic flow sheet of energy consumption						
	Please attach					
Remarks						

2. Samples of Scoring by Check Sheet

EE&C Inspection Scoring Example (Headquarter)

Check Points	Self-check	Auditor	Point	
			Allocation	Actual
Management System Check Points Energy management organization is established Energy managers / officers are alocated in each division	○	○	5	10
Management Policy Check Points Energy management policy is established Energy management policy is noticed on a placard	○	○	5	10
Annual target and mid-term target Check Points Annual target of each division is established Mid-term target of each division is established Annual target and achievement is noticed on a placard Achievement of the past target	○	○	5	10
Annual report Check Points Submission of annual report Tendency of energy intensity	○	△	5	5
Cooperation with each division Check Points Period of EE&C meeting and members Information on improvement at each dividion	○	X	5	0
Headquater Total Score				**35**

EE&C Inspection Scoring Example (Site)

Check Points	Self-check	Auditor	Point	
			Allocation	Actual
Management System Check Points Energy management organization is established Energy managers / officers are adequately alocated	○	○	5	10
Energy Management Standard Check Points Establishment of EM standard Contents and numerical indicators of EM standard Application of EM standard Operation control Measurement and record Maintenace	○	○	5	10
Annual target and mid-term target Check points Annual target of each group is established Mid-term target of each group is established Annual target and achievement is noticed on a placard Achievement of the past target	○	○	5	10
Improved items Check Points Improved items and results of past 3-year Sitesurvey of the improved items	○	△	5	5
Site survey Check Points EM standard application	○	○	5	10
Total Division Score				**45**
Headquater Score				**35**
Grand Total Score				**80**

3. Format of the Inspection Report (made by the Inspector)

EE&C Inspection Report

Inspected Date			Reported date	
Inspector	Main inspector		Sub inspector	
Company/Factory Name				
Address				
Person in charge	Name		Position	
	Tel		E-mail	
Inspected Result				
Total score				
Headquartaer score				
Division score				
Outline of the designated organization				
Business desctription				
Main product/building area				
Number of emploees				
Operation days per year				
Operation days per week				
Daily operation hours				

Annual production and energy consumption		2010	2011	2012	Remarks
Product	Product A				
Annual Sales/Building area					
Energy	Electricity kWh				
	Heat MJ				
	Natural Gas m3				
	Mazut ton				
	Coal ton				
	Others				
	Total MJ				
Energy intensity					
Remarks					

4. Methodology of the Inspection

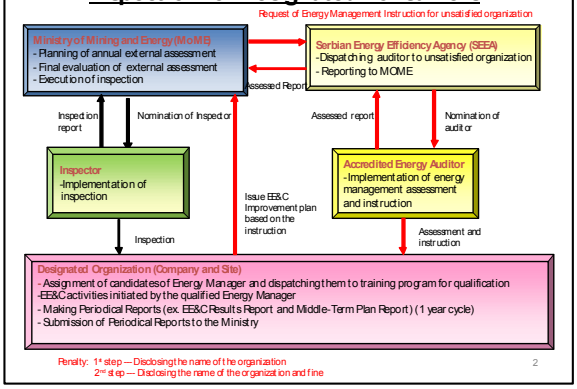
1

Methodology of Inspection Standard

NOVEMBER 2010
JICA STUDY TEAM
TAKAHASHI

2

Inspection for Designated Consumers



3

Steps of EE&C Inspection

1. MoME selects organizations to implement random EE&C inspection
2. MoME plans annual schedule and order its execution to inspectors
3. Inspector coordinates actual schedule with the target organization and order to fill up required documents
4. The organization prepare and issue the documents
5. The inspectors execute inspection
6. The inspectors report the result to MoME
7. MoME requests SEEA to dispatch auditors for unsatisfied organizations
8. Auditor s investigate the organization and give instructions for EE& C improvement
9. SEEA reports the result to MoME
10. The organization must issue EE&C improvement plan to MoME
11. MoME charges penalty to the organization if the plan is poor or is not implemented

Penalty: 1st step -– Disclosing the name of the organization
2nd step -– Disclosing the name of the organization and fine

4

Introduction of Random Check in Japan

Please see another Power Point File

5

Discussion Points

1. Annual numbers of inspection
2. Classification of the target organization by sub sectors
3. Contents of required questionnaire documents prior to the assessment
4. Assessment schedule (one day)
5. Assessment scoring

6

Classification of the Target Organizations by Sub-Sectors

MoME plans inspection schedule of the target organizations by sub-sectors

(1) Energy suppliers
(2) Metal, Steel & Iron manufacturers
(3) Chemical, Paper manufacturers
(4) Food industry
(5) Machinery, electric equipment manufacturers
(6) Municipal government
(7) School, Hotel, Shopping malls

7

Steps and Schedule of inspection

1. Inspectors will scrutinize questionnaire documents prior to the assessment
2. Visiting HQ and check-up official EE&C reports
   (carried out in the morning)
3. Visiting designated site of the organization
   (carried out in the afternoon)
4. Issue inspected report to MoME
5. MoME checks and evaluates report

8

Contents of Questionnaire documents

The format of the documents will be prepared by MoME and submitted to the target organization

1. Energy consumption of past 3-year
2. Production volume of main products of past 3 year
3. Schematic process flow of main products
4. Schematic flow sheet of energy consumption
5. Self checklist of assessing items

9

Inspecting Items at HQ

1. Management system
   Organization, Allocation of Energy Manager(s) and Energy Officer(s)
2. Management policy and plan
   Contents of management policy document
3. Annual target and mid & long term target
   Target of whole organization
4. Periodical Report
   Detail of periodical report and transition of energy intensity
5. EE&C management coordination with site(s)
   Frequency of energy management meeting and attendants

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Inspecting Items at Site

1. Management system
   Organization, Allocation of Energy Manager(s) and Energy Officer(s)
2. Management Standard
   Contents of management standard and its application
3. Annual target and mid and long term target
   Target of the site
   Bulletin of the target
4. EE&C improvement
   Facility modification and operation improvement at site
   Effectiveness by numerical value
5. Field survey at site
   Survey of major equipment base on management standard

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Point allocation of inspected items

1. Head Quarter

(1) Management system	5 Point
(2) Management policy and plan	5 Points
(3) Annual target and mid & long term target	5 Point
(4) Periodical Report	5 Points
(5) EE&C management coordination with site(s)	5 Points
Total	25 Points (multiplied full score is 50)

2. Site

(1) Management system	5 Points
(2) Management Standard	5 Points
(3) Annual target and mid & long term target	5 Points
(4) EE&C improvement	5 Points
(5) Field survey at site	5 Points
Total	25 Points (multiplied full score is 50)

12

Scoring By inspectors

Inspectors assess and score multiplying allocated points for each item as follows;

1. ○ (2) Existence of the item and certain execution
2. △ (1) Existing but insufficient execution
3. × (0) Not existing

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Scoring Example of Headquater

Check Points	Self-check	Auditor	Point Allocation	Point Actual
Management System Check Points Energy management organization is established Energy managers / officers are alocated in each division	○	○	5	10
Management Policy Check Points Energy management policy is established Energy management policy is noticed on a placard	○	○	5	10
Annual target and mid-term target Check Points Annual target of each division is established Mid-term target of each division is established Annual target and achievement is noticed on a placard Achievement of the past target	○	○	5	10
Annual report Check Points Submission of annual report Tendency of energy intensity	○	△	5	5
Cooperation with each division Check Points Period of EE&C meeting and members Information on improvement at each dividion	○	X	5	0
Headquater Total Score				**35**

14

Scoring Example of Division and Total

Check Points	Self-check	Auditor	Point Allocation	Point Actual
Management System Check Points Energy management organization is established Energy managers / officers are adequately alocated	○	○	5	10
Energy Management Standard Check Points Establishment of EM standard Contents and numerical indicators of EM standard Application of EM standard Operation control Measurement and record Maintenace	○	○	5	10
Annual target and mid-term target Check points Annual target of each group is established Mid-term target of each group is established Annual target and achievement is noticed on a placard Achievement of the past target	○	○	5	10
Improved items Check Points Improved items and results of past 3-year Sitesurvey of the improved items	○	△	5	5
Site survey Check Points EM standard application	○	○	5	10
Total Division Score				**45**
Headquater Score				**35**
Grand Total Score				**80**

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Evaluation of Inspection Assessment

1. 80 Points and over
   Pass the inspection assessment

2. Less than 80 to 60 Points
   Ordered to issue improvement plan if annual improvement of energy intensity was less than 1%

3. Less than 60 Pints
   Surveyed by Accredited Auditor immediately and execute EE&C improvement based on the instruction

Appendix 10

Scope of Works for EMS-DB

Contents

Abbreviation

	Contents
DB	Data Base
Entity ID	Entity Identification
EMS	Energy Management System
EPS	Electric Power Industry of Serbia
Site ID	Site Identification
MOME	Ministry of Mines and Energy
SE	System Engineer
SEEA	Serbia Energy Efficiency Agency

Chapter 1 Table layouts and Program and Code Design

1.1 Master Table Generation, Output and Maintenance

(1) Procedures of Master Files (Tables)

- The master files are referred when MOME creates initial periodical report and registers new entities and factories / buildings.

- The following Master filers (tables) are required
  - Site ID master table
  - Sector name master table
  - Municipality master table
  - Energy Conversion master table
- All master files are maintained by MOME.
- Initial Site ID Codes are set by MOME
- MOME can open and revise any periodical report.
- Users can open their periodical report by using their Site Codes and Passwords, and can input their data from the periodical report [1]on MS-EXCEL to the EMS-DB.
- The programs for generation and maintenance of the master files are as the following table.

Program Names	Functions
IMF program	Entity and Site ID master table
SMF program	Sector name master table
MMF program	Municipality name master table
CMF program	Converter master table

[1] For simplifying input works, the data has to be inputted from EXCEL sheet to the DB automatically. In the basic design, the program to do it is out of scope.

(2) Energy Conversion Master File and CMF Program

<< Functions>>

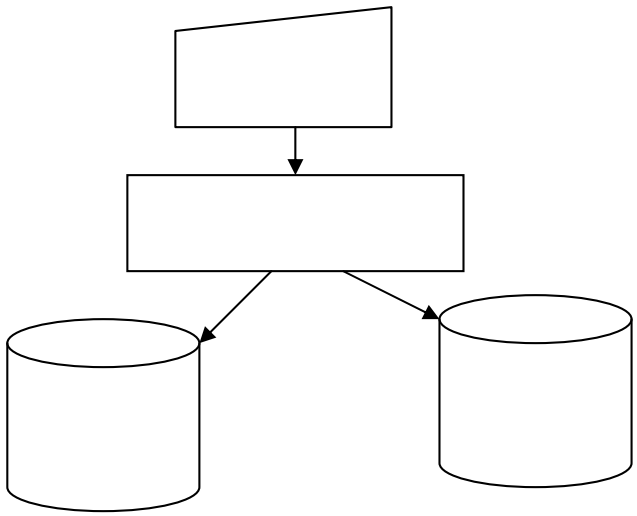
- "CMF program" generates and maintains Energy conversion master file. And the conversion file is attached in the master file layouts that is an additional MS-EXCEL sheet .
- CMF program is used by MOME.

<< Procedures >>

- System Engineer (SE) has to design input menu with referring input layout of energy conversion master file.
- Energy conversion master file (table) is generated and maintained by MOME exclusively and the data are attached to the periodical report every year, the data of the master file (table) are attached in periodical report for users to calculate heat values.
- SE has to design the output layout for screens and lists.

<< IO Structure & Layouts>>

- Refer to "Energy conversion master file (table)" sheet in Master Table Layouts.



Energy conversion master table **Converter in Periodical report**

(3) Sector Name Master File (Table) and SMF Program

<< Functions>>

- "SMF program" generates and maintains Sector name master table.
- The program is used by MOME.

<< Procedures >>

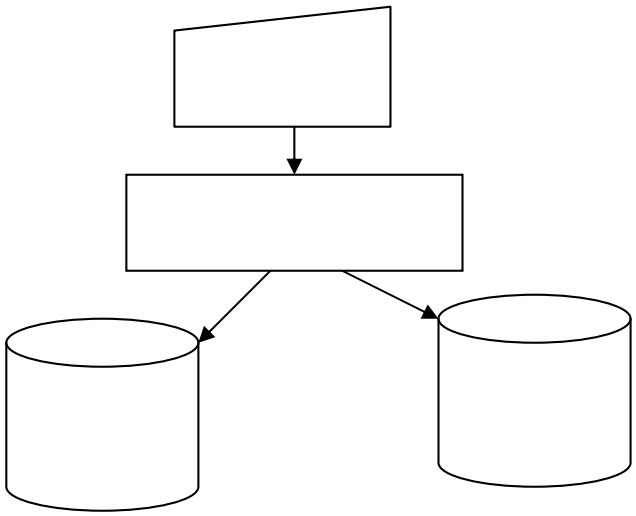
- SE has to design input menu with referring Sector name master file (table).
- Sector name master file is generated and maintained by MOME exclusively and it is attached to

Periodical Report every year.

- SE has to check and design between the input layouts and output layouts of SMF program.
- SE has to deign layouts of the screen and list

<< I/O Structures & Layouts>>

- Refer to Sector name master file sheet in Master Table layouts.



Sector name master file **Sectors in Periodical report**

(4) Municipality Master File (Table) and MMF Program

<< Functions>>

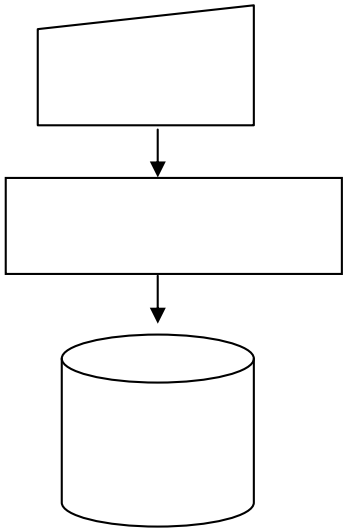
- MMF program generates and maintains Municipality master file (table).
- The program is used by MOME.

<<Procedures >>

- SE has to design input menu with referring the input layouts of Municipality master file.
- Municipality master file is generated and maintained by MOME exclusively.
- Input and Output layouts of municipality master file is almost the same formula.
- SE has to design municipality master file with referring the table layout in master layout file.
- SE has to deign output layouts of Municipality master table for the screen and the list.

<< IO Structures & Layouts>>

Refer to “Municipality master table” in Master Layout File.



Municipality Master File

(5) Site ID Master File (Table) (IMF Program)

<<Functions>>

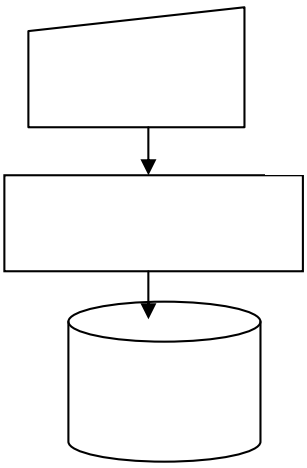
- IMF program" generates and maintains Site ID Master file (Table).
- The program is used by MOME.

<<Procedures >>

- SE has to design input screen menu with referring the Input layout.
- Site ID master file (table) is generated and maintained by MOME exclusively.
- MOME has to add the Entity and Site ID and the names to Site ID master file after receiving requests of user registration.
- Site ID registered in the Site ID master file has to be informed from MOME to users as soon as possible.
- SE has to deign the output formats of Site ID master file to the screen and the list.

<<IO structures & Formats >>

- Refer to "Site ID master file" in Master Layout File.



Site ID master file

1.2 Transaction Table Generation, Output and Maintenance

(1) Procedures of Transaction table (T/F)

- The contents of the periodical report are entered to EMS-DB through PC terminal of the users or MS-EXCEL sheet sent by users.
- Users can open their periodical report by using Site ID and Password, and they can input their data from the periodical report to EMS-DB.
- SE has to design the screen menu and input data check.
- There are several Transaction tables, Table C-0 (Entity cover sheet), Table C-1(Site list) Table S-0(Site cover sheet), Table S-1(Energy consumption), Table S-2(Facility list), Table S-3(Consumption trend), Table S-4(Reason not to achieve), Table S-5(Compliance check), Table S-6(Other measures) and Table S-7 (Middle and Long Term Plan) transaction tables.
- The programs developed for transaction table of generation and maintenance are as the following table.

Program Names	Functions
TBL0 program	Entity cover sheet, Site list and Site cover sheet
TBL1 Program	Quantity of annual energy consumption
TBL2 Program	Facilities which can contribute to EE&C and other major facilities consuming energy.
TBL3 Program	Energy consumption trend
TBL4 Program	Reasons not to be achieved
TBL5 Program	Compliance check with evaluation criteria
TBL6 Program	Other measures taken for EE&C
TBL7 Program	Handle Middle and Long Term Plan

(2) TBL0 Cover Sheet Table (TBL0 program)

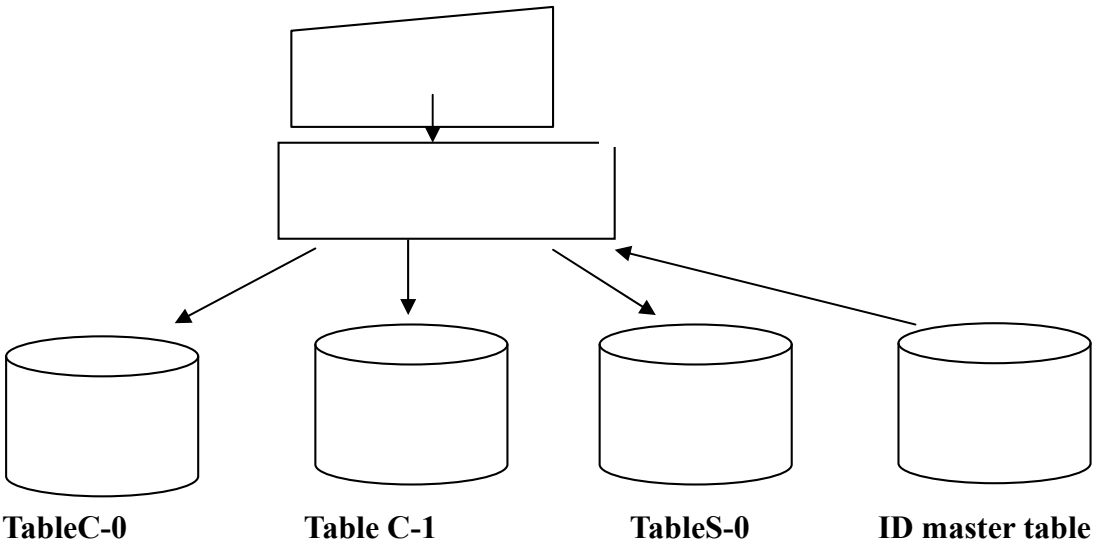
<<Functions>>

- Table C-0 and Table C-1 are Entity cover sheet and Site list respectively.
- Table S-0 is Site cover sheet.
- "TBL0 program" generates and maintains Table C-0, Table C-1 and Table S-0 in the periodical report.
- "TBL0 program" is used by the administrators and the users.

<<Procedures >>

- SE has to design the input menu with referring the input layouts of the above sheet.
- Entity and Site cover sheet of the periodical report is generated by MOME exclusively.
- Users can retrieve the cover sheet by using Site ID and Password.
- User can enter and revise the data of the cover sheet data through TBL0 program.
- The above cover sheet has to be searched by using Year and Site ID.

<< IO structures & Format>>



(3) Table 1 Energy Consumption Table (TBL1 program)

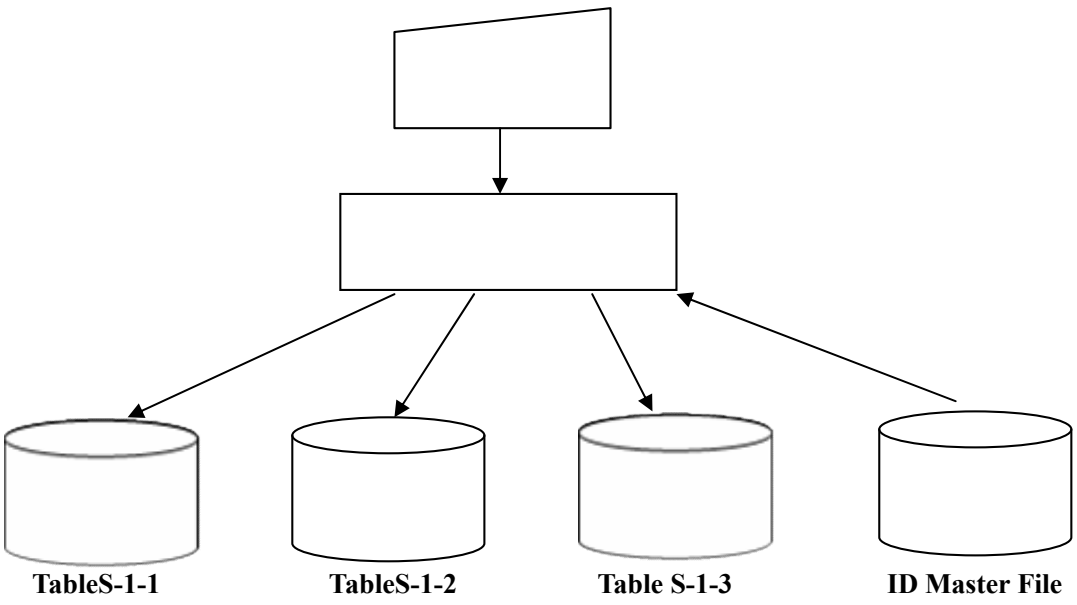
<<Functions>>

- The contents of Table1 in the periodical report are Quantity of annual energy consumption.
- "TBL1 program" generates and maintains Table S-1-1, Table S-1-2 and Table S-1-3 of the periodical report.
- "TBL1 program" is used by the administrators and the designated entities and sites.(Users)

<<Procedures >>

- SE has to design input menu with referring the Input layouts of the above tables.
- The users can retrieve Table S-1-1, Table S-1-2 and Table S-1-3 by using Site ID and Password.
- The users can enter and revise the data in the tables through TBL1 program
- Table S-1-1, Table S-1-2 and Table S-1-3 are searched by using Year and Site ID by the administrators and the users.

<< IO structures & Format>>



(4) Table S-2 Rational Use Facility File (table) (TBL2 program)

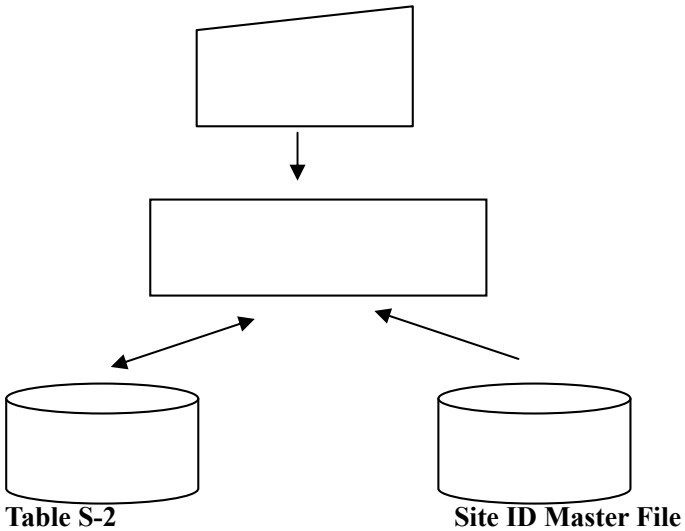
<< Functions>>

- The contents of Table S-2 are lists of facilities that can contribute to EE&C and other major facilities consuming energy. The list should cover more than 80% of total energy consumption and describe situation of operation including new installation, remodeling or dismantling in the periodical report.
- TBL 2 program generates and maintains Table S-2 of the periodical report.
- TBL2 program is used by the administrators and the designated entities and sites. (Users).

<<Procedures >>

- SE has to design input menu with referring the Input layouts of the table.
- The users can retrieve Table S-2 by using Site ID and Password.
- The users can enter and revise the data of Table S-2 through TBL2 program
- Table S-2 is searched with using Year and Site ID by administrators and the users.

<< IO structures & Format>>



(5) Table S-3 Energy Consumption Trend (TBL3 program)

<<Functions>>

- The contents of TableS-3 are energy consumption trends.
- TBL3 program generates and maintains Table S-3 of the periodical report.
- TBL3 program is used by the administrators and the designated entities and sites (Users).

<<Procedures >>

- SE has to design input menu with referring the input layouts of TableS-3.
- The users can retrieve Table S-3 by using Site ID and Password.
- The users can enter and revise the data of Table S-3 through TBL3 program
- Table S-3 is searched with using Year and Site ID by the administrators and the users .

<< IO structures & Formats>>

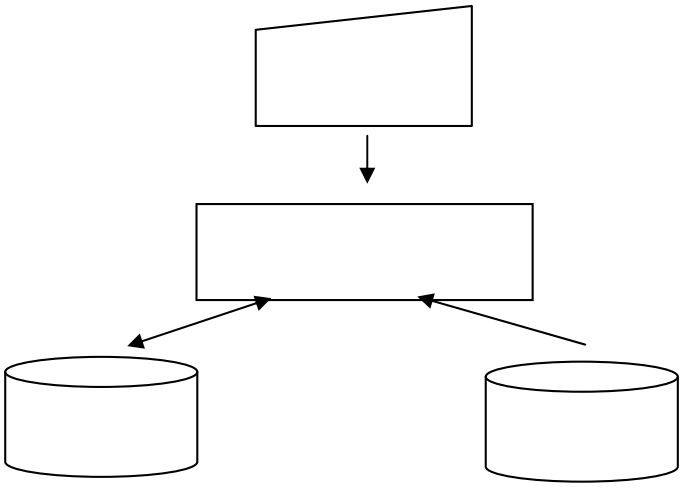


Table S-3 **Site ID Master File**

(6) Table S-4 Reasons not to be achieved (TBL4 program)

- The contents of Table S-4 are reasons where average change of energy consumption for the past five years did not achieved by 1 % or more.
- TBL4 program generates and maintains TableS-4 of the periodical report.
- TBL4 program is used by the administrators and the designated entities and sites.(Users)

<<Procedures >>

- SE has to design input menu with referring the input layouts of Table S-4.
- The users can retrieve the Table S-4 by using Site ID and Password.
- The users can enter and revise the data of Table S-4 data through TBL 4 program.
- Table 4 is searched with using Year and Site ID by the administrators and the users.

<< IO structures & Formats>>

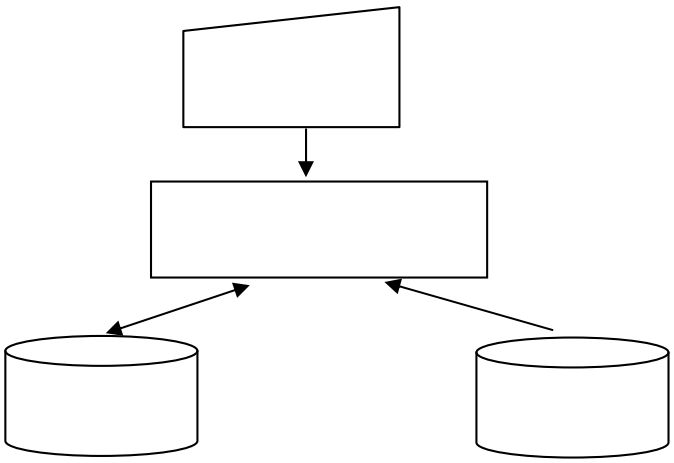


Table S-4 **Site ID Master File**

(7) Table S-5 Compliance check with evaluation criteria (TBL5 program)

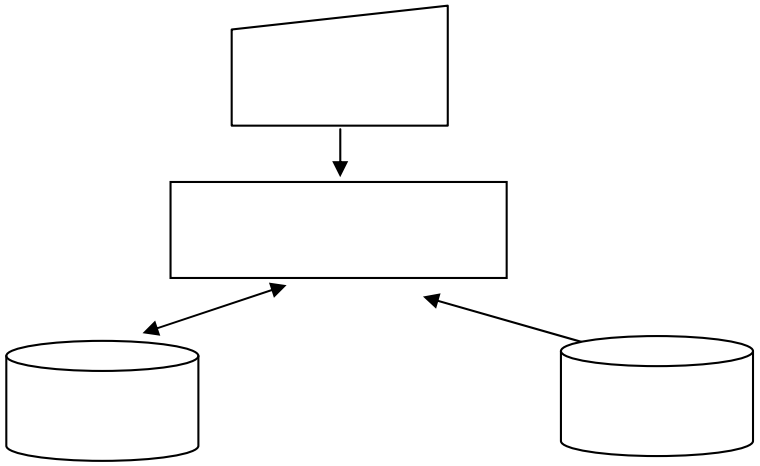
<<Functions>>

- The contents of Table 5 are compliance check with evaluation criteria.
- TBL5 program generates and maintains TableS-5 of the periodical report.
- TBL5 program is used by the administrators and the designated entities and sites.(Users)

<<Procedures >>

- SE has to design input menu with referring the input layouts of Table S-5.
- The users can retrieve TableS-5 by using Site ID and Password.
- The users can enter and revise the data of Table S-5 through TBL5 program.
- Table5 is searched with using Year and Site ID by the administrators and the users.

<< IO structures & Formats>>



(8) Table 6 Other Measures Taken for EE&C (TBL6 program)

<<Functions>>

- The contents of TableS-6 are other measures taken for EE&C.
- TBL6 program generates and maintains Table S-6 of the periodical report.
- TBL6 program is used by the administrators and the designated entities and sites.(Users)

<<Procedures >>

- SE has to design the input menus with referring the input layouts of Table S-6.
- The users can retrieve TableS-6 by using Site ID and Password.
- The users can enter and revise the data of TableS-6 through TBL6 program.
- Table S-6 is searched with using Year and Site ID by the administrators and the users.

<< IO structures & Formats>>

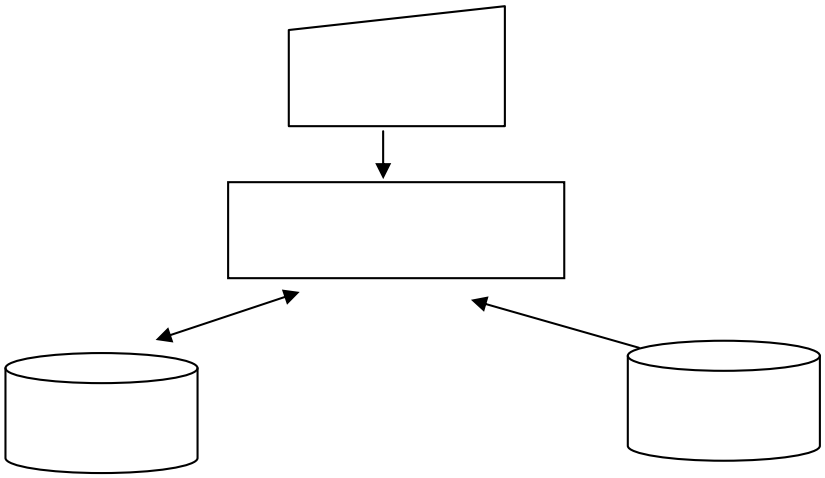


Table S-6 **Site ID Master File**

(9) Middle and Long Term Plan (TBL7 program)

<<Functions>>

- The contents of Middle and Long Term Plan are “Planning period”, ”Plan for EE&C and Expected effects”, “Comparison or Change to plan of Previous fiscal year” and “Other issues on Planning”.
- TBL7 program generates and maintains Table S-7 for the Middle and Long Term Plan of the periodical report.
- The program is used by the administrators and the users.

<<Procedures >>

- SE has to design the input menus with referring the input layouts of Middle and Long Term Plan.
- The users can retrieve Middle and Long Term Plan table by using Site ID and Password.
- The users can input and revise the data of Middle and Long Term Plan through TBL 7 program.
- Table S-7 is searched with using Year and Site ID by the administrators and the users.

<<IO structures & Format>>

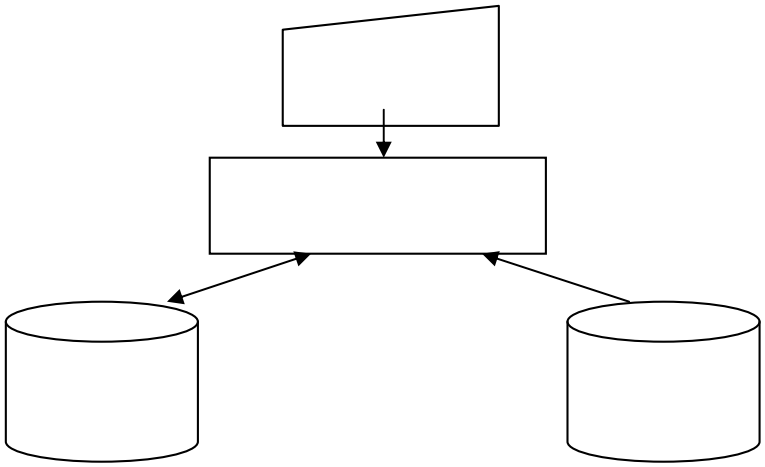


Table S-7 **Site ID Master File**

1.3 Output and Data Analysis for Administrators

(1) Output Functions

- MOME needs several kinds of electrical and/or list outputs. As basic output functions, the following output programs are required.

Programs	Contents of Outputs	Tables
OUP program	Output of User Password, Entity ID	C-0
OEI program	Output of Entity information	C-1, C-2
OSI program	Output of Site information	S-0
OES program	Output of energy consumption	S-1-1, S-1-2, S-1-3
FRU program	Output of Facility related rational use	S-2
ECT program	Output of Energy consumption trend	S-3
SOE program	Output of reasons not to be improved	S-4
CCE program	Output of compliance check with evaluation criteria	S-5
OMT program	Output of other measures taken for EE&C	S-6
MLP program	Output of middle and long term plan	S-7

- The above programs can be make outputs by using single transaction table except referring master files (tables). The functions of the aforementioned programs are basically all transaction record outputs.
- The programs with complicated functions for supporting the analysis and the study of MOME should be considered in stage of system development in future.
- As representative example, I/O structures for the above programs are shown by the following figure.

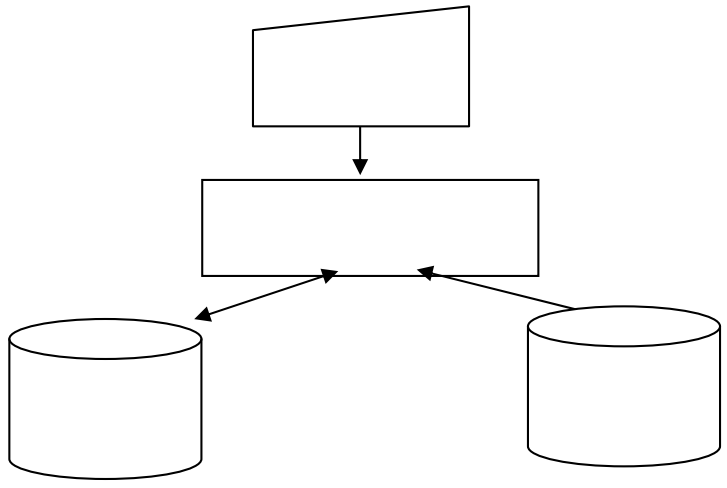


Table S-3 **Site ID Master file**

(2) Output of User Password and Site ID (OUP program)

- ◆ The administrator should maintain the IDs, Password and Entity names. The administrators can output the following output lists.
- ◆ OUP program has to make the following output lists from Table C-0.

Year	Entity ID	Receipt			Entity administration						
		Registered Date			Registered number	Name	Address				
	Entity ID	Day	Month	Year			Code	Address	Phone	Fax	E-mail

Resposible document creator									Name and position of Energy Officer of organization, when assigned		Date of previsous energy audit by an accredited energy auditor	Date of previsous inspection by an inspector on an organization	Has Name or Address of company changed		
Registered Enaergy Mnager			Address items					Regisrered licence							
Name	Title	Departmen t	Code	Address	Phone	Fax	E-mail		Name	Position			Yes or No	Previous Code	Previous Address

(3) Output of Factory (Building) Information (OEI program)

- The administrators should maintain Factory / Building names. The administrators can output with the following formats of the factory and building names.
- OEI program has to make the following output from Table C-1 and Table C-2.

Year	Entity ID	Designation (Factory/Building)							Table C-2
		Category of designation (Factory/Building)	Site ID	Name of Site (Factory/Building)	Address of Site (Factory/Building)	Energy Consumption (toe) (primary energy)	Business category No.	Name of business category	Award scheme application
CHAR(4)	CHAR(7)	CHAR(15)	CHAR(9)	VARCHAR(50)	VARCHAR(50)	Number(12,3)	CHAR(6)	CHAR(20)	CHAR(3)

(3) Output of User Password and designated Site (OEI program)

- The administrators can outputs of the designated site information.
- OEI program has to make the following output lists from Table S-0.

Year	Entity & Factory ID		Receipt			Factory / Buildings									
			Registered Date			Registered DEM	Registered DEF	Name	Address					Business type	
	Entity ID	Site ID	Day	Month	Year				Code	Address	Phone	Fax	E-mail	Code	Sub-sector name

Registered license number of Qualified Energy Manager or Energy Officer of the document creator	Name and position of Energy Officer of site, when assigned		Date of previsous energy audit by an accredited energy auditor	Date of previsous inspection by an inspector on an organization
	Nmae	Position		

(4) Output of Energy Consumption (OES program)

- The administrators can see the energy consumption from Table S-1-1, Table S-1-2 and Table S-1-3.
- OES program has to set the following data from the above tables.

Year	Entity ID	Site ID	Energy Code	Energy	Unit	Input energy A	Exclueded energy B	Net Total A-B	Final Energy (toe)	Primary Energy (toe)	Carbon Dioxide (tCO2)

TableS-1-2: Re-calculation of renewable energy		TableS-1-3: Quantity of water usage			
Final Energy (toe)	Primary Enegy (toe)	Dringing water/well water	Industrial water	Any water	Total

(5) Output of Facility related Rational Use (FRU program)

- The administrators can see the information on “Facility list which can contribute to EE&C and other major facilities consuming energies from Table S-2.
- FRU program has to set the following data from Table S-2.

	Year	Entity & Factory Building		Facility code	Facilities related to rational use of energy or Major faclities consuming energy			
		Entity ID	Site ID		Name of facilities	Outline of facilities	Operationnal status	New installation, remodeling or removal
Entity 001								
Entity 001								
Entity 001								
Entity 002								
Entity 002								
Entity 002								
Entity 003								
Entity 003								
Entity 003								

(6) Output of Energy Consumption (ECT program)

- The administrators can see the energy consumption from Table S-3.
- ECT program has to set the following data from Table S-3.

Year	Entity & Factory Building		Primary energy consumption					Comparison to previous fisical year				
	Entity ID	Site ID	Lag 4	Lag 3	Lag 2	Lag 1	Current year	Lag 3	Lag 2	Lag 1	Current year	Average of 5 years
			toe	toe	toe	toe	toe	%	%	%	%	%

(7) Outputs of Reasons not to be Achieved (SOE program)

- The administrators can see the reasons to be unable to achieve the energy improvement from Table S-4.
- SOE program has to set the following data from Table S-4.

Year	Entity & Factory Building		Reasons for (A)	Reasons for (B)
	Entity ID	Site ID		

(8) Outputs of Compliance Check with Evaluation Criteria

- The administrators can see compliance check lists from Table S-5.
- CCE program has to set the following data from Table S-5.

Year	Entity & Factory Building		Target	1.Rationalization of fuel combustion (Combustion facility)				
	Entity ID	Site ID	Codes	Status of establishing management standards		Status of observing mesurement/record	Status of observing maintenance/inspection	Status of measures to betaken on new installation

2Rationalization of heating, cooling and heat transfer (Heat consumption facility)									
Status of establishing management standards for heating equipment and others		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of heating equipment and	Status of establishing management standards for air conditioning and hot water supply facility		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of air conditioning facility and

]

3.Waste heat recovery (Waste heat recovery facility)				
Status of establishing management standards for waste heat recovery facility		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of waste heat recovery facility

4. Rationalization of converting heat to power and others (Power generation facility and cogeneration facility)									
Status of establishing management standards for gas turbine of power generation facility and others		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of power generation facility	Status of establishing management standards for boiler of cogeneration facility and others		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of cogeneration facility

5. Prevention of energy loss by radiation, conduction, resistance and others (Heat consumption facility, power receiving & transforming facility and distribution facility)									
Status of establishing management standards for heat loss		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of heat consumption facility	Status of establishing management standards for electricity loss		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of power receiving & transforming facility and distribution

6 Rationalization of converting electricity to power and heat and others (Electricity utilizing facility)									
Status of establishing management standards for electricity utilizing facility of applied electric power facility, electric heating facility, electrolysis facility and others		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of applied electric power facility and others	Status of establishing management standards for lighting facility and others		Status of mesurement/record defined in management standards	Status of maintenance/inspection defined in management standards	Status of measures to be taken on new installation of lighting facility and others

(9) Outputs of Other Measures taken for EE&C (OMT program)

- The administrators can see other measures taken for EE&C from Table S-6.
- OMT program has to set the following data from Table S-6.

Year	Entity & Factory Building		
	Entity ID	Site ID	Outline measures
CHAR(4)	CHAR(7)	CHAR(9)	VARCHAR(500)

(10) Outputs of Middle Long Term Plan (MLT program)

- The administrators can see Middle Long Term Plan from Table S-7.
- MLT program has to set the following data from Table S-7.

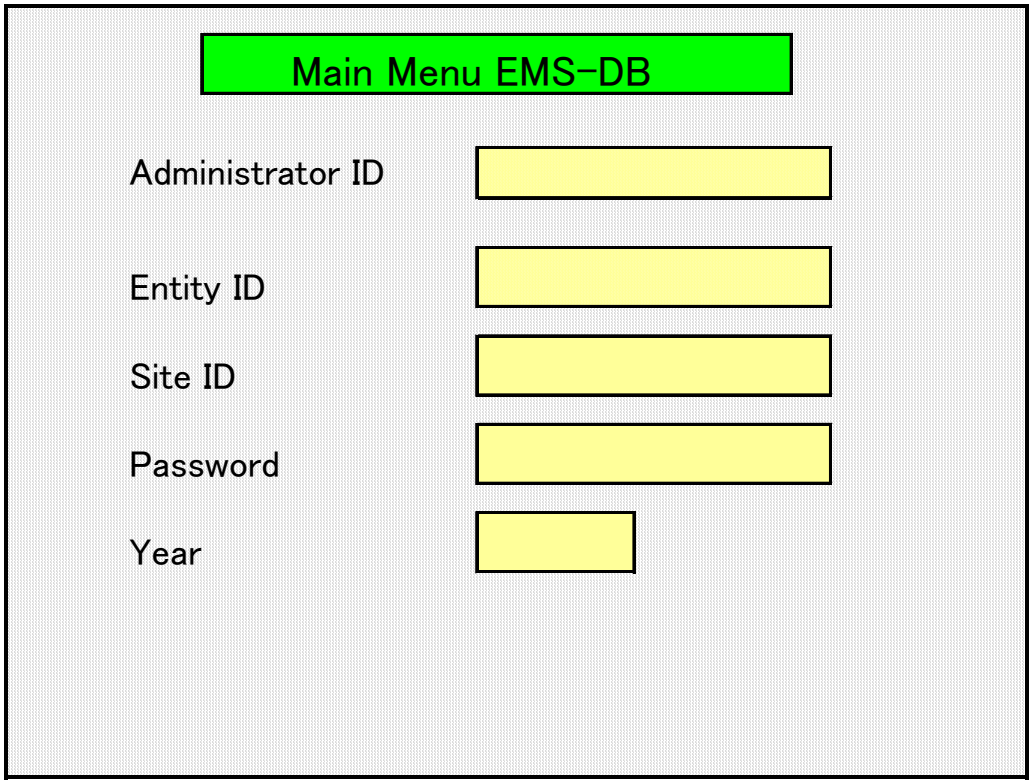
Year	Entity & Factory		Planning Period		Plan codes	Plan for EE&C and Expected Effects (Hard, Soft, Comparison or Change)			Other Issues on Planning
	Entity ID	Site ID	Start	Finish		Process/Facility	Plan	Expected Effects(toe) in primary energy	

Chapter 2 Screen Menu for Administrators and Users

2.1. Screen Menu for Administrators

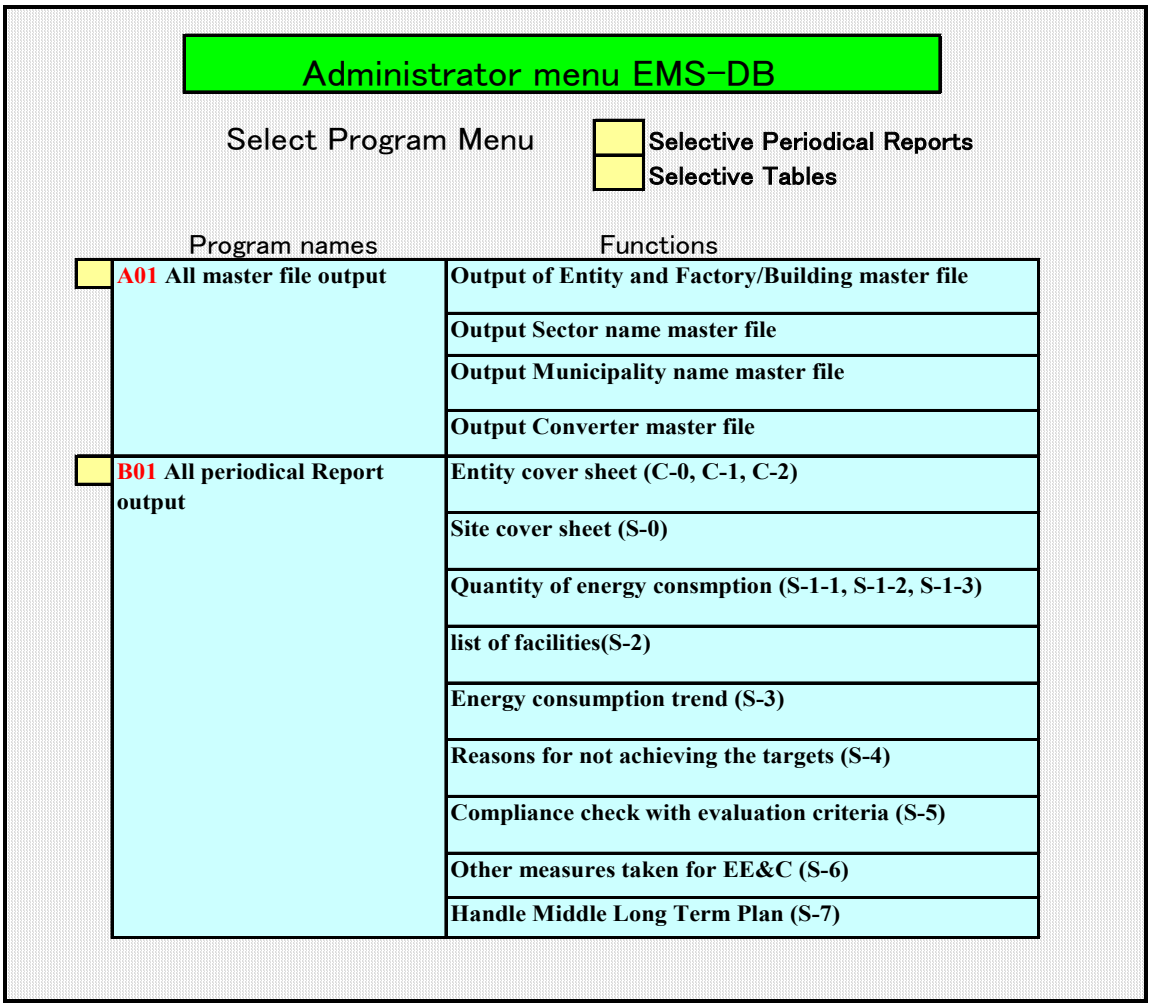
(1) Main Menu

- The administrators can login through the following Main Menu.
- SE has to design input error check and error messages.



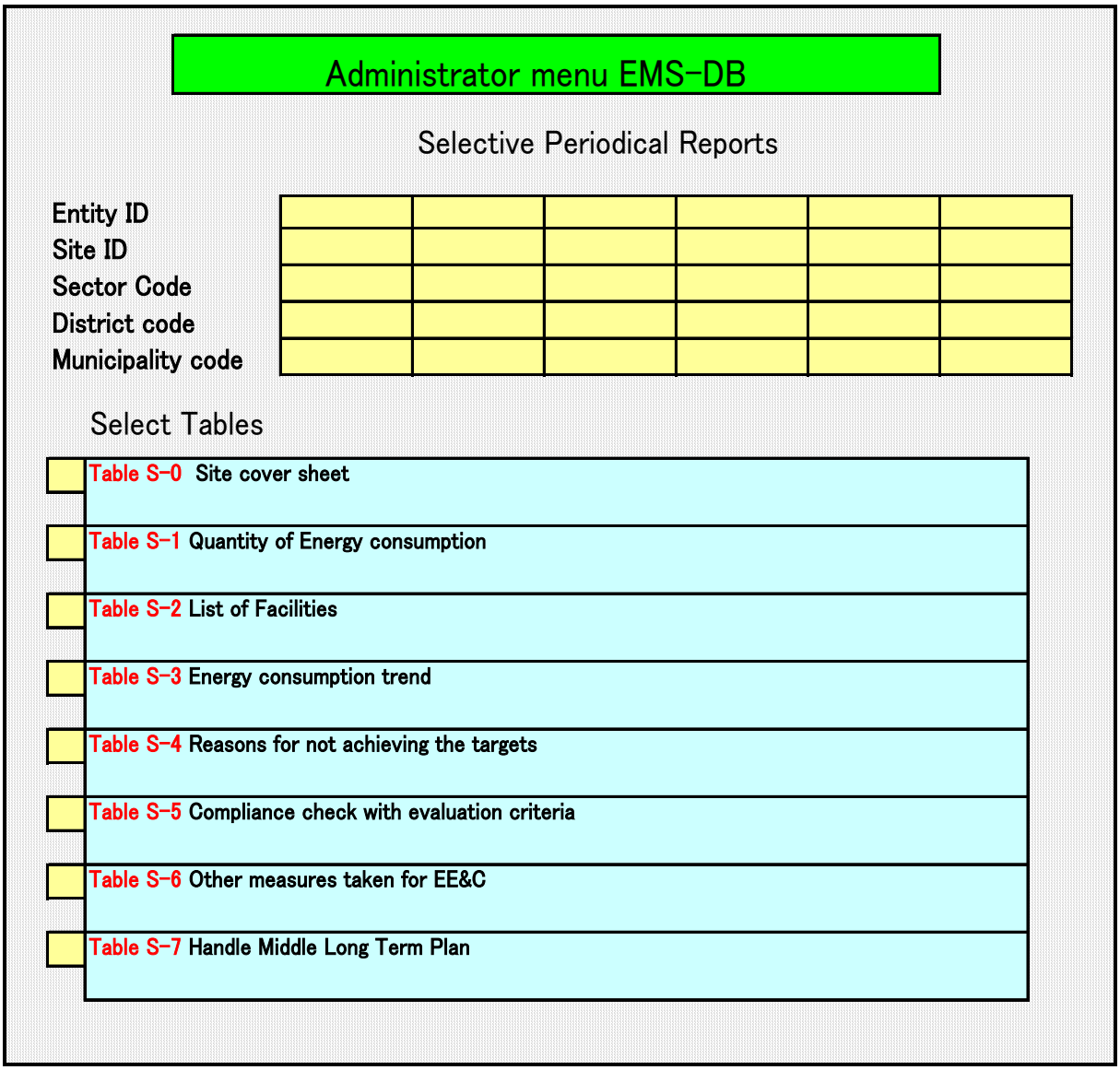
(2) Administration Menu

- When selecting “Selective Periodical report”, the screen is moved to “Selective Periodical Report Menu” and the operators can output the periodical report selected by Site ID, Sector code, Area code and the combinations.
- When selecting “Selective Tables”, the screen is moved to “Selective Table Menu” and the operators can output information from Master files and the periodical report selected by Site ID, Sector code, Area code and the combinations.
- When selecting “All master table output”, the operators can output all information from all Master files.
- When selecting “All periodical report output”, the operators can output all information from all periodical reports in the transaction files.



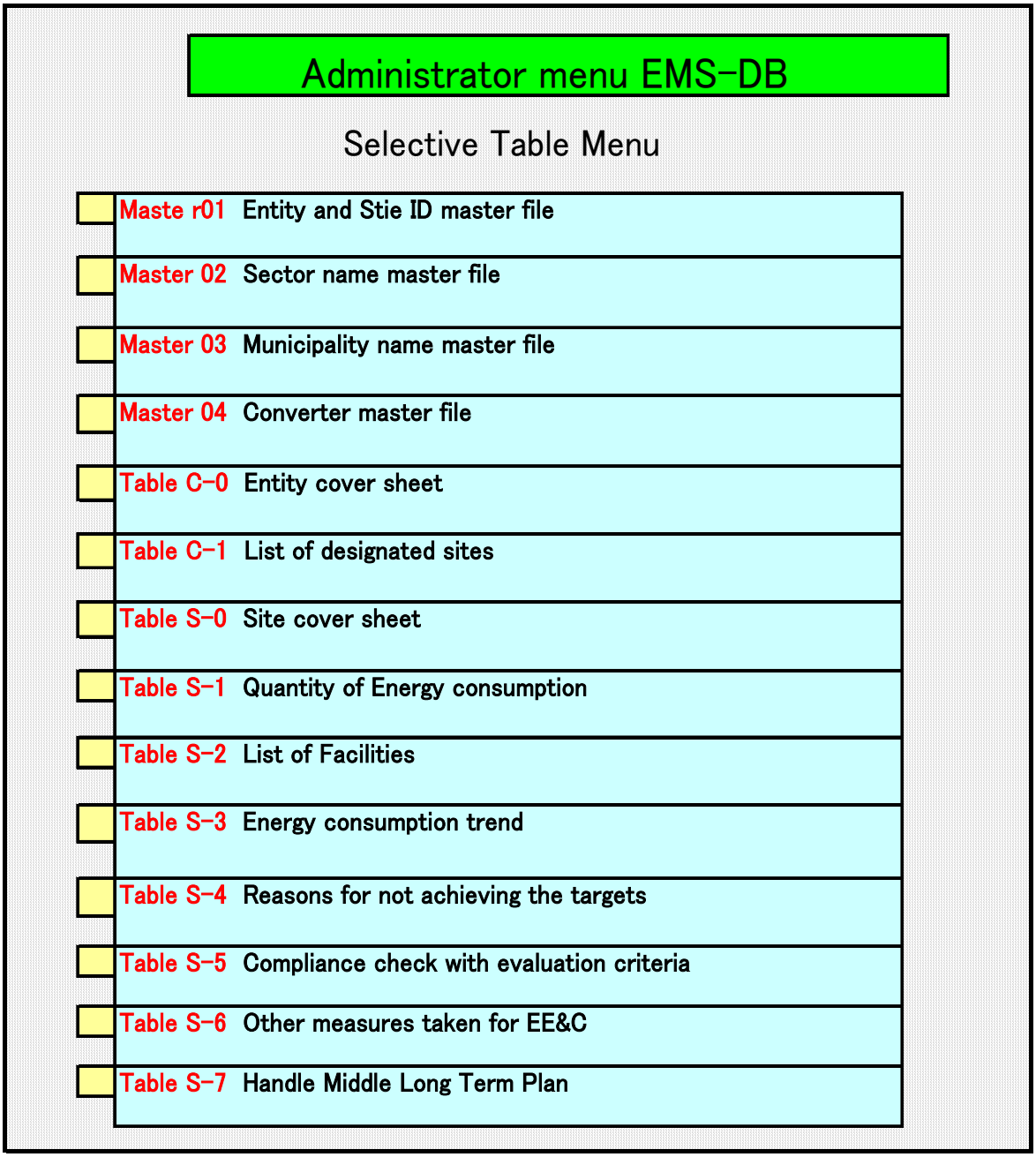
(3) Selective Periodical Reports

- The administrators can output the information of the periodical report by using Site ID, Sector code, District code and Municipality code as selection key.
- In a selective key, the maximum five codes are set in the prepared cells.
- At the same time, the administrators can select tables of the periodical report to be required for the outputs. The required files (tables) have to be selected in the following menus.



(4) Selective Tables

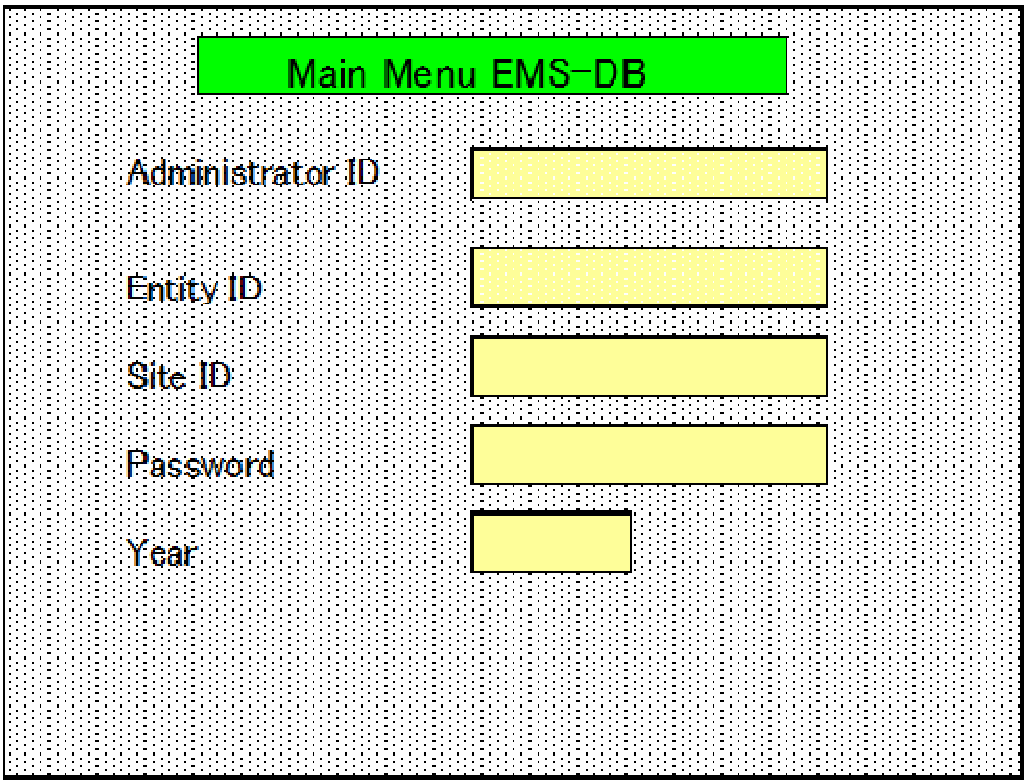
- The administrators can output the information from Master files and Tables of the periodical report.
- By selecting the programs (master and /or table names), the operators can output all information from selected master table and tables of the periodical report.



2.2. Screen Menu for System Users

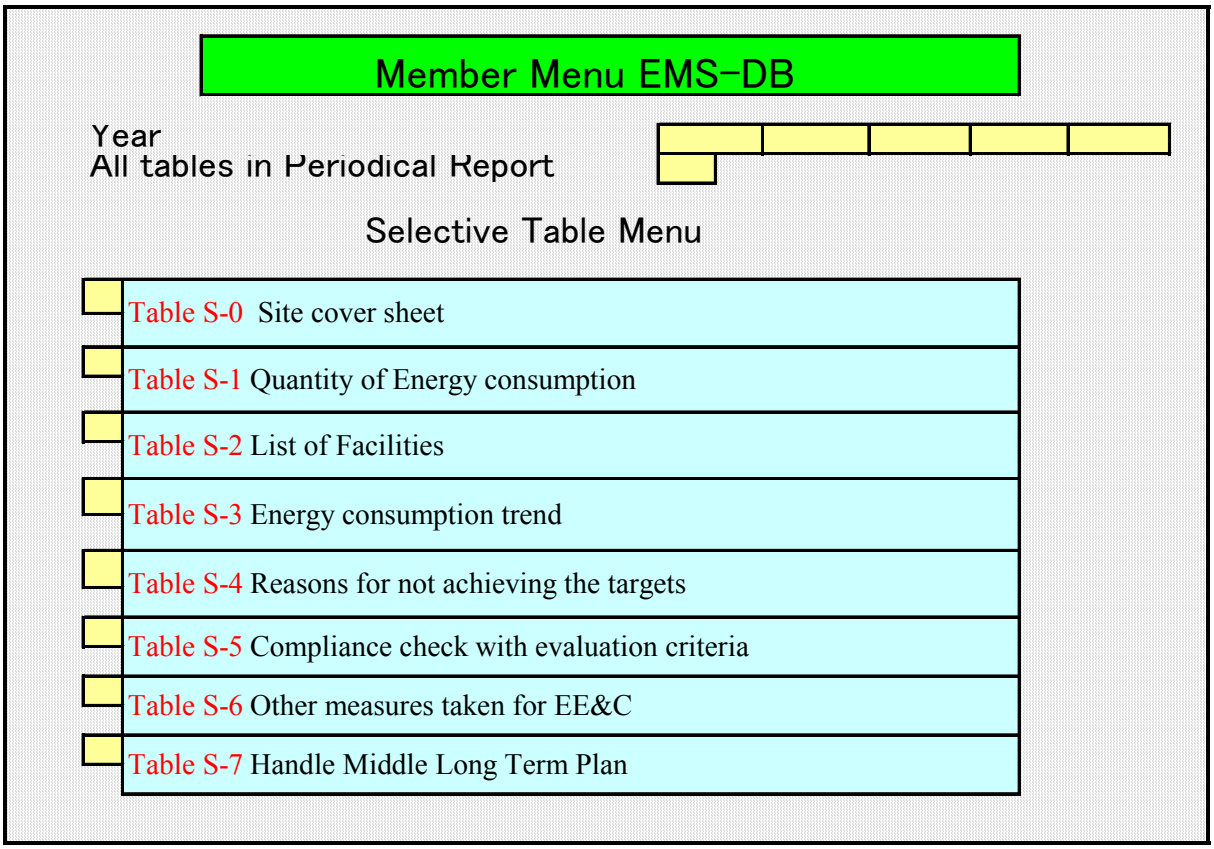
(1) Main Menu

- The designated entities and sites (Users) can login through the following Main Menu.
- SE has to design input error check and error messages.



(2) User Menu

- The users can output information of own periodical report, and change the data and descriptions in the report.
- The system users have to set the years that they want output.
- When the users want to output all tables of the periodical report, the operatiors have to select "All tables in the periodical report".
- The users can select the tables required from own periodical report.



Reference: Program List

NO	Program Names	Contents
Master Table Maintenance Programs		
1	IMF program	**Entity and Site ID master table**
2	SMF program	Sector name master table
3	MMF program	Municipality name master table
4	CMF program	Converter master table
Periodical Report handling Programs		
5	TBL 0 program	**Entity cover sheet, Site list and Site cover sheet**
6	TBL 1 Program	Quantity of annual energy consumption
7	TBL 2 Program	List of facilities
8	TBL 3 Program	Energy consumption trend
9	TBL 4 Program	Reasons not to be achieved
10	TBL 5 Program	Compliance check with evaluation criteria
11	TBL 6 Program	Other measures taken for EE&C
12	TBL 7 Program	Handle Middle and Long Term Plan
Output Programs		
13	OUP program	Output of User Password, Entity ID
14	OEI program	Output of Entity information
15	OSI program	Output of Site information
16	OES program	Output of energy consumption
17	FRU program	Output of Facility related rational use
18	ECT program	Output of Energy consumption trend
19	SOE program	Output of reasons not to be improved
20	CCE program	Output of compliance check with evaluation criteria
21	OMT program	Output of other measures taken for EE&C
22	MLP program	Output of middle and long term plan